SPRING Working Group
Internet-Draft
Intended status: Standards Track
Expires: September 5, 2020

C. Li
Huawei Technologies
W. Cheng
China Mobile
M. Chen
D. Dhody
Huawei Technologies
R. Gandhi
Cisco Systems, Inc.
March 4, 2020

Path Segment for SRv6 (Segment Routing in IPv6)
draft-li-spring-srv6-path-segment-05

Abstract

Segment Routing (SR) allows for a flexible definition of end-to-end paths by encoding paths as sequences of sub-paths, called "segments". Segment routing architecture can be implemented over an MPLS data plane as well as an IPv6 data plane.

Further, Path Segment has been defined in order to identify an SR path in SR-MPLS networks, and used for various use-cases such as end-to-end SR Path Protection and Performance Measurement (PM) of an SR path. Similar to SR-MPLS, this document defines the Path Segment in SRv6 networks in order to identify an SRv6 path.

Table of Contents

1. Introduction 2
   1.1. Requirements Language 3
   1.2. Terminology 4
2. Use Cases of SRv6 Path Segment 4
3. SRv6 Path Segment 5
4. SRv6 Path Segment Allocation 5
5. Operations 6
6. IANA Considerations 6
7. Security Considerations 6
8. Contributors 6
9. Acknowledgements 6
10. References 6
   10.1. Normative References 7
   10.2. Informative References 7
Authors' Addresses 8

1. Introduction

Segment routing (SR) [RFC8402] is a source routing paradigm that explicitly indicates the forwarding path for packets at the ingress node by inserting an ordered list of instructions, called segments.

When segment routing is deployed on MPLS dataplane, called SR-MPLS [I-D.ietf-spring-segment-routing-mpls], a segment is an MPLS label. When segment routing is deployed on IPv6 dataplane, called SRv6 [I-D.ietf-6man-segment-routing-header], a segment is a 128 bit value, and it can be an IPv6 address of a local interface but it does not have to. For supporting SR, an extended header called Segment Routing Header (SRH), which contains a list of SIDs and several needed information such as Segments Left, has been defined in [I-D.ietf-6man-segment-routing-header].

In an SR-MPLS network, when a packet is transmitted along an SR path, the labels in the MPLS label stack will be swapped or popped, so no label or only the last label may be left in the MPLS label stack when the packet reaches the egress node. Thus, the egress node can not determine from which ingress node or SR path the packet came in. For identifying an SR-MPLS path, Path Segment is defined in [I-D.ietf-spring-mpls-path-segment].

Likewise, a path needs to be identified in an SRv6 network for several use cases such as binding bidirectional paths [I-D.ietf-pce-sr-bidir-path] and end-to-end performance measurement [I-D.gandhi-spring-udp-pm]. An SRv6 path can be identified by the content of segment list (i.e., the several SRv6 segments that are in the segment list).

However, the segment list may not be a good key to identify an SRv6 path, since the the length of segment list is flexible according to the number of SIDs. Also, the length of SID list will be too long to be a key when it contains many SIDs. For instance, if packet A uses the SRH with 3 SIDs while Packet B uses the SRH with 10 SIDs, the key to identify these two paths will be a 384-bits value and a 1280-bits value.

This document defines a new SRv6 segment called "SRv6 Path Segment", which is a 128-bits value, to identify an SRv6 path. Using the Path Segment as an SRv6 SID will improve performance and operations in both SR-MPLS and SRv6.

Also, In reduced mode [I-D.ietf-6man-segment-routing-header], an SRv6 path can not be indentified by the information carried by SRH. When the SRv6 Path Segment is used in reduced SRH [I-D.ietf-6man-segment-routing-header], the entire path information is indicated by the Path Segment, and the performance will be better than using SID list as the path identifier, while the overhead equals to the normal SRH.

The SRv6 Path Segment will be used for identifying an SRv6 path and path related services, and it will not be updated to the IPv6 destination address, so it is not routable.

1.1. 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.

1.2. Terminology

MPLS: Multiprotocol Label Switching.

PM: Performance Measurement.

SID: Segment ID.

SR: Segment Routing.

SR-MPLS: Segment Routing with MPLS data plane.

SRH: Segment Routing Header.

PSID: Path Segment Identifier.

PSP: Penultimate Segment Popping.

Further, this document makes use of the terms defined in [RFC8402] and [I-D.ietf-spring-srv6-network-programming].

2. Use Cases of SRv6 Path Segment

Similar to SR-MPLS Path Segment [I-D.ietf-spring-mpls-path-segment], SRv6 Path Segment also can be used for identifying an SRv6 Path in some use cases:

- Performance Measurement: For Passive measurement [RFC7799], path identification at the measuring points is the pre-requisite [I-D.ietf-spring-mpls-path-segment]. SRv6 Path segment can be used by the measuring points (e.g., the ingress/egress nodes of an SRv6 path) or a centralized controller to correlate the packets counts/timestamps, then packet loss/delay can be calculated.

- Bi-directioinal SRv6 Path Association: In some scenarios, such as mobile backhaul transport network, there are requirements to support bidirectional path. Similar to SR-MPLS [I-D.ietf-spring-mpls-path-segment], to support bidirectional SRv6 path, a straightforward way is to bind two unidirectional SRv6 paths to a single bidirectional path. SRv6 Path segments can be used to correlate the two unidirectional SRv6 paths at both ends of the paths. [I-D.ietf-pce-sr-bidir-path] defines how to use PCEP and Path segment to initiate a bidirectional SR path.

- End-to-end Path Protection: For end-to-end 1+1 path protection (i.e., Live-Live case), the egress node of an SRv6 path needs to know the set of paths that constitute the primary and the secondary(s), in order to select the primary packet for onward

transmission, and to discard the packets from the secondary(s), so each SRv6 path needs a unique path identifier at the egress node, which can be an SRv6 Path Segment.

3. SRv6 Path Segment

As defined in [I-D.ietf-spring-srv6-network-programming], an SRv6 segment is a 128-bit value.

In order to identify an SRv6 path, this document defines a new segment called SRv6 Path Segment.

The SRv6 Path Segment MUST appear only once in a SID list. The detailed encoding of SRv6 Path Segment is out of scope of this document, and it is defined in [I-D.li-6man-srv6-path-segment-encap].

Depending on the use case, an SRv6 Path Segment identifies:

- an SRv6 path within an SRv6 domain

- an SRv6 Policy

- a Candidate-paths or a SID-List in a SRv6 Policy [I-D.ietf-spring-segment-routing-policy]

Note that, based on the use-case, the different SID-Lists of SR Policies may use the same SRv6 Path Segment.

4. SRv6 Path Segment Allocation

A Path Segment is a local segment allocated by an egress node. A Path Segment can be allocated through several ways, such as CLI, BGP [I-D.ietf-idr-sr-policy-path-segment], PCEP [I-D.ietf-pce-sr-path-segment] or other ways. The mechanisms through which a Path Segment is allocated is out of scope of this document.

When the Path Segment is allocated by the egress, it MUST be distributed to the ingress node. In this case, only the egress will process the Path Segment, and other nodes specified by SIDs in the SID list do not know how to process the Path Segment.

Depending on the use case, a Path Segment may be distributed to the SRv6 nodes along the SRv6 path. In this case, the SRv6 nodes that learned Path Segment may process the Path Segment depending on the use case.

5. Operations

An egress node or other SRv6 nodes along the SRv6 path supporting the Path Segment processing will inspect the last entry of the segment list (giving the the node will inspect the last entry in the SID list and obtain the Path Segment. The processing of the Path Segment is described in [I-D.li-6man-srv6-path-segment-encap].

6. IANA Considerations

This document does not require any IANA actions.

7. Security Considerations

This document does not introduce additional security requirements and mechanisms other than the ones described in [RFC8402].

8. Contributors

Zhenbin Li
Huawei Technologies
Huawei Campus, No. 156 Beiqing Rd.
Beijing 100095
China

Email: lizhenbin@huawei.com

Jie Dong
Huawei Technologies
Huawei Campus, No. 156 Beiqing Rd.
Beijing 100095
China

Email: jie.dong@huawei.com

9. Acknowledgements

The authors would like to thank Stefano Previdi and Zafar Ali for their valuable comments and suggestions.

10. References

10.1. Normative References

[I-D.ietf-6man-segment-routing-header]
Filsfils, C., Dukes, D., Previdi, S., Leddy, J., Matsushima, S., and D. Voyer, "IPv6 Segment Routing Header (SRH)", draft-ietf-6man-segment-routing-header-26 (work in progress), October 2019.

[I-D.ietf-spring-srv6-network-programming]
Filsfils, C., Camarillo, P., Leddy, J., Voyer, D., Matsushima, S., and Z. Li, "SRv6 Network Programming", draft-ietf-spring-srv6-network-programming-11 (work in progress), March 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>.

10.2. Informative References

[I-D.gandhi-spring-udp-pm]
Gandhi, R., Filsfils, C., daniel.voyer@bell.ca, d., Salsano, S., Ventre, P., and M. Chen, "UDP Path for In-band Performance Measurement for Segment Routing Networks", draft-gandhi-spring-udp-pm-02 (work in progress), September 2018.

[I-D.ietf-idr-sr-policy-path-segment]
Li, C., Li, Z., Telecom, C., Cheng, W., and K. Talaulikar, "SR Policy Extensions for Path Segment and Bidirectional Path", draft-ietf-idr-sr-policy-path-segment-00 (work in progress), October 2019.

[I-D.ietf-pce-sr-bidir-path]
Li, C., Chen, M., Cheng, W., Gandhi, R., and Q. Xiong, "PCEP Extensions for Associated Bidirectional Segment Routing (SR) Paths", draft-ietf-pce-sr-bidir-path-01 (work in progress), February 2020.

[I-D.ietf-pce-sr-path-segment]
Li, C., Chen, M., Cheng, W., Gandhi, R., and Q. Xiong, "Path Computation Element Communication Protocol (PCEP) Extension for Path Segment in Segment Routing (SR)", draft-ietf-pce-sr-path-segment-00 (work in progress), October 2019.

[I-D.ietf-spring-mpls-path-segment]
Cheng, W., Li, H., Chen, M., Gandhi, R., and R. Zigler, "Path Segment in MPLS Based Segment Routing Network", draft-ietf-spring-mpls-path-segment-02 (work in progress), February 2020.

[I-D.ietf-spring-segment-routing-mpls]
Bashandy, A., Filsfils, C., Previdi, S., Decraene, B., Litkowski, S., and R. Shakir, "Segment Routing with MPLS data plane", draft-ietf-spring-segment-routing-mpls-22 (work in progress), May 2019.

[I-D.ietf-spring-segment-routing-policy]
Filsfils, C., Sivabalan, S., Voyer, D., Bogdanov, A., and P. Mattes, "Segment Routing Policy Architecture", draft-ietf-spring-segment-routing-policy-06 (work in progress), December 2019.

[I-D.li-6man-srv6-path-segment-encap]
Li, C., Cheng, W., Li, Z., and D. Dhody, "Encapsulation of Path Segment in SRv6", draft-li-6man-srv6-path-segment-encap-01 (work in progress), November 2019.

[RFC7799] Morton, A., "Active and Passive Metrics and Methods (with Hybrid Types In-Between)", RFC 7799, DOI 10.17487/RFC7799, May 2016, <https://www.rfc-editor.org/info/rfc7799>.

Authors' Addresses

Cheng Li
Huawei Technologies

Email: chengli13@huawei.com

Weiqiang Cheng
China Mobile

Email: chengweiqiang@chinamobile.com

Mach(Guoyi) Chen
Huawei Technologies

Email: mach.chen@huawei.com

Dhruv Dhody
Huawei Technologies
Divyashree Techno Park, Whitefield
Bangalore, Karnataka 560066
India

Email: dhruv.ietf@gmail.com

Rakesh Gandhi
Cisco Systems, Inc.
Canada

Email: rgandhi@cisco.com