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**Path Segment for SRv6 (Segment Routing in IPv6)
draft-li-spring-srv6-path-segment-03**

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.

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[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 [\[I-D.li-pce-sr-bidir-path\]](#) 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 length of segment list is too long and flexible according to the number of 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 which the Packet A and B belong to 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, when the SRv6 Path Segment is used in reduced SRH [\[I-D.ietf-6man-segment-routing-header\]](#), the entire path information is maintained in SRH and the performance will be better than using SID list as the path identifier, while the overhead equals to the normal SRH. The Path Segment is inserted as the last segment in the segment list and will not affect the order of the original SID list and has the solely scope to give a unique identifier to the segment list.

[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:

- o 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.
- o Bi-directional 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.li-pce-sr-bidir-path](#)] defines how to use PCEP and Path segment to initiate a bidirectional SR path.
- o 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, which can be represented as LOC:FUNCT.

In order to identify an SRv6 path, this document defines a new segment called SRv6 Path Segment. A Path Segment is solely used in order to identify an SRv6 path.

The Path Segment MUST appear only once in a SID list, and it MUST appear at the last entry.

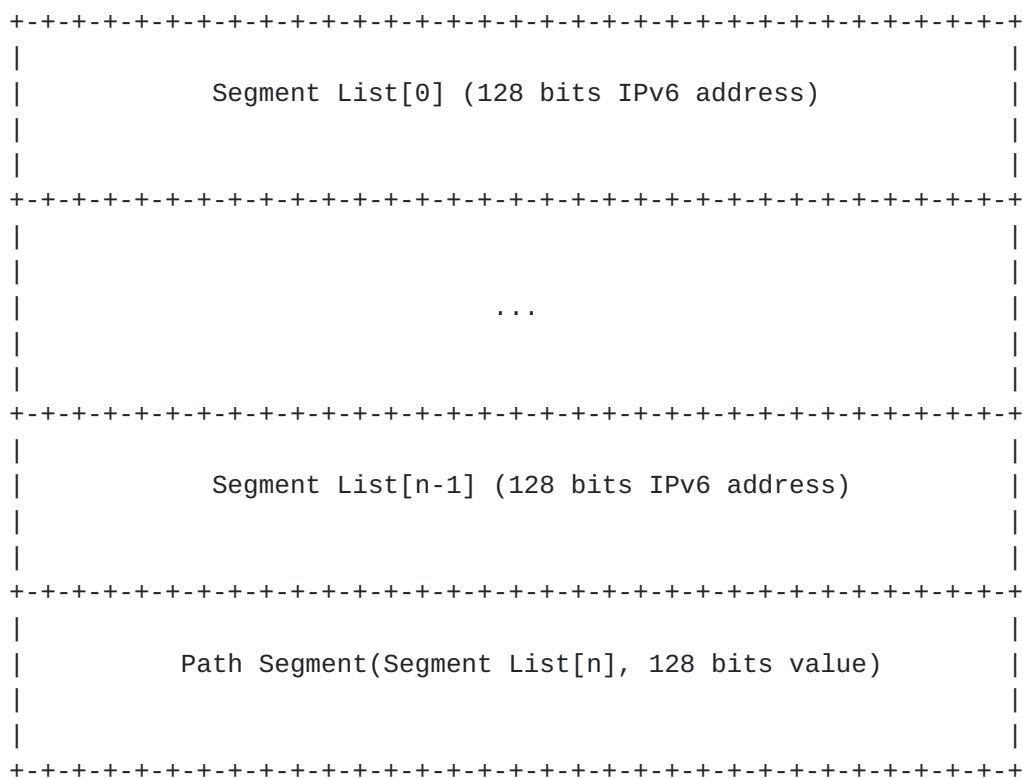


Figure 1. SRv6 Path Segment in SID List

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, a Path Segment identifies:

- o an SRv6 path within an SRv6 domain
- o an SRv6 Policy
- o 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.li-idr-sr-policy-path-segment-distribution](#)], PCEP [[I-D.li-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. Acknowledgements

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