                Encapsulation of Path Segment in SRv6
                draft-li-6man-srv6-path-segment-encap-06

Abstract

   Segment Routing (SR) allows for a flexible definition of end-to-end
   paths by encoding an ordered list of instructions, called "segments".
   The SR architecture can be implemented over an IPv6 data plane,
   called SRv6. In some use-cases such as end-to-end SR Path Protection
   and Performance Measurement (PM), an SRv6 path needs to be
   identified. An SRv6 Path Segment can be used for identifying an SRv6
   path. This document defines a P-flag in the Segment Routing Header
   to indicate the appearence of SRv6 Path Segment.

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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 an IPv6 data plane, it is called
   SRv6, and it uses a new IPv6 [RFC8200] Routing Header (EH) called the
   IPv6 Segment Routing Header (SRH) [RFC8754] to construct an SRv6
   path. As per [RFC8986], an SRv6 segment identifier is a 128-bit
   value.

   In several use cases, such as binding bidirectional path
   [I-D.ietf-pce-sr-bidir-path] and end-to-end performance measurement
   [I-D.gandhi-spring-twamp-srpm], the ability to implement path
   identification is a pre-requisite.

   An SRv6 path MAY be identified by the content of a segment list in
   the SRH. However, the segment list may not be a good key, since the
   length of a segment list is flexible according to the number of
   required SIDs. Also, the length of a segment list may be too long to
   be a key when it contains many SIDs. For instance, if packet A uses

an SRH with 3 SIDs while Packet B uses an SRH with 10 SIDs, the key
to identify these two paths will be a 384-bits value and a 1280-bits
value, respectively. Furthermore, an SRv6 path cannot be identified
by the information carried by the SRH in reduced mode [RFC8754] as
the first SID is not present. Also, different SRv6 policies may use
the same segment list for different candidate paths, so the traffic
of different SRv6 policies are merged, resulting in the inability to
measure the performance of the specific path. Therefore,
[I-D.ietf-spring-srv6-path-segment] defines an SRv6 Path Segment to
identify an SRv6 path.

This document defines a P-bit in SRH to indicate the appeerance of
SRv6 Path Segment in SRH.

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

PM: Performance Measurement.

SID: Segment ID.

SL: Segment List.

SR: Segment Routing.

SRH: Segment Routing Header.

PSID: Path Segment Identifier.

PSP: Penultimate Segment Popping.

Further, this document makes use of the terms defined in [RFC8402]
and [RFC8986].

2. Encoding of an SRv6 Path Segment

This section describes the SRH encoding of an SRv6 Path Segment
[I-D.ietf-spring-srv6-path-segment].

2.1. SRH.P-flag

   As per [I-D.ietf-spring-srv6-path-segment], an SRv6 Path Segment is a
   128-bits value, and it MUST appear only once in a SID list, and it
   MUST appear as the last entry.

   To indicate the existence of a Path Segment in the SRH, this document
   defines a P-flag in the SRH flag field. The encapsulation of SRv6
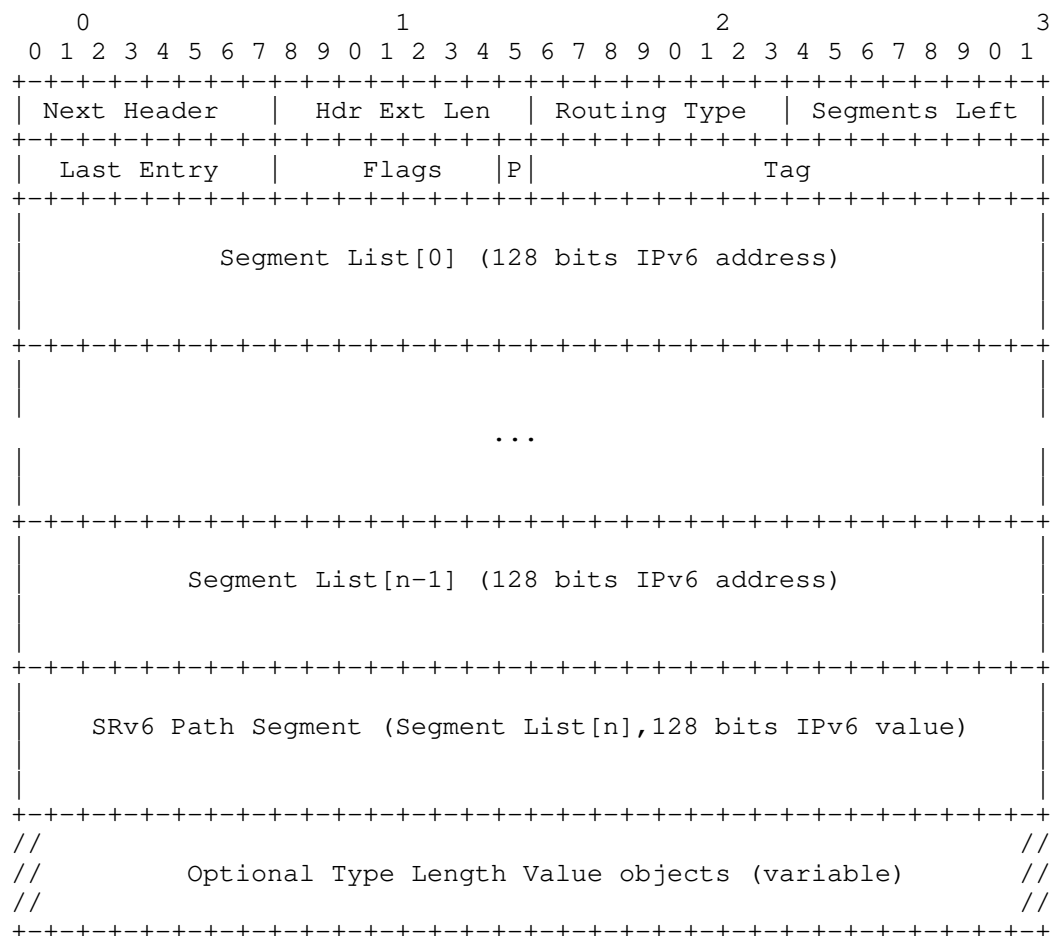   Path Segment is shown below.

```
     0                   1                   2                   3
     0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    | Next Header   | Hdr Ext Len   | Routing Type  | Segments Left |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    | Last Entry    |     Flags     |P|             Tag             |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                                                               |
    |            Segment List[0] (128 bits IPv6 address)            |
    |                                                               |
    |                                                               |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                                                               |
    |                                                               |
                                   ...
    |                                                               |
    |                                                               |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                                                               |
    |           Segment List[n-1] (128 bits IPv6 address)           |
    |                                                               |
    |                                                               |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |                                                               |
    |      SRv6 Path Segment (Segment List[n],128 bits IPv6 value)  |
    |                                                               |
    |                                                               |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    //                                                             //
    //        Optional Type Length Value objects (variable)       //
    //                                                             //
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

                 Figure 1. SRv6 Path Segment in SID List

   o P-bit: set when SRv6 Path Segment is inserted. It MUST be ignored
      when a node does not support SRv6 Path Segment processing.

SRH.P-bit processing can be enabled or disabled by configuration on
devices, it can be done by CLI, NETCONF YANG or other ways, and this
is out of the scope of this document.

The pseudo code of SRH.P-bit processing is described as below.

```
S01.  if SRH.P-flag processing is enabled:
S02.     if SRH.P-flag is set:
S03.        SRv6 Path Segment processing        ;;ref1
```

Ref1: The SRv6 Path Segment processing is accosiated with the
specific application, such as SRv6 Path Segment based Performance
measurement, and this is out of the scope of this document.

In some use cases, only the egress need to process the SRv6 Path
Segment, therefore, the P-bit processing can be done at the egress
node only while the intermediate nodes do not need to process it.
This feature can be enabled by configuration like CLI , NETCONF YANG
or other ways. In this case, the pseudo code is described as below.

```
S01.  if SRH.P-flag processing is enabled:
S02.     if intermediate node processing is disabled:
S03.        if SRH.P-flag is set and SRH.SL == 0:
S03.           SRv6 Path Segment processing
S04     else:
S05.        if SRH.P-flag is set:
S06.           SRv6 Path Segment processing
```

3. Processing of SRv6 Path Segment

   The processing of SRv6 path segment is out of the scope of this
   document and is defined in [I-D.ietf-spring-srv6-path-segment].

4. IANA Considerations

   This document requests IANA to allocate bit position TBA within the
   "Segment Routing Header Flags" registry defined in [RFC8402].

5. Security Considerations

   TBA

6. Acknowledgements

    TBA

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7.1. Normative References

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