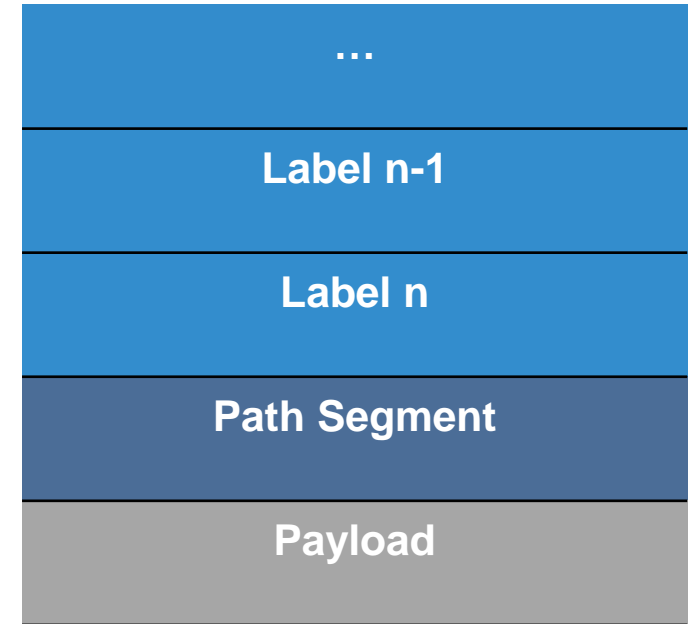# SRv6 Path Segment

for PM, OAM and IOAM

Cheng Li / Zhenbin Li
IP Research Department
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Why SR-MPLS Path Segment

- In SR-MPLS, when a packet reaches the egress node, some or all of the labels have been popped off, the egress node can not determine from which SR path the packet is received
- **China Mobile** will introduce SR-MPLS into their new PTN, called SPN(Slicing Packet Network), since SR-MPLS can provide better programmability for network control.
- However, more OAM mechanisms are needed in SR-MPLS to meet TP requirement.
- Transport Profile requires(RFC 5654):
  - control and deterministic usage of network resources.
  - end-to-end control to engineer network paths and to efficiently utilize network resources.
  - capabilities to support static or dynamic provisioning of deterministic, protected, and secured services and their associated resources.
- We proposed a draft:**draft-ietf-spring-mpls-path-segment-00** to identify a SR path with path segment.
- Huawei is implementing Path Segment based PM and Bidirectional SR path.

Path segment for SR-MPLS

- A Path Segment (PSID) is assigned by the egress node of an SR path, it uniquely identifies the SR path at the egress node.
  - Could be from either SRLB or SRGB
- Inserted at the ingress and immediately follows the last label of the SR path
  - The SR path can be either a sub-path or an end-to-end path.
- The Path Segment MUST be popped off at the egress node of the SR path
  - Means PHP MUST NOT be enabled.

...
Label n-1
Label n
Path Segment
Payload

Use case for Path segment

- Path Segment based performance measurement
  - the algorithm of PM can base on IPFPM, RFC6374, TWAMP, etc. Path Segment only provide the data plane identification mechanism.
- Path Segment based path correlation, e.g., associate two unidirectional paths to form a bi-directional path
- …
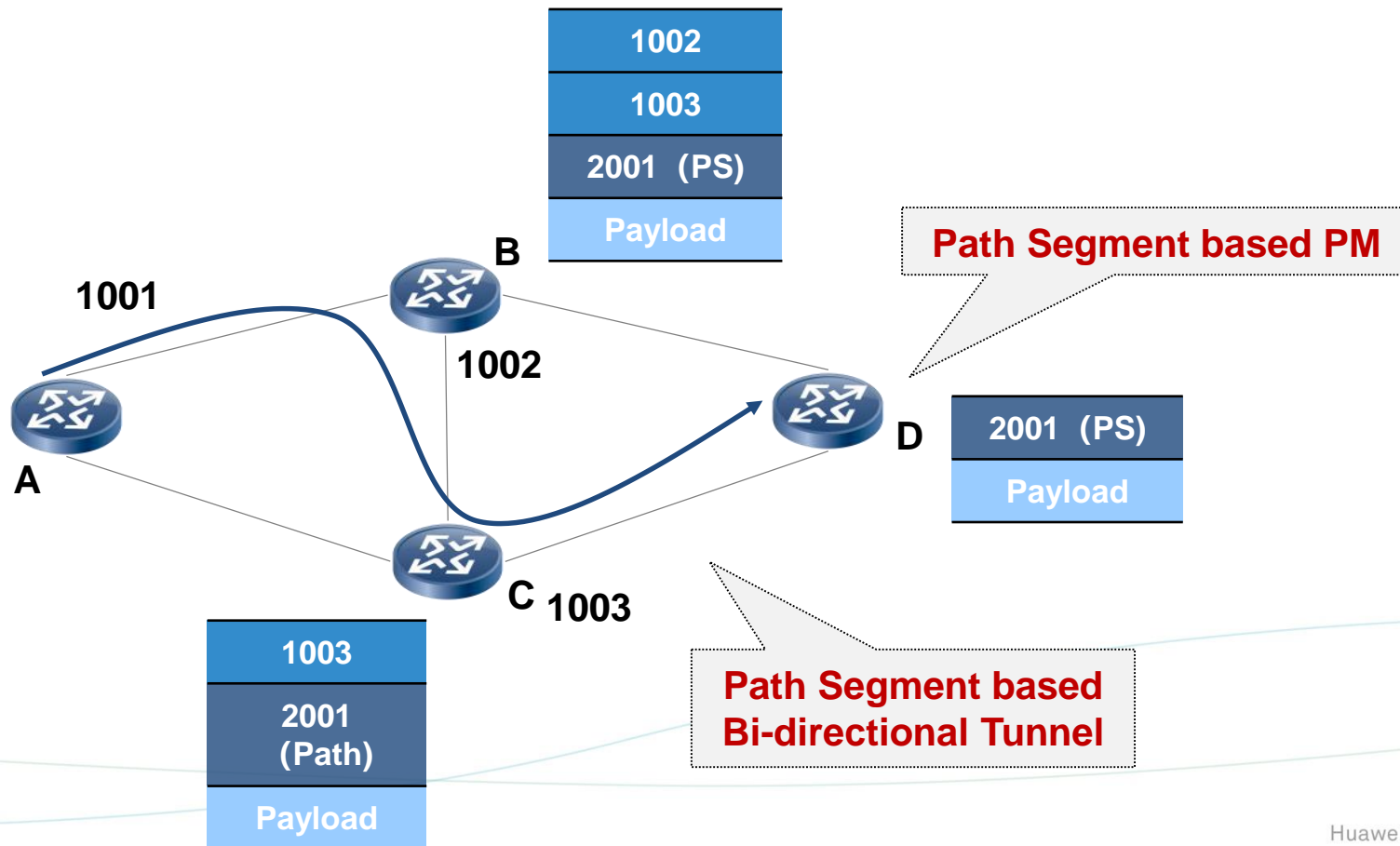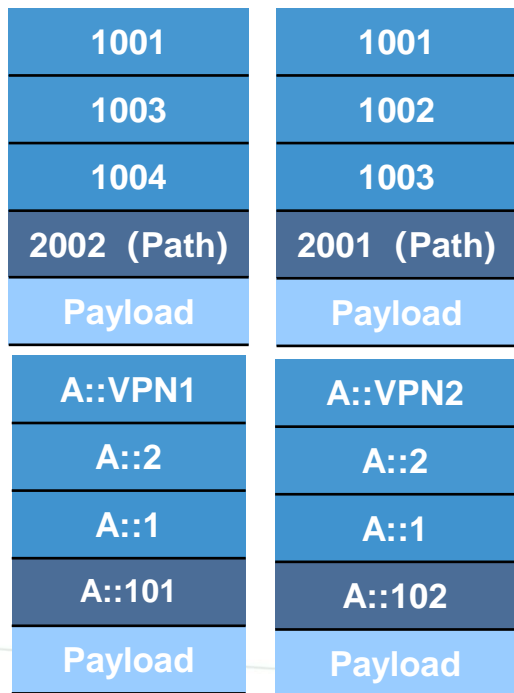
Why SRv6 Path Segment

- **In SRv6, the segment list may not be a good key to identify an SRv6 path as the length of segment list is too long and flexible.**
- For instance, using SID list as the key to identify SRv6 Path
    - SID list 1 with 5 SIDs, 128 *5 = 640 bits
    - SID list 2 with10 SIDs, 128 *10 = 1280 bits
- **1280bits is way too long to be a Path ID. The length of this Path ID is flexible.**
- Egress needs to compare the whole SID list, too complicated! Performance of PM, OAM, and use case based on Flow Path/Path Identification will not be much worse due to this mechanism.

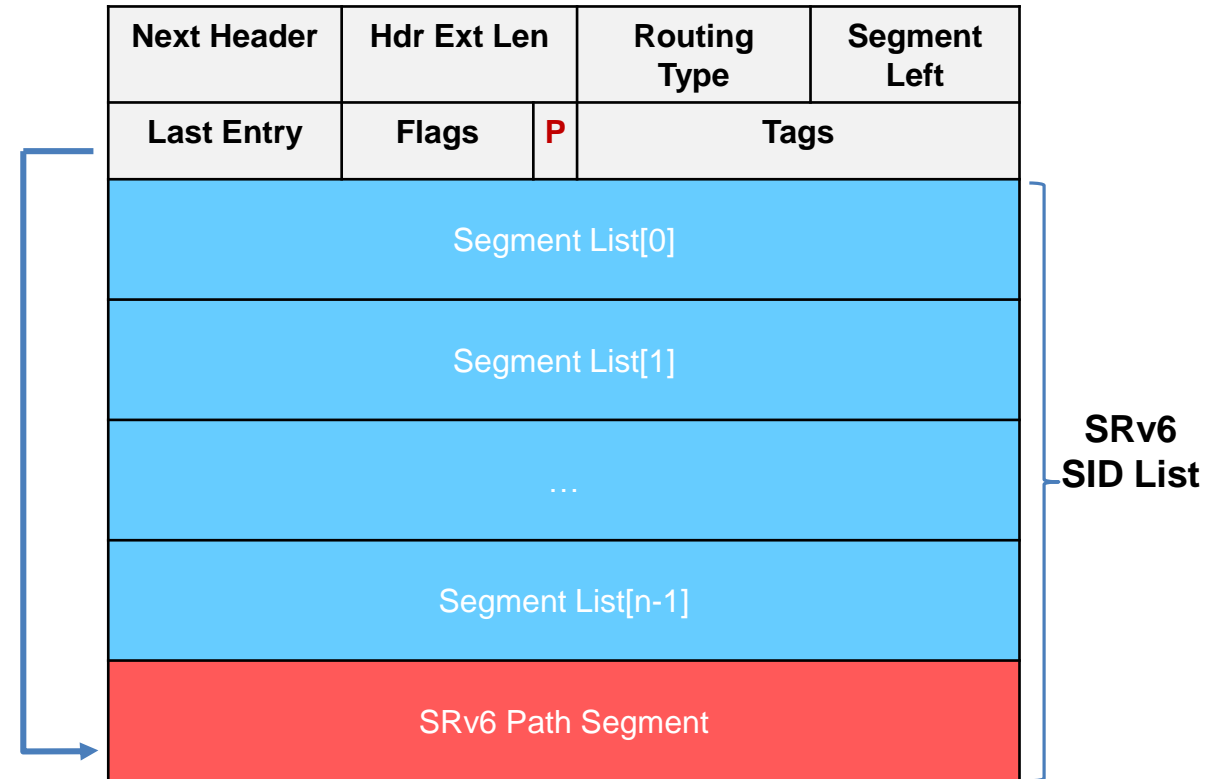| Next Header	Hdr Ext Len	Routing Type	Segment Left
Last Entry	Flags	Tags	
Segment List[0]			
Segment List[1]			
...			
Segment List[n-1]			

SRv6 SID List = Path ID ❌ ➡ **Not a good mechanism**

- **A Path ID is needed, even though we have SID list in the SRH due to it's bad Performance in path identification.**
- **Also, in reduced mode, the Path Info is incomplete so that the SID list is unable to be a Path ID anymore.**

Path Segment Encapsulation in SRv6

- An SRv6 Path Segment that can identify an SRv6 path, Candidate-paths or SRv6 Policy is proposed in draft-li-spring-srv6-path-segment-02.

- To indicate the existence of Path Segment in the SRH, a P-bit is defined.
  - P-bit: set when SRv6 Path Segment is inserted. It SHOULD be ignored when a node does not support SRv6 Path Segment processing.

- The SRv6 Path Segment MUST appear only once in a SID list, and it MUST appear at the last entry.

- We suggest to use Path Segment in reduced mode, which will not bring extra space, but provide a better mechanism to identify an SRv6 Path.

Next Header	Hdr Ext Len	Routing Type	Segment Left
Last Entry	Flags	P	Tags

Segment List[0]
Segment List[1]
…
Segment List[n-1]
SRv6 Path Segment

SRv6 SID List

Format of SRv6 Path Segment

- This document defines two formats of SRv6 Path Segment.
  - SRv6 Path Segment: Locator and Local ID
    - where the LOC part identifies the egress node that allocates the Path Segment,
    - the FUNCT part is an unique local ID to identify an SRv6 Path towards to the egress on the egress

Locator	Function ID

Locator	BSID Function ID	Path ID

  - SRv6 Path Segment: Global ID
    - the SRv6 Path Segment will not be copied to the IPv6 Destination Address, so the SRv6 Path Segment ID can be allocated from an independent 128-bits ID Space.
    - In this case, a new table should be maintained at the node for SRv6 Path Segment.

Global ID/PSID

128 Bits

Processing of SRv6 Path Segment

- An SRv6 Path Segment can be allocated through several ways, such as
    - PCEP [I-D.li-pce-sr-path-segment]
    - BGP [I-D.li-idr-sr-policy-path-segment-distribution]
- When the SRv6 Path Segment is allocated by the egress, it MUST be distributed to the ingress node.
- An SRv6 Path Segment may be distributed to the SRv6 nodes along the path depending on use cases.
- When the SRv6 Path Segment is used, the following rules apply:
    - The SRv6 Path Segment MUST appear only once in a SID list, and it MUST appear at the last entry.
    - Only the one that appears at the last entry in the SID list will be processed. SRv6 Path Segment appears at other location in the SID list will be treated as an error.
    - When an SRv6 Path Segment is inserted, the SL MUST be initiated to be less than the value of Last Entry, and will not point to SRv6 Path Segment.
    - The SRv6 Path Segment MUST NOT be copied to the IPv6 destination address.
    - Penultimate Segment Popping (PSP) MUST be disabled.
    - The ingress needs to set the P-bit when an SRv6 Path Segment is inserted in the SID List.
    - The specific SRv6 Path Segment processing depends on use cases.

The benefits of SRv6 Path Segment

- An better and easy mechanism to identify an SRv6 Path.
  - Easy extension, a SID in the SID list pointed by the Last entry.
  - Better Performance, much better than other key, SID list, or Path ID in SRH TLV, or HBH or DH.
    - Easy to be inserted as part of SID list. Better Performance than inserting Path ID in HBH or other IPv6 EH
    - Easy to inspect since it's fixed location, can be located by the last entry.
    - Easy to process since it's fixed length

- Naturally supports IPFPM, RFC6374, TWAMP, or other PM/OAM mechanisms, since it only provides an efficient SRv6 Path Identification mechanism.

- Supports per-hop Telemetry, IOAM (Postcard mode, send metadata to the control plane hop by hop).

- Integrated SRv6 Solution.

Thanks

Huawei Link