DetNet Data Plane: IEEE 802.1 Time Sensitive Networking over SRv6

draft-wang-detnet-tsn-over-srv6-00

IETF 106, Singapore
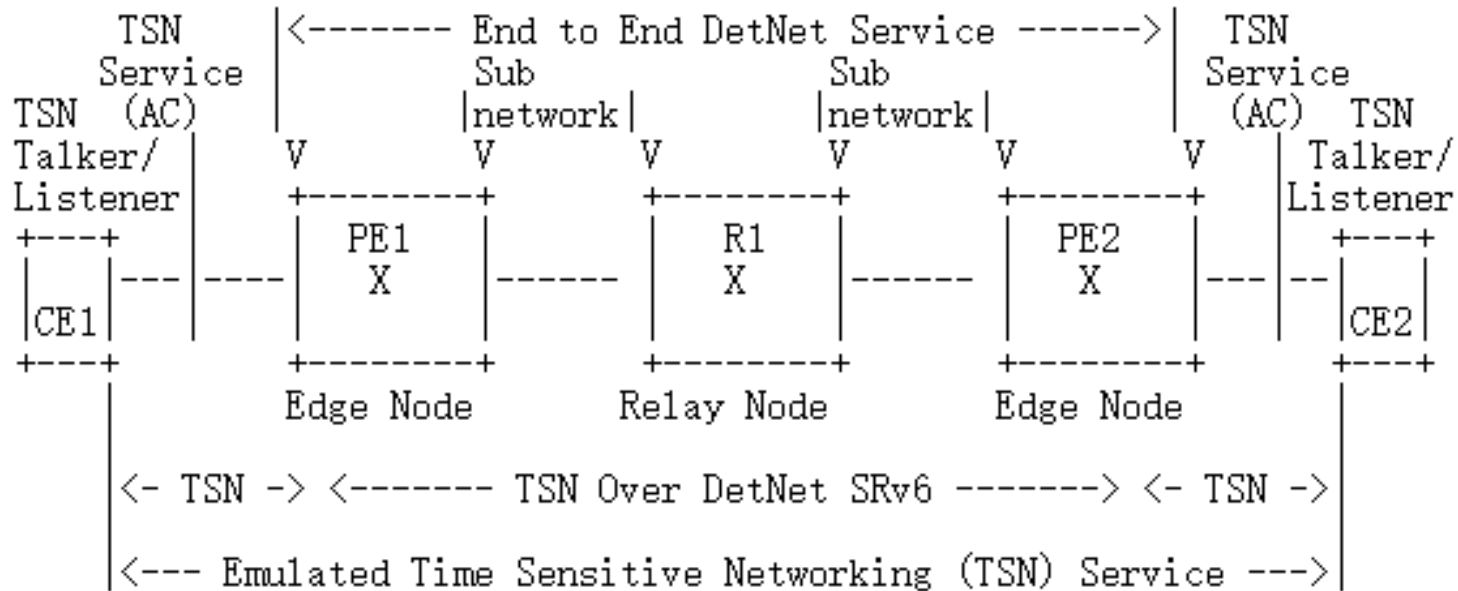
Xueshun Wang(Fiberhome/CICT)
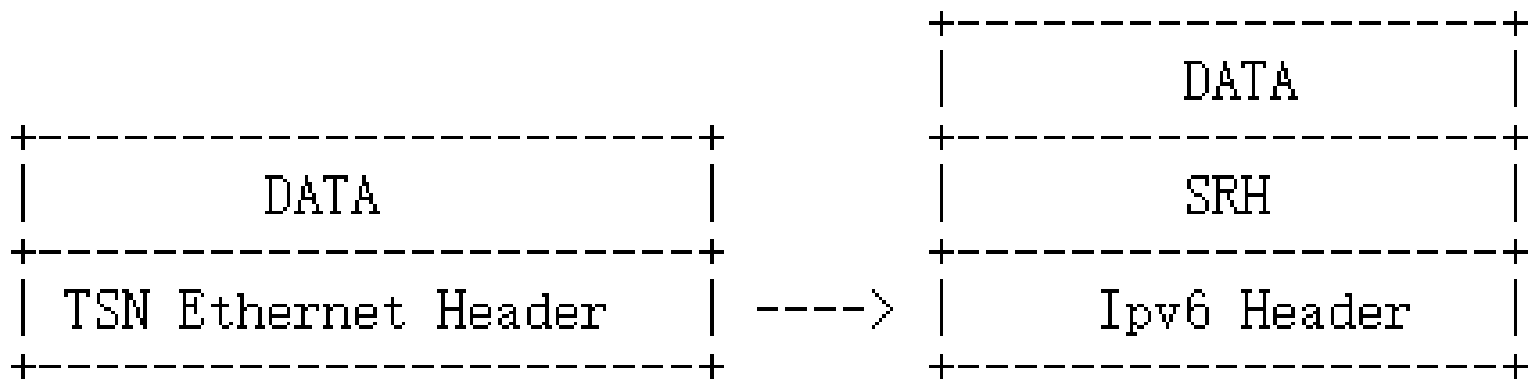Jinyou Dai(Fiberhome/CICT)
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TSN over DETNET

```
          TSN     |<------- End to End DetNet Service ------>|  TSN
        Service   |        Sub                  Sub          |Service
 TSN     (AC)     |      |network|            |network|      | (AC)    TSN
Talker/      V    |   V        V          V        V       V |       Talker/
Listener|         +---------+   +--------+   +---------+     |       Listener
+---+   |         |  PE1    |   |  R1    |   |  PE2    |      |       +---+
|   |---|-----|   |   X     |------|   X   |------|   X     |---|--|      |   |
|CE1|   |     |   |         |   |        |   |         |     |      |CE2|
+---+   |         +---------+   +--------+   +---------+     |       +---+
        |         Edge Node    Relay Node    Edge Node       |
        |
        |<- TSN -> <------- TSN Over DetNet SRv6 -------> <- TSN ->|
        |
        |<--- Emulated Time Sensitive Networking (TSN) Service --->|

   X    = Service protection
```
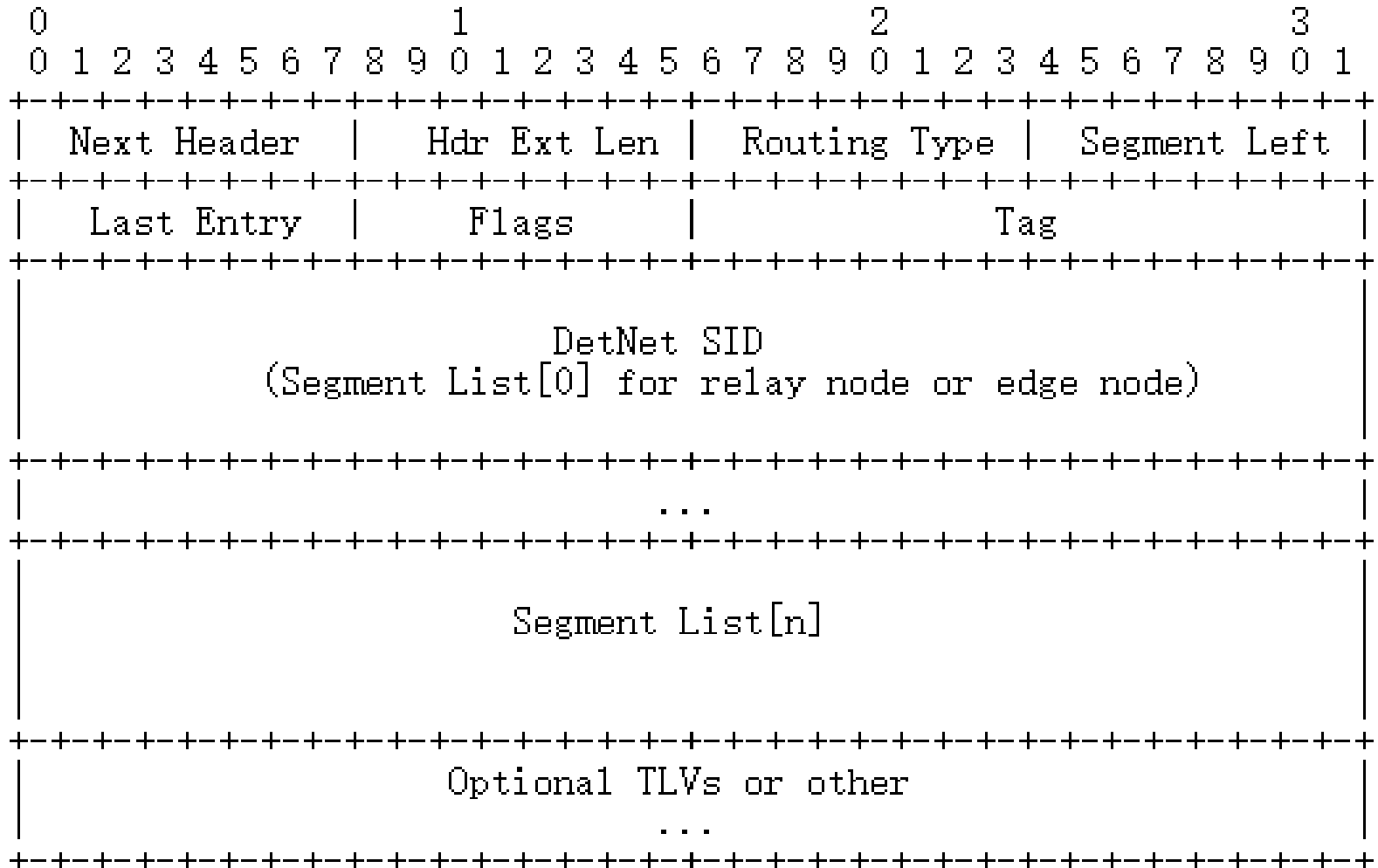
Solution for TSN over SRv6

```
                                          +-----------------------+
                                          |         DATA          |
       +-----------------------+          +-----------------------+
       |         DATA          |          |          SRH          |
       +-----------------------+          +-----------------------+
       |  TSN Ethernet Header  | ----->   |      Ipv6 Header      |
       +-----------------------+          +-----------------------+
```

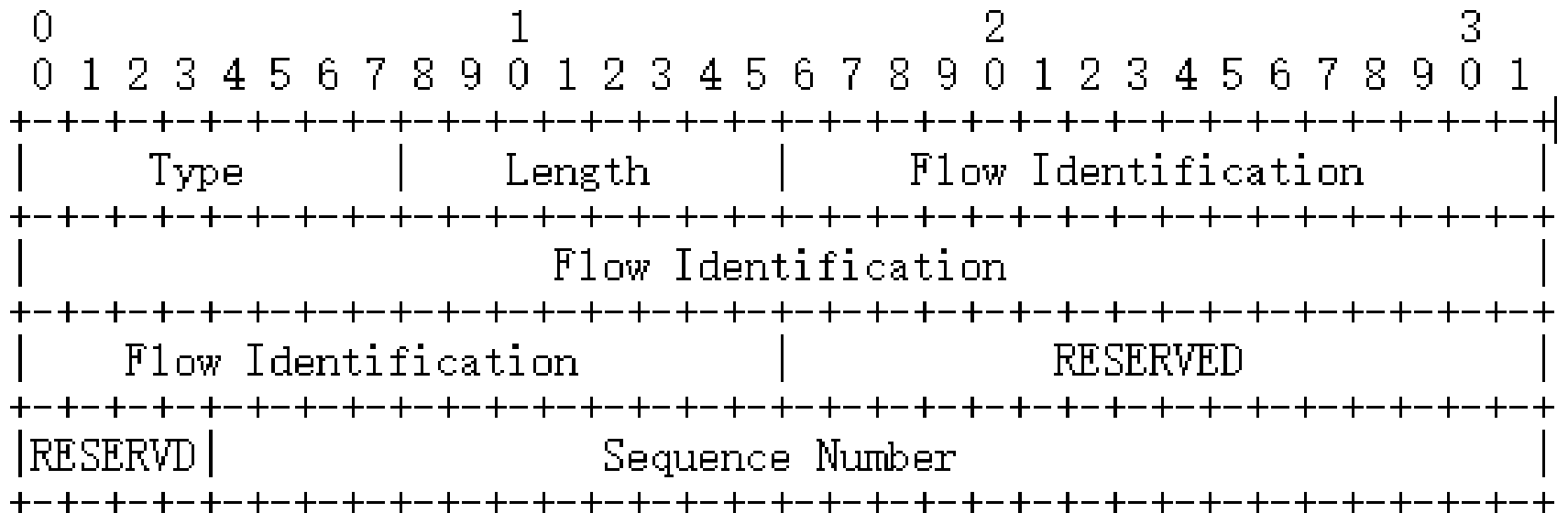# SRv6-aware edge node MUST support the following TSN components

1. For recognizing flows:
   * Stream Identification (SRv6-flow-aware)

2. For FRER used inside the TSN domain, additionally:
   * Sequencing function (SRv6-flow-aware)
   * Sequence encode/decode function

3. For FRER when the node is a TSN replication or elimination point

.

SRH for DETNET

```
 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  | Segment Left  |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| Last Entry    |    Flags      |              Tag              |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               |
|                          DetNet SID                           |
|        (Segment List[0] for relay node or edge node)          |
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                             ...                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               |
|                        Segment List[n]                        |
|                                                               |
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                     Optional TLVs or other                    |
|                             ...                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

SID for Flow Identification

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|     Type      |     Length    |      Flow Identification      |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                      Flow Identification                      |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|     Flow Identification       |           RESERVED            |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|RESERVD|                Sequence Number                       |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

End. B.Replication DetNet SID: Packet Replication Function

S01. IF NH=SRH & SL>0 THEN {

S02. Extract the DetNet SID values from the SRH or TSN Stream identification and TSN Rtag.

S03. Create two new outer IPv6+SRH headers: IPv6-SRH-1 and IPv6-SRH-2 Insert the policy-instructed segment lists in each newly created SRH (SRH-1 and SRH-2). Also, add the extracted DetNet SID into SRH-1 and SRH-2.

S04. Remove the incoming outer IPv6+SRH header, restore DATA as the original packet.

S05. Create a duplication of the restore DATA as the duplicate packet.

S06. Encapsulate the original packet into the first outer IPv6+SRH header: (IPv6-SRH-1) (original packet)

S07. Encapsulate the duplicate packet into the second outer IPv6+SRH header: (IPv6-SRH-2) (duplicate packet)

S08. Set the IPv6 SA as the local address of this node.

S09. Set the IPv6 DA of IPv6-SRH-1 to the first segment of the SRv6 Policy in of SRH-1 segment list.

S10. Set the IPv6 DA of IPv6-SRH-2 to the first segment of the SRv6 Policy in of SRH-2 segment list.

S11. }

End. B. Elimination: Packet Elimination Function

S01. IF NH=SRH & SL>0 & "the packet is not a redundant packet" THEN {

S02. Do not decrement SL nor update the IPv6 DA with SRH[SL]

S03. Extract the value of DetNet SID from the SRH

S04. Extract Flow Identification and Sequence Number from DetNet SID.

S05. IF NOT receive the packet with the same Flow Identification
      and Sequence Number {

S06.   Create a new outer IPv6+SRH header

S07.   Insert the policy-instructed segment lists in the newly created SRH and add the retrieved DetNet SID in the newly created SRH

S08.   Remove the incoming outer IPv6+SRH header.

S09.   Set the IPv6 DA to the first segment of the SRv6 Policy in the newly created SRH

S10. } Else {

S11.   Drop the packet

S12. }

S13. }

SRv6 Data Plane Considerations

➢ DetNet PREOF

➢ Edge Node Processing

Management and Control Information Summary

o TSN Stream identification and TSN R-tag information to be mapped to SRv6 SRH SID. Note that a single TSN Stream identification can map to one SRH DetNet SID, and it can used for PREOF.

o IPv6 source address.

o IPv6 destination address.

o IPv6 Traffic Class.

Thank you!