Performance Measurement Using Simple TWAMP for Segment Routing Networks

draft-gandhi-spring-stamp-srpm-05

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Agenda

- Requirements and Scope

- Summary of Procedure

- Next Steps

Requirements and Scope

Requirements:

- Delay and Loss Measurement
  - ✓ Links and end-to-end P2P/P2MP SR paths
    - ✓ Links include physical, virtual, LAG (bundle), LAG member, numbered/unnumbered links
  - ✓ Applicable to SR-MPLS/SRv6 data planes
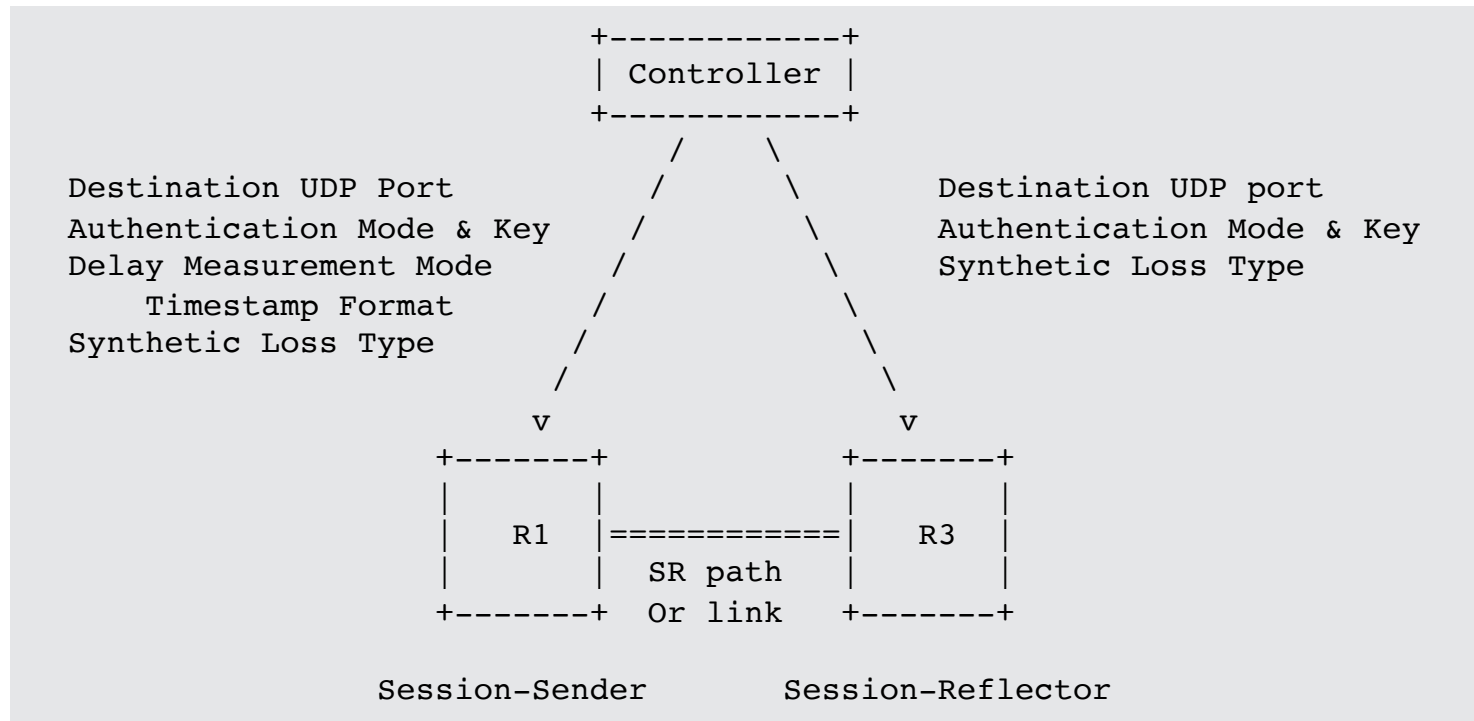- Handle ECMP for SR paths

Goals:

- Avoid per session provisioning on Session-Reflector
- Avoid control-channel signaling for sessions
- Very high scale for number of sessions and faster detection interval
  - Support hardware implementation

Scope:

- STAMP [RFC 8762]
- STAMP Extensions [RFC8972]
- draft-gandhi-ippm-stamp-srpm

Example Provisioning Model

```
                        +------------+
                        | Controller |
                        +------------+
                            /     \
Destination UDP Port       /       \        Destination UDP port
Authentication Mode & Key /         \       Authentication Mode & Key
Delay Measurement Mode   /           \      Synthetic Loss Type
    Timestamp Format    /             \
Synthetic Loss Type    /               \
                      /                 \
                     v                   v
              +-------+           +-------+
              |       |           |       |
              |  R1   |===========|   R3  |
              |       |  SR path  |       |
              +-------+  Or link  +-------+

          Session-Sender        Session-Reflector
```

Session-Sender Test Packet for Links

- For **links**, the STAMP session-sender test packet is routed over the links using local and remote link addresses.
- User-configured destination UDP **port1** is used for STAMP test packets
- TTL is set 1.
- Applicable to physical, virtual, LAG, LAG member, numbered/unnumbered links

```
+---------------------------------------------------------------+
| IP Header                                                     |
.   Source IP Address = Session-Sender IPv4 or IPv6 Address     .
.   Destination IP Address = Session-Reflector IPv4 or IPv6 Addr .
.   Protocol = UDP                                              .
.                                                               .
+---------------------------------------------------------------+
| UDP Header                                                    |
.   Source Port = As chosen by Session-Sender                   .
.   Destination Port = User-configured Port                     .
.                                                               .
+---------------------------------------------------------------+
| Payload = Test Packet specified in Section 4.2 of RFC 8762   |
.                                                               .
+---------------------------------------------------------------+

           Figure 1: Session-Sender Test Packet for links
```

Session-Sender Test Packet for SR-MPLS and SRv6 Policy

For **end-to-end** SR Policy, the STAMP session-sender test packet is sent on the SR Policy with:

1. MPLS label stack of SR-MPLS Policy
2. SRv6 SRH [RFC 8754] with Segment List of SRv6 Policy
   - Using upper layer processing in SRv6 network programming

- User-configured destination UDP **port1** is used for STAMP test packets
- TTL is set 255
- RA not set.
- Color only SR-MPLS Policy:
  - Destination Address in 127/8 address
  - TTL is set 1.
- P2MP SR-MPLS Policy
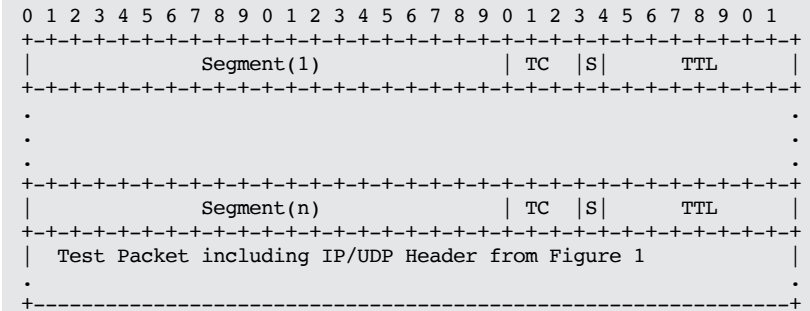 - Destination Address in 127/8 range
  - TTL is set 1

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                  Segment(1)                | TC  |S|    TTL     |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 .                                                             .
 .                                                             .
 .                                                             .
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                  Segment(n)                | TC  |S|    TTL     |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|    Test Packet including IP/UDP Header from Figure 1          |
 .                                                             .
+---------------------------------------------------------------+

Figure 2: Example session-sender test packet for SR-MPLS Policy
```

```
 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
+---------------------------------------------------------------+
| IP Header                                                     |
 .  Source IP Address = Session-Sender IPv6 Address             .
 .  Destination IP Address = Destination IPv6 Address           .
 .                                                             .
+---------------------------------------------------------------+
| SRH as specified in RFC 8754                                  |
 .  <Segment List>                                              .
 .                                                             .
+---------------------------------------------------------------+
| IP Header                                                     |
 .  Source IP Address = Session-Sender IPv6 Address             .
 .  Destination IP Address = Session-Reflector IPv6 Address     .
 .                                                             .
+---------------------------------------------------------------+
| UDP Header                                                    |
 .  Source Port = As chosen by Session-Sender                   .
 .  Destination Port = User-configured Port                     .
 .                                                             .
+---------------------------------------------------------------+
| Payload = Test Packet specified in Section 4.2 of RFC 8762    |
 .                                                             .
+---------------------------------------------------------------+

Figure 3: Example session-sender test packet for SRv6 Policy
```
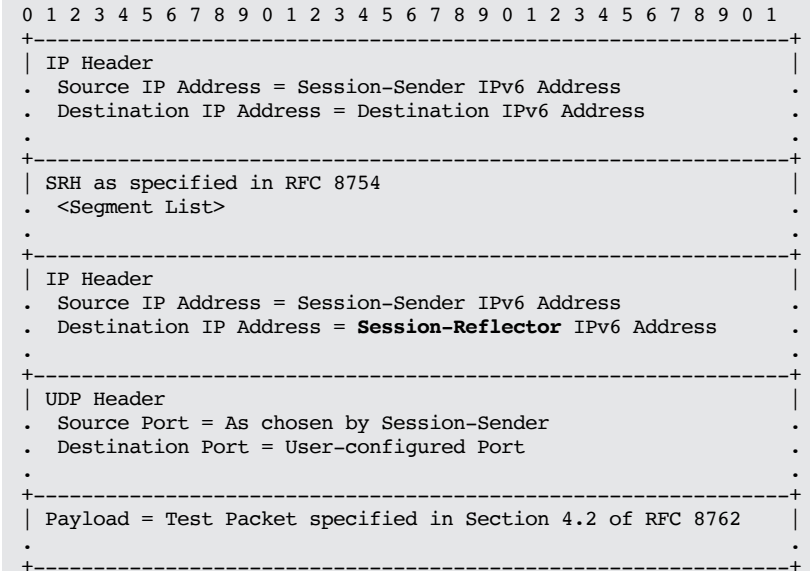
Session-Reflector Test Packet

- The test packet reply is sent using the IP/UDP information from the received test packet.
- Link - Use Control Code from the received test packet if set.
- SR path - Use Segment List from Return Path TLV if present in received test packet.

```
+------------------------------------------------------------------+
|  IP Header                                                       |
.   Source IP Address = Session-Reflector IPv4 or IPv6 Address    .
.   Destination IP Address = Source IP Address from Test Packet   .
.   Protocol = UDP                                                .
.                                                                 .
+------------------------------------------------------------------+
|  UDP Header                                                      |
.   Source Port = As chosen by Session-Reflector                  .
.   Destination Port = Source Port from Test Packet               .
.                                                                 .
+------------------------------------------------------------------+
|  Payload = Test Packet specified in Section 4.3 of RFC 8762     |
.                                                                 .
+------------------------------------------------------------------+

              Figure 4: Session-Reflector Test Packet
```

ECMP Support for SR Path

- SR Path can have ECMP between the ingress and transit nodes, between transit nodes and between transit and egress nodes.
- Sending test packets that can take advantage of the hashing function in forwarding plane.
- Existing forwarding mechanisms are applicable to test packets. Examples are:
  - For IPv4
    - Sweeping destination address in IPv4 header (e.g. 127/8)
    - Identify intended actual destination node in "Destination Node Address TLV"
  - For IPv6
    - Sweeping flow label in IPv6 header

Performance Measurement Modes

- One-way Delay Measurement Mode

  - Existing default behavior

- Two-way Delay Measurement Mode

  - Test packet reply sent "in-band" on reverse path

    - Link - Use Control Code from the received test packet

    - SR path - Use Return Path TLV for STAMP from the received test packet

- Loopback Measurement Mode

  - Session-sender test packet carries the return path in the header

Example PM Metrics

- Compute following example delay metrics:
  - Minimum delay
  - Maximum delay
  - Average delay
  - Delay variance
- Compute following example loss metrics:
  - Synthetic packet loss (aka indirect-mode packet loss)
  - Connectivity loss (aka liveness heart-beat failure detection)

Next Steps

- Welcome your comments and suggestions

- Requesting WG adoption

Thank you