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, LAG member links
    - ✓ Applicable to SR-MPLS/SRv6 data planes
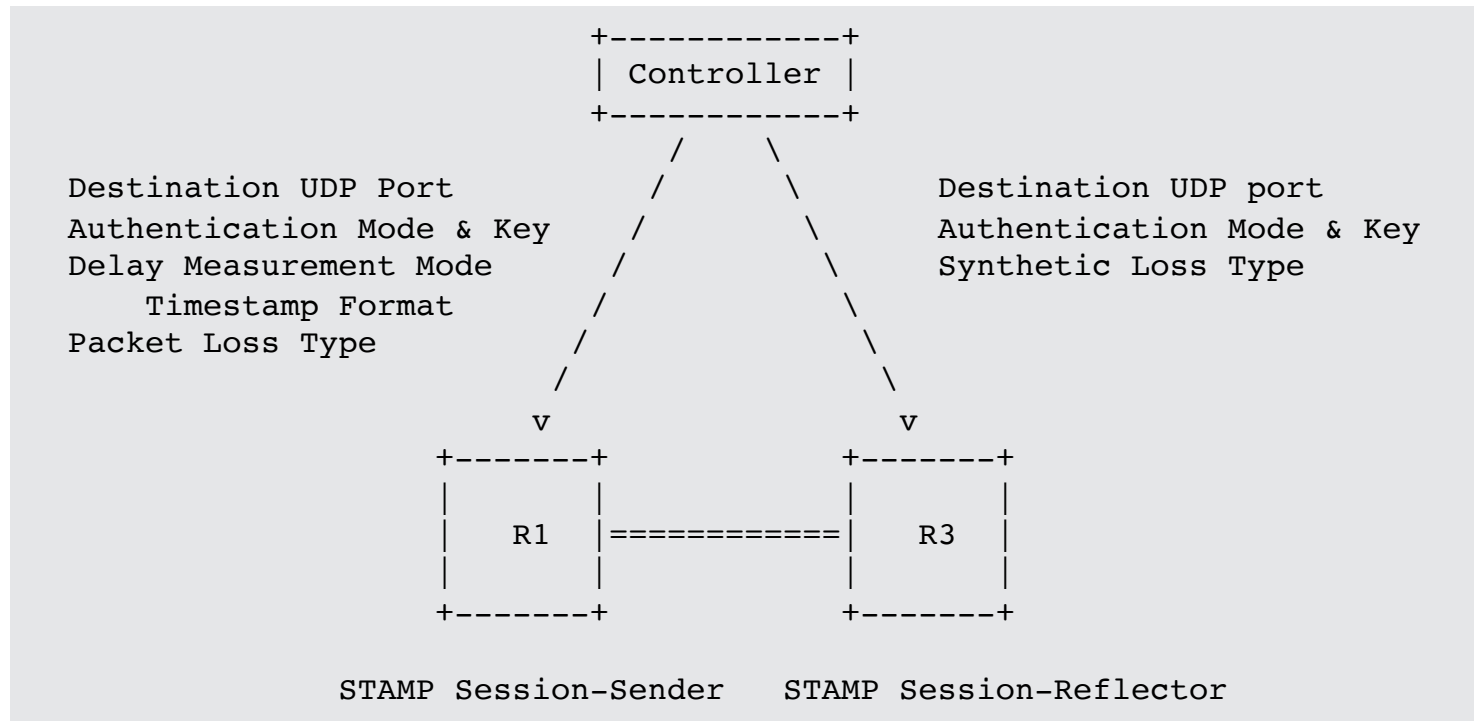- Handle ECMP for SR paths

Goals:

- Avoid provisioning sessions on Session-Reflector for stateless mode
- Avoid control-channel signaling for dynamic parameters
- 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 STAMP Reference Model

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

        STAMP Session-Sender    STAMP Session-Reflector
```

Session-Sender Test Packet for Links

- For links, the STAMP Session-Sender test packets are transmitted over the links using local and remote link addresses
- User-configured destination UDP **port1** is used for STAMP test packets (also port 862)
- TTL is set 1
- Applicable to physical, virtual, LAG, LAG member 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 & 862                .
.                                                               .
+----------------------------------------------------------------+
| Payload = Test Packet specified in Section 4.2 of RFC 8762    |
.                                                               .
+----------------------------------------------------------------+

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

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

For end-to-end SR Policy, the STAMP Session-Sender test packets are transmitted 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 (also port 862)
- TTL is set 255
- Color only SR-MPLS Policy:
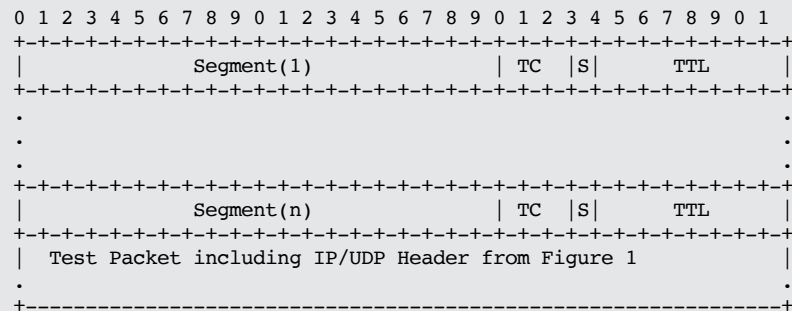 – Destination Address in 127/8 address
  – TTL is set 1

```
 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 & 862              .
.                                                              .
+--------------------------------------------------------------+
| Payload = Test Packet specified in Section 4.2 of RFC 8762   |
.                                                              .
+--------------------------------------------------------------+
```
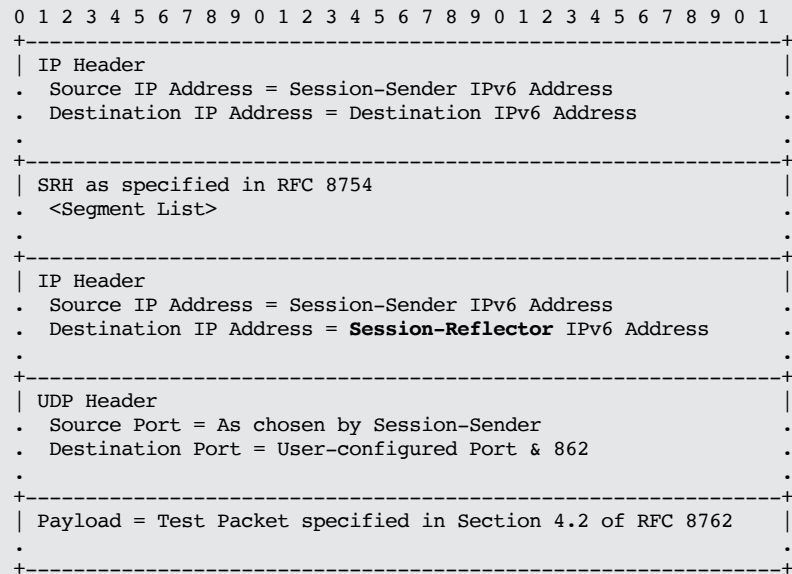
Figure 3: Example Session-Sender test packet for SRv6 Policy

STAMP Session-Sender Test Packet for P2MP SR-MPLS Policy

For end-to-end P2MP SR-MPLS Policy, the STAMP Session-Sender test packet is sent with:

- – Tree-SID of the SR-MPLS Policy

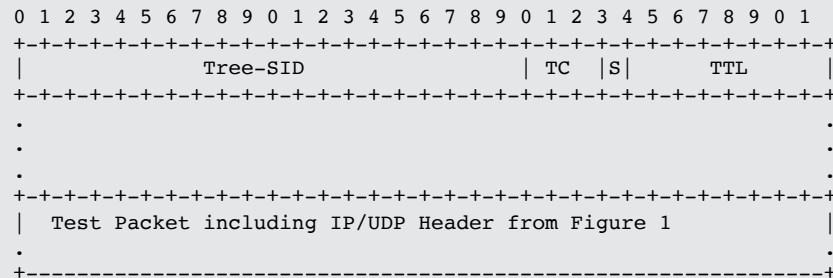- IPv4 destination address set from 127/8 range

- 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                  Tree-SID                   | TC  |S|    TTL    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
.                                                               .
.                                                               .
.                                                               .
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|  Test Packet including IP/UDP Header from Figure 1            |
.                                                               .
+---------------------------------------------------------------+

 Figure 4: Example Session-Sender test packet for SR-MPLS Policy
```

STAMP Session-Reflector Test Packet

- The STAMP reply test packet is sent using the IP/UDP information from the received test packet.
- Link - Use Control Code from the received test packet.
- SR path - Use Segment List in Return Path TLV from the 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 5: STAMP 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 STAMP 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

  - STAMP test packet reply sent "in-band" on reverse path

    - Link - Use Control Code from the received test packet

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

- Loopback Measurement Mode

  - STAMP 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:
  - Test packet loss (aka synthetic packet loss)
  - Data packet loss (aka direct measurement)
  - Connectivity loss (aka liveness heart-beat failure detection)

Next Steps

- Welcome your comments and suggestions
- Requesting WG adoption

Thank you