Performance Measurement Using Simple TWAMP for Segment Routing Networks

draft-gandhi-spring-stamp-srpm-05

Rakesh Gandhi - Cisco Systems (rgandhi@cisco.com) - Presenter
Clarence Filsfils - Cisco Systems (cfilsfil@cisco.com)
Daniel Voyer - Bell Canada (daniel.voyer@bell.ca)
Mach(Guoyi) Chen - Huawei (mach.chen@huawei.com)
Bart Janssens - Colt (Bart.Janssens@colt.net)

Agenda

- Requirements and Scope

- Summary of Procedure

- Next Steps

Requirements, Goals and Scope

Requirements:

- In-band Performance 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
- One-way, two-way, round-trip delay and packet loss metrics

Goals:

- Avoid provisioning and maintaining each test session on Session-Reflector - Stateless mode
- Avoid control protocol for signaling dynamic parameters

Scope:

- STAMP [RFC 8762]
- STAMP Extensions [RFC 8972]
- STAMP Extensions for SR [draft-gandhi-ippm-stamp-srpm]

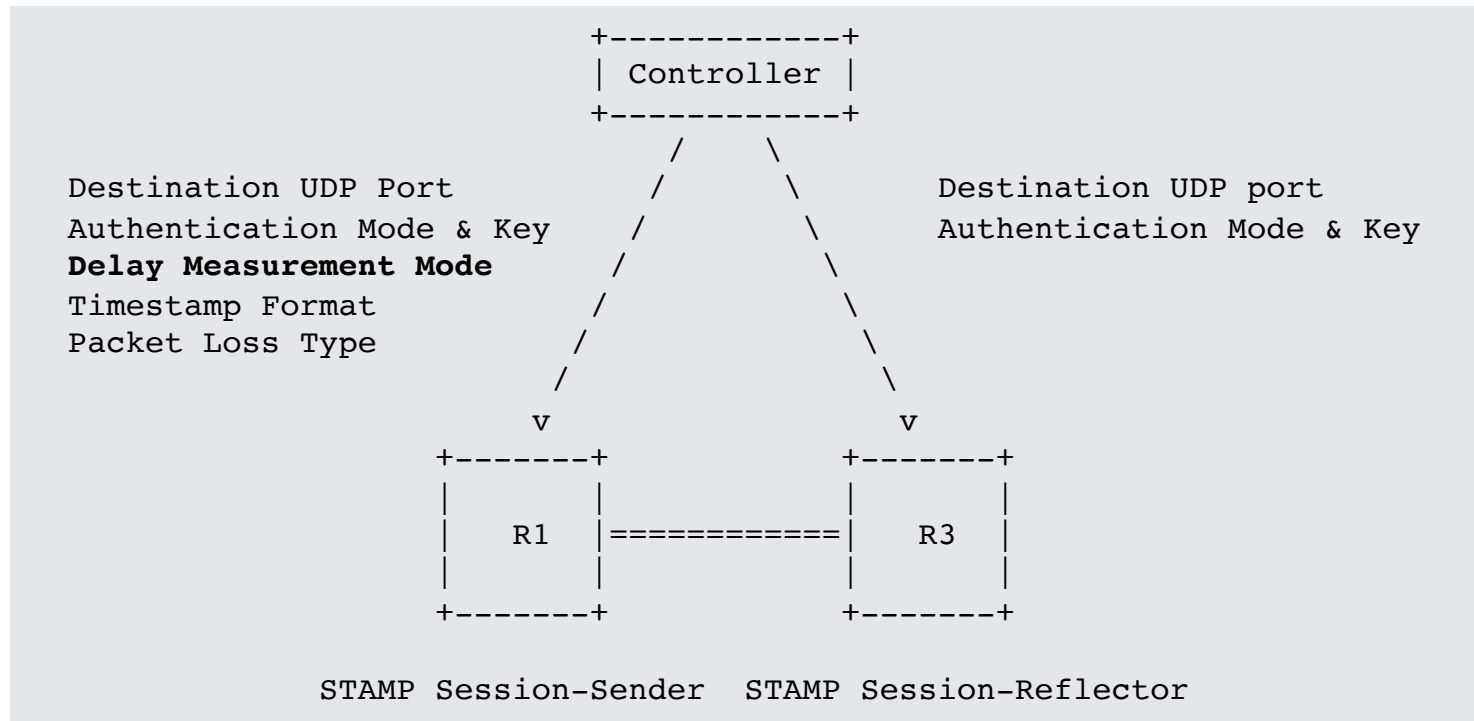# Updates Since Version-02

Updates:

- ✓ Replaced TWAMP Light draft with STAMP draft
- ✓ Draft status - Informational
- ✓ Updated terminology to align with STAMP
- ✓ Added (synthetic) packet loss section
- ✓ Removed stand-alone direct measurement messages
- ✓ Removed text for IPv6/UDP test packet with zero checksum
- ✓ Various editorial changes to address review comments

Open Items:

- ▪ None

Example STAMP Reference Model

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

          STAMP Session-Sender   STAMP Session-Reflector
```

STAMP Session-Sender Test Packet for Links

- For links, STAMP Session-Sender test packets are transmitted over the links using local and remote link addresses
- User-configured destination UDP port is used for STAMP test packets (or port 862)
- IPv4 TTL /IPv6 Hop-limit is set to 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: STAMP Session-Sender Test Packet for links
```

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

- For end-to-end SR Policy, STAMP Session-Sender test packets are transmitted with:
  1. MPLS label stack of SR-MPLS Policy
  2. SRv6 SRH [RFC 8754] with Segment List of SRv6 Policy
     - Using upper-layer processing defined in SRv6 network programming
- User-configured destination UDP port is used for STAMP test packets (or port 862)
- IPv4 TTL/IPv6 Hop-limit is set to 255
- Color-Only Destination Steering:
  - IPv4
    - Destination Address in 127/8 range
    - TTL is set to 1
  - IPv6
    - Destination Address set to ::1/128
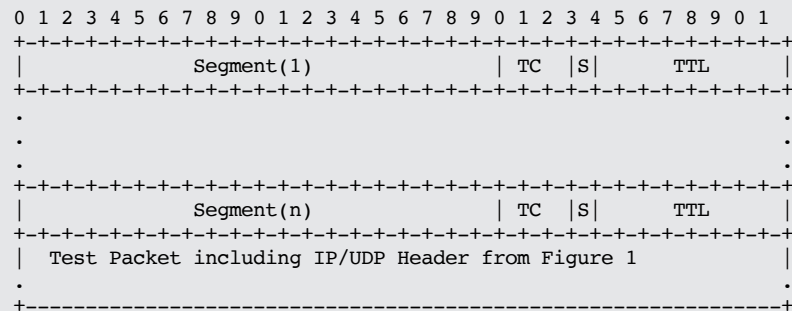   - Hop Limit is set to 1

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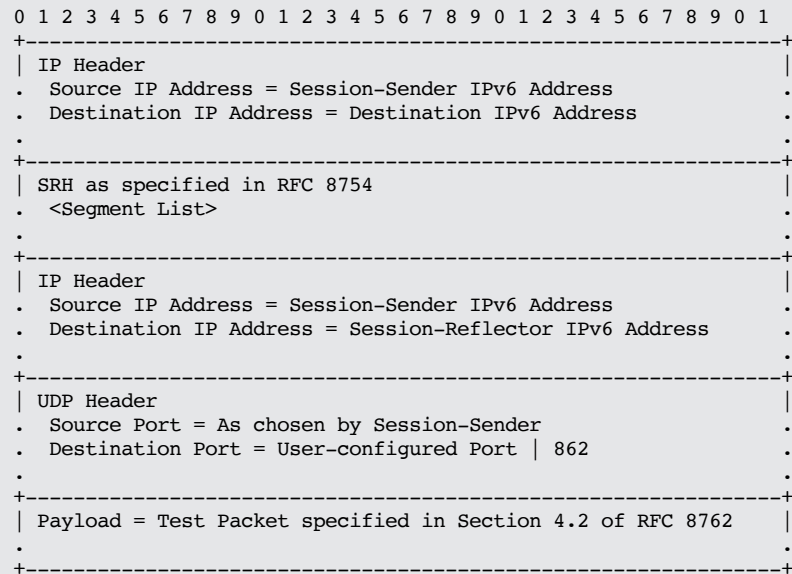
STAMP Session-Sender Test Packet for P2MP SR-MPLS Policy

- For end-to-end P2MP SR-MPLS Policy, STAMP Session-Sender test packets are transmitted with:

  - Tree-SID of the P2MP SR-MPLS Policy

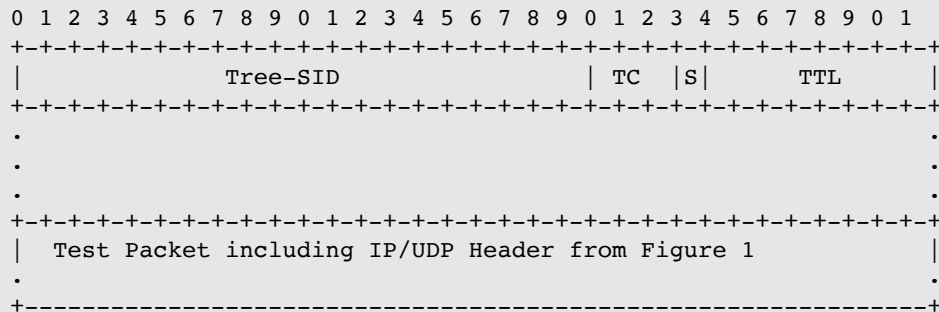 - IPv4 destination address selected from 127/8 range

  - IPv4 TTL is set to 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

- STAMP Session-Reflector reply test packet is sent using the IP/UDP information from the received test packet.

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

          Figure 5: STAMP Session-Reflector Test Packet
```

Performance Measurement Modes

- Need to measure in-band one-way, two-way and round-trip delay metrics in SR networks

- One-way Delay Measurement Mode

  - Existing (default) behavior

- Two-way Delay Measurement Mode

  - STAMP Session-Reflector test packet sent "in-band" on reverse path

  - Stateless mode of Session-Reflector – per each test session

  - Link: Use Control Code Sub-TLV in the Return Path TLV from the received test packet.

  - E2E SR path: Use Segment List Sub-TLV in the Return Path TLV from the received test packet.

- Round-trip Delay Measurement Mode

  - STAMP Session-Sender test packet sent in loopback mode, carries the return path in the packet header

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

Example PM Metrics

- Compute following example (one-way, two-way, round-trip) delay metrics:
  - Minimum delay
  - Maximum delay
  - Average delay
  - Delay variance
- Compute following example loss metrics:
  - Packet loss (i.e., synthetic packet loss)
  - Direct measurement packet counters
  - Session status succeeded/failed (i.e., measurement is active)

Next Steps

- Welcome your comments and suggestions
- Requesting WG adoption

Thank you