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
- Handle ECMP for SR paths

Goals:

- Avoid provisioning and maintaining test sessions on Session-Reflector - Stateless mode
- Avoid control protocol for signaling dynamic parameters
- High scale for number of test sessions and faster detection interval
  - Support hardware implementation

Scope:

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

Updates Since Version-02

Updates:

- ✓ STAMP Extensions for SR was moved to draft-gandhi-ippm-stamp-srpm
- ✓ Replaced TWAMP Light draft with STAMP draft
- ✓ Draft status - Informational
- ✓ Updated terminology to align with STAMP
- ✓ Added (test) packet loss section
- ✓ Removed STAMP direct measurement stand-alone messages
- ✓ Removed text for using IPv6/UDP test packets 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   /       \    Packet Loss Type
    Timestamp Format    /         \
Packet Loss Type       /           \
                      /             \
                     v               v
              +-------+         +-------+
              |       |         |       |
              |  R1   |=========|   R3  |
              |       |         |       |
              +-------+         +-------+

        STAMP Session-Sender  STAMP Session-Reflector
```
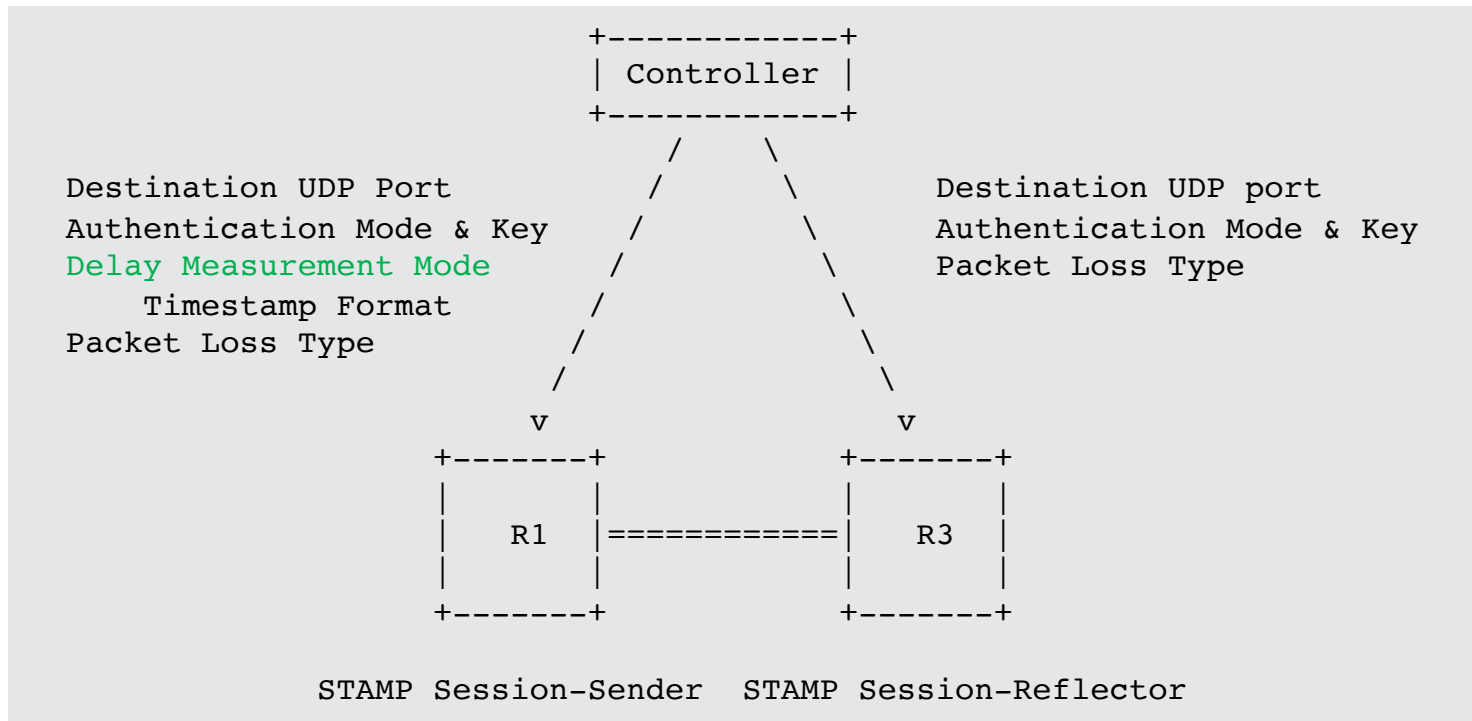
Session-Sender Test Packet for Links

- For links, the STAMP Session-Sender test packets are transmitted over the links using local and remote link addresses
- User-configured destination UDP 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: Session-Sender Test Packet for links
```
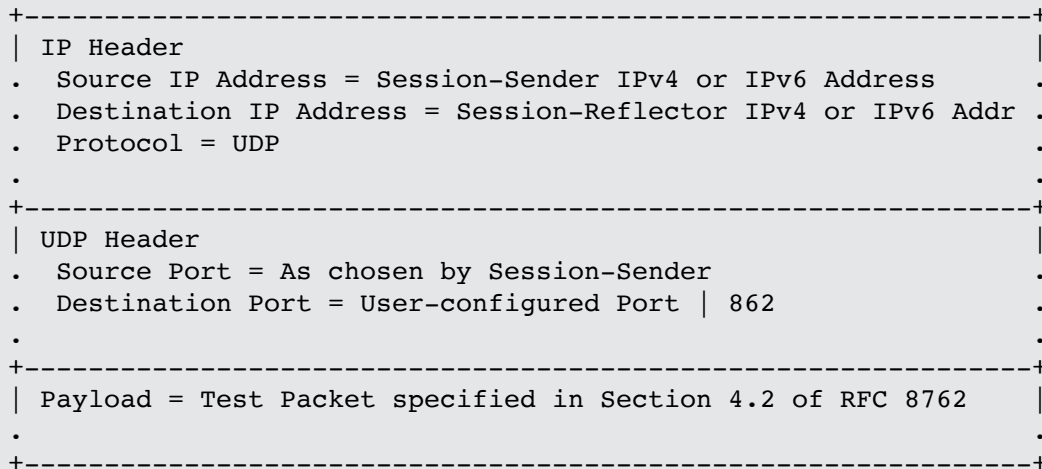
STAMP Session-Sender Test Packet for SR-MPLS and SRv6 Policy

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 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
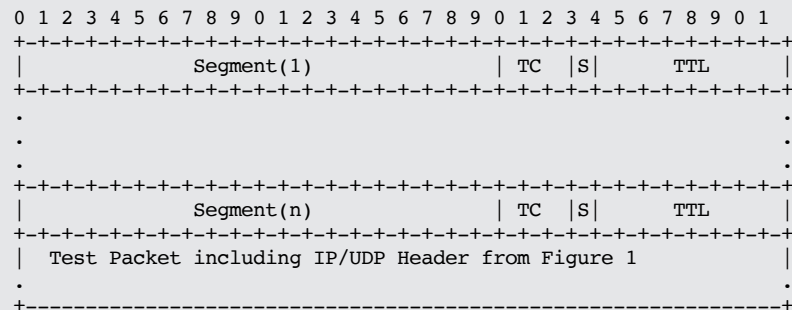   - Destination Address set to ::1/128
    - Hop Limit is set to 1

```
 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   |
.                                                               .
+---------------------------------------------------------------+
```
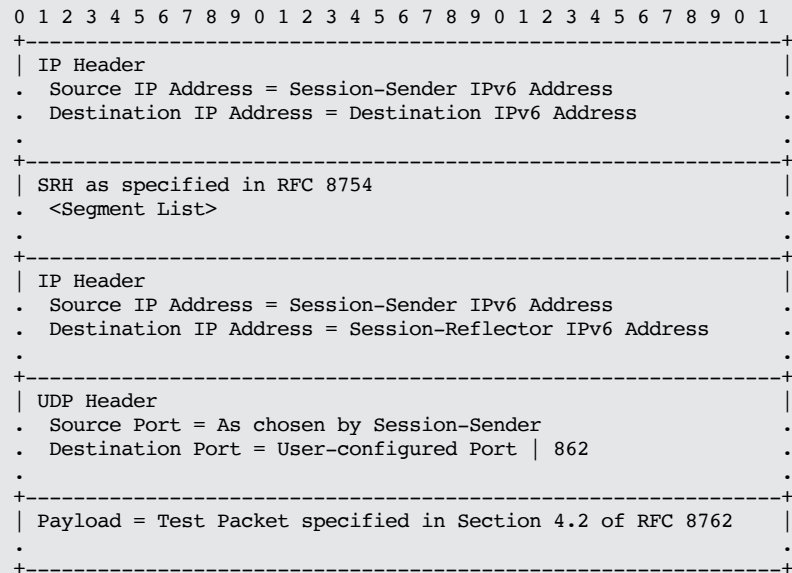
Figure 3: Example Session-Sender test packet for SRv6 Policy

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

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

- Tree-SID of the SR-MPLS Policy

- IPv4 destination address selected from
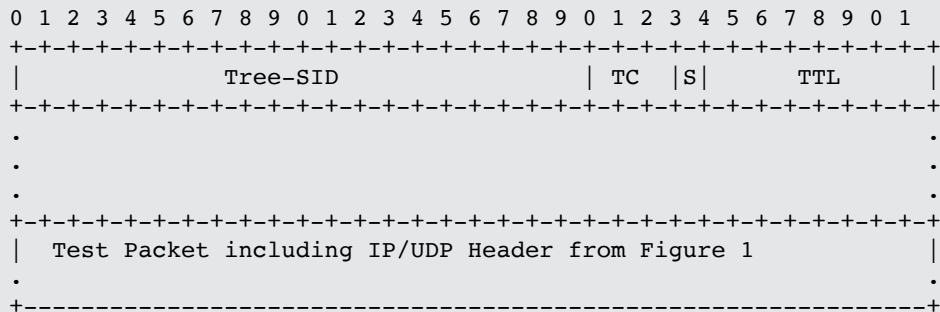 127/8 range

- 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

- The STAMP 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
  - 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:
  - Test packet loss (i.e., synthetic packet loss)
  - Data packet loss (i.e., direct measurement)
  - Session state succeeded/failed (i.e., measurement is active)

Next Steps

- Welcome your comments and suggestions
- Requesting WG adoption

Thank you