Performance Measurement Using STAMP for Segment Routing Networks

draft-ietf-spring-stamp-srpm-19

Rakesh Gandhi - Cisco Systems (rgandhi@cisco.com) - Presenter
Clarence Filsfils - Cisco Systems (cfilsfil@cisco.com)
Bart Janssens - Colt (Bart.Janssens@colt.net)
Mach(Guoyi) Chen - Huawei (mach.chen@huawei.com)
Richard Foote - Nokia (footer.foote@nokia.com)

Requirements, Goals, and Scope

Requirements

1. Measurement Modes in SR Networks
   - ✓ (1) One-way, (2) Two-way, (3) Loopback, (4) Loopback with Timestamp and Forward
2. STAMP Encapsulation for Measurement Mode in SR Networks
   - ✓ Links including physical, virtual, and LAG
   - ✓ SR paths including SR Policies, Flex-Algo paths, and L3/L2 services
   - ✓ SR-MPLS and SRv6 Data plane

Goals

1. Higher STAMP session scale and faster measurement interval
   - ✓ Optimize STAMP processing on Session-Reflector

Scope

1. STAMP [RFC 8762]
2. STAMP Optional Extensions [RFC 8972]
3. STAMP Extensions for SR [RFC 9503]

(1) One-Way Measurement Mode

1. Session-Sender transmits test packets on SR path/Flex-Algo or L3/L2 VPN service
    a. Same encapsulation as used by the data traffic being measured
2. Stateful Session-Reflector provisioned to not transmit reply packet for the Session
    a. User configured destination UDP port
3. One-way delay = (T2 - T1) -> measured by Stateful Session-Reflector

```
               T1                       T2
              /                        /
    +--------+   STAMP Test Packet   +--------+
    |        | - - - - - - - - - - > |        |
    |   S1   |=======================|   R1   |
    |        |                       |        |
    +--------+                       +--------+
  Session-Sender               Stateful Session-Reflector

    Figure: STAMP Test Session in One-Way Mode
```

(2) Two-Way Measurement Mode

1. STAMP Session-Sender test packets punted to slow path and re-injected
2. STAMP Session-Reflector reply test packets on the same SR path/Flex-Algo or L3/L2 VPN service in the reverse direction
3. Using SR Return Path STAMP TLV defined in RFC 9503
4. Round-trip delay = (T4 - T1) – (T3 - T2)
5. One-way delay = (T2 - T1)

```
              T1                       T2
             /                        /
   +-------+    STAMP Test Packet    +-------+
   |       | - - - - - - - - - - - > |       |
   |   S1  |=========================|   R1  |
   |       |<- - - - - - - - - - - - |       |
   +-------+    Return Test Packet   +-------+
             \                        \
              T4                       T3
  Session-Sender                 Session-Reflector

    Figure: STAMP Test Session in Two-Way Mode
```

(3) Loopback Measurement Mode

1. New mode defined in SR
2. STAMP Session-Sender test packet header carries the return path (SR or IP)
3. Session-Reflector forwards STAMP test packets in fast path
4. Session-Reflector does not perform STAMP packet processing (no punt/re-inject)
5. Loopback delay = (T4 - T1)

```
           T1
          /
+-------+   STAMP Test Packet   +-------+
|       | - - - - - - - - - - - |       |
|   S1  |=====================||   R1   |
|       |<- - - - - - - - - - - |       |
+-------+   Return Test Packet  +-------+
          \                     Loopback
           T4

Session-Sender               Session-Reflector
                             (Simply Forward)

  Figure: STAMP Test Session Loopback Mode
```

(4) Loopback Measurement Mode - Network Programming

1. New mode defined in SR
2. Network programming function to optimize "operations of punt and re-inject return test packet" on Session-Reflector
   a. SRv6: Endpoint Function (End.TSF) for Timestamp and Forward with Session-Reflector node Locator SID
   b. SR-MPLS: MNA opcode for Timestamp and Forward (MNA.TSF) as In-Stack Network Action (I2E or Select Scope)
3. Session-Reflector adds receive timestamp T2 in the payload in fast path - Statically defined timestamp offset and format
4. One-way delay = (T2 - T1)
5. Loopback delay = (T4 - T1)

```
          T1                        T2
         /                         /
+--------+  STAMP Test Packet  +--------+
|        | - - - - - - - - - - |        |
|   S1   |=====================||  R1   |
|        |<- - - - - - - - - - |        |
+--------+  Return Test Packet +--------+
         \                      Loopback
          T4

Session-Sender                Session-Reflector
                              (Timestamp and Forward)

STAMP Loopback Measurement Mode with TSF Function
```

STAMP Session-Sender Test Packet for SR-MPLS Paths

✓ Measure SR Policy, SR IGP Flex-Algo Path, L3/L2 VPN Service

SR Policy

- Separate STAMP session for each segment list of SR Policy

SR IGP Flex-Algo Path

- STAMP test packets carry Flex-Algo Prefix SID

L3VPN Service

- L3VPN SID + Source and Destination IP Addresses in L3VPN table

L2VPN Service

- L2VPN SID + TTL=1 to punt packet to CPU

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                Label(1)                | TC  |S|      TTL      |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
.                                                               .
.                                                               .
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                Label(n)                | TC  |1|      TTL      |
+---------------------------------------------------------------+
| IP Header                                                     |
.  Source IP Address = Session-Sender IPv4 or IPv6 Address      .
.  Destination IP Address=Session-Reflector IPv4 or IPv6 Address.
.  Next-Header = 17 (UDP)                                       .
.                                                               .
+---------------------------------------------------------------+
| UDP Header                                                    |
.  Source Port = Chosen by Session-Sender                       .
.  Destination Port = User-configured Destination Port | 862    .
.                                                               .
+---------------------------------------------------------------+
| Payload = Test Packet as specified in Section 3 of RFC 8972   |
.           in Figure 1 and Figure 3                            .
.                                                               .
+---------------------------------------------------------------+
```

Figure: Example Session-Sender test packet for SR-MPLS Path

STAMP Session-Sender Test Packet for SRv6 Paths

✓ Measure SR Policy, SR IGP Flex-Algo Path, L3/L2 VPN Service

Encoding Modes:

- **Insert-Mode:** No inner IP Header (NH=UDP causes punt)
  - Reflector processes less headers
  - Example: header added in slow path (by CPU), for explicit SR paths
  - PSP is N/A
- **Encaps-Mode:** With inner IP Header
  - Reflector processes two IP headers
  - Similar to the encap for data packets added in fast path (by NPU)

```
+-----------------------------------------------------------------+
| IPv6 Header                                                     |
.  Source IP Address = Session-Sender IPv6 Address               .
.  Destination IP Address = Segment List[Segments Left]          .
.  Next-Header = 43 (IPv6-Route)                                 .
+-----------------------------------------------------------------+
| Routing Type = 4 (SRH)                                          |
.  Segment List[0] = Session-Reflector IPv6 Address or           .
.                    Last Segment of Segment List or             .
.                    Optional PSID                               .
.  <Remained Segment List of Forward Path>                       .
.  Next-Header = 17 (UDP)                                        .
+-----------------------------------------------------------------+
| UDP Header and Payload as shown in Figure 1                     |
+-----------------------------------------------------------------+
```

Example 1: Using Insert-Mode Encoding

```
+-----------------------------------------------------------------+
| IPv6 Header                                                     |
.  Source IP Address = Session-Sender IPv6 Address               .
.  Destination IP Address = Segment List[Segments Left]          .
.  Next-Header = 43 (IPv6-Route)                                 .
+-----------------------------------------------------------------+
| Routing Type = 4 (SRH)                                          |
.  Segment List[0] = Session-Reflector IPv6 Address or           .
.                    Last Segment of Segment List or             .
.                    Optional PSID                               .
.  <Remained Segment List of Forward Path>                       .
.  Next-Header = 41 (IPv6) or 4 (IPv4)                           .
+-----------------------------------------------------------------+
| IP Header as shown in Figure 1                                  |
+-----------------------------------------------------------------+
| UDP Header and Payload as shown in Figure 1                     |
+-----------------------------------------------------------------+
```

Example 2: Using Encaps-Mode Encoding

Next Steps

- Thanks for the recent review comments from Gyan, Boris, Greg, Zafar, Ruediger, Liyan, Zhenqiang, et al.
  - Welcome further review comments and suggestions

Requests:

1. Split into two documents: for SR-MPLS and SRv6
   - Document is > 50 pages long
   - SR-MPLS has MNA dependency from MPLS WG
   - SRv6 progress faster
2. Ready for WGLC

Thank you!