Performance Measurement Using TWAMP Light for Segment Routing Networks

draft-gandhi-spring-twamp-srpm-08

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Agenda

- Requirements and Scope

- History of the Draft

- Updates Since IETF-106

- Summary

- Next Steps

Requirements and Scope

Requirements:

- Delay and Loss Performance Measurement (PM)
    - ✓ Links and End-to-end P2P/P2MP SR Policies
    - ✓ Applicable to SR-MPLS/SRv6 data planes
- No need to bootstrap PM session (e.g. to negotiate UDP port) - spirit of SR
    - ✓ Stateless on egress node - spirit of SR
- Handle ECMP for SR Policies
- Support stand-alone direct-mode loss measurement

Scope:

- RFC 5357 (TWAMP) defined probe messages - TWAMP Light
- User-configured IP/UDP path for probe messages

History of the Draft

- Feb 2019
    - Draft was first published - *draft-gandhi-spring-twamp-srpm-00*
- May 2019
    - Added STAMP TLV for Return Path
- Mar 2019
    - Presented revision-00 at IETF 104 Prague in SPRING WG
- July 2019
    - Presented revision-01 at IETF 105 Montreal in IPPM WG
        - Slide 9 Titled - Applicability of STAMP – STAMP is supported
- Aug 2019
    - Revision-02 updates included a section stand-alone LM messages
- Nov 2019
    - **SPRING Chairs announced in the meeting the agreement with IPPM chairs to progress the draft in SPRING WG**
    - Presented revision-04 at IETF 106 Singapore in SPRING WG
- Mar 2020
    - Moved STAMP support to *draft-gandhi--spring-stamp-srpm-00*

Updates Since IETF-106 (Revision-04)

Updates:

1. Defined Control Code for "In-band Response Requested" for TWAMP Light
   - ✓ Updated Two-way mode procedure using the Control Code
2. Moved STAMP support to a new draft - *draft-gandhi-spring-stamp-srpm*
3. Informational draft - as TWAMP Light is informational, see Appendix I in RFC 5357 and Appendix A RFC 8545
4. Various editorial changes

Open Items:

- None

TWAMP Light Control Code Field

For a Query: Sender Control Code

0x0: Out-of-band Response Requested.
This is also the default behavior.

0x1: In-band Response Requested.
Indicates that this query has been sent over a bidirectional path and the probe response is required over the same path in the reverse direction.
The bidirectional path does not have to be an SR path.

For a Response: Reflector Control Code

0x1: Error - Invalid Message.
Indicates that the operation failed because the received query message could not be processed.
0xN: Additional Error will be defined in future

```
.                                                           .
.                                                           .
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                         Timestamp                          |
|                                                           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|         Error Estimate         |         MBZ              |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|          MBZ                              |Se Control Code|
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
.                                                           .
.                                                           .
```

```
.                                                           .
.                                                           .
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| Session-Sender Error Estimate | MBZ        |Re Control Code|
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|Ses-Sender TTL |               MBZ                          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
.                                                           .
.                                                           .

         Figure 6: Control Code in TWAMP Light Message
```
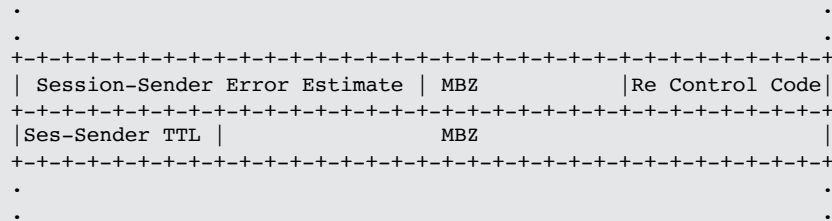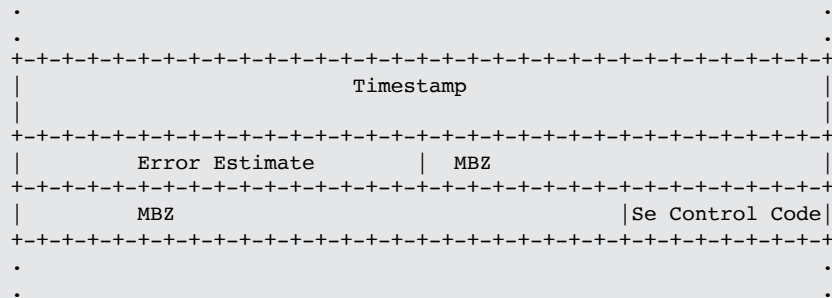
Performance Measurement Modes

- One-way Measurement Mode

  - Reply sent "out of band" on IP/UDP path - default

- Two-way Measurement Mode

  - Reply sent "in-band" on reverse SR path

    - Based on Control Code from the probe query message

- Loopback Measurement Mode

  - Probe message carries the return path in the header of the packet
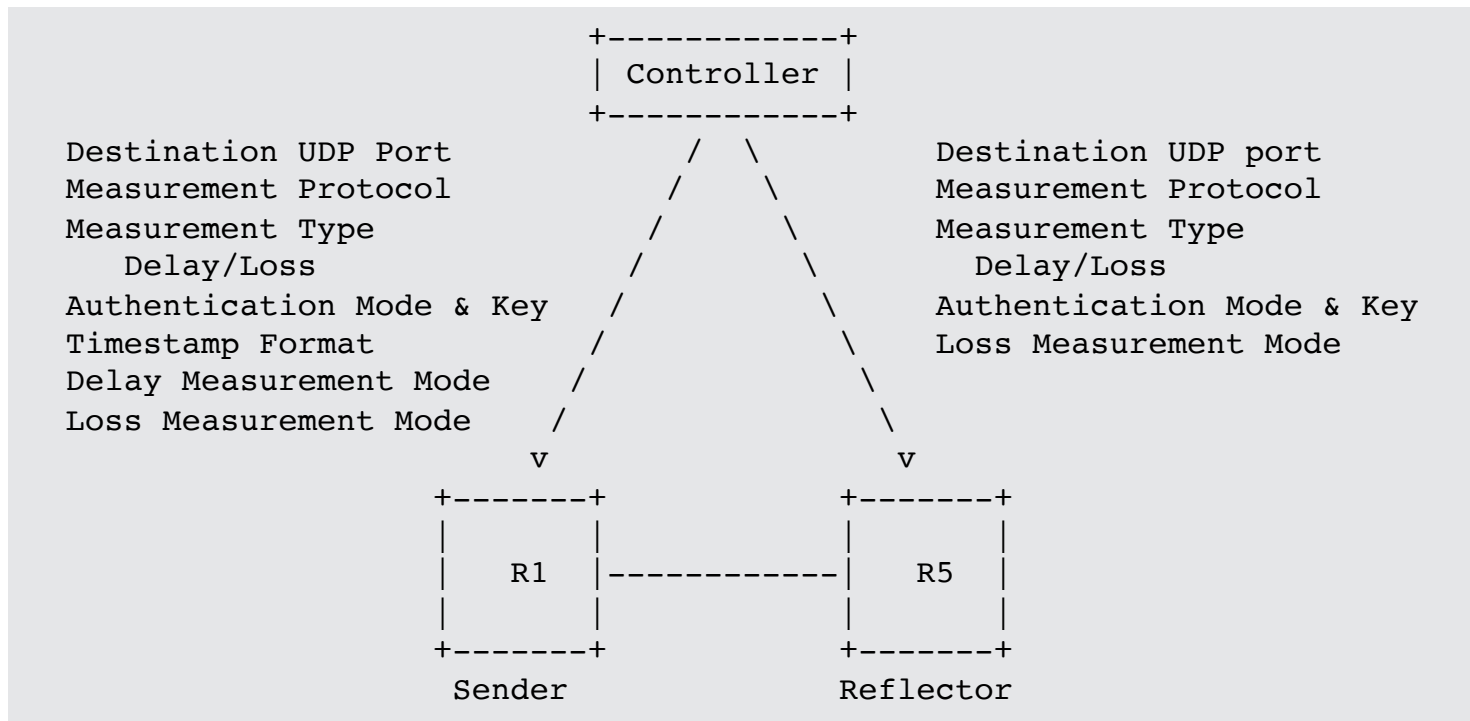
Next Steps

- Welcome your comments and suggestions

- Implementation exists

- In WG adoption (SPRING WG) queue

- Keep IPPM WG in the loop about the milestones

Thank you

Backup

Example Provisioning Model

```
                                   +------------+
                                   | Controller |
                                   +------------+
Destination UDP Port                   /  \        Destination UDP port
Measurement Protocol                  /    \       Measurement Protocol
Measurement Type                     /      \      Measurement Type
    Delay/Loss                      /        \         Delay/Loss
Authentication Mode & Key          /          \     Authentication Mode & Key
Timestamp Format                  /            \    Loss Measurement Mode
Delay Measurement Mode           /              \
Loss Measurement Mode           /                \
                        v                    v
                     +-------+            +-------+
                     |       |            |       |
                     |  R1   |------------|  R5   |
                     |       |            |       |
                     +-------+            +-------+
                       Sender               Reflector
```

Probe Query Message

- PM probe query message sent for Links and End-to-end P2P/ P2MP SR Policies.
- User-configured destination UDP **port1** is used for DM probe messages in unauthenticated mode and **port2** is used for LM probe messages in unauthenticated mode.
- For DM, payload contains RFC 5357 (TWAMP Light) defined probe message as shown below.

```
+--------------------------------------------------------------+
| IP Header                                                    |
.  Source IP Address = Sender IPv4 or IPv6 Address             .
.  Destination IP Address = Reflector IPv4 or IPv6 Address     .
.  Protocol = UDP                                              .
.                                                              .
+--------------------------------------------------------------+
| UDP Header                                                   |
.  Source Port = As chosen by Sender                           .
.  Destination Port = User-configured Port for Delay Measurement.
.                                                              .
+--------------------------------------------------------------+
| Payload = Message as specified in Section 4.2.1 of RFC 5357  |
. Payload = Message as specified in Section 4.1.2 of RFC 5357  .
.                                                              .
+--------------------------------------------------------------+

              Figure: DM Probe Query Message
```

Probe Query for SR-MPLS and SRv6 Policy

For **end-to-end** performance delay/loss measurement of SR Policy, the probe query messages are sent on the SR Policy path with:

1. MPLS label stack for SR-MPLS Policies
2. SRv6 SRH [RFC 8754] with SID list for SRv6 Policies
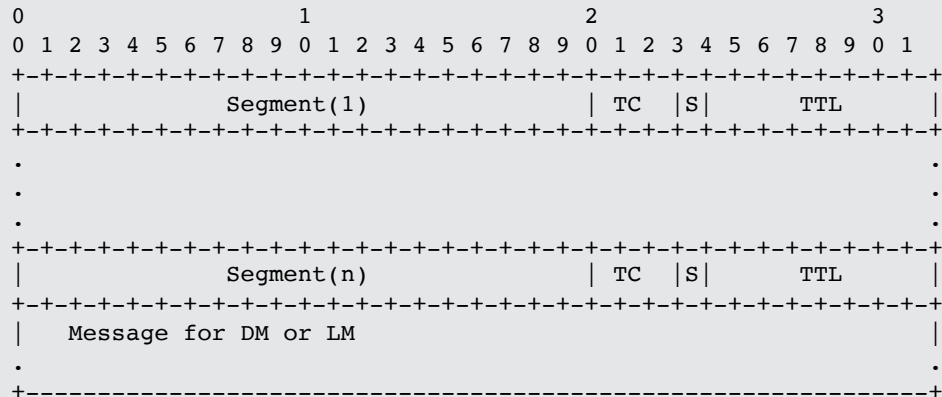   - END.OTP (for DM) or END.OP (for LM) for target SID for SRv6 Policies

```
 0                   1                   2                   3
 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    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|    Message for DM or LM                                       |
.                                                               .
+---------------------------------------------------------------+

        Figure: Probe Query Message for SR-MPLS Policy
```

```
 0                   1                   2                   3
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                            SRH                                |
.                                                               .
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|    Message for DM or LM                                       |
.    (Using IPv6 Addresses)                                     .
.                                                               .
+---------------------------------------------------------------+

        Figure: Probe Query Message for SRv6 Policy
```
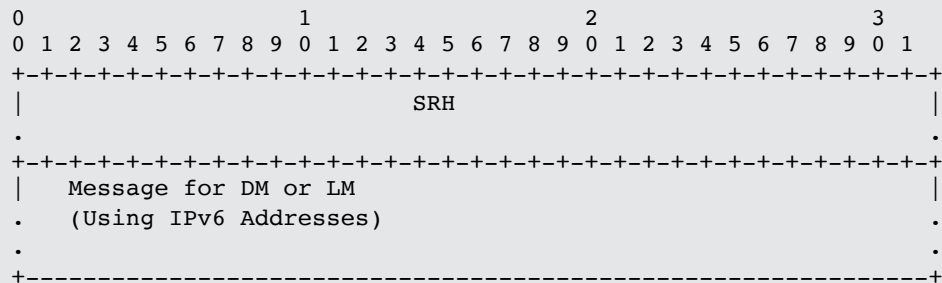
Probe Response Message

- The probe response message is sent using the IP/UDP information from the probe query message.

```
+----------------------------------------------------------------+
| IP Header                                                      |
.  Source IP Address = Reflector IPv4 or IPv6 Address           .
.  Destination IP Address = Source IP Address from Query        .
.  Protocol = UDP                                                .
.                                                                .
+----------------------------------------------------------------+
| UDP Header                                                     |
.  Source Port = As chosen by Reflector                         .
.  Destination Port = Source Port from Query                    .
.                                                                .
+----------------------------------------------------------------+
| DM Payload as specified in Section 4.2.1 of RFC 5357, or      |
. LM Payload as specified in this document                      .
.                                                                .
+----------------------------------------------------------------+

          Figure: Probe Response Message
```

Stand-alone LM Message Format for TWAMP Light

- Loss Measurement (LM) message defined
  - Hardware efficient counter-stamping
    - Well-known locations for transmit and receive traffic counters
  - Stand-alone LM message, not tied to DM
- LM message format is also defined for authenticated mode
- User-configured destination UDP **port2** is used for identifying LM probe packets
- **Does not modify existing TWAMP Light (which is for DM) procedure as different UDP destination port2 is used for LM.**

```
+---------------------------------------------------------------+
| IP Header                                                     |
.  Source IP Address = Sender IPv4 or IPv6 Address              .
.  Destination IP Address = Reflector IPv4 or IPv6 Address      .
.  Protocol = UDP                                               .
.  Router Alert Option Not Set                                  .
.                                                               .
+---------------------------------------------------------------+
| UDP Header                                                    |
.  Source Port = As chosen by Sender                            .
.  Destination Port = User-configured Port2 for Loss Measurement.
.                                                               .
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                      Sequence Number                          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                      Transmit Counter                         |
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|X|B| Reserved  | Block Number  | MBZ                           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                      Receive Counter                          |
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                   Sender Sequence Number                      |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                      Sender Counter                           |
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|X|B| Reserved  |Sender Block Nu|    MBZ                         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| Sender TTL   | Padding (3 Bytes)                              |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                      Padding                                  |
.                                                               .
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

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ECMP Support for SR Policy

- SR Policy can have ECMP between the ingress and transit nodes, between transit nodes and between transit and egress nodes.
- Sending PM probe queries that can take advantage of the hashing function in forwarding plane.
- Existing forwarding mechanisms are applicable to PM probe messages:
  - For IPv4 and IPv6
    - Destination addresses in IP header (e.g. 127/8 for IPv4 and FFFF:7F00/104 for IPv6)
    - Flow label in IPv6 header

Thank you