Performance Measurement Using TWAMP Light for Segment Routing Networks

draft-gandhi-spring-twamp-srpm-09

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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 Paths
    - ✓ Applicable to SR-MPLS/SRv6 data planes
- No need to negotiate UDP port to bootstrap PM session - spirit of SR
    - ✓ Stateless on egress node - spirit of SR
- Handle ECMP for SR Paths
- Support stand-alone direct-mode loss measurement

Scope:

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

History of the Draft

- Feb 2019
  - Draft was published - *draft-gandhi-spring-twamp-srpm-00*
- Mar 2019
  - Presented *draft-gandhi-spring-twamp-srpm-00* at IETF 104 Prague in SPRING WG
- July 2019
  - Presented *draft-gandhi-spring-twamp-srpm-01* at IETF 105 Montreal in IPPM WG
    - Slide 9 Titled - Applicability of STAMP
- Nov 2019
  - SPRING Chairs announced in the meeting the agreement with IPPM chairs to progress the draft in SPRING WG
  - Presented *draft-gandhi-spring-twamp-srpm-04* at IETF 106 Singapore in SPRING WG
- Mar 2020
  - Moved STAMP support to *draft-gandhi-spring-**stamp**-srpm-00*
  - Keep TWAMP Light support as informational in *draft-gandhi-spring-**twamp**-srpm-08*

Updates Since IETF-106 (Version-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-00*
3. Informational draft - as TWAMP Light is informational, see Appendix I in RFC 5357 and Appendix A RFC 8545
4. Various editorial changes
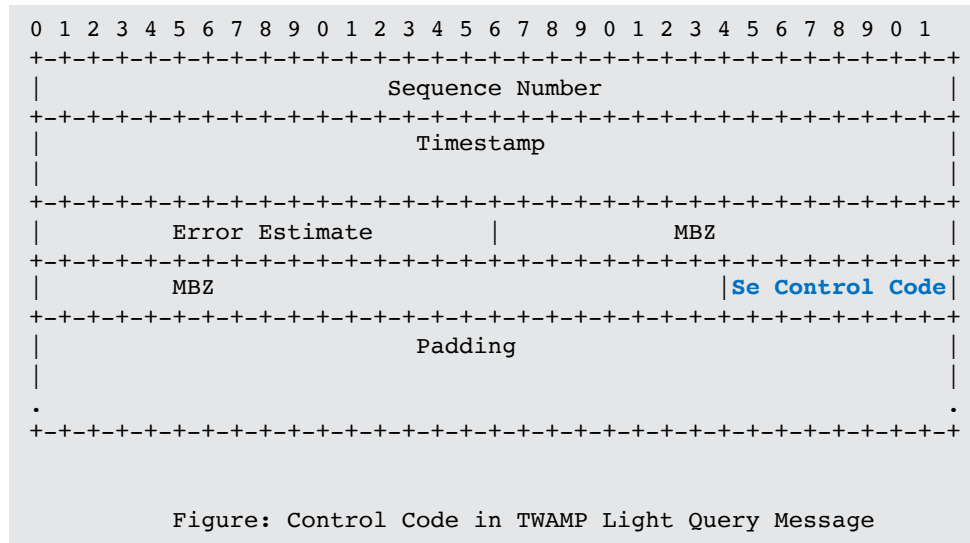
Open Items:

- None

TWAMP Light Control Code Field

In 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.

0x2: No Response Requested.

Also applicable to non-SR paths.

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


     Figure: Control Code in TWAMP Light Query 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

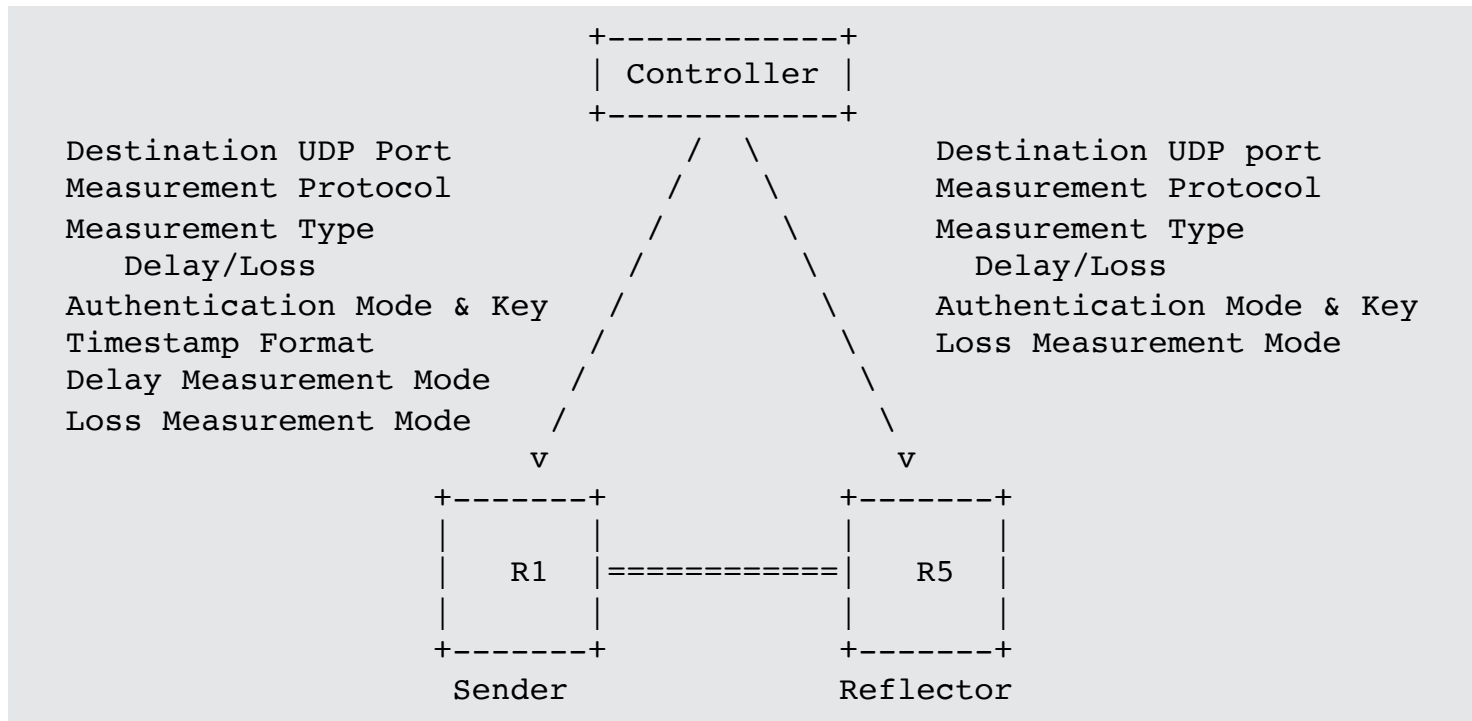   - Based on Control Code from the probe query message

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 for Links

- User-configured destination UDP **port1** is used for DM probe messages and **port2** is used for LM probe messages, both in unauthenticated mode.

```
+------------------------------------------------------------------+
| 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                        .
.                                                                 .
+------------------------------------------------------------------+
| Payload = DM Message as specified in Section 4.2.1 of RFC 5357|
. Payload = DM Message as specified in Section 4.1.2 of RFC 5357.
. Payload = LM Message as specified in this document             .
.                                                                 .
+------------------------------------------------------------------+

                   Figure: 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 message is sent on the SR Policy with:

1. MPLS label stack of SR-MPLS Policy
2. SRv6 SRH [RFC 8754] with Segment List of SRv6 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                 Segment(1)                | TC  |S|    TTL    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
.                                                              .
.                                                              .
.                                                              .
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                 Segment(n)                | TC  |S|    TTL    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|   DM or LM Query Message including IP/UDP Header             |
.                                                              .
+--------------------------------------------------------------+
```

Figure: Example Probe Query Message 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 = Sender IPv6 Address                     .
.  Destination IP Address = Destination IPv6 Address           .
.                                                              .
+--------------------------------------------------------------+
| SRH as specified in RFC 8754                                 |
.  <Segment List>                                              .
.                                                              .
+--------------------------------------------------------------+
| IP Header (Optional)                                         |
.  Source IP Address = Sender IPv6 Address                     .
.  Destination IP Address = Reflector IPv6 Address             .
.                                                              .
+--------------------------------------------------------------+
| UDP Header                                                   |
.  Source Port = As chosen by Sender                           .
.  Destination Port = User-configured Port                     .
.                                                              .
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|   Payload = DM or LM Query Message                           |
.                                                              .
+--------------------------------------------------------------+
```

Figure: Example 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                    .
.                                                                .
+----------------------------------------------------------------+
| Payload = DM Message specified in Section 4.2.1 of RFC 5357 | |
. Payload = LM Message 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 destination UDP is used for LM

```
+-----------------------------------------------------------+
| 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 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                                |
.                                                           .
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

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 PM probe queries that can take advantage of the hashing function in forwarding plane.
- Existing forwarding mechanisms are applicable to PM probe messages. Examples are:
  - For IPv4
    - Sweeping destination address in IPv4 header (e.g. 127/8)
  - For IPv6
    - Sweeping flow label in IPv6 header

Thank you