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
- May 2019
  - Added STAMP TLV for Return Path
- July 2019
  - Presented *draft-gandhi-spring-twamp-srpm-01* at IETF 105 Montreal in IPPM WG
    - Slide 9 Titled - Applicability of STAMP – STAMP is supported
- Aug 2019
  - *draft-gandhi-spring-twamp-srpm-02* included 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 *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. Moved Loopback mode to a new draft - *draft-gandhi-spring-sr-enhanced-plm-00*
5. 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.
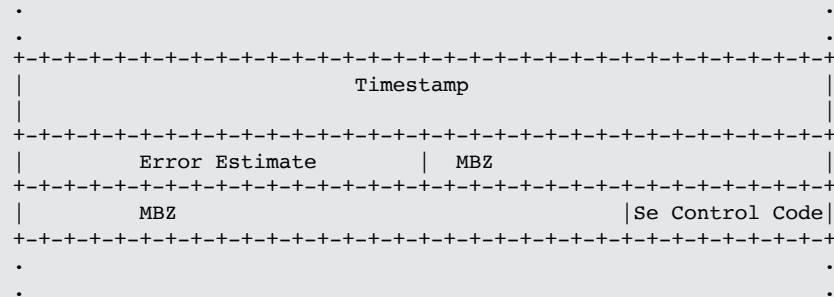The bidirectional path does not have to be an SR path.

For a Response: Reflector Control Code

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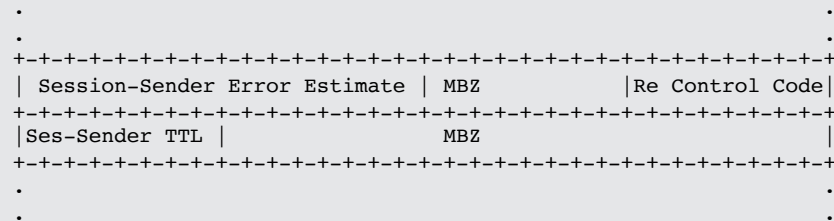**0xN: Additional Error will be defined in future**

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

      Figure: Control Code in TWAMP Light Query Message
```

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

      Figure: Control Code in TWAMP Light Response 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
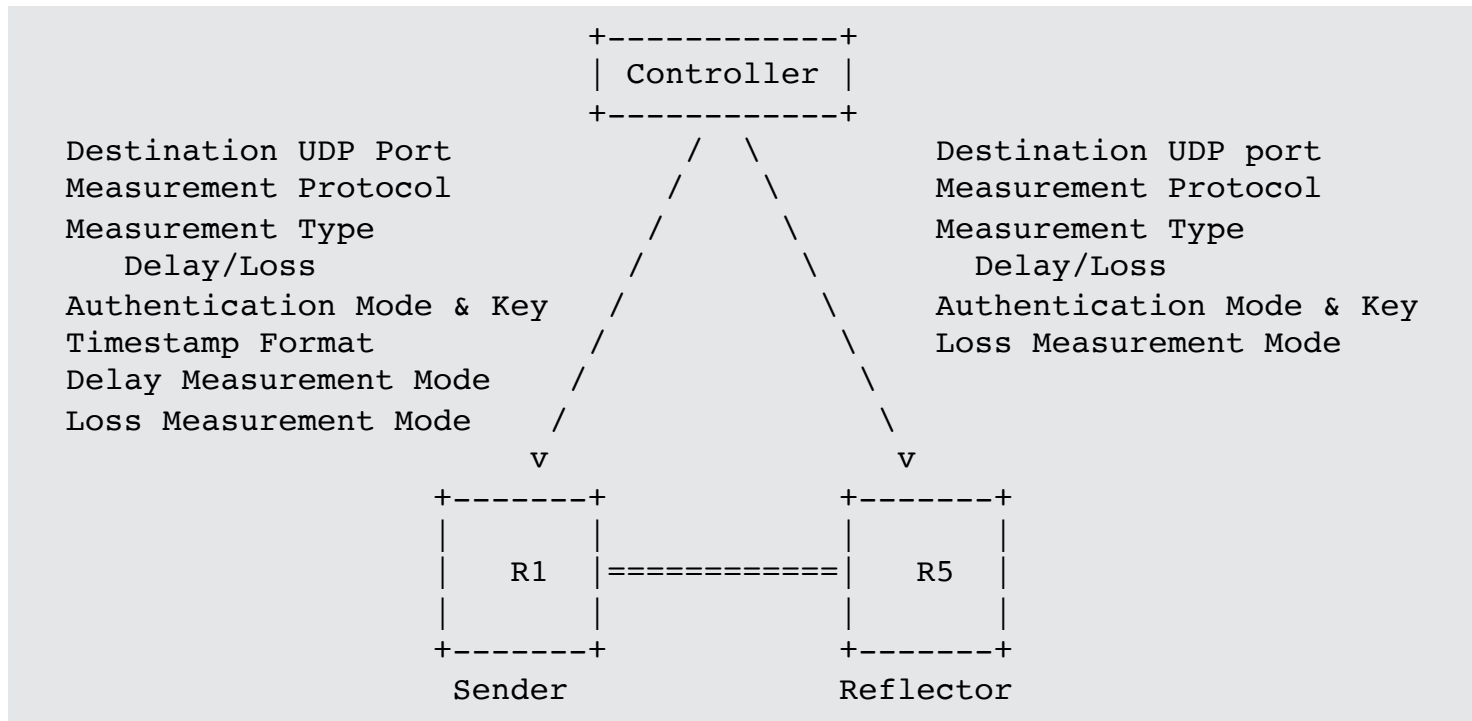   - Based on Control Code from the probe query message

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 for SR-MPLS Policies
2. SRv6 SRH [RFC 8754] with SID list for SRv6 Policies

```
 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 = Next Hop IPv6 Address               .
.                                                              .
+--------------------------------------------------------------+
| SRH as specified in RFC 8754                                 |
. <SID 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
```

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

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