In-band Performance Measurement Using TWAMP for Segment Routing Networks

draft-gandhi-spring-twamp-srpm-00

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Agenda

- Requirements and Scope

- Probe Query and Response Messages

- ECMP Support

- Next Steps

Requirements and Scope

Requirements:

- Delay and Loss Performance Measurement (PM) for SR 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
- One-way and two-way measurements
- Handle ECMP for SR Policies

Scope:

- Use RFC 5357 (TWAMP) defined probe message formats
- **User-configured** IP/UDP path for probe messages

Probe Query Messages

- User defined IP/UDP path for PM probe messages for delay and loss measurements for SR links and end-to-end P2P/ P2MP SR Policies.

- Payload contains RFC 5357 defined message for Delay Measurement (DM).

- User-configured UDP port1 is used for identifying DM probe packets.

```
+-----------------------------------------------------------+
| IP Header                                                 |
.  Source IP Address = Querier IPv4 or IPv6 Address         .
.  Destination IP Address = Responder IPv4 or IPv6 Address  .
.  Protocol = UDP                                           .
.  Router Alert Option Not Set                              .
.                                                           .
+-----------------------------------------------------------+
| UDP Header                                                |
.  Source Port = As chosen by Querier                       .
.  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 4656 |
.                                                           .
+-----------------------------------------------------------+

         Figure 1: DM Probe Query Message for TWAMP
```

LM Message Format for TWAMP

- Loss Measurement (LM) message defined with **fixed offsets** for transmit and receive traffic counters.
  - Hardware friendly counter-stamping
  - No need to include DM packet
- LM Message format is also defined for authenticated mode.
- User-configured UDP port2 is used for identifying LM probe packets.

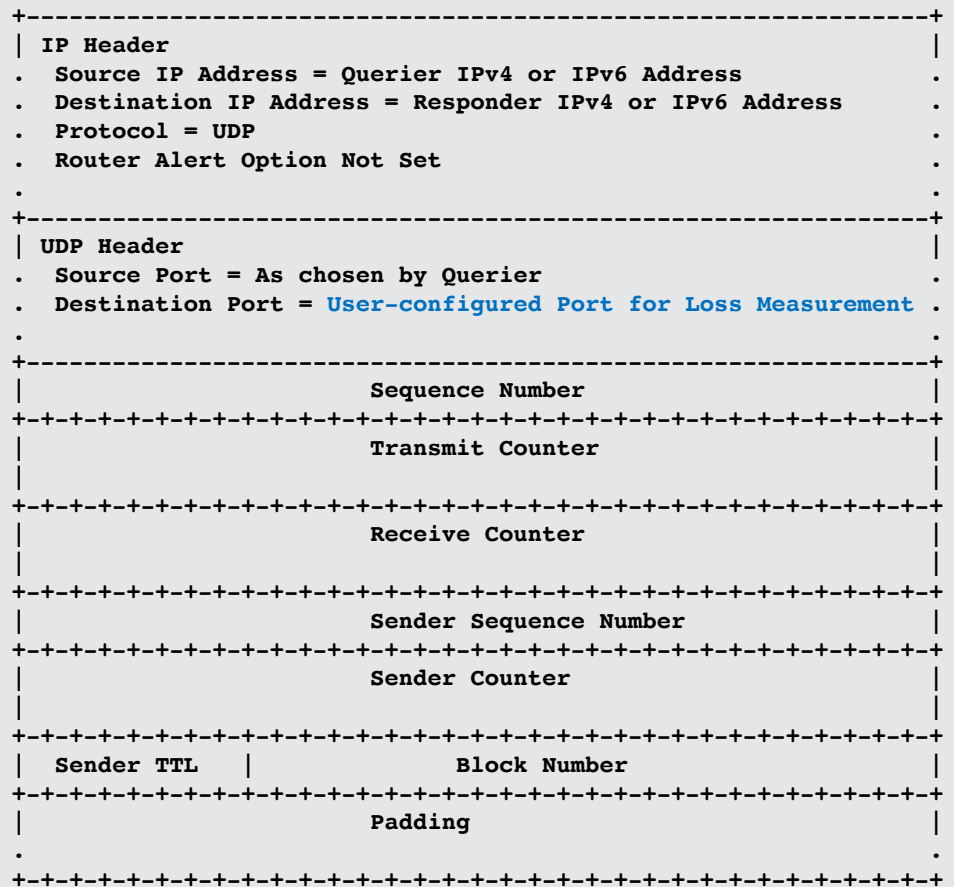There is LM TLV proposed in *draft-mirsky-ippm-stamp-option-tlv*

```
+-----------------------------------------------------------+
| IP Header                                                 |
. Source IP Address = Querier IPv4 or IPv6 Address          .
. Destination IP Address = Responder IPv4 or IPv6 Address   .
. Protocol = UDP                                            .
. Router Alert Option Not Set                               .
.                                                           .
+-----------------------------------------------------------+
| UDP Header                                                |
. Source Port = As chosen by Querier                        .
. Destination Port = User-configured Port for Loss Measurement .
.                                                           .
+-----------------------------------------------------------+
|                    Sequence Number                        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                    Transmit Counter                       |
|                                                           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                    Receive Counter                        |
|                                                           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                 Sender Sequence Number                    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                    Sender Counter                         |
|                                                           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| Sender TTL    |              Block Number                 |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                       Padding                             |
.                                                           .
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 2A: LM Probe Query Message for TWAMP

Probes for SR-MPLS or SRv6 TE Policy

- For **end-to-end** performance measurement of SR Policy, the probe query messages are sent in-band with:
- 1) MPLS label stack for SR-MPLS Policies, Or,
- 2) SRv6 SRH with SID list and END.OTP (for DM) or END.OP (for LM) for target SID for SRv6 Policies.
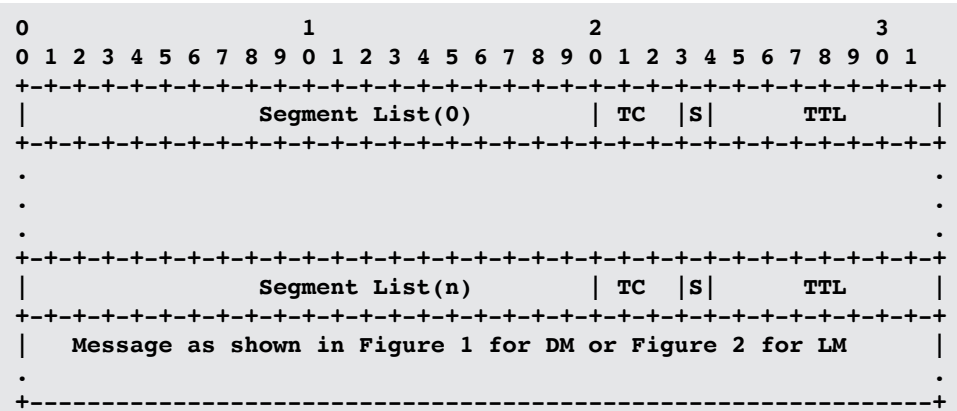
```
0                   1                   2                   3
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|              Segment List(0)          | TC  |S|     TTL      |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
.                                                              .
.                                                              .
.                                                              .
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|              Segment List(n)          | TC  |S|     TTL      |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|    Message as shown in Figure 1 for DM or Figure 2 for LM    |
.                                                              .
+--------------------------------------------------------------+

       Figure 3: 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                                |
.   END.OTP (DM) or END.OP (LM) with Target SRv6 SID          .
.                                                              .
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|    Message as shown in Figure 1 for DM or Figure 2 for LM    |
.    (Using IPv6 Addresses)                                   .
.                                                              .
+--------------------------------------------------------------+

         Figure 4: Probe Query Message for SRv6 Policy
```
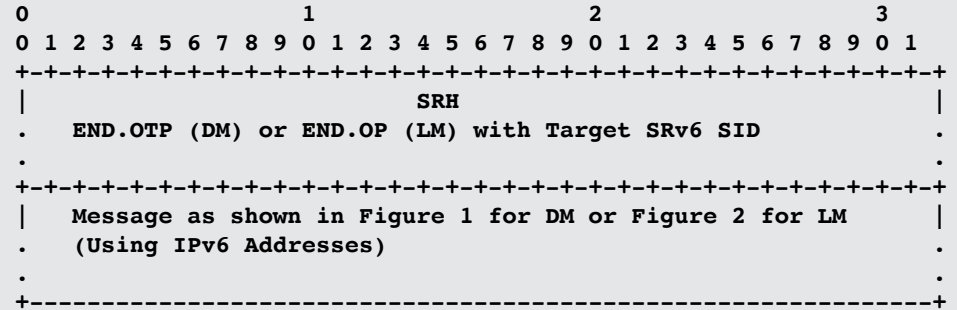
Probe Response Message

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

```
+-------------------------------------------------------------+
| IP Header                                                   |
.  Source IP Address = Responder IPv4 or IPv6 Address         .
.  Destination IP Address = Source IP Address from Query      .
.  Protocol = UDP                                             .
.  Router Alert Option Not Set                                .
.                                                             .
+-------------------------------------------------------------+
| UDP Header                                                  |
.  Source Port = As chosen by Responder                       .
.  Destination Port = Source Port from Query                  .
.                                                             .
+-------------------------------------------------------------+
| TWAMP Payload for DM or LM                                  |
.                                                             .
+-------------------------------------------------------------+
```

ECMP Support

- 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
    - Different Destination Addresses in IP/UDP header (E.g. 127/8 for IPv4)
  - For SR-MPLS
    - Entropy label
  - For SRv6
    - Flow Label in SRH

Next Steps

- Update direct Loss Measurement payload format:
  - UDP checksum correction field, flags for packet vs. byte counters and 64-bit vs. 32-bit counters.
  - Discuss LM message (*draft-mirsky-ippm-stamp-option-tlv*)
- Updates for two-way measurement
  - Update text on source-port usage
  - Add Return Path
- Elaborate on P2MP SR Policy
- Can use both HMAC-SHA1 and HMAC-SHA-256 for integrity protection
- Welcome your comments and suggestions

Thank you