Performance Measurement Using STAMP for Segment Routing Networks

draft-gandhi-spring-stamp-srpm-01

(previously *draft-gandhi-spring-twamp-srpm-07*)

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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
- Handle ECMP for SR Paths
- Support stand-alone direct-mode loss measurement

Scope:

- STAMP [RFC 8762]
- STAMP TLVs [draft-ietf-ippm-stamp-option-tlv]

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 STAMP
   - ✓ Updated Two-way mode procedure using the Control Code
2. Defined Destination Address in STAMP Node Address TLV to identify the intended Destination node
3. Added Return Address Sub-TLV in the STAMP Return Path TLV to send response to a specific node
4. Various editorial changes

Open Items:

- Identify TLV as Mandatory or Optional
- Update IANA registry action

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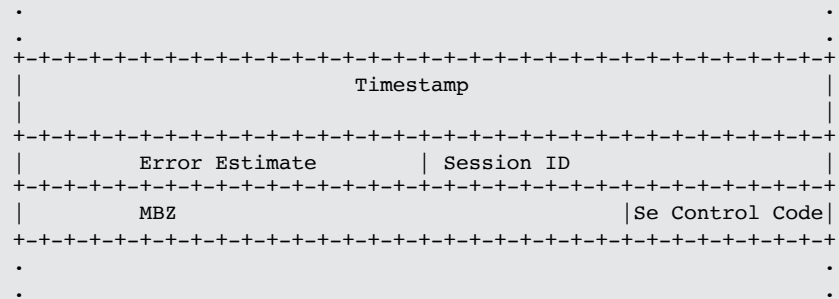
```
 .                                                       .
 .                                                       .
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |                                                       |
 |                     Timestamp                         |
 |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

    Figure: Sender Control Code in STAMP DM Message
```
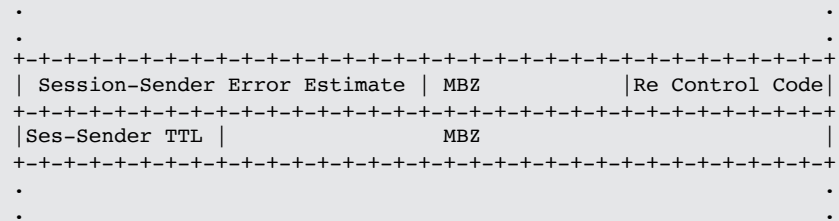
```
 .                                                       .
 .                                                       .
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 | Session-Sender Error Estimate | MBZ        |Re Control Code|
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |Ses-Sender TTL |               MBZ                     |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 .                                                       .
 .                                                       .

    Figure: Reflector Control Code in STAMP DM Message
```

Performance Measurement Modes

- One-way Measurement Mode
  - Reply sent "out of band" on IP/UDP path by default

- Two-way Measurement Mode
  - Reply sent "in-band" on reverse SR path
    - Based on Control Code from the probe query message
  - Use Return Path TLV for STAMP from the probe query message

- Loopback Measurement Mode
  - Probe message carries the return path in the header of the packet

Destination Address in STAMP Node Address TLV

Destination Node Address (value TBA1):

- Indicates the address of the intended recipient node of the query message.
- The reflector node MUST NOT send response if it is not the intended destination node of the query.
- Useful when query is sent with 127/8 destination address.
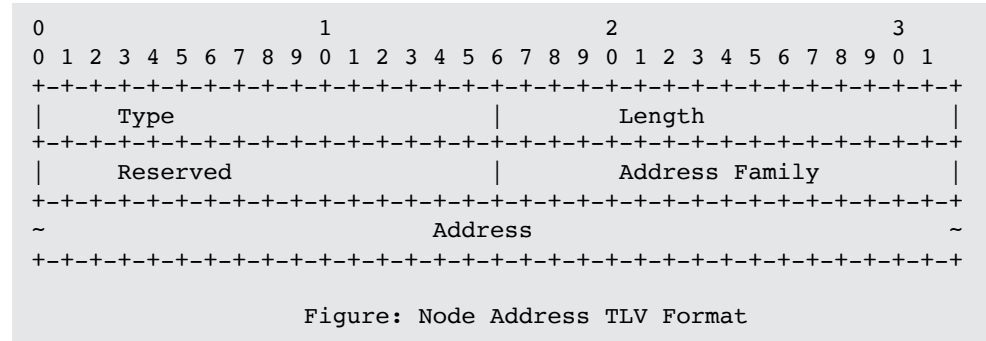
```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|      Type                     |              Length           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|      Reserved                 |          Address Family       |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
~                             Address                           ~
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+

              Figure: Node Address TLV Format
```

Return Address in STAMP Return Path TLV

Return Path (value TBA2):

Sub-TLVs Types:

- Type (value 0): Return Address. Target node address of the response different than the Source Address in the query

- Type (value 1): SR-MPLS Label Stack of the Reverse SR Path

- Type (value 2): SR-MPLS Binding SID [draft-ietf-pce-binding-label-sid] of the Reverse SR Policy

- Type (value 3): SRv6 Segment List of the Reverse SR Path

- Type (value 4): SRv6 Binding SID [draft-ietf-pce-binding-label-sid] of the Reverse SR 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|   Type = TBA2                 |           Length              |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                    Return Path Sub-TLVs                       |
.                                                              .
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+

              Figure: Return Path TLV
```

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|     Type                     |           Length              |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                    Segment(1)                                |
.                                                              .
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
.                                                              .
.                                                              .
.                                                              .
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                    Segment(n)                                |
.                                                              .
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+

         Figure: Segment List Sub-TLV in Return Path TLV
```

Stand-alone LM Message Format for STAMP

- Loss Measurement (LM) message defined
  - Hardware efficient counter-stamping
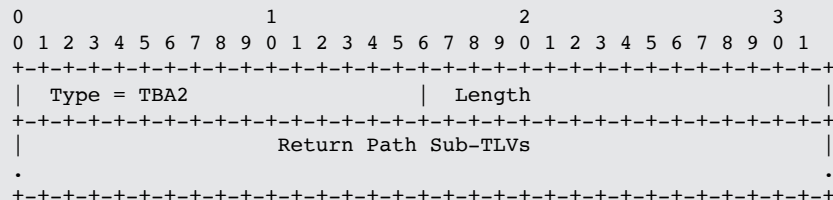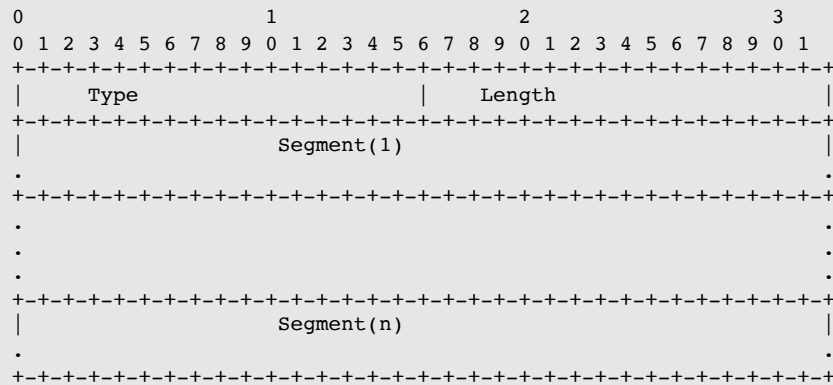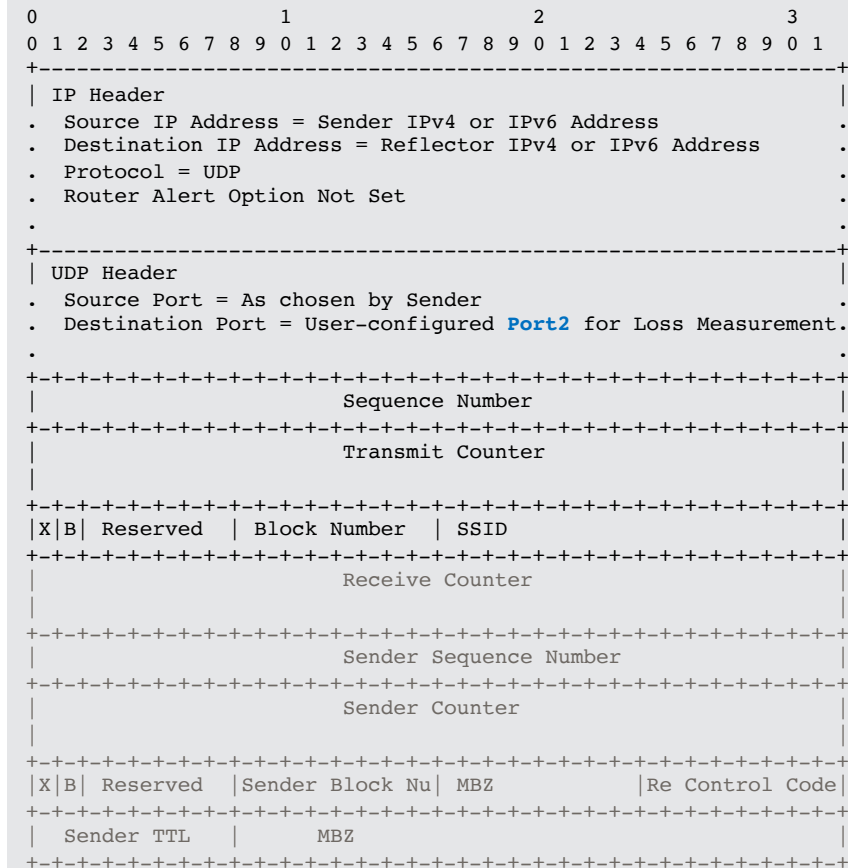   - Well-known locations for transmit and receive traffic counters
  - Stand-alone LM message, not tied to DM
- LM message format is also defined for authenticated mode
- User-configured destination UDP **Port2** is used for identifying LM probe packets
- **Does not modify existing STAMP (which is for DM) procedure as different UDP destination Port2 is used for LM**

```
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
+---------------------------------------------------------------+
| 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  |  SSID                      |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                     Receive Counter                           |
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                     Sender Sequence Number                    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                     Sender Counter                            |
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|X|B|  Reserved   |Sender Block Nu| MBZ        |Re Control Code|
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|   Sender TTL    |      MBZ                                    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
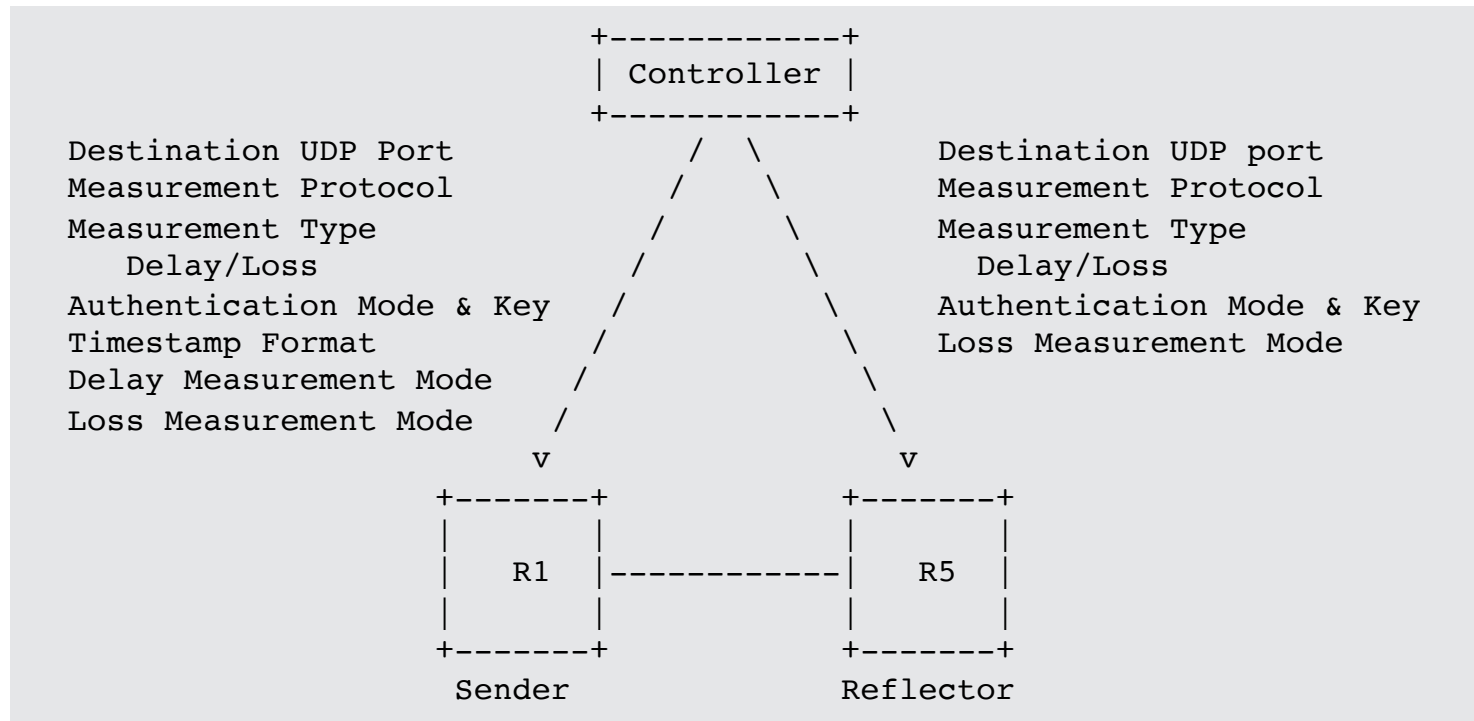
Next Steps

- Welcome your comments and suggestions

- Implementation exists

- In WG adoption (SPRING WG) queue

- Keep IPPM WG in the loop about the milestones

Thank you

IETF – April 2020

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 for Query |                                |
. Payload = LM Message for Query                                  .
.                                                                 .
+------------------------------------------------------------------+

                    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 messages are sent on the SR Policy path with:

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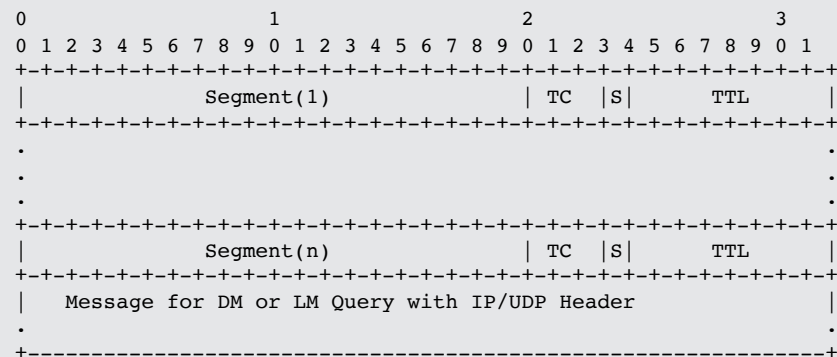2. SRv6 SRH [RFC 8754] with SID list for SRv6 Policies

```
 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 Query with IP/UDP Header              |
.                                                               .
+---------------------------------------------------------------+

    Figure: Example 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
+---------------------------------------------------------------+
| IP Header                                                     |
.   Source IP Address = Sender IPv6 Address                     .
.   Destination IP Address = Next Hop IPv6 Address              .
.   Next Header = 43 (Routing Header)                           .
.                                                               .
+---------------------------------------------------------------+
| SRH                                                           |
. <SID List>                                                    .
.   Next Header = 17 (UDP)                                      .
.                                                               .
+---------------------------------------------------------------+
| UDP Header                                                    |
.   Source Port = As chosen by Sender                           .
.   Destination Port = User-configured Port                     .
.                                                               .
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|    Message for DM or LM Query                                 |
.                                                               .
+---------------------------------------------------------------+

     Figure: Example Probe Query Message for SRv6 Policy
```
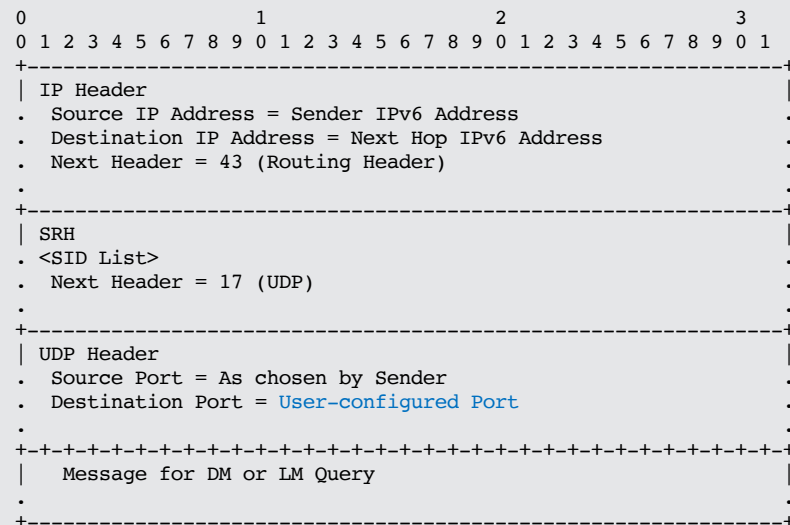
IET

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 Response Message |                               |
.  Payload = LM Response Message                                 .
.                                                               .
+----------------------------------------------------------------+

                Figure: Probe Response Message
```

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

Backup

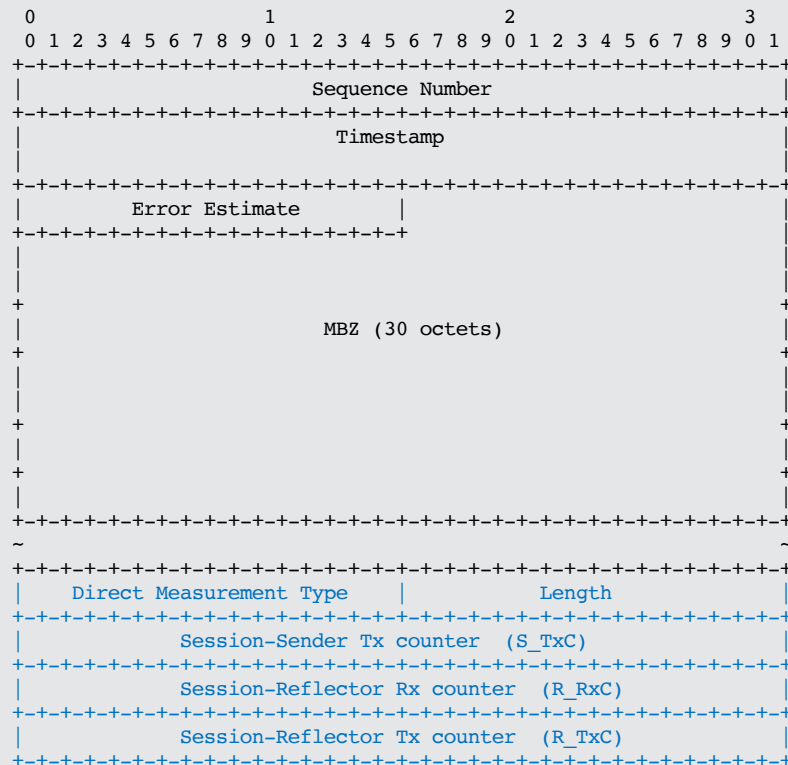# STAMP DM Message with Direct Measurement TLV (DM+LM Combined Probe Message)

Figure: Sender Message Format

Figure: Reflector Message Format

Thank you