Simple TWAMP (STAMP) Extensions for Direct Measurement

draft-gandhi-ippm-stamp-direct-00

Rakesh Gandhi - Cisco Systems (rgandhi@cisco.com) - Presenter
Clarence Filsfils - Cisco Systems (cfilsfil@cisco.com)
Daniel Voyer - Bell Canada (daniel.voyer@bell.ca)
Mach(Guoyi) Chen - Huawei (mach.chen@huawei.com)
Bart Janssens - Colt (Bart.Janssens@colt.net)

Agenda

- Requirements and Scope
- Summary of Extensions
- Next Steps

Requirements and Scope

Requirements:

- Support stand-alone Direct Measurement for Packet Loss

Goals:

- Avoid per session provisioning on Session-Reflector
- Avoid control-channel signaling for sessions
- Very high scale for number of sessions and faster detection interval
  - Support hardware implementation

Scope:

- STAMP [RFC 8762]
- STAMP Extensions [RFC8972]

Stand-alone Direct Measurement Test Packet for Packet Loss

- Stand-alone Direct Measurement test packet defined
  - Hardware efficient counter-stamping
    - Well-known locations for transmit and receive traffic counters
  - Block number of the counters for alternate marking method [RFC 8321]
  - Traffic class of the counters for per class packet loss
- Direct Measurement test packet is also defined for authenticated mode
- User-configured destination UDP **Port2** is used for identifying direct measurement test packets
- Does not modify the existing STAMP procedure as different destination UDP port is used for direct measurement test packets
- Other than Timestamp vs. Counter in the test packet, the protocol is same as STAMP
- Sequence Numbers allow to detect test packet loss, and connectivity loss
- Flags
  - X set to 1 for 64-Bit Counter, set to 0 for 32-Bit Counter
  - B set to 1 for Byte Counter, set to 0 for Packet Counter
  - T set to 1 for Sender-DSCP scoped Counter

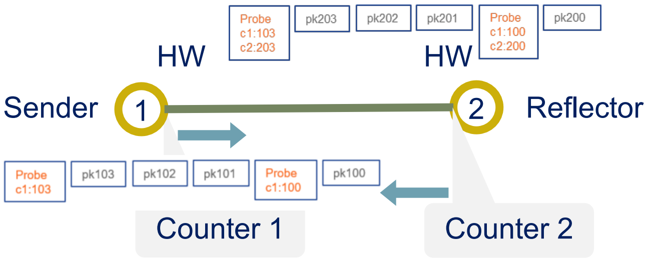
```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+---------------------------------------------------------------+
| IP Header                                                     |
.  Source IP Address = Session-Sender IPv4 or IPv6 Address      .
.  Destination IP Address = Session-Reflector IPv4 or IPv6 Addr .
.  Protocol = UDP                                               .
.                                                               .
+---------------------------------------------------------------+
| UDP Header                                                    |
.  Source Port = As chosen by Session-Sender                    .
.  Destination Port = User-configured Port2 direct measurement  .
.                                                               .
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                        Sequence Number                        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                        Transmit Counter                       |
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|X|B|T| DSCP.     | Block Number| SSID                          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                        Receive Counter                        |
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                        Session-Sender Sequence Number         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                        Session-Sender Counter                 |
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                        MBZ (4 octets)                         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| Ses-Sender TTL|       MBZ                                     |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+

     Figure: Session-Reflector Direct Measurement Test Packet
```

Direct Measurement TLV vs. Direct Measurement Test Packet

STAMP Direct Measurement TLV	Direct Measurement Test Packet
1. Complex to implement counter collection in hardware for Sender TX, Reflector RX and Reflector TX to detect packet loss. – Session-reflector hardware to parse STAMP TLVs in receive packets to decide if receive counter to be punted to the control-plane – Reply test packet with transmit counter NOT at the same location – needed for hardware counter-stamping (like STAMP timestamp) – Hardware needs to write both timestamp and counter in the injected packet – not capable	1. Suitable for collecting data packet counters from hardware – inline counter-stamping (for P2P connections) – Reply test packet with transmit counter at the same location – important property for hardware counter-stamping (like STAMP timestamp)
2. Need STAMP TLV processing in hardware	2. No TLV processing in hardware
3. Counter not at fixed location due to TLVs	3. Counter at fixed location, well-known location for SRv6 network programming, needed for hardware implementation
4. Counter location deeper into the packet (Eth 18, IPv6 40, UDP 8, STAMP 44, TLV Type 4, Total = 114 Byte) – load into write-able memory	4. Counter location earlier into the packet (Eth 18, IPv6 40, UDP 8, Seq 4, Total = 70 Byte)
5. Direct Measurement TLV supports **32-bit packet** counters	5. Direct Measurement Test Packet supports **32-bit packet and byte** counters and **64-bit packet and byte** counters
6. For control-plane implementation, how can we measure packet loss without alternate marking method (block number)?	6. Direct Measurement Test Packet identifies the block number of the counters - used for alternate marking method (RFC 8321) for control-plane based packet loss
7. Does not support per-traffic class direct measurement (DSCP TLV processing not specified for Counters)	7. Per traffic-class counter collection (per traffic-class loss measurement) (e.g., drop best effort traffic)

Link Loss Direct Measurement (P2P Circuits) - Inline Counter-stamping in Hardware



- Advertise extended TE metrics – link loss percentage
  - RFC 8570 (IS-IS)
  - RFC 7471 (OSPF)
  - RFC 8571 (BGP-LS)

- One Way Packet Loss %
  = 100* (((C1(t) – C1(t-1)) – (C2(t) – C2(t-1)) / (C1(t) – C1(t-1))
  = 100* (((103 – 100) – (203 – 200)) / (103 – 100))
  = 0
- Traffic Counters – counter-stamping in hardware

```
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     |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|A|  RESERVED   |                  Link Loss                    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Alternate Marking Method for Packet Loss

- RFC 8321 - Alternate-Marking Method for Passive and Hybrid Performance Monitoring
- RFC 8957 - Synonymous Flow Label Framework
- Control plane-based packet loss with distributed forwarding LCs, using block number of the counters

```
   A: packet with A coloring
   B: packet with B coloring

             |           |           |           |           |
             |           |  Traffic Flow         |           |
    ------------------------------------------------------------------->
     BBBBBBB AAAAAAAAAAA BBBBBBBBBBB AAAAAAAAAAA BBBBBBBBBBB AAAAAAA
    ------------------------------------------------------------------->
       ...   |  Block 5  |  Block 4  |  Block 3  |  Block 2  |  Block 1
             |           |           |           |           |
```

Figure 2: Traffic Coloring

Packet Loss Calculation

```
          C1                     C2
           /                       \
+--------+     Test Packet      +--------+
|        | - - - - - - - - - ->|        |
|   R1   |=====================|   R3   |
|        |<- - - - - - - - - - |        |
+--------+  Reply Test Packet  +--------+
           \                       /
            C4                     C3

Session-Sender                 Session-Reflector

             Reference Topology
```

- Using the Counters C1, C2, C3 and C4 as per reference topology, from the n^{th} and $(n-1)^{th}$ direct measurement test packets.
- One-way receive packet loss[n-1, n] = (C2[n] - C2[n-1]) - (C1[n] - C1[n-1])
- Two-way receive packet loss[n-1, n] = (C4[n] - C4[n-1]) - (C3[n] - C3[n-1])
  + (C2[n] - C2[n-1]) - (C1[n] - C1[n-1])

Next Steps

- Welcome your comments and suggestions
- Requesting WG adoption

Thank you

STAMP Test Packet with Direct Measurement 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                        Sequence Number                        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                          Timestamp                            |
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|         Error Estimate        |                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+                               |
|                                                               |
|                                                               |
+                                                               +
|                         MBZ (30 octets)                       |
+                                                               +
|                                                               |
|                                                               |
+                                                               +
|                                                               |
+                                                               +
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
~                                                               ~
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|STAMP TLV Flags|    Type       |         Length                |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|             Session-Sender Tx counter  (S_TxC)                |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|             Session-Reflector Rx counter  (R_RxC)             |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|             Session-Reflector Tx counter  (R_TxC)             |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+

           Figure: Session-Sender Test Packet Format
```

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                        Sequence Number                        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                          Timestamp                            |
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|         Error Estimate        |           MBZ                 |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                          Receive Timestamp                    |
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                 Session-Sender Sequence Number                |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                  Session-Sender Timestamp                     |
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| Session-Sender Error Estimate |           MBZ                 |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|Ses-Sender TTL |                      MBZ2                     |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
~                                                               ~
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|STAMP TLV Flags|    Type       |         Length                |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|             Session-Sender Tx counter  (S_TxC)                |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|             Session-Reflector Rx counter  (R_RxC)             |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|             Session-Reflector Tx counter  (R_TxC)             |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+

           Figure: Session-Reflector Test Packet Format
```