Enhanced Performance Measurement Using Simple TWAMP in Segment Routing Networks

draft-gandhi-spring-enhanced-srpm-00

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Agenda

• Requirements and Scope
• History and Summary
• Next Steps
Requirements and Scope

Requirements:
- Performance Measurement in SR networks
  - End-to-end SR paths
  - Applicable to SR-MPLS/SRv6 data planes

Goals:
- No Session-Reflector dependency for one-way delay measurement
  - Session-Reflector unaware of the measurement protocol
    - State is in the packet - spirit of SR
- Higher test session scale and faster detection interval

Scope:
- Using RFC 8762 (Simple TWAMP (STAMP))
- Further extension of [draft-ietf-spring-stamp-srpm]
History of the Draft

- March 2020
  - Draft was published
- April 2020
  - Presented version 00 in IETF 107 Virtual MPLS WG Meeting
- July 2020
  - Presented version 02 in IETF 108 Online SPRING WG meeting
- September 2020
  - Presented version 02 in MPLS WG Interim meeting
- March 2021
  - Presented version 04 in IETF 110 Online SPRING WG meeting
Loopback Mode for SR Policy [draft-ietf-spring-stamp-srpm]

- STAMP test packets in Loopback Mode as defined in [draft-ietf-spring-stamp-srpm]
- STAMP test packets are transmitted for each Segment List(s) of the SR Policy Candidate Path(s)
- STAMP test packets are forwarded in fast-path just like data traffic on Session-Reflector
- Session-Reflector is agnostic to the STAMP protocol
- Round-trip delay = (T4 - T1)

Figure: STAMP Loopback Mode
Enhanced Loopback Mode Enabled with Network Programming Function

- STAMP test packets transmitted in enhanced loopback mode
  - The network programming function optimizes the "operations of punt and generate the reply test packet" on Session-Reflector
  - As STAMP test packets are forwarded in fast-path, higher session scale with faster detection interval is achieved
- Session-Reflector adds receive timestamp at a specific location in the payload of the received test packet in fast-path
  - Only adds the receive timestamp if the source address in the received test packet matches the local node address
  - Ensure loopback STAMP test packets return from the intended Session-Reflector
- One-way delay = (T2 – T1) (Note: assumes the clocks on the Session-Sender and Session-Reflector are synchronized)
Example Provisioning Model

* Provisioned, Flooded/Signaled or IANA Allocated
Using STAMP Session-Sender test packets
Session-Sender adds Transmit Timestamp (T1)
Session-Reflector adds Receive Timestamp (T2) at offset-byte location in payload, for example,
- offset 16 bytes from the start of the payload in unauthenticated mode, or
- offset 32 bytes from the start of the payload in authenticated mode, or
- locally provisioned location (consistently in the network)

<table>
<thead>
<tr>
<th>Sequence Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmit Timestamp (T1)</td>
</tr>
<tr>
<td>Transmit Error Estimate</td>
</tr>
<tr>
<td>Receive Timestamp (T2)</td>
</tr>
<tr>
<td>MBZ (12 octets)</td>
</tr>
</tbody>
</table>

| MBZ (4 octets) |
| Receive Error Estimate |
| MBZ (32 octets) |

| MBZ (6 octets) |
| MBZ (16 octets) |

| MBZ (4 octets) |
| HMAC (16 octets) |

STAMP Test Packet Format in Unauthentication Mode

STAMP Test Packet Format in Authentication Mode
SR-MPLS with Timestamp MPLS Label

- Timestamp MPLS labels (TBA1 for offset-16 and TBA2 for offset-32) defined for Timestamp and Forward function
- Source and Destination Addresses are swapped in the IP header that represent the Reverse direction path
- Reverse path can be IP
  - Session-Reflector removes MPLS Header
- Reverse path can be SR-MPLS
  - Reverse direction SR-MPLS path label stack carried in MPLS Header
  - Session-Reflector does not remove the MPLS Header

Example STAMP Test Packet with Timestamp Label for SR-MPLS
Loopback Mode with Timestamp and Forward for SR-MPLS Policy

IPv4/UDP
Source: PE4
Destination: PE2
Payload
TX Timestamp1

IPv4/UDP
Source: PE4
Destination: PE2
Payload
TX Timestamp1, RX Timestamp2

Extension Label 15
TS LABEL TBA1
IPv4/UDP
Source: PE4
Destination: PE2
Payload
TX Timestamp1

Extension Label 15
TS LABEL TBA1
IPv4/UDP
Source: PE4
Destination: PE2
Payload
TX Timestamp1, RX Timestamp2

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SRv6 with Timestamp Endpoint Function

<table>
<thead>
<tr>
<th>IP Header</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source IP Address = Session-Sender IPv6 Address</td>
</tr>
<tr>
<td>Destination IP Address = Destination IPv6 Address</td>
</tr>
<tr>
<td>SRH as specified in RFC 8754</td>
</tr>
<tr>
<td>&lt;Segment List&gt;</td>
</tr>
<tr>
<td>End.TSF (TBA3 or TBA4) with Session-Reflector SID</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IP Header</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source IP Address = Session-Reflector IPv6 Address</td>
</tr>
<tr>
<td>Destination IP Address = Session-Sender IPv6 Address</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>UDP Header</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source Port = As chosen by Session-Sender</td>
</tr>
<tr>
<td>Destination Port = As chosen by Session-Sender</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>STAMP Test Packet</th>
</tr>
</thead>
</table>

Example STAMP Test Packet with Timestamp Endpoint Function for SRv6

- Timestamp Endpoint Functions End.TSF (TBA3 for offset-16 and TBA4 for offset-32) defined for Timestamp and Forward and carried with the Session-Reflector node SID
- Reverse path can be IP
  - Inner IPv6 header is required
  - Source and Destination Addresses are swapped that represent the Reverse direction path in the inner IPv6 header
  - Session-Reflector removes SRH
- Reverse path can be SRv6
  - Inner IPv6 header not required
  - Reverse direction SRv6 path segment-list carried in SRH
  - Session-Reflector does not remove the SRH
Performance Metric Notifications

- Delay metrics are notified as an example, when consecutive M number of STAMP test packets have delay values exceed the configured thresholds (absolute/percentage).
- Synthetic packet loss is notified when X number of STAMP return test packets not received at the Session-Sender out of last Y STAMP test packets transmitted (with configured XofY threshold).
- Session state Up is initially notified as soon as one or more STAMP return test packets are received at the Session-Sender.
- Session state Down is notified when consecutive N number of STAMP return test packets are not received at the Session-Sender.
Next Steps

- Welcome your comments and suggestions
- Requesting SPRING WG adoption
Thank you