Enhanced Performance Delay and Liveness Monitoring in Segment Routing Networks

draft-gandhi-spring-sr-enhanced-plm-02

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Agenda

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

Requirements:

- Performance Delay Monitoring & Liveness Monitoring in SR networks
  - End-to-end P2P/P2MP SR paths
  - Applicable to SR-MPLS/SRv6 data planes
- Running single protocol in SR networks
  - Simplify implementations and reduce development cost
  - Simplify deployment and reduce operational complexity
- No endpoint dependency
  - Stateless on endpoint (e.g. endpoint unaware of the protocol)
  - Higher scale and faster detection interval

Scope:

- RFC 5357 (TWAMP Light) defined probe messages
- RFC 8762 (STAMP) defined probe messages
History of the Draft

- March 2020
  - Draft was published
- April 2020
  - Presented version 00 in IETF MPLS WG Virtual Meeting
- July 2020
  - Presented version 02 in IETF SPRING WG Online meeting
PM Probes in Loopback Mode for SR Policy

- Using PM probes (TWAMP Light/STAMP delay measurement messages) in Loopback Mode
- Probe messages sent using Segment List(s) of the SR Policy Candidate Path(s)
- Probe messages are not punted on the reflector node out of fast-path in forwarding
- Reflector is agnostic of the protocol

Figure: PM Loopback Mode
Using PM probes in loopback mode enabled with network programming function

- The network programming function optimizes the "operations of punt, add receive timestamp and inject the probe packet" on the reflector node
- As probe packets are forwarded in fast-path, faster liveness failure detection is possible

Reflector node adds the receive timestamp in the payload of the received probe message without punting the message

- Only adds the receive timestamp if the source address or destination address in the probe message matches the local node address
- Ensure loopback probe packets return from the intended reflector node
Failure Notification

- Delay metrics are notified when consecutive $M$ number of probe messages have delay values exceed the configured thresholds.
- Liveness failure (loss of heartbeats) is notified when consecutive $N$ number of return probe messages are not received at the sender.
Probe Messages for Timestamp and Forward Function

- Leverage existing TWAMP implementations and deployments
- Sender adds Transmit Timestamp (t1)
- Reflector adds Receive Timestamp (t2) at fixed offset in payload locally provisioned (consistently in the network)
  - E.g. offset-byte 16 from the start of the payload

Figure: TWAMP Light Probe Message Format

Figure: STAMP Probe Message Format
SR-MPLS with Timestamp and Forward Function

| Label(1) | TC |S|      TTL      |
| TC  |S|      TTL      |
| Label(n) | TC |S|      TTL      |
| Timestamp Label (TBA1) | TC |S|      TTL      |

Extended Special-purpose label (TBA1) is defined for Timestamp and Forward network programming

Reverse Path can be IP or SR-MPLS

Source and Destination Addresses are swapped to represent the Reverse direction path

Example Probe Message with Timestamp Label for SR-MPLS
SRv6 with Timestamp and Forward SID Function

• Endpoint SID Function End.TSF is defined for Timestamp and Forward network programming and is carried for the Reflector node SID
• Reverse path can be IP
  – Reflector node removes SRH
• Reverse path can be SR
  – Reverse direction SR path Segment-list carried in SRH
  – Reflector node does not remove the SRH
• Source and Destination Addresses are swapped to represent the Reverse direction path in the inner IPv6 header

Example Probe Message with Endpoint Function for SRv6
ECMP Support for SR Paths

• SR Paths can have ECMP between the ingress and transit nodes, between transit nodes and between transit and egress nodes.
• PM probe messages 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) if return path is also SR-MPLS
  - For IPv6
    • Sweeping flow label in IPv6 header
Example Provisioning Model

+----------+
| Controller |
+----------+

PDLM Mode

<table>
<thead>
<tr>
<th>LB or Enhanced Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network Programming Label</td>
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</table>

<table>
<thead>
<tr>
<th>Measurement Protocol</th>
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<tbody>
<tr>
<td>Timestamp2 Offset</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Missed Probe Message Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network Programming Label</td>
</tr>
<tr>
<td>Timestamp Format</td>
</tr>
<tr>
<td>Delay threshold/Count</td>
</tr>
<tr>
<td>Source/Dest UDP Ports</td>
</tr>
</tbody>
</table>

\[ \begin{align*}
\text{Sender} & \quad \text{Reflector} \\
\text{R1} & \quad \text{SR Path} & \quad \text{R5} \\
\end{align*} \]

Figure 2: Example Provisioning Model
Next Steps

• Welcome your comments and suggestions
• Requesting SPRING WG adoption
Thank you
Backup
Loopback Mode with Timestamp and Forward for SR-MPLS Policy

IPv4/UDP
Source: PE4
Destination: PE2
Payload
Timestamp1

IPv4/UDP
Source: PE4
Destination: PE2
Payload
Timestamp1

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

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

Probe

Return Probe

2 PE

3

4 PE

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Thank you