

Performance Measurement in Segment Routing Networks with MPLS Data Plane

draft-gandhi-spring-sr-mpls-pm-02

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Agenda

- Requirements and Scope
- In-band Probes for SR Links and SR Policies
- DM and LM Packets for SR Links and SR Policies
- Probe Responses
- SR Link Extended TE Metrics Advertisements
- Next Steps

Requirements and Scope

Requirements:

- Delay and loss Performance Measurement (PM) for SR links and end-to-end SR Policies
- Delay and loss extended TE link metrics advertisement in the network

Scope:

- Segment Routing (SR) with MPLS data plane
- In-band PM **probe messages**
- Use RFC 6374 (defined for MPLS-TP) based mechanisms
- Use RFC 7876 (UDP return path) for probe response messages
- Informational

PM Probes for SR Links

- For SR links, the PM probe query messages for link delay and packet loss measurements are sent **in-band** using MPLS GAL/GAch header as defined in [RFC6374].

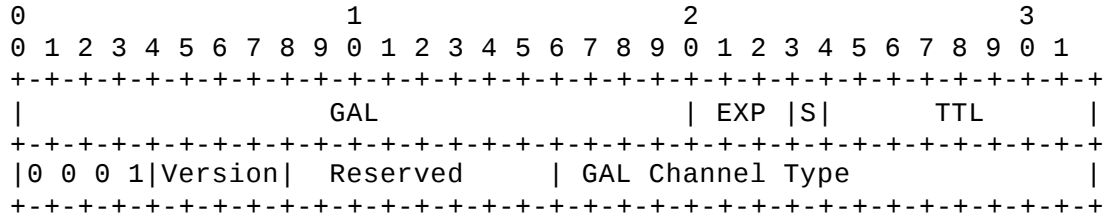


Figure 3: Probe Packet Header for an SR-MPLS Link

DM Probes for SR Links and SR Policies

DM probes use the message format defined in [RFC6374] as payload.

GAL : 13

GACH : 0x000C

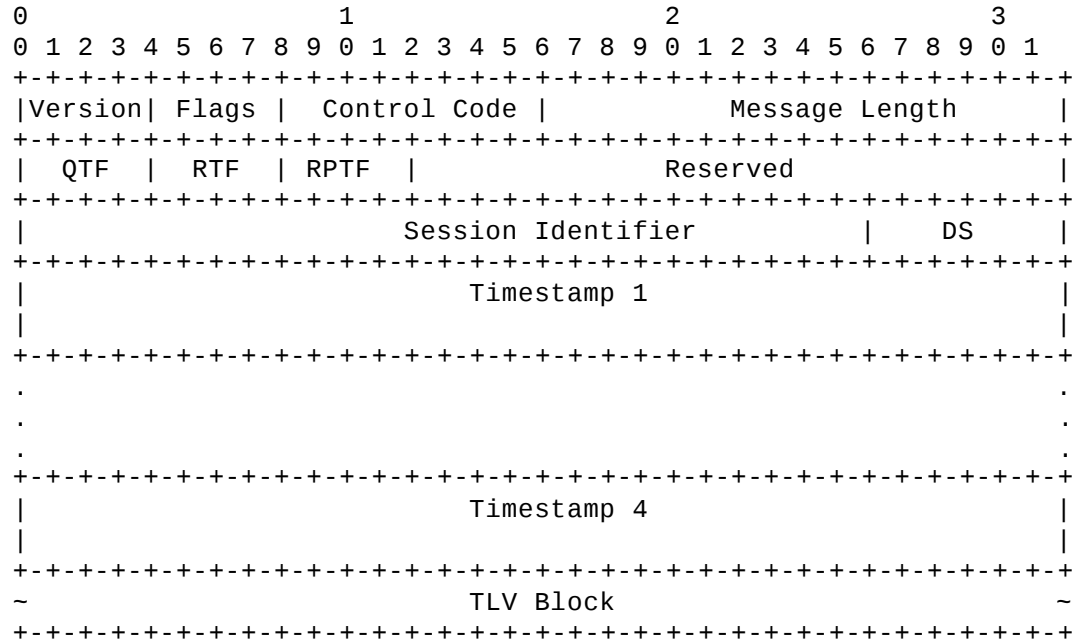


Figure 4: Delay Measurement Message Format

LM Probes for SR Links and SR Policies

LM probes use the message format defined in [RFC6374] as payload.

GAL : 13

GACh : 0x000A (Direct)

0x000B (Inferred)

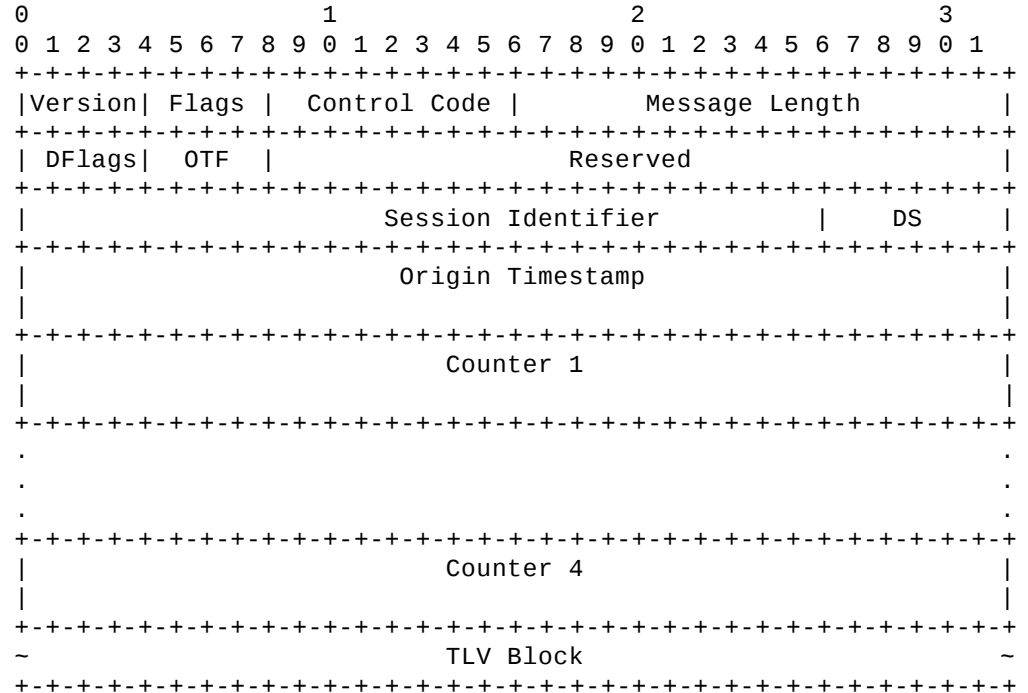


Figure 5: Loss Measurement Message Format

Probe Responses

- One-way Measurement Response (out-of-band)
 - Sent to the querier node using the information from the UDP Return Object (URO) TLV [RFC7876].
 - URO TLV is sent by the querier node in the probe query messages and contains the UDP destination port and IP address.
- Two-way Measurement Response (in-band)
 - Sent to the querier node using a message similar to the in-band probe query message as SR-MPLS packet.

SR Link Extended TE Metrics Advertisement

- PM procedure is used to measure delay and loss performance of SR Links.
- Compute SR Link Delay metrics (minimum-delay, maximum-delay, average-delay, delay-variance) and SR Link Packet Loss metric.
- SR link extended TE metrics advertised in the network using the TLVs defined in the following RFCs/Drafts:
 - OSPF [RFC7471]
 - ISIS [RFC7810] [draft-ietf-lsr-isis-rfc7810bis]
 - BGP-LS [draft-ietf-idr-te-pm-bgp]

Next Steps

- Welcome your comments and suggestions
- Multiple implementations already exist
- Request for WG adoption

UDP Path for In-band Performance Measurement for Segment Routing Networks

draft-gandhi-spring-udp-pm-01

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Agenda

- Requirements and Scope
- Probe Query Message
- Probe Response Message
- Return Path Segment List
- ECMP Support
- Next Steps

Requirements and Scope

Requirements:

- Delay and Loss Performance Measurement (PM) for SR links and end-to-end SR Policies
- Agnostic to data plane (SR-MPLS/SRv6/IP)
- 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 6374 defined **probe message formats**
- Use RFC 7876 (IP/UDP return path) defined probe response messages
- Define IP/UDP path for PM probe query messages

Probe Query Messages

- IP/UDP path is defined for PM probe query messages for delay and loss measurements for SR links and end-to-end SR Policies.
- For **end-to-end** performance measurement, the probe query messages are sent in-band with MPLS label stack for SR-MPLS Policies and SRv6 SRH with SID list for SRv6 Policies.
- Payload contains [RFC6374] defined message for DM or LM.
- UDP port IANA-TBA1 is used for identifying DM probe packets.
- UDP port IANA-TBD2 is used for identifying LM probe packets.

```
+-----+
| IP Header |
. Source IP Address = Querier IPv4 or IPv6 Address .
. Destination IP Address = Responder IPv4 or IPv6 Address .
. Protocol = UDP .
. IP TTL = 1 .
. Router Alert Option Not Set .
.
+-----+
| UDP Header |
. Source Port = As chosen by Querier .
. Destination Port = TBA1 by IANA for DM, TBA2 for LM .
.
+-----+
| Payload = Message as specified in RFC 6374 for DM and LM |
.
+-----+
```

Probe Response Messages

- Probe response messages can be sent in-band (two-way measurement) or out-of-band (one-way measurement) for SR links and SR Policies.
- Use the information from the UDP Return Object (URO) TLV [RFC7876] from the received Probe query message payload, otherwise use the IP/UDP information (Source IP Address and Source UDP port) from the received Probe query message header.

```
+-----+
| IP Header |
. Source IP Address = Responder IPv4 or IPv6 Address
. Destination IP Address = URO.Address
. Protocol = UDP
. Router Alert Option Not Set
.
+-----+
| UDP Header |
. Source Port = As chosen by Responder
. Destination Port = URO.UDP-Destination-Port
.
+-----+
| Message as specified in RFC 6374 Section 3.2 for DM, or
. Message as specified in RFC 6374 Section 3.1 for LM
.
+-----+
```

```
+-----+
| 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
.
+-----+
| Message as specified in RFC 6374 Section 3.2 for DM, or
. Message as specified in RFC 6374 Section 3.1 for LM
.
+-----+
```

Return Path Segment List

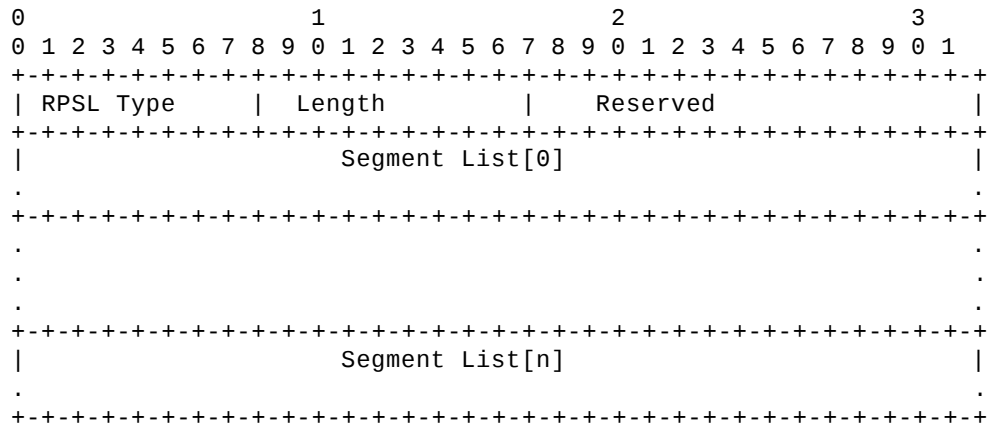
- For two-way end-to-end performance measurement of SR Policies, the responder node needs to send the probe response messages in-band on a specific reverse SR path.
- Querier node can request the responder node to send the probe response messages back on a given reverse path (e.g. co-routed path) by adding a Return Path Segment List (RPSL) TLV in the probe query messages.
- This does not require any SR Policy state on the egress node.

- TBA3: SR-MPLS RPSL

- TBA4: SRv6 RPSL

- TBA5: SR-MPLS BSID

- TBA6: SRv6 BSID



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 SR-MPLS
 - Different Destination Addresses in the range of 127/8 or different Source Addresses or different Source UDP ports in IP/UDP header.
 - For SR-MPLS
 - Entropy label.
 - For IPv6
 - 3-tuple of Flow Label, Source Address and Destination Address fields in the IPv6 header.
 - For SRv6
 - Flow Label in SRH.

Next Steps

- Welcome your comments and suggestions
- Implementations of building blocks already exist (e.g. RFC6374, IP/UDP paths for probes)
- Request for WG adoption

Performance Measurement in Segment Routing Networks with IPv6 Data Plane (SRv6)

draft-ali-spring-srv6-pm-02

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Passive Performance Measurement for SRv6 Network Programming

[draft-li-spring-passive-pm-for-srv6-np-00](#)

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Agenda

- Requirements and Scope
- IOAM and Passive PM for SRv6 Data plane
- Plans
- Next Steps

Requirements and Scope

- Performance delay and loss measurement
- In-Situ OAM (IOAM)
 - Performance measurement information carried by the actual data traffic
- Passive PM
 - Performance measurement based on the actual data traffic (as opposed to test traffic)
- SRv6 data plane
 - End-to-end and hop-by-hop performance measurement of SR Policies
- Out of scope
 - PM Probe messages

IOAM and Passive PM for SRv6

- Data packets carry PM information as part of the SRH (SRv6 Header)
 - The PM information is sent in PM TLV(s) defined for SRH
 - The PM information (e.g. timestamps for delay measurement and counters for loss measurement) carried is for the actual data traffic
- Copy of the data packets punted to collect PM information

Plans for Combined Draft

- Authors of the two drafts are collaborating to combine both the drafts and are planning to publish a new draft before the next IETF meeting.
- The combined draft will provide details on the solution(s) for IOAM and passive PM.

Next Steps

- Publish a combined draft for SRv6 IOAM/passive PM solution
- Welcome your comments and suggestions

Thank you.