Enhanced Performance Measurement and Liveness Monitoring in Segment Routing Networks

draft-gandhi-spring-sr-enhanced-plm-01

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Agenda

- Requirements and Scope
- Summary
- Next Steps

Requirements and Scope

Requirements:

- Performance Measurement & Liveness Monitoring in SR networks
  - ✓ End-to-end P2P/P2MP SR paths
  - ✓ Applicable to SR-MPLS/SRv6 data planes
  - ✓ Support ECMP SR paths
- Running single protocol for liveness detection and performance measurement in SR networks
  - ✓ Simplify deployment and reduce operational complexity
- No endpoint dependency
  - ✓ Stateless on endpoint (e.g. endpoint unaware of the probe protocol)
  - ✓ Higher scale and faster detection interval (e.g. packets not punted out of fast-path)

Scope:

- RFC 5357 (TWAMP Light) defined probe messages
- RFC 8762 (STAMP) defined probe messages
- User-configured IP/UDP path for probe messages

Liveness Monitoring of SR Policy

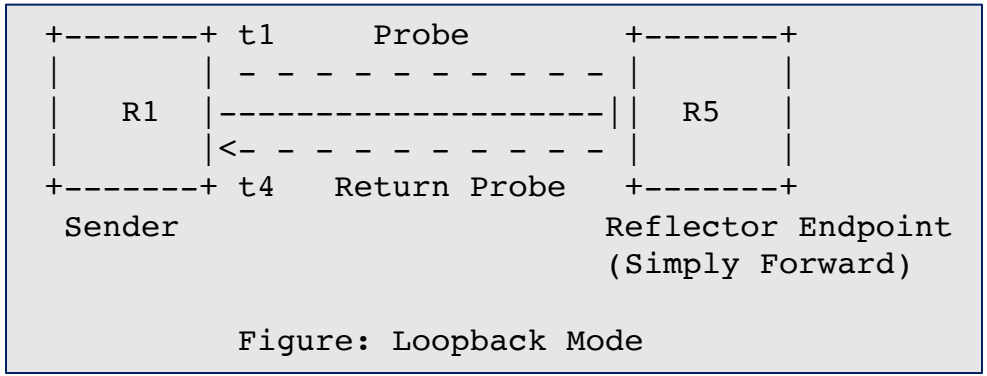


Figure: Loopback Mode

- Liveness monitoring for SR Policy uses 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 remote node (endpoint/reflector) out of fast-path
- Return path can be IP or SR
- Liveness failure is notified when consecutive N number of probe messages are not received back at the sender

Enhanced Liveness Monitoring of SR Policy

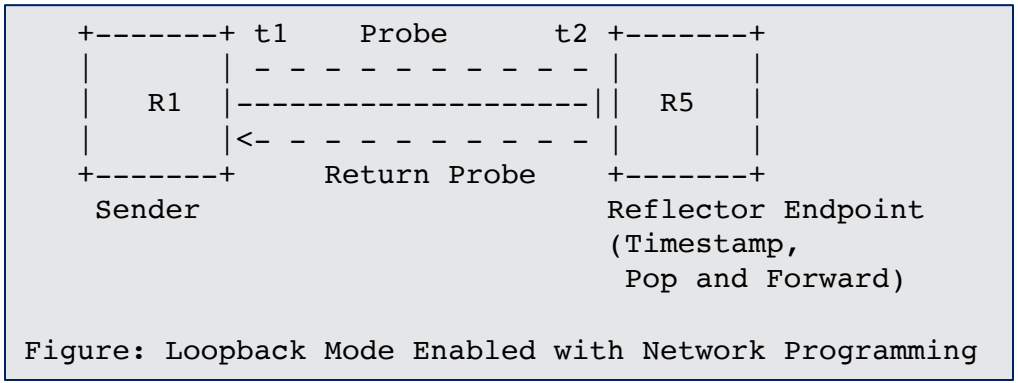


Figure: Loopback Mode Enabled with Network Programming

- Use 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
- The endpoint node adds the receive timestamp in the payload of the received TWAMP Light or STAMP probe message without punting the probe message
  - Only add the receive timestamp if the source address in the probe message matches the local node address
- Liveness failure is notified when consecutive N number of probe messages are not received back at the sender
- Delay metrics are notified when consecutive N number of probe messages have delay values exceed the configured thresholds

TWAMP Light Probe Message

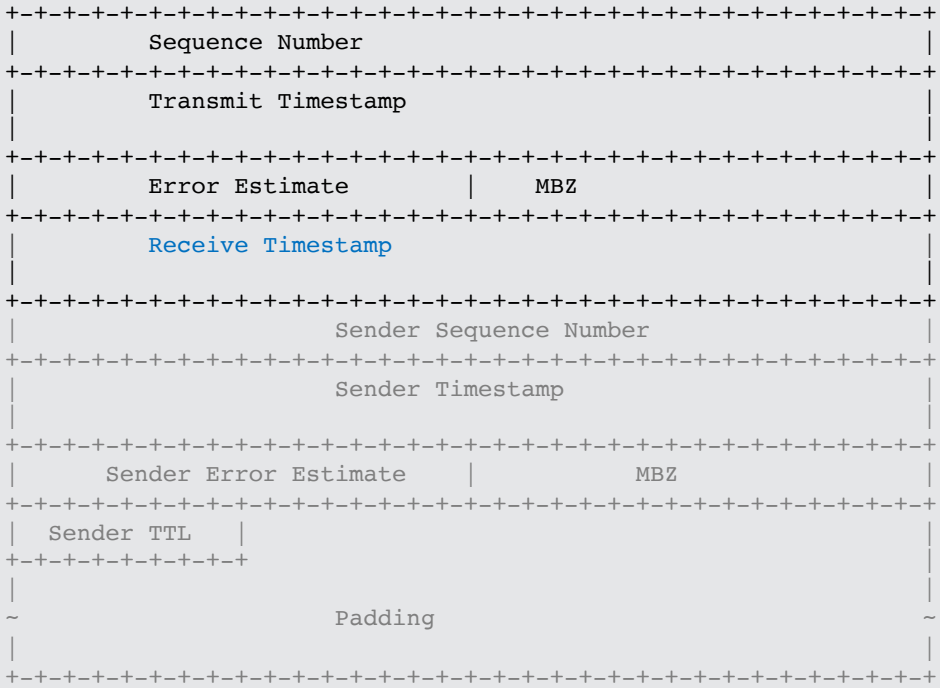


Figure: TWAMP Light Probe Message Format

Enhanced Loopback Mode

- Sender adds the Transmit Timestamp
- Reflector adds the Receive Timestamp at fixed offset locally provisioned (consistently in the network)
  - For TWAMP Light packets, it is at offset-byte 16 from the start of the payload
- Sender Sequence Number, Sender Timestamp, Sender Error Estimate and Sender TTL in the TWAMP Light messages are not used
  - Reflector does not copy them

STAMP Probe Message

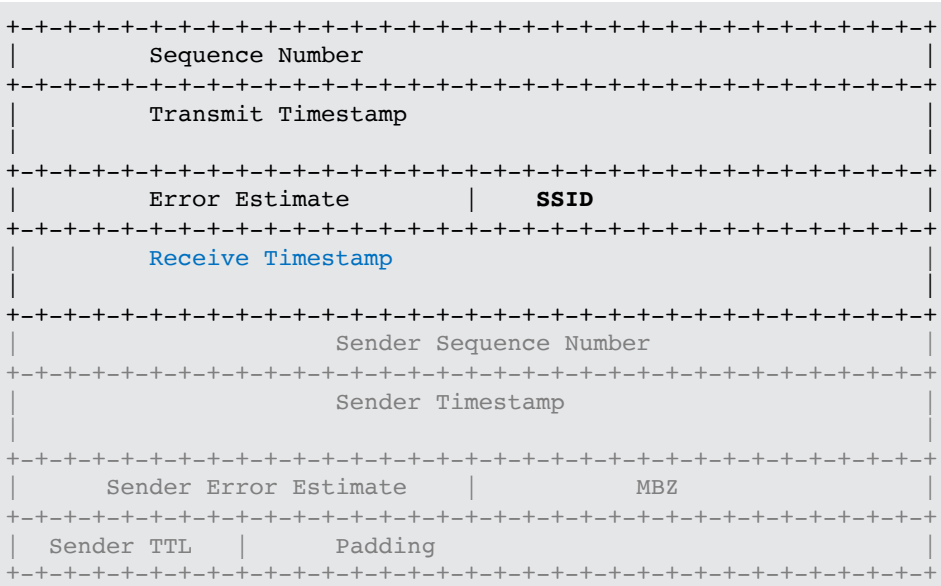


Figure: STAMP Probe Message Format

Enhanced Loopback Mode

- Sender adds the Transmit Timestamp
- Reflector adds the Receive Timestamp at fixed offset locally provisioned (consistently in the network)
  - For STAMP packets, it is at offset-byte 16 from the start of the payload
- Sender Sequence Number, Sender Timestamp, Sender Error Estimate and Sender TTL in the STAMP messages are not used
  - Reflector does not copy them

SR-MPLS with Timestamp Label Example

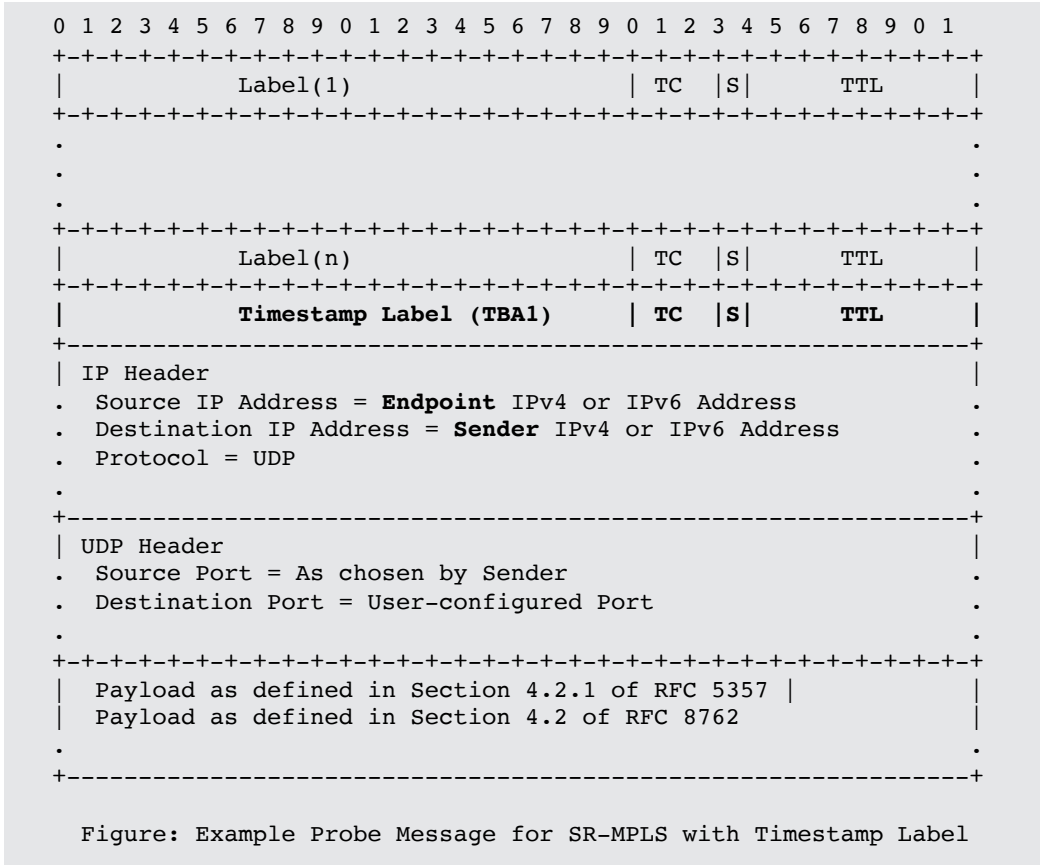


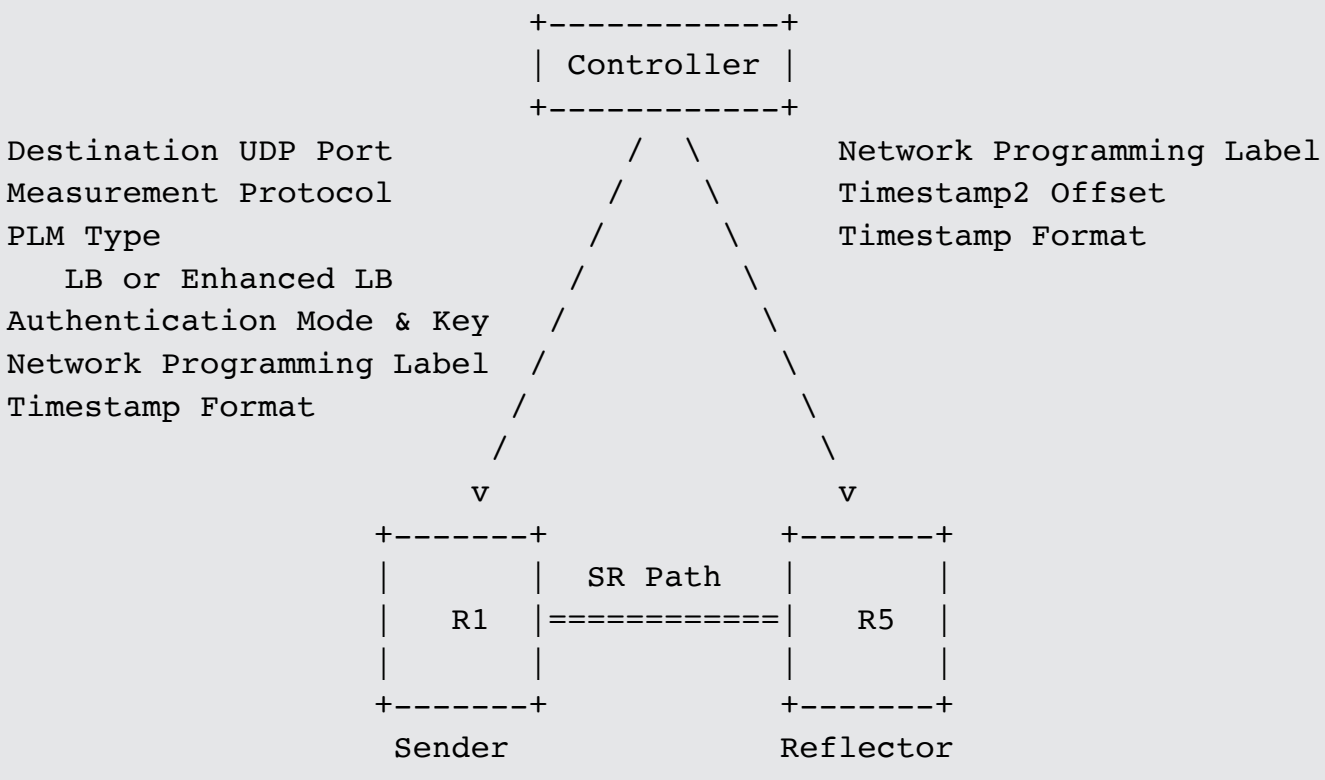
Figure: Example Probe Message for SR-MPLS with Timestamp Label

- Timestamp Label (TBA1) allocated by IANA from Extended Special-Purpose MPLS Label Values
  - Used for Timestamp, Pop and Forward network programing function
  - I.e. Timestamp Label (TBA1) is popped by the reflector node
- Source and Destination Addresses are swapped - represent Reverse direction path
- Optionally, Reverse direction SR path label stack can follow the Timestamp Label TBA1

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.
- 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
    - Destination addresses in IPv4 header (e.g. 127/8) when return path is SR-MPLS
  - For IPv6
    - Destination addresses in IPv6 header (e.g. ::FFFF:127/104) when return path is SRv6
    - Flow label in IPv6 header

Example Provisioning Model

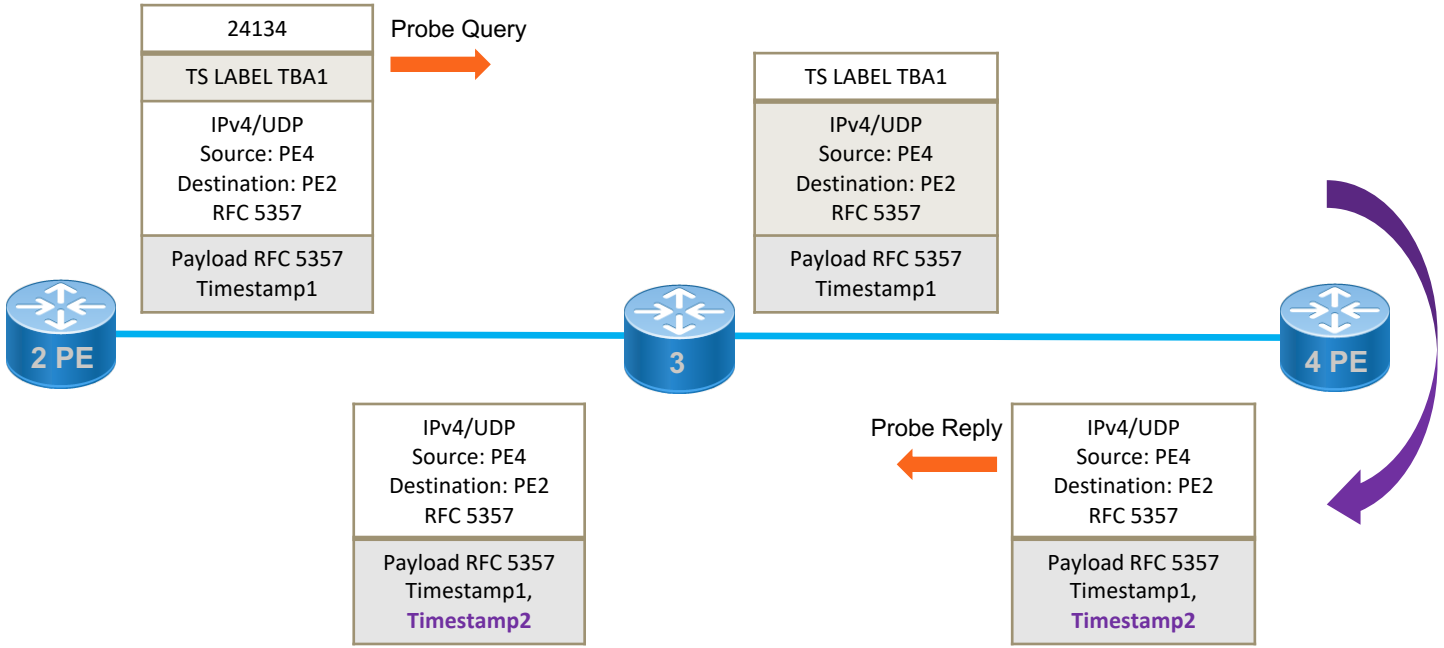


Next Steps

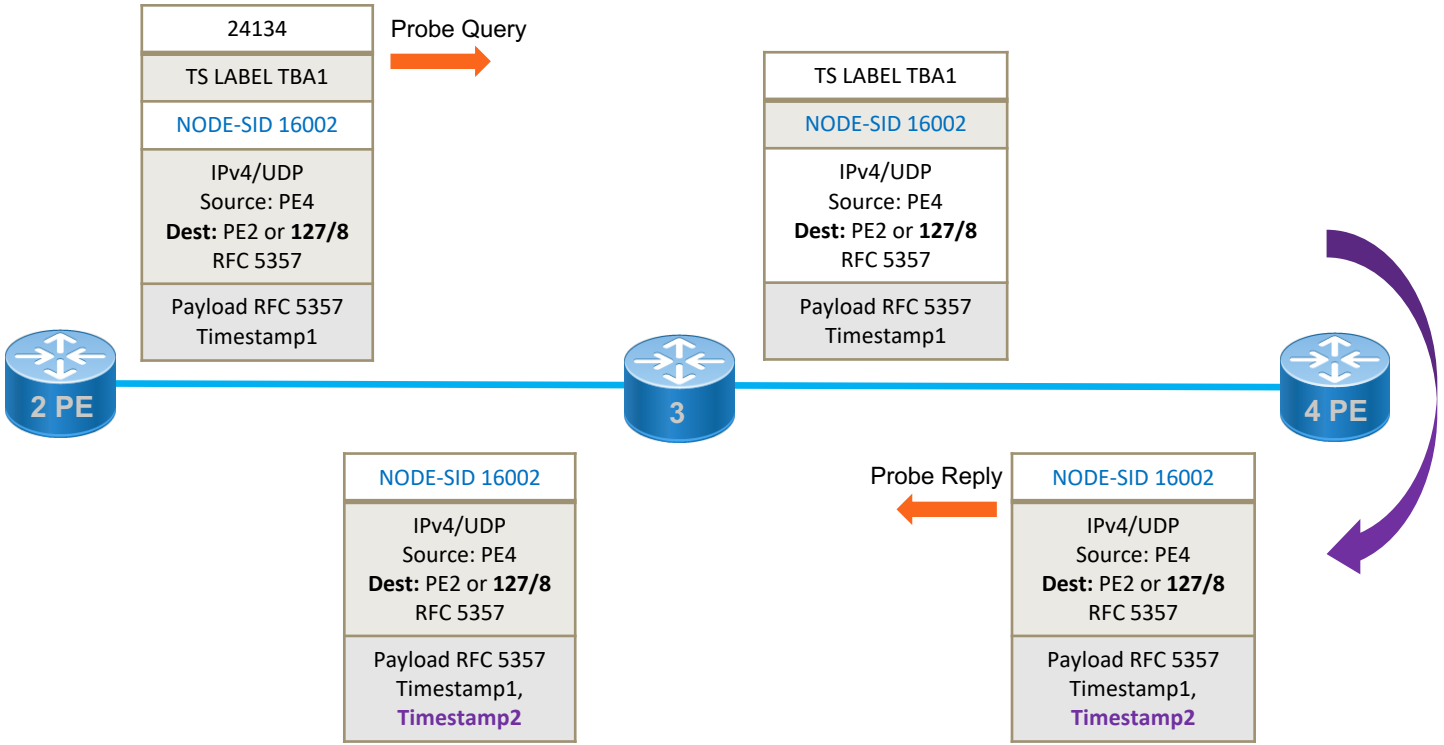
- Welcome your comments and suggestions
- Requesting WG adoption

Thank you

Enhanced Loopback Mode for SR-MPLS Policy - IP/UDP Return Path



Enhanced Loopback Mode for SR-MPLS Policy - SR Return Path



Thank you

Backup

SRv6 with Timestamp and Forward Function Example 1

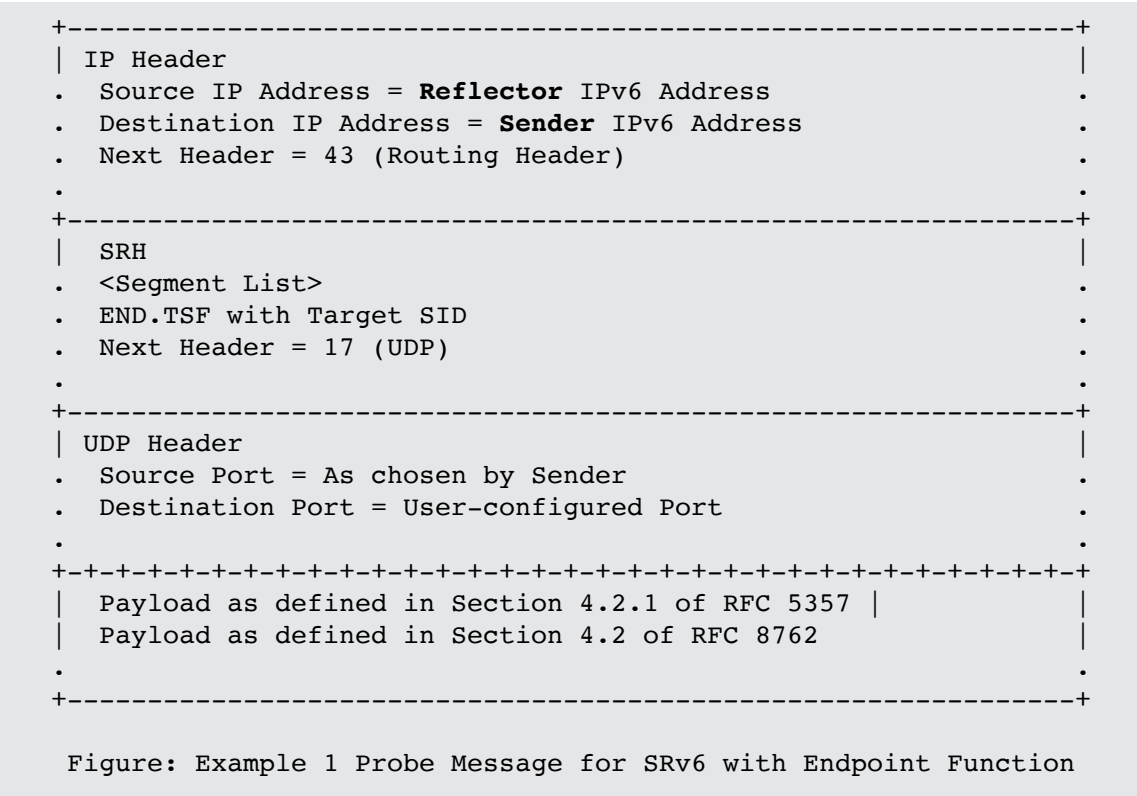


Figure: Example 1 Probe Message for SRv6 with Endpoint Function

- Endpoint Function END.TSF is defined for Timestamp and Forward and carried for the Reflector node SID
- Reflector node does not remove the SRH, Sender node removes the SRH
- Reverse direction SR path carried in SRH
- Source and Destination Addresses are swapped for the Reverse direction path in the **outer** IPv6 header

SRv6 with Timestamp and Forward Function Example 2

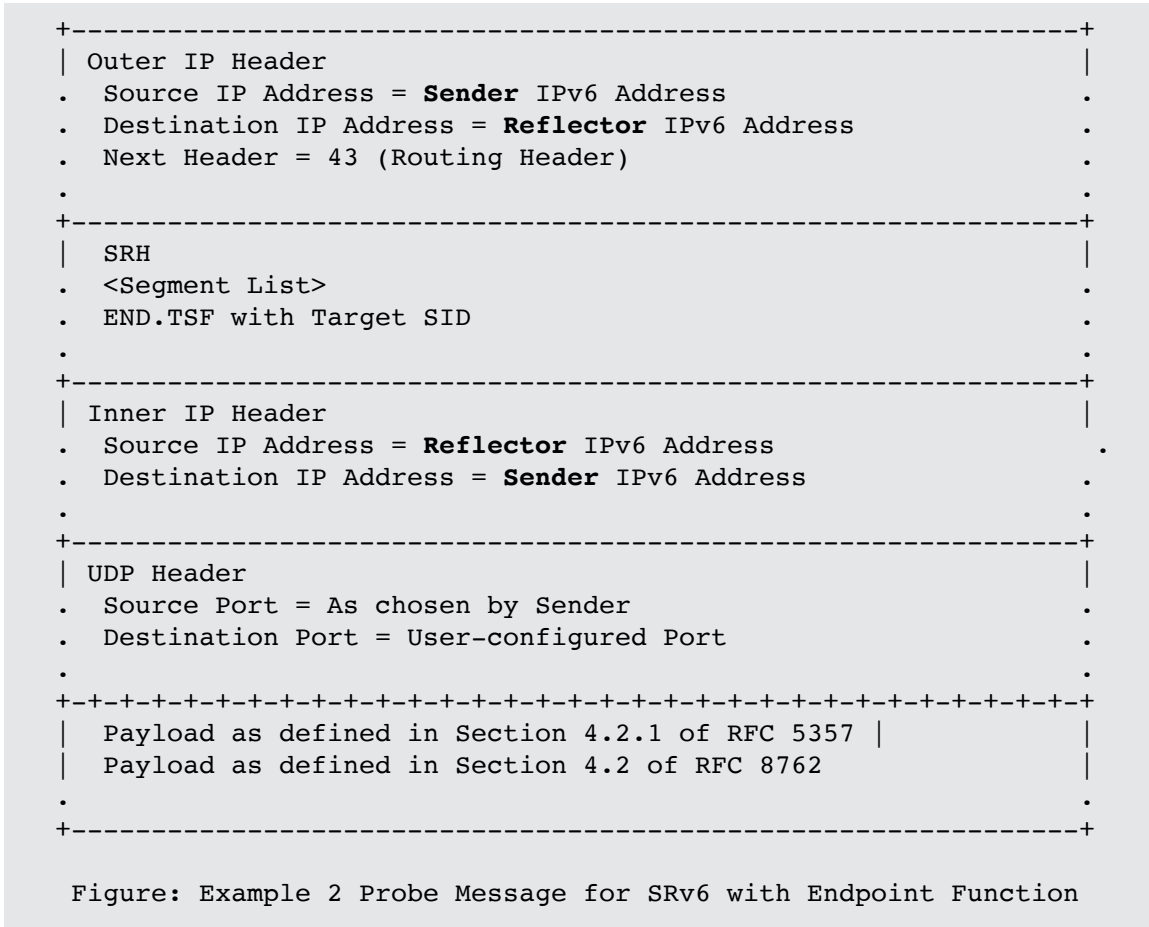


Figure: Example 2 Probe Message for SRv6 with Endpoint Function

- Endpoint Function END.TSF is defined for Timestamp and Forward and carried for the Reflector node SID
- Reflector node removes SRH
- Reverse direction path is IP
- Source and Destination Addresses are swapped for the Reverse direction path in the **inner** IPv6 header