Performance Measurement Using STAMP for Segment Routing Networks

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Agenda

- Requirements, Goals, and Scope
- Measurement Modes
- Encapsulation for each Measurement Mode
- Next Steps

Requirements, Goals, and Scope

Requirements

1. Measurement Modes in SR Networks
   - ✓ (1) One-way, (2) Two-way, (3) Loopback, (4) Loopback with Timestamp and Forward
2. STAMP Encapsulation for Measurement Mode in SR Networks
   - ✓ Links - including physical, virtual, LAG, LAG members
   - ✓ SR paths - including SR Policies, Flex-Algo paths, and L3/L2 services
   - ✓ SR-MPLS and SRv6 Data plane

Goals

1. Higher STAMP session scale and faster measurement interval
2. Optimize STAMP processing on Session-Reflector

Scope

1. STAMP [RFC 8762]
2. STAMP Optional Extensions [RFC 8972]
3. STAMP Extensions for SR [RFC 9503]

Measurement Modes and Encapsulations for SR-MPLS

STAMP Test Packet

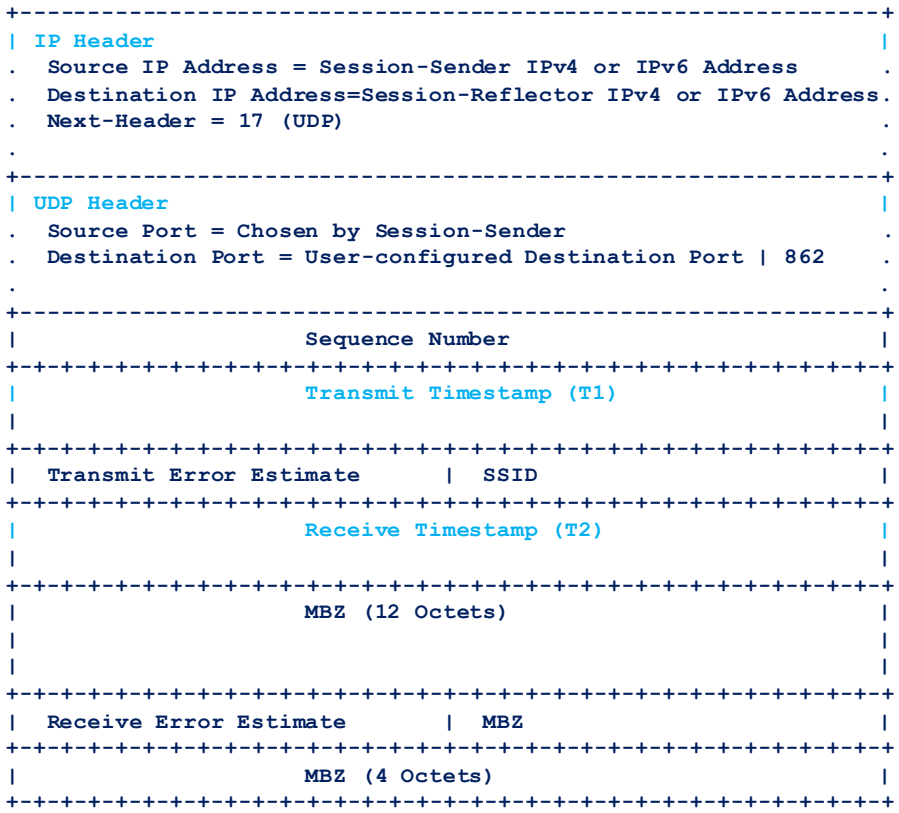


Figure 1: Example STAMP Session-Sender Test Packet

(1) One-Way Measurement Mode in SR Networks

1. Session-Sender transmits STAMP test packets on SR path
2. Stateful Session-Reflector provisioned to not transmit reply test packet for the Session ID
   - User configured destination UDP port
3. One-way delay (T2 - T1) measured by Stateful Session-Reflector

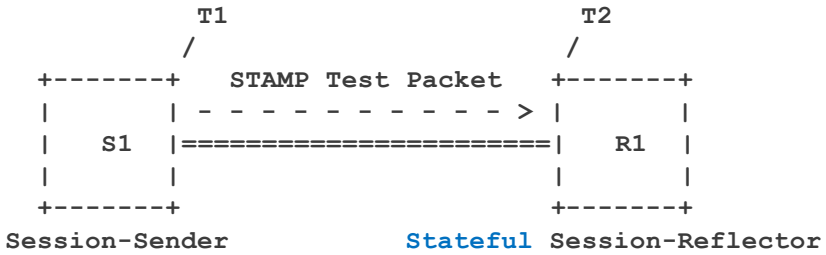


Figure: STAMP Test Session

STAMP Session-Sender Test Packet for SR-MPLS Paths

SR Policy

- STAMP Session-Sender test packets transmitted for each label stack of SR Policy by creating a separate STAMP session for it

SR IGP Flex-Algo Path

- STAMP Session-Sender test packets carry the Flex-Algo Prefix Label of the Session-Reflector

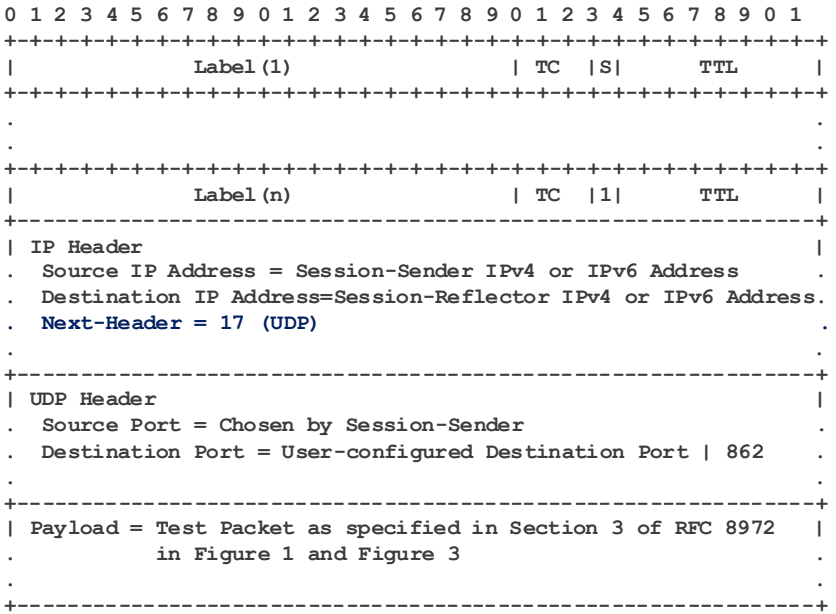


Figure: Example Session-Sender test packet for SR-MPLS Path

STAMP Session-Sender Test Packet for L3 Service

1. STAMP Session-Sender test packets transmitted using the same encapsulation as L3 Service
2. L3VPN Label advertised by Session-Reflector
3. IP header contains Source and Destination Addresses in the L3VPN table

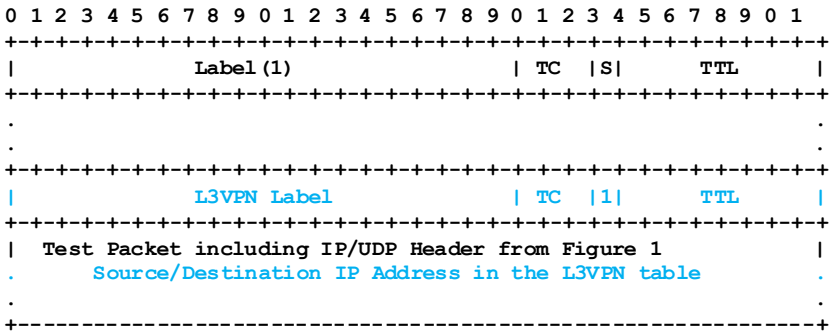


Figure: Example Session-Sender packet for L3 Service over SR-MPLS

STAMP Session-Sender Test Packet for L2 Service

1. STAMP Session-Sender test packets transmitted using the same encapsulation as L2 Service
2. L2VPN Label advertised by Session-Reflector
3. TTL=1 for L2VPN Label to punt test packet to CPU on Session-Reflector

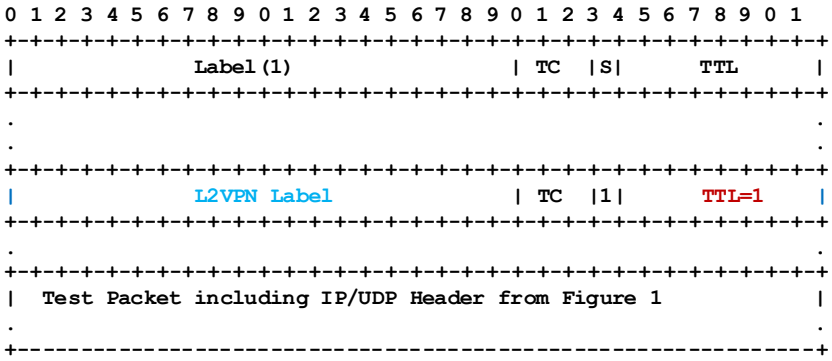


Figure: Example Session-Sender packet for L2 Service over SR-MPLS

(2) Two-Way Measurement Mode in SR Networks

1. STAMP Session-Sender test packets punted to slow path and re-injected
2. STAMP Session-Reflector reply test packets on the same SR path/Flex-Algo/L3VPN/L2VPN service in the reverse direction
3. Using Return SR Path STAMP TLV defined in RFC 9503
4. Round-trip delay = (T4 - T1) – (T3 - T2)
5. One-way delay = (T2 - T1)

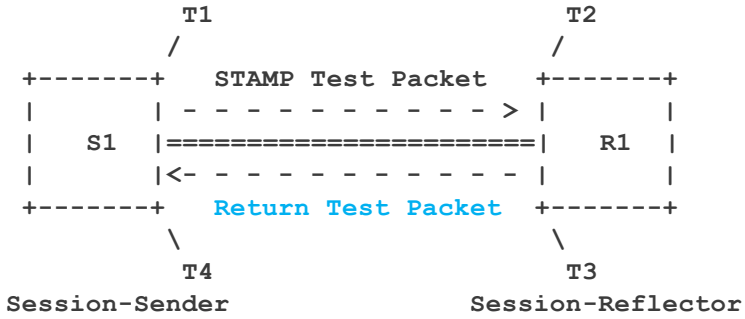


Figure: STAMP Test Session

(3) Loopback Measurement Mode in SR Networks

1. New mode defined in SR
2. STAMP Session-Sender test packet header carries the return SR or IP path
3. Session-Reflector forwards STAMP test packets in fast path
4. Session-Reflector does not perform STAMP packet processing (no punt/re-inject)
5. Only measure loopback delay = (T4 - T1)

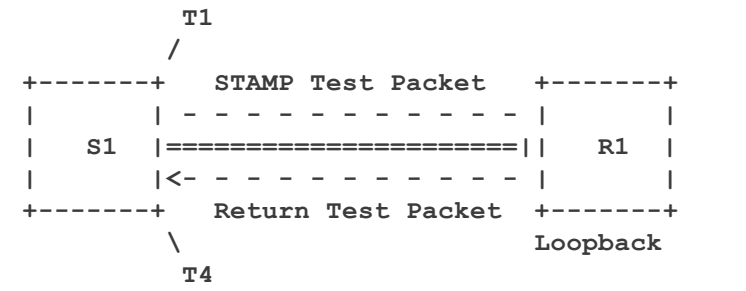


Figure: STAMP Loopback Measurement Mode

Loopback Measurement Mode for SR-MPLS Path

1. STAMP test packets transmitted on SR-MPLS Path (e.g., Segment List of SR-MPLS Policy)
   - Need to ensure STAMP packet reaches the Session-Reflector (no PHP)
2. IP header for return path contains Session-Sender Address as Source and Destination Address
3. SR-MPLS Return Path
   - Reverse direction SR-MPLS path label stack carried in the MPLS Header
4. IP/UDP Return Path
   - Session-Reflector decapsulates the SR-MPLS header and forwards using inner IP header

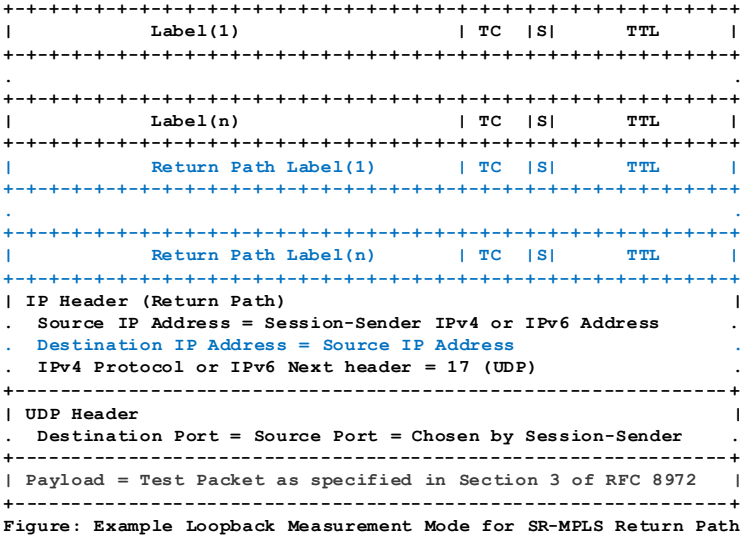


Figure: Example Loopback Measurement Mode for SR-MPLS Return Path

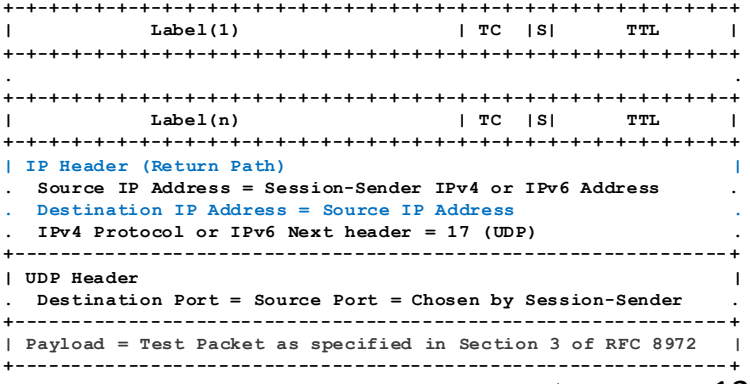
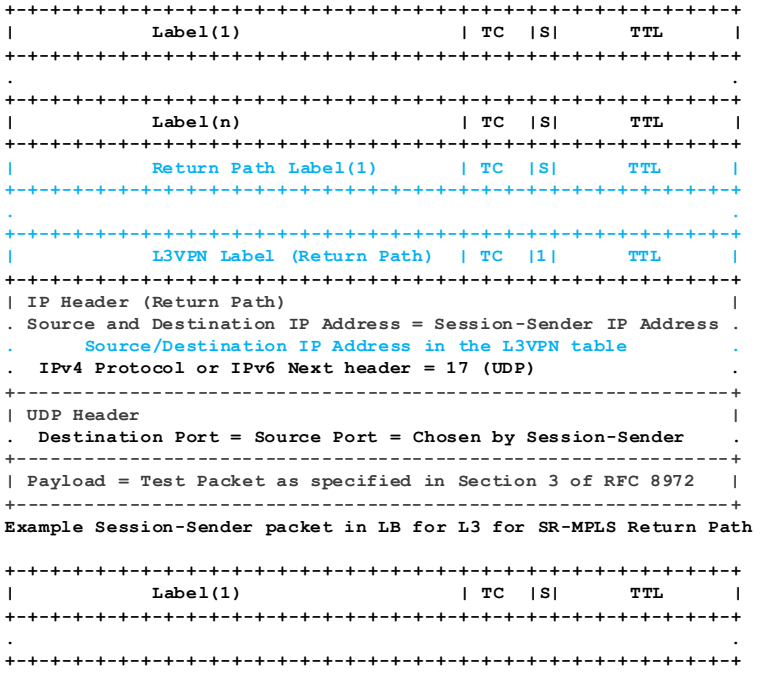


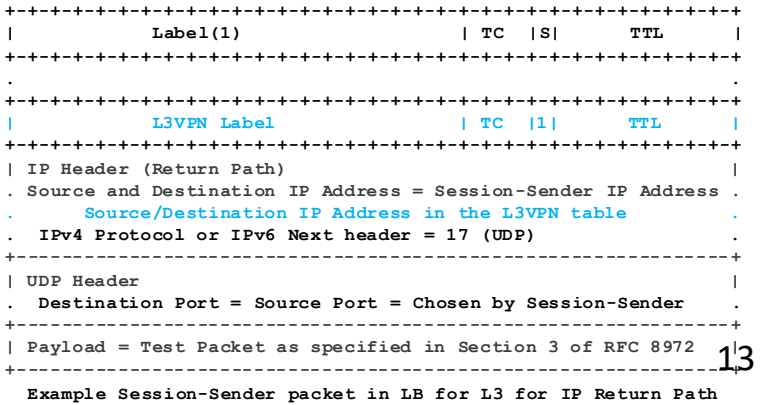
Figure: Example Loopback Measurement Mode for IP/UDP Return Path

Loopback Measurement Mode for L3 Service

1. STAMP Session-Sender test packets transmitted using the same encapsulation as L3 Service
2. STAMP test packets traverse the same path in the forward and reverse direction of the L3 Service
3. IP header for return path contains Session-Sender Address as Source and Destination Address L3VPN table
4. SR-MPLS Return Path
   - L3VPN Label advertised by Session-Sender
   - Reverse direction SR-MPLS path label stack carried in the MPLS Header
5. IP/UDP Return Path
   - L3VPN Label advertised by Session-Reflector
   - Session-Reflector decapsulates the SR-MPLS header and forwards using inner IP header



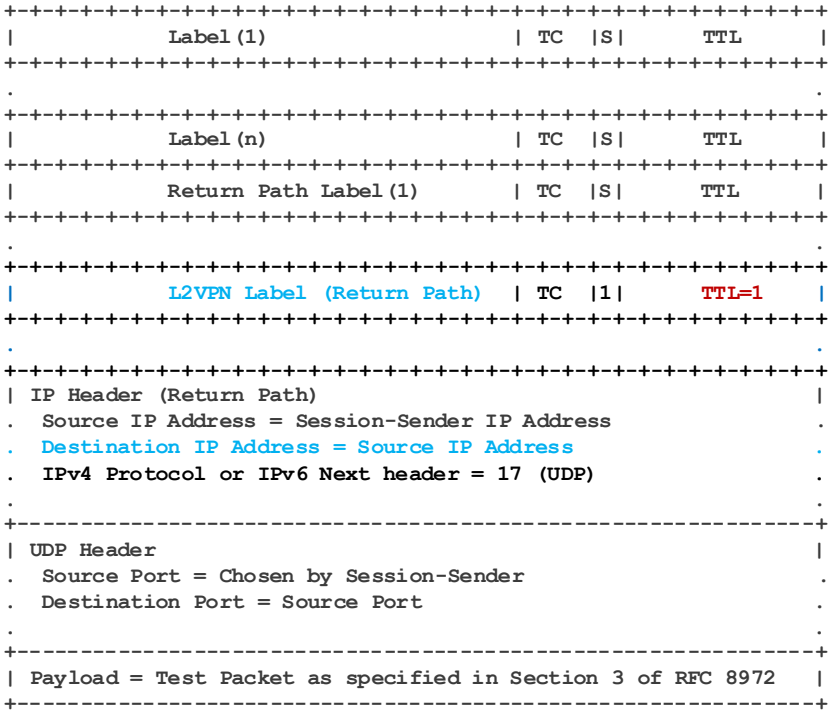
Example Session-Sender packet in LB for L3 for SR-MPLS Return Path



Example Session-Sender packet in LB for L3 for IP Return Path

Loopback Measurement Mode for L2 Service

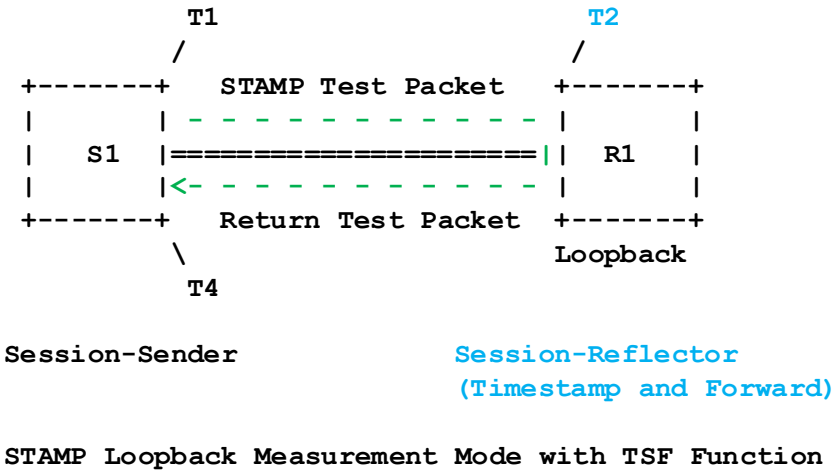
1. STAMP Session-Sender test packets transmitted using same encapsulation as L2 Service - using the L2VPN Label of reverse direction L2 service
2. STAMP test packets traverse same path in forward and reverse direction of L2 service
3. SR-MPLS Return Path
   - L2VPN Label advertised by Session-Sender
   - Return path in MPLS label stack
   - TTL=1 for L2VPN Label to punt test packet to CPU on Session-Sender
4. IP/UDP Return Path - out of scope



Example Session-Sender packet in LB for L2 Service over SR-MPLS

(4) Loopback Measurement Mode- TSF Network Programming

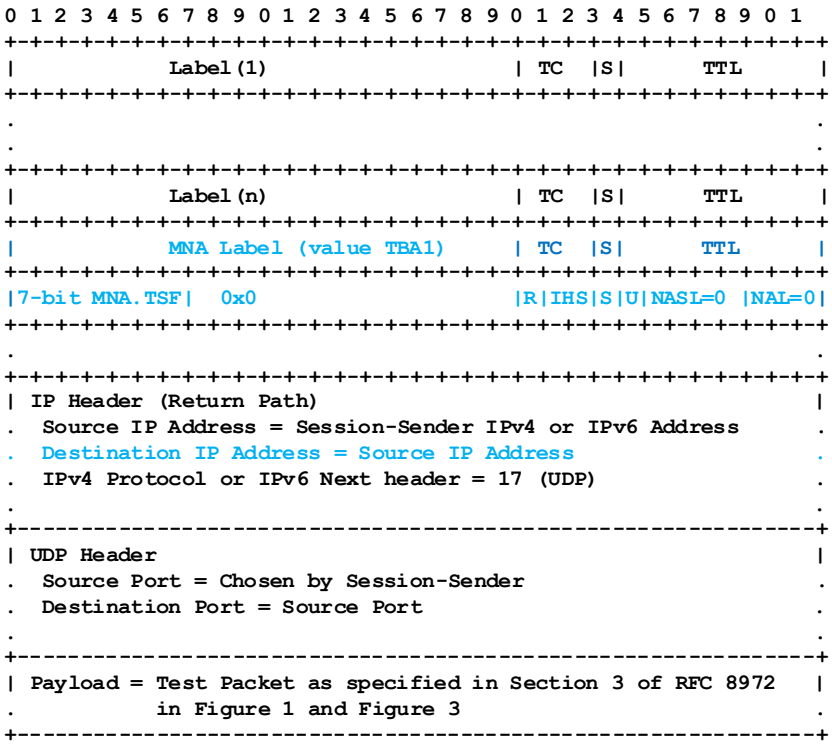
1. New mode defined in SR
2. STAMP test packets transmitted in loopback mode with TSF Function
   a. Network programming function to optimize "operations of punt and re-inject return test packet" on Session-Reflector
   b. Higher STAMP session scale and faster measurement interval
3. Session-Reflector adds receive timestamp **T2** at a specific location in the payload in fast path
4. One-way delay = (**T2** - T1) (Note: assumes the clocks on the Session-Sender and Session-Reflector are synchronized)
5. Loopback delay = (T4 - T1)



STAMP Loopback Measurement Mode with TSF Function

SR-MPLS with Timestamp and Forward Network Action

1. **MPLS Network Action (MNA)** Sub-Stack [draft-ietf-mpls-mna-hdr] added by Session-Sender as follows:
   a. MNA Label (bSPL value TBA1)
   b. 7-bit MNA opcode for Timestamp and Forward (MNA.TSF) as In-Stack Network Action
   c. Action statically defined including timestamp offset and timestamp format
   d. Session-Reflector removes the MNA Sub-Stack
2. IP header for return path contains Session-Sender Address as Source and Destination Address
3. SR-MPLS Return Path
   a. IHS field scope set to “SELECT”
   b. MNA Sub-Stack added before reverse label stack
4. IP/UDP Return Path
   a. IHS field scope set to “I2E (Ingress-To-Egress)”
   b. MNA Sub-Stack added at the bottom of the stack
   c. Session-Reflector decapsulates the SR-MPLS header and forwards using inner IP header



Example STAMP Test Packet with MNA TSF Opcode for SR-MPLS

Next Steps

- Welcome your review comments and suggestions
- Requesting WGLC in SPRING

Thank you!