SR-TE PM: Liveness of SR Policy Endpoint

Table 1: Feature History

Feature Name	Release Information	Description
SR-TE PM: Liveness of SR Policy Endpoint	Cisco IOS XE Bengaluru 17.5.1	This feature enables Performance Measurement (PM) liveness detection and delay measurement for an SR policy on all the segment lists of every candidate path that are present in the forwarding table using PM probes. Thus, you can easily monitor the traffic path and efficiently detect any drop of traffic due to cable or hardware or configuration failures.
		This feature provides the following benefits:
		• End-to-end liveness is verified before activating the candidate path in the forwarding table.
		• End-to-end liveness failure can trigger re-optimization to another path by deactivating the current path.

Metrics such as packet loss, delay, delay variation (jitter) and bandwidth utilization help you evaluate the performance of your network. You can use these metrics as input for Traffic Engineering (TE) and direct the flow of traffic through the network to conform to Service Level Agreements (SLAs). Network operators can use the performance measurement (PM) feature to monitor the network metrics for links. An SR-TE policy uses one or more candidate paths. A candidate path is a single segment list (SID-list) or a set of weighted SID-lists (for weighted equal cost multi-path [WECMP]). A candidate path is either dynamic or explicit.

Prior to Cisco IOS XE Bengaluru Release 17.5.1, PM could only measure delay for active candidate paths.

Starting with Cisco IOS XE Bengaluru Release 17.5.1, the liveness of SR policy endpoint configuration enables Performance Measurement (PM) liveness detection and delay measurement for an SR policy on all the segment lists of every candidate path that are present in the forwarding table using PM probes. Also,

SR-TE retains the existing traffic paths till PM liveness monitors and validates the new paths. Thus, you can easily monitor the traffic path and efficiently detect any drop of traffic due to cable or hardware or configuration failures.

PM sessions are created to the endpoint address of SR policy. If a candidate path has multiple segment-lists, PM sessions are created for each segment list. The probe query messages are sent using the segment-list SIDs (or labels) of the SR policy and SR-TE resolves the outgoing interface. SR-TE uses the First Hop Resolution (FHR) Equal Cost Multi Path Protocol (ECMP) feature.

Also, starting with this release, the default measurement mode for delay profile is changed from one-way mode to two-way mode.

Note By default, a packet is sent every 3 seconds per session. With the default liveness detection multiplier, which is 3, a session goes down in approximately 9 seconds. The maximum PPS rate considered is approximately 30 PPS per session.

Benefits

This feature provides the following benefits:

- End-to-end liveness is verified before activating the candidate path in the forwarding table.

- End-to-end liveness failure can trigger re-optimization to another path by deactivating the current path.

Restrictions

- A maximum of 500 SR-TE PM and 1000 SR-TE PM liveness session SR policies are supported for Cisco ASR RSP2 module and Cisco ASR RSP3 modules, respectively.

- A maximum of 10 CP per SR-TE policy is recommended.

- You must maintain a maximum of 500 (for Cisco ASR RSP2 module) and a maximum of 1000 (for Cisco ASR RSP3 module) PM PPS (PPS = PM Sessions X Burst Interval). The burst interval is 3 seconds by default.

- Liveness PCE-initiated policy is not supported.

Probe Query Message

The probe messages defined in RFC5357 are used for delay measurement for links and end-to-end SR paths including SR policies. The probe query messages for performance measurement of an end-to-end SR Policy is sent using its SR-MPLS header containing the MPLS segment list. The sender IPv4 or IPv6 address is used as the source address. The endpoint IPv4 or IPv6 address is used as the destination address.

PM probes can allow both liveness monitoring and delay measurement using the same set of probes. This reduces the operational complexity in the network.

Starting with Cisco IOS XE Bengaluru Release 17.5.1, the default measurement mode for delay profile is changed from one-way mode to two-way mode. In two-way measurement mode, when using a bidirectional path, the probe response message as defined in Figure 6 is sent back to the sender node on the congruent path of the data traffic on the same reverse direction Link or associated reverse SR Policy.

Probe Message Throughput

Probe messages run in asynchronous pipeline mode, where the querier does not wait for a reply message before sending the next query message. This allows to send probe queries at a faster rate and hence the liveness failure can be detected faster.

When a PM session starts, the query messages are received for that particular PM session. The liveness module waits until the pipe is full and then starts counting the missed consecutive packets after the. Once message counting has started, any delayed message (for example, due to queuing) is dropped.

SR-TE Re-optimization (Make-Before-Break)

Prior to Cisco IOS XE Bengaluru Release 17.5.1, during SR-TE reoptimization, after each Path Calculation (PCALC), the algorithm to calculate the best path from the head end LSR to the tail end LSR, SR-TE used to destroy the existing traffic paths before forwarding the new ones.

Starting with Cisco IOS XE Bengaluru Release 17.5.1, SR-TE retains the existing traffic paths till PM liveness monitors and validates the new paths. Thus, you can easily monitor the traffic path and efficiently detect any drop of traffic due to cable or hardware or configuration failures.

Performance Measurement Named Profile

Performance Measurement (PM) named profile provides an ability to create a number of profiles for a given transport mode (for example, interface or SR policy). The implementation provides only a global profile for each type of transport mode. This prevents from having different configuration for a transport mode. Since PM named profile enables the ability to have unique configuration for each instance of a transport mode, when a particular policy is configured with a particular configuration, rest of the policies also have the same configuration.

Configure SR-TE PM: Liveness of SR Policy Endpoint

To configure SR-TE PM liveness:

On Router 1:

```
policy FAST
  color 100 end-point 11.11.11.11
  performance-measurement
   delay-measurement
    profile FAST
    liveness-detection
     invalidation-action down
  candidate-paths
   preference 100
    explicit segment-list SRTE1
    !
    constraints
     segments
      dataplane mpls
     !
   preference 2
    explicit segment-list SRTE11.11.11.11
    !
    constraints
     segments
      dataplane mpls
```

On Router 2:

```
Performance-measurement
```

Configuration Example: Default Delay Profile for Liveness

Liveness Detection Multiplier

Liveness detection multiplier is refered to the number of consecutive missed probe packets before PM session is declared as down. The default value is 3. The PM requires at least one probe packet to declare a PM session as us.

The following example shows the configuration of default delay profile for liveness:

1. **Profile Type for SR Policies Configuration**:

```
Router#performance-measurement
delay-profile sr-policy
```

2. **SR-MPLS Policy Configuration**:

```
probe
computation-interval [3-3600sec]
burst-interval [30-15000msec]
sweep
destination ipv4 127.x.x.x [1-128]
```

3. **Liveness Detection Multiplier Configuration**:

```
liveness-detection multiplier [2-10]
```

Configuration Example: PM Named Profiles

The following example shows the configuration of PM names profiles:

1. **SR Policy Delay Profile Configuration**:

```
Router#performance-measurement
delay-profile sr-policy [policy name]
```

2. **SR Policy Delay Profile Configuration Under Policy Bar**:

```
Router#
 !
segment-routing traffic-eng
 policy bar
  performance-measurement
   delay-measurement
    profile [profile name]
```

3. **Interface Delay Profile Configuration**:

```
Router#performance-measurement
    delay-profile interface [interface name]
```

4. **Interface Delay Profile Configuration Under Interface Ethernet 0/0**:

```
Router#performance-measurement
 interface Ethernet 0/0
  delay-measurement
   profile [profile name]
```

Note The name of the profile must be unique for a given transport mode and the same name can be used for different transport modes. Also, in absence of a profile, the probe will stop transmitting.

Configuration Example: SR Policy for Liveness Detection

The following example shows the configuration of SR policy for liveness detection:

1. **End-to-End Delay for All Candidate Paths**:

```
Router# segment-routing traffic-eng
policy [policy-name]
color 4 endpoint ipv4 1.1.1.5
performance-measurement
delay-measurement
```

2. **End-to-End Liveness Detection**:

```
liveness-detection
invalidation-action [Down|None]
```

Bidirectional Forwarding Detection (BFD) mechanisms are specified to monitor the unidirectional MPLS Label Switched Paths (LSPs) via BFD MPLS. Use the **invalidation-action** {*down* | *none*} command to set the action to be taken when BFD session is invalidated.

Table 2: Syntax Description

Keyword	Description
None	This is the default option. When the PM session goes down, use this option to record the failure without modifying the SR policy operational state.

Keyword	Description
Down	When the PM session liveness state is up, use this option to configure the LSP to operational up state. When the PM session goes down, the LSP state is immediately brought down.

Verification of SR-TE PM: Liveness of SR Policy Endpoint Configuration

Use the **show segment-routing traffic-eng policy name** [*policy-name*] **detail** command to verify the SR-TE policy name configuration:

```
Router#show segment-routing traffic-eng policy name policy-name detail
Name: FAST (Color: 100 End-point: 11.11.11.11)
  Owners : CLI
  Status:
    Admin: up, Operational: up for 01:12:44 (since 01-11 17:17:00.092)
  Candidate-paths:
    Preference 100 (CLI):
      PM State: Up
      Explicit: segment-list SRTE1 (active)
        Weight: 1, Metric Type: TE
          16006 [Prefix-SID, 6.6.6.6]
          16008 [Prefix-SID, 8.8.8.8]
          16011 [Prefix-SID, 11.11.11.11]
    Preference 2 (CLI):
      PM State: Up
      Explicit: segment-list SRTE11.11.11.11 (inactive)
        Weight: 1, Metric Type: TE
          16011 [Prefix-SID, 11.11.11.11]
Attributes:
    Binding SID: 16
      Allocation mode: dynamic
      State: Programmed
  Tunnel ID: 65536 (Interface Handle: 0x20)
  Per owner configs:
    CLI
      Binding SID: dynamic
  Stats:
    5 minute output rate 0 bits/sec, 0 packets/sec
    Packets: 0  Bytes: 0
  PM profile: FAST
Router#
Event history:
    Timestamp               Client                Event type            Context:
Value
    ---------               ------                ----------            -------:
-----
    01-11 17:17:00.092      CLI                   Policy created        Name: CLI
    01-11 17:17:00.096      CLI                   Set colour            Colour: 100

    01-11 17:17:00.096      CLI                   Set end point         End-point:
 11.11.11.11
    01-11 17:17:00.129      CLI                   Set delay measure     status:
Enabled
    01-11 17:17:00.130      CLI                   PM Profile name       config:
FAST
```

```
    01-11 17:17:00.131         CLI                      Set Live Detection      status:
Enabled
    01-11 17:17:00.131         CLI                      Set Live Invalidation   action:
down
    01-11 17:17:00.134         CLI                   Set explicit path      Path option:
 SRTE1
    01-11 17:17:00.139         CLI                   Set explicit path      Path option:
 SRTE11.11.11.11
    01-11 17:17:11.033         CLI                      BSID allocated       FWD: label
 16
    01-11 17:22:25.510         FH Resolution            Liveness             CP: 100,
SL1 is Waiting
    01-11 17:24:27.038         PM                       Liveness             CP: 100,
SL1 is Down
    01-11 18:16:36.368         FH Resolution            Liveness             CP: 2, SL2
 is Waiting
    01-11 18:16:39.048         PM                       Liveness             CP: 2, SL2
 is Up
    01-11 18:16:39.048         PM                       Liveness             CP: 100,
SL1 is Up
    01-11 18:16:39.053         FH Resolution            Policy state UP       Status:
PATH RESOLVED CP: 100
```

Use the **show performance-measurement summary** command to verify the performance measurement summary information:

```
Router#show performance-measurement summary
Total interfaces                          : 0
Total SR Policies                         : 1
Maximum PPS                               : 1000 pkts/sec

Interface Delay-Measurement:
  Total sessions                          : 0
  Counters:
    Packets:
      Total sent                          : 0
      Total received                      : 0
    Errors:
      Total sent errors                   : 0
      Total received errors               : 0
    Probes:
      Total started                       : 0
      Total completed                     : 0
      Total incomplete                    : 0
      Total advertisements                : 0
SR Policy Delay-Measurement:
  Total sessions                          : 2-□2 CP configured
  Counters:
    Packets:
      Total sent                          : 2
      Total received                      : 2
    Errors:
      Total sent errors                   : 0
      Total received errors               : 0
    Probes:
      Total started                       : 0
      Total completed                     : 0
      Total incomplete                    : 0
      Total advertisements                : 0
Global Delay Counters:
  Total packets sent                      : 2
  Total query packets received            : 2
  Total invalid session id                : 0
  Total no session                        : 0
```

```
HW Support for MPLS-GAL [RFC6374] timestamp   : No
HW Support for IPv4 TWAMP [RF5357] timestamp  : Yes
HW Support for IPv6 TWAMP [RF5357] timestamp  : No
HW Support for 64 bit timestamp               : Yes
HW Support for IPv4 UDP Cheksum               : No
```

Use the **show performance-measurement sr-policy name** [*sr-policy name*] command to verify the performance measurement SR policy name configuration:

```
Router#show performance-measurement sr-policy name sr-policy name
SR Policy name: FAST
  Color                         : 100
  Endpoint                      : 11.11.11.11
  Source                        : 2.2.2.2
  Profile name                  : FAST
  Policy Update Timestamp       : 18:16:39  11 2021
  Number of candidate-paths     : 2

  Candidate-Path:
    Preference                  : 2
    Protocol-origin             : Configured
    Discriminator               : 0
    Active:                     : No
    Number of segment-lists     : 1
    Number of atomic paths      : 1
    Number of live UP atomic paths: 1
    Number of live Unknown atomic : 0
Max Pkts per Burst            : 1500
    Max Pkts per Probe          : 15000
    AP Min Run per Probe        : 3
    Round-robin bursts          : 1
    Round-robin probes          : 1
    Last advertisement:
      Advertised at: 18:18:56  11 2021 (1073 seconds ago)
      Advertised delays (uSec): avg: 520, min: 450, max: 893, variance: 70
    Next advertisement:
      Check scheduled at the end of the current probe (roughly every 120 seconds)
      Aggregated delays (uSec): avg: 485, min: 421, max: 602, variance: 64
    Last probe:
      Packets Sent: 10, received: 10
      Measured delays (uSec): avg: 488, min: 459, max: 550, variance: 29
    Current probe:
      Packets Sent: 8, received: 8
      Measured delays (uSec): avg: 478, min: 447, max: 511, variance: 31
```

Use the **show performance-measurement sr-policy detail private verbose** command to verify the performance measurement SR policy detail configuration:

```
Router#show performance-measurement sr-policy detail private verbose
SR Policy name: FAST
  Color                         : 100----------------□policy color
  Endpoint                      : 11.11.11.11
  Source                        : 2.2.2.2
  Profile name                  : FAST --------------------□policy Name
  Policy Update Timestamp       : 22:31:38  12 2021
  Number of candidate-paths     : 2
  Candidate-Path:
    Preference                  : 2
    Protocol-origin             : Configured
    Discriminator               : 0
    Active:                     : No
    Number of segment-lists     : 1
    Number of atomic paths      : 1
    Number of live UP atomic paths: 1
    Number of live Unknown atomic : 0
```

```
      Max Pkts per Burst        : 6
      Max Pkts per Probe        : 60
      AP Min Run per Probe      : 3
      Round-robin bursts        : 1
      Round-robin probes        : 1
Last advertisement:
      Advertised at: 11:41:37  13 2021 (1879 seconds ago)
      Advertised delays (uSec): avg: 500, min: 435, max: 924, variance: 65
    Next advertisement:
      Check scheduled in 1 more probe (roughly every 120 seconds)
      Aggregated delays (uSec): avg: 702, min: 437, max: 3940, variance: 265
    Last probe:
      Packets Sent: 10, received: 10
      Measured delays (uSec): avg: 527, min: 441, max: 686, variance: 86
    Current probe:
      Packets Sent: 7, received: 7
      Measured delays (uSec): avg: 452, min: 436, max: 475, variance: 16
    Segment-List:
      Name                      : SL2
      Number of atomic paths    : 1
      Last advertisement:
        Advertised at: 11:41:37  13 2021 (1879 seconds ago)
        Advertised delays (uSec): avg: 500, min: 435, max: 924, variance: 65
      Next advertisement:
        Aggregated delays (uSec): avg: 702, min: 437, max: 3940, variance: 265
      Last probe:
        None
Current probe:
      None
      Atomic path:
      Hops                      : 11.11.11.11
      Labels                    : 16011
      Outgoing Interface        : GigabitEthernet0/5/1
      Next Hop                  : 102.0.0.1
      Destination               : 11.11.11.11
      Session ID                : 409
      Last advertisement:
        Advertised at: 11:41:37  13 2021 (1879 seconds ago)
        Advertised reason: Periodic timer, avg delay threshold crossed
        Advertised delays (uSec): avg: 500, min: 435, max: 924, variance: 61
      Next advertisement:
        Aggregated delays (uSec): avg: 702, min: 437, max: 3940, variance: 263
        Rolling average (uSec): 625
      Last probe:
        None
      Current probe:
        Packets Sent: 7, received: 7
        Measured delays (uSec): avg: 452, min: 436, max: 475, variance: 16
Probe samples:
            Packet Rx Timestamp Measured Delay
               12:12:55  13 2021 441680
               12:12:52  13 2021 475040
               12:12:49  13 2021 436400
               12:12:46  13 2021 438320
               12:12:43  13 2021 443120
               12:12:40  13 2021 471200
               12:12:37  13 2021 461800
      Liveness Detection:
        Session Creation Timestamp: 22:31:34  12 2021
        Session State: Up
        Last State Change Timestamp: 22:31:35  12 2021
        Missed count   [consecutive]: 0
        Received count [consecutive]: 16427
        Backoff                     : 0
```

```
          Unique Path Name            : Path-3
        Candidate-Path:
            Preference                : 100
            Protocol-origin           : Configured
            Discriminator             : 0
            Active:                   : Yes
            Number of segment-lists   : 1
            Number of atomic paths    : 1
            Number of live UP atomic paths: 1
            Number of live Unknown atomic : 0
            Max Pkts per Burst        : 6
            Max Pkts per Probe        : 60
            AP Min Run per Probe      : 3
            Round-robin bursts        : 1
            Round-robin probes        : 1
            Last advertisement:
              Advertised at: 01:35:36  13 2021 (38240 seconds ago)
              Advertised delays (uSec): avg: 507, min: 430, max: 1053, variance: 77
            Next advertisement:
              Check scheduled in 1 more probe (roughly every 120 seconds)
              Aggregated delays (uSec): avg: 533, min: 443, max: 846, variance: 90
            Last probe:
              Packets Sent: 10, received: 10
              Measured delays (uSec): avg: 541, min: 443, max: 846, variance: 98
        Current probe:
            Packets Sent: 7, received: 7
            Measured delays (uSec): avg: 478, min: 444, max: 502, variance: 34

            Segment-List:
              Name                      : SL1
              Number of atomic paths    : 1
              Last advertisement:
                Advertised at: 01:35:36  13 2021 (38240 seconds ago)
                Advertised delays (uSec): avg: 507, min: 430, max: 1053, variance: 77
              Next advertisement:
                Aggregated delays (uSec): avg: 533, min: 443, max: 846, variance: 90
              Last probe:
                None
              Current probe:
                None
         Atomic path:
              Hops                      : 6.6.6.6, 8.8.8.8, 11.11.11.11
              Labels                    : 16006, 16008, 16011
              Outgoing Interface        : GigabitEthernet0/5/1
              Next Hop                  : 102.0.0.1
              Destination               : 11.11.11.11
              Session ID                : 408
          Candidate-Path:
            Preference                : 100
            Protocol-origin           : Configured
            Discriminator             : 0
            Active:                   : Yes
            Number of segment-lists   : 1
            Number of atomic paths    : 1
            Number of live UP atomic paths: 1
            Number of live Unknown atomic : 0
            Max Pkts per Burst        : 6
            Max Pkts per Probe        : 60
            AP Min Run per Probe      : 3
            Round-robin bursts        : 1
            Round-robin probes        : 1
            Last advertisement:
              Advertised at: 01:35:36  13 2021 (38240 seconds ago)
              Advertised delays (uSec): avg: 507, min: 430, max: 1053, variance: 77
```

```
    Next advertisement:
      Check scheduled in 1 more probe (roughly every 120 seconds)
      Aggregated delays (uSec): avg: 533, min: 443, max: 846, variance: 90
    Last probe:
      Packets Sent: 10, received: 10
      Measured delays (uSec): avg: 541, min: 443, max: 846, variance: 98
Last advertisement:
        Advertised at: 01:35:36  13 2021 (38240 seconds ago)
        Advertised reason: Periodic timer, avg delay threshold crossed
        Advertised delays (uSec): avg: 507, min: 430, max: 1053, variance: 60
      Next advertisement:
        Aggregated delays (uSec): avg: 533, min: 443, max: 846, variance: 85
        Rolling average (uSec): 533
      Last probe:
        None
      Current probe:
        Packets Sent: 7, received: 7
        Measured delays (uSec): avg: 478, min: 444, max: 502, variance: 34
      Probe samples:
Packet Rx Timestamp Measured Delay
                  12:12:56  13 2021 491200
                  12:12:53  13 2021 488440
                  12:12:50  13 2021 444280
                  12:12:47  13 2021 466360
                  12:12:44  13 2021 455160
                  12:12:41  13 2021 502480
                  12:12:38  13 2021 500720
Liveness Detection:
        Session Creation Timestamp: 22:31:34  12 2021
        Session State: Up
        Last State Change Timestamp: 22:31:35  12 2021
        Missed count   [consecutive]: 0
        Received count [consecutive]: 16427
        Backoff                     : 0
        Unique Path Name            : Path-4
```

SR-PM Delay Deduction (Loopback Mode)

Table 3: Feature History

Feature Name	Release Information	Description
SR-PM Delay Deduction (Loopback Mode)	Cisco IOS XE Bengaluru 17.5.1	This feature improves the SR-PM detection time as the PM probes are not punted on the remote nodes. Also, it does not a require a third-party support for interoperability.

Prior to Cisco IOS XE Bengaluru Release 17.5.1, you could not configure loopback mode for SR-PM detection.

Starting with Cisco IOS XE Bengaluru Release 17.5.1, you can configure the loopback mode at the head nodes of the router while the remote nodes can be used for any third-party configuration. As the PM probes are not punted on the remote nodes, the SR-PM detection time is enhanced and improved. Also, third-party support for interoperability is not required.

Configuration Example: SR-PM Delay Deduction (Loopback Mode)

Use the **reverse-path** command to configure reverse path configuration before you configure loopback mode. This configuration enables an MPLS label configuration that is pushed in PM probe messages above the existing label list received from the SR policy manager for the particular path.

The following example shows the configuration of SR-PM delay deduction (loopback mode):

```
policy FAST
  color 100 end-point 11.11.11.11
  performance-measurement
   delay-measurement
    profile FAST
    liveness-detection
     invalidation-action down
    reverse-path
     label 16002
  candidate-paths
   preference 100
    explicit segment-list SRTE1
    !
    constraints
     segments
      dataplane mpls
     !
    !
   preference 2
    explicit segment-list SRTE11.11.11.11
    !
    constraints
     segments
      dataplane mpls
     !
    !
   !


performance-measurement
!
delay-profile sr-policy name FAST
  probe
   measurement-mode loopback
```

Verify SR-PM Delay Deduction (Loopback Mode) Configuration

Use the **show performance-measurement profile sr-policy** *policy-name* command to verify the performance measurement SR policy configuration using the loopback mode:

```
Router#show performance-measurement profile sr-policy policy-name
FAST SR Policy Delay Measurement:
  Profile configuration:
    Measurement Type                    : Loopback
    Computation interval                : 30 (effective : 30) seconds
    Burst interval                      : 3000 mSec
    Burst count                         : 10
    Protocol                            : TWAMP-Lite Unauth
    Destination sweeping mode           : Disabled
    Periodic advertisement              : Enabled
      Interval                          : 120 (effective: 120) sec
      Threshold                         : 10%
      Minimum-Change                    : 500 uSec
    Accelerated advertisement           : Disabled
```

```
    Threshold crossing check                 : Average-delay
    Liveness-detection multiplier            : 3
```

Use the **show segment-routing traffic-eng policy name** [*policy-name*] **detail** command to verify the SR-TE policy name configuration using looback mode:

```
Router#show segment-routing traffic-eng policy name policy-name detail
Name: FAST (Color: 100 End-point: 11.11.11.11)
  Owners : CLI
  Status:
    Admin: up, Operational: up for 183:26:26 (since 01-28 20:10:24.628)
  Candidate-paths:
    Preference 100 (CLI):
      PM State: Up
      Explicit: segment-list SRTE1 (active)
        Weight: 1, Metric Type: TE
          16006 [Prefix-SID, 6.6.6.6]
          16008 [Prefix-SID, 8.8.8.8]
          16011 [Prefix-SID, 11.11.11.11]
    Preference 2 (CLI):
      PM State: Up
      Explicit: segment-list SRTE11.11.11.11 (inactive)
        Weight: 1, Metric Type: TE
          16011 [Prefix-SID, 11.11.11.11]
  Attributes:
    Binding SID: 16
      Allocation mode: dynamic
      State: Programmed
  Tunnel ID: 65536 (Interface Handle: 0x20)
  Per owner configs:
    CLI
      Binding SID: dynamic
  Stats:
    5 minute output rate 0 bits/sec, 0 packets/sec
    Packets: 0  Bytes: 0
  PM profile: FAST

  Event history:
    Timestamp               Client             Event type          Context:
Value
    ---------               ------             ----------          -------:
-----
    01-20 08:50:22.483      FH Resolution      Liveness            CP: 2, SL2
 is Waiting
    01-20 08:50:22.492      PM                 Liveness            CP: 100,
SL1 is Up
    01-20 08:50:22.492      PM                 Liveness            CP: 2, SL2
 is Up
    01-20 08:50:22.494      FH Resolution      REOPT triggered     Status:
REOPTIMIZED CP: 100
    01-20 08:51:54.426      FH Resolution      REOPT triggered     Status:
REOPTIMIZED CP: 100
    01-20 08:52:00.964      FH Resolution      REOPT triggered     Status:
REOPTIMIZED CP: 100
    01-20 08:55:10.264      FH Resolution      REOPT triggered     Status:
REOPTIMIZED CP: 100
    01-20 12:04:06.663      FH Resolution      Liveness            CP: 100,
SL1 is Waiting
    01-20 12:04:06.664      FH Resolution      Liveness            CP: 2, SL2
 is Waiting
    01-20 12:04:08.773      PM                 Liveness            CP: 2, SL2
 is Up
    01-20 12:04:08.836      FH Resolution      REOPT triggered     Status:
```

```
REOPTIMIZED CP: 2
     01-20 12:04:08.954        PM                Liveness             CP: 100,
SL1 is Up
     01-20 12:04:09.001        FH Resolution     REOPT triggered      Status:
REOPTIMIZED CP: 100
     01-20 14:31:41.138        FH Resolution     Liveness             CP: 100,
SL1 is Waiting
     01-20 14:31:41.138        FH Resolution     Liveness             CP: 2, SL2
 is Waiting
     01-20 14:31:44.292        PM                Liveness             CP: 2, SL2
 is Up
     01-20 14:31:44.430        FH Resolution     REOPT triggered      Status:
REOPTIMIZED CP: 2
     01-20 14:31:45.099        PM                Liveness             CP: 100,
SL1 is Up
     01-20 14:31:45.232        FH Resolution     REOPT triggered      Status:
REOPTIMIZED CP: 100
     01-21 16:17:05.118        FH Resolution     REOPT triggered      Status:
REOPTIMIZED CP: 100
     01-21 16:58:34.741        FH Resolution     REOPT triggered      Status:
REOPTIMIZED CP: 100
     01-22 08:13:05.533        FH Resolution     REOPT triggered      Status:
REOPTIMIZED CP: 100
     01-22 08:17:51.393        FH Resolution     REOPT triggered      Status:
REOPTIMIZED CP: 100
     01-22 13:10:38.098        FH Resolution     REOPT triggered      Status:
REOPTIMIZED CP: 100
     01-28 12:04:30.402        FH Resolution     REOPT triggered      Status:
REOPTIMIZED CP: 100
     01-28 12:07:29.883        FH Resolution     Liveness             CP: 100,
SL1 is Waiting
     01-28 12:07:29.883        FH Resolution     Liveness             CP: 2, SL2
 is Waiting
     01-28 12:07:29.961        PM                Liveness             CP: 100,
SL1 is Up
     01-28 12:07:29.962        PM                Liveness             CP: 2, SL2
 is Up
     01-28 12:07:30.323        FH Resolution     REOPT triggered      Status:
REOPTIMIZED CP: 100
     01-28 12:44:13.208        FH Resolution     Policy state DOWN    Status:
PATH NOT RESOLVED
     01-28 12:44:13.392        PM                Liveness             CP: 100,
SL1 is Unknown
     01-28 12:44:13.392        PM                Liveness             CP: 2, SL2
 is Unknown
     01-28 19:40:14.414        FH Resolution     Liveness             CP: 2, SL2
 is Waiting
     01-28 19:40:16.137        PM                Liveness             CP: 2, SL2
 is Up
     01-28 19:40:16.277        FH Resolution     Policy state UP      Status:
PATH RESOLVED CP: 2
     01-28 20:10:24.628        FH Resolution     Policy state DOWN    Status:
PATH NOT RESOLVED
     01-28 20:10:24.971        PM                Liveness             CP: 2, SL2
 is Unknown
     01-28 20:10:27.656        FH Resolution     Liveness             CP: 2, SL2
 is Waiting
     01-28 20:10:30.219        PM                Liveness             CP: 2, SL2
 is Up
     01-28 20:10:30.311        PM                Liveness             CP: 2, SL2
 is Unknown
     02-05 11:27:57.404        CLI               Set PM delay loopbac :
     02-05 11:34:48.918        FH Resolution     Liveness             CP: 100,
SL1 is Waiting
```

```
      02-05 11:35:42.025          FH Resolution          Liveness          CP: 2, SL2
 is Waiting
      02-05 11:35:44.792          PM                     Liveness          CP: 100,
SL1 is Up
      02-05 11:35:45.030          PM                     Liveness          CP: 2, SL2
 is Up
      02-05 11:35:45.031          FH Resolution          Policy state UP   Status:
PATH RESOLVED CP: 2
      02-05 11:35:46.701          FH Resolution          REOPT triggered   Status:
REOPTIMIZED CP: 2
      02-05 11:35:47.937          PM                     Liveness          CP: 100,
SL1 is Up
      02-05 11:35:47.938          FH Resolution          REOPT triggered   Status:
REOPTIMIZED CP: 100
```

Use the **show performance-measurement counters sr-policy name** *sr-policy name* to display the PM link-delay session counters.

```
Router#show performance-measurement counters sr-policy name sr-policy name
SR Policy name: FAST
  Candidate-Path:
    Preference                          : 2
    Protocol-origin                     : Configured
    Discriminator                       : 0
    Active                              : No
    Packets:
      Total sent                        : 55
      Total received                    : 55
    Errors:
      Total sent errors                 : 0
      Total received errors             : 0
    Probes:
      Total started                     : 5
      Total completed                   : 5
      Total incomplete                  : 0
      Total advertisements              : 1
    Segment-list:
      Name                              : SL2
      Packets:
       Total sent                       : 55
        Total received                  : 55
      Errors:
        Total sent errors               : 0
        Total received errors           : 0
      Probes:
        Total started                   : 5
        Total completed                 : 5
        Total incomplete                : 0
        Total advertisements            : 1
  Candidate-Path:
    Preference                          : 100
    Protocol-origin                     : Configured
    Discriminator                       : 0
    Active                              : Yes
    Packets:
      Total sent                        : 56
      Total received                    : 56
    Errors:
      Total sent errors                 : 0
      Total received errors             : 0
    Probes:
      Total started                     : 5
      Total completed                   : 5
```

```
                    Total incomplete                     : 0
                    Total advertisements                 : 0
            Segment-list:
              Name                                       : SL1
              Packets:
               Total sent                                : 56
                Total received                           : 56
              Errors:
                Total sent errors                        : 0
                Total received errors                    : 0
              Probes:
                Total started                            : 5
                Total completed                          : 5
                Total incomplete                         : 0
                Total advertisements                     : 0
```