



Configuring Loss Measurement Management

Loss Measurement Management (LMM) is a loss monitoring feature implemented using the Smart SFP. The LMM functionality is developed to monitor the loss and delay traffic measurement data on the router.

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Prerequisites for LMM

- Smart SFP must be installed on the port where Frame Loss Ratio and Availability (Loss Measurements with LMM or LMR) is calculated.
- Continuity check messages (CCM)s must be enabled for LM and DM on the Smart SFP.
- An untagged EFP BD should be configured on the Smart SFP interface for LMM.



Note Smart SFP must be installed on the router running with Cisco IOS XE Release 3.12S and later post the ISSU upgrade. However, if the smart SFP must be installed on a router running prior to Cisco IOS XE Release 3.12S, we recommend that an IM OIR is performed post ISSU upgrade and an SSO performed post ISSU upgrade.

Restrictions for Smart SFP

- Smart SFP does *not* support Digital Optical Monitoring (DOM).
- Maximum number of MEPS supported on the interfaces with Smart SFP is 64.

- Maximum of 2 MEPs can be configured under EFP on a Smart SFP for LMM or Delay measurement management (DMM).
- Off-loaded CC interval is not supported for EVC BD UP MEP.
- Performance management (PM) sessions are generated with an interval of 1 second. The maximum number of sessions that are supported are 1000.
- LMM is *not* supported on the ten gigabit ethernet interface.
- A single Smart SFP can act as an UP or down MEP only.
- A MEP can participate in per cos LM or aggregate LM, but participating on both is *not* supported.
- Y.1731 measurements are *not* supported on the Smart SFP which is connected to a port-channel.
- The UP MEP, CFM and Y.1731 messages initiating or terminating at the MEP, are *not* accounted for in the LM statistics.
- LMM is *not* support on below encapsulations:
 - Untagged
 - Priority-tagged
 - Default tagged
- In the case of EVC BD UP MEP, all the interfaces on the BD participating in performance measurement should have Smart SFPs installed, however the core facing interface associated with the MEP may have a standard SFP installed.
- An untagged EVC BD must be configured on the interface installed with Smart SFP where MEP is configured for LM session.
- Interoperability with platforms supporting long pipe QoS model requires explicit qos policy for cos to exp mapping and vice versa.

Information About Loss Measurement Management (LMM)

Loss measurement management is achieved by using the Smart SFP.

Y.1731 Performance Monitoring (PM)

Y.1731 Performance Monitoring (PM) provides a standard Ethernet PM function that includes measurement of Ethernet frame delay, frame delay variation, frame loss, and frame throughput measurements specified by the ITU-T Y-1731 standard and interpreted by the Metro Ethernet Forum (MEF) standards group. As per recommendations, devices should be able to send, receive and process PM frames in intervals of 1000ms (1000 frames per second) with the maximum recommended transmission period being 1000ms (1000 frames per second) for any given service.

To measure Service Level Agreements (SLAs) parameters, such as frame delay or frame delay variation, a small number of synthetic frames are transmitted along with the service to the end point of the maintenance region, where the Maintenance End Point (MEP) responds to the synthetic frame. For a function such as

connectivity fault management, the messages are sent less frequently, while performance monitoring frames are sent more frequently.

ITU-T Y.1731 Performance Monitoring in a Service Provider Network

ITU-T Y.1731 performance monitoring provides standard-based Ethernet performance monitoring that encompasses the measurement of Ethernet frame delay, frame-delay variation, and throughput as outlined in the ITU-T Y.1731 specification and interpreted by the Metro Ethernet Forum (MEF). Service providers offer service level agreements (SLAs) that describe the level of performance customers can expect for services. This document describes the Ethernet performance management aspect of SLAs.

Frame Delay and Frame-Delay Variation

The Frame Delay parameter can be used for on-demand OAM measurements of frame delay and frame-delay variation. When a maintenance end point (MEP) is enabled to generate frames with frame-delay measurement (ETH-DM) information, it periodically sends frames with ETH-DM information to its peer MEP in the same maintenance entity. Peer MEPs perform frame-delay and frame-delay variation measurements through this periodic exchange during the diagnostic interval.

An MEP requires the following specific configuration information to support ETH-DM:

- MEG level—MEG level at which the MEP exists
- Priority
- Drop eligibility—marked drop ineligible
- Transmission rate
- Total interval of ETH-DM
- MEF10 frame-delay variation algorithm

A MEP transmits frames with ETH-DM information using the *TxTimeStampf* information element. *TxTimeStampf* is the time stamp for when the ETH-DM frame was sent. A receiving MEP can compare the *TxTimeStampf* value with the *RxTimef* value, which is the time the ETH-DM frame was received, and calculate one-way delay using the formula $frame\ delay = RxTimef - TxTimeStampf$.

One-way frame-delay measurement (1DM) requires that clocks at both the transmitting MEP and the receiving MEPs are synchronized. Measuring frame-delay variation does not require clock synchronization and the variation can be measured using 1DM or a frame-delay measurement message (DMM) and a frame-delay measurement reply (DMR) frame combination.

If it is not practical to have clocks synchronized, only two-way frame-delay measurements can be made. In this case, the MEP transmits a frame containing ETH-DM request information and the *TxTimeStampf* element, and the receiving MEP responds with a frame containing ETH-DM reply information and the *TxTimeStampf* value copied from the ETH-DM request information.

Two-way frame delay is calculated as $(RxTimeb - TxTimeStampf) - (TxTimeStampb - RxTimeStampf)$, where *RxTimeb* is the time that the frame with ETH-DM reply information was received. Two-way frame delay and variation can be measured using only DMM and DMR frames.

To allow more precise two-way frame-delay measurement, the MEP replying to a frame with ETH-DM request information can also include two additional time stamps in the ETH-DM reply information:

- RxTimeStampf—Time stamp of the time at which the frame with ETH-DM request information was received.
- TxTimeStampb—Time stamp of the time at which the transmitting frame with ETH-DM reply information was sent.
- The timestamping happens at the hardware level for DMM operations.

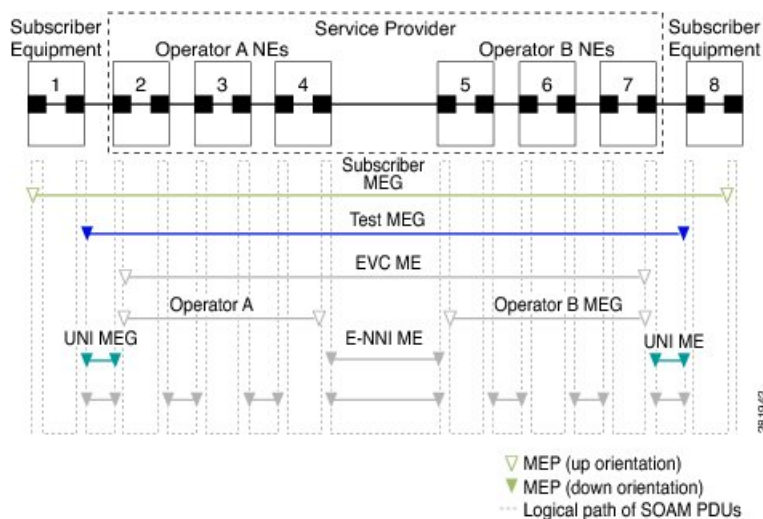


Note The frame-loss, frame-delay, and frame-delay variation measurement processes are aborted when faults related to continuity and availability occur or when known network topology changes occur.

An MIP is transparent to the frames with ETH-DM information; therefore, an MIP does not require information to support the ETH-DM function.

The figure below shows a functional overview of a typical network in which Y.1731 performance monitoring is used.

Figure 1: Y.1731 Performance Monitoring



Overview of Smart SFP

The smart SFP is an optical transceiver module that provides solutions for monitoring and troubleshooting Ethernet services using standardized protocols. It supports CFM and Y.1731 protocols as a standalone device.

The Smart SFP maintains per vlan per cos statistics for all MEP configured on the router. When the Smart SFP receives a loss measurement (LM) frame matching a particular MEP, the statistics associated with that particular MEP are inserted on the LM frame. To support performance management (PM), the router uses the Smart SFP to maintain per vlan per cos frame statistics and to add statistics and timestamps for PM frames when the local router is used as the source or the destination.

OAM functions described in ITU-T Y.1731 allow measurement of the following performance parameters:

- Frame Delay and Frame Delay variation
- Frame Loss Ratio and Availability

Ethernet frame delay and frame delay variation are measured by sending periodic frames with ETH-DM (Timestamps) information to the peer MEP and receiving frames with ETH-DM reply information from the peer MEP. During the interval, the local MEP measures the frame delay and frame delay variation.

ETH-LM transmits frames with ETH-LM (frame counts) information to a peer MEP and similarly receives frames with ETH-LM reply information from the peer MEP. The local MEP performs frame loss measurements which contribute to unavailable time. A near-end frame loss refers to frame loss associated with ingress data frames. Far-end frame loss refers to frame loss associated with egress data frames.

To embed ETH-LM information on a LM frame, the platform should be capable of maintaining per vlan per cos statistics and insert this statistics into LM frames based on the vlan and cos present on the LM frame. This is performed by the Smart SFP on the router.

Connectivity

The first step to performance monitoring is verifying the connectivity. Continuity Check Messages (CCM) are best suited for connectivity verification, but is optimized for fault recovery operation. It is usually not accepted as a component of an SLA due to the timescale difference between SLA and Fault recovery. Hence, Connectivity Fault Management (CFM) and Continuity Check Database (CCDB) are used to verify connectivity. For more information on CFM, see [Configuring Ethernet Connectivity Fault Management in a Service Provider Network](#).

IP SLA

IP Service Level Agreements (SLAs) for Metro-Ethernet gather network performance metrics in service-provider Ethernet networks. For more information on SLM or DM see [Configuring IP SLAs Metro-Ethernet 3.0 \(ITU-T Y.1731\) Operations](#).

Configuring Loss Measurement Management

Loss Measurement Management (LMM) is a loss monitoring feature implemented using the Smart SFP. The LMM functionality is developed to monitor the loss and delay traffic measurement data on the router.

Configuring LMM

Procedure

	Command or Action	Purpose
Step 1	enable Example: Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> • Enter your password if prompted.
Step 2	configure terminal Example: Router# configure terminal	Enters global configuration mode.

	Command or Action	Purpose
Step 3	<p>interface <i>type number</i></p> <p>Example:</p> <pre>Device(config)# interface gigabitethernet 0/0/0</pre>	Specifies the Gigabit Ethernet interface for configuration and enters interface configuration mode.
Step 4	<p>service instance <i>id ethernet name</i></p> <p>Example:</p> <pre>Device(config-if)# service instance 333 ethernet</pre>	<p>Configure an EFP (service instance) and enter service instance configuration) mode.</p> <ul style="list-style-type: none"> • <i>id</i>—Specifies the number is the EFP identifier, an integer from 1 to 4000 • ethernet name—Specifies the name of a previously configured EVC. <p>Note You do not need to use an EVC name in a service instance.</p> <p>Note The name should be the same as the evc name configured under the CFM domain</p> <p>Note Use service instance settings such as encapsulation, dot1q, and rewrite to configure tagging properties for a specific traffic flow within a given pseudowire session.</p>
Step 5	<p>encapsulation {default dot1q priority-tagged untagged}</p> <p>Example:</p> <pre>Router (config-if-srv)# encapsulation dot1q 10</pre>	<p>Configure encapsulation type for the service instance.</p> <ul style="list-style-type: none"> • default—Configure to match all unmatched packets. • dot1q—Configure 802.1Q encapsulation. See Encapsulation for details about options for this keyword. • priority-tagged—Specify priority-tagged frames, VLAN-ID 0 and CoS value of 0 to 7. • untagged—Map to untagged VLANs. Only one EFP per port can have untagged encapsulation.
Step 6	<p>bridge-domain <i>bridge-id</i> [split-horizon group <i>group-id</i>]</p> <p>Example:</p>	<p>Configure the bridge domain ID. The range is from 1 to 4000.</p> <p>You can use the split-horizon keyword to configure the port as a member of a split</p>

	Command or Action	Purpose
	Router (config-if-srv) # bridge-domain 10	horizon group. The <i>group-id</i> range is from 0 to 2.
Step 7	rewrite ingress tag pop {1 2} symmetric Example: Router (config-if-srv) # rewrite ingress tag pop 1 symmetric	(Optional) Specify that encapsulation modification to occur on packets at ingress. <ul style="list-style-type: none"> • pop 1—Pop (remove) the outermost tag. • pop 2—Pop (remove) the two outermost tags. • symmetric—Configure the packet to undergo the reverse of the ingress action at egress. If a tag is popped at ingress, it is pushed (added) at egress. This keyword is required for rewrite to function properly.
Step 8	xconnect peer-ip-address vc-id {encapsulation {l2tpv3 [manual] mpls [manual]} pw-class pw-class-name} [sequencing {transmit receive both}] Example: Router (config-if-srv) # xconnect 10.1.1.2 101 encapsulation mpls	Binds the Ethernet port interface to an attachment circuit to create a pseudowire. This example uses virtual circuit (VC) 101 to uniquely identify the PW. Ensure that the remote VLAN is configured with the same VC. Note When creating IP routes for a pseudowire configuration, we recommend that you build a route from the xconnect address (LDP router-id or loopback address) to the next hop IP address, such as ip route 10.30.30.2 255.255.255.255 10.2.3.4.
Step 9	cfm mep domain domain-name mpid id Example: Router (config-if-srv) # cfm mep domain SSFP-2 mpid 2	Configures the MEP domain and the ID.
Step 10	monitor loss counter priority value Example: Router (config-if-srv) # monitor loss counter priority 0-7	Configures monitor loss on the router. <ul style="list-style-type: none"> • priority value—Specifies the Cos value. the valid values are 0 to 7.
Step 11	end Example: Device (config-if-srv) # end	Returns to privileged EXEC mode.

Configuring a Sender MEP for a Single-Ended Ethernet Frame Loss Ratio Operation



Note To display information about remote (target) MEPs on destination devices, use the **show ethernet cfm maintenance-points remote** command.

Perform this task to configure a sender MEP on the source device.

Before you begin

- Class of Service (CoS)-level monitoring must be enabled on MEPs associated to the Ethernet frame loss operation by using the **monitor loss counter** command on the devices at both ends of the operation. See the *Cisco IOS Carrier Ethernet Command Reference* for command information. See the "Configuration Examples for IP SLAs Metro-Ethernet 3.0 (ITU-T Y.1731) Operations" section for configuration information.



Note Cisco IOS Y.1731 implementation allows monitoring of frame loss for frames on an EVC regardless of the CoS value (any CoS or Aggregate CoS cases). See the "Configuration Examples for IP SLAs Metro-Ethernet 3.0 (ITU-T Y.1731) Operations" section for configuration information.

Procedure

	Command or Action	Purpose
Step 1	enable Example: Device> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> Enter your password if prompted.
Step 2	configure terminal Example: Device# configure terminal	Enters global configuration mode.
Step 3	ip sla operation-number Example: Device(config-term)# ip sla 11	Begins configuring an IP SLAs operation and enters IP SLA configuration mode.
Step 4	ethernet y1731 loss {LMM SLM} [burst] domain domain-name {evc evc-id vlan vlan-id} {mpid target-mp-id mac-address	Begins configuring a single-ended Ethernet frame loss ratio operation and enters IP SLA Y.1731 loss configuration mode.

	Command or Action	Purpose
	<p><i>target-address</i>} CoS <i>CoS</i> {source {mpid <i>source-mp-id</i> mac-address <i>source-address</i>}}</p> <p>Example:</p> <pre>Device(config-ip-sla)# ethernet y1731 loss LMM domain xxx vlan 12 mpid 34 CoS 4 source mpid 23</pre>	<ul style="list-style-type: none"> To configure concurrent operations, use the SLM keyword with this command. Repeat the preceding two steps to configure each concurrent operation to be added to a single IP SLA operation number. Concurrent operations are supported for a given EVC, CoS, and remote-MEP combination, or for multiple MEPs for a given multipoint EVC. <p>Note The session with <i>mac-address</i> will not be inactivated when there is CFM error.</p>
Step 5	<p>aggregate interval <i>seconds</i></p> <p>Example:</p> <pre>Device(config-sla-y1731-loss)# aggregate interval 900</pre>	(Optional) Configures the length of time during which performance measurements are conducted and the results stored.
Step 6	<p>availability algorithm {sliding-window static-window}</p> <p>Example:</p> <pre>Device(config-sla-y1731-loss)# availability algorithm static-window</pre>	(Optional) Specifies availability algorithm used.
Step 7	<p>frame consecutive <i>value</i></p> <p>Example:</p> <pre>Device(config-sla-y1731-loss)# frame consecutive 10</pre>	(Optional) Specifies number of consecutive measurements to be used to determine availability or unavailability status.
Step 8	<p>frame interval <i>milliseconds</i></p> <p>Example:</p> <pre>Device(config-sla-y1731-loss)# frame interval 100</pre>	(Optional) Sets the gap between successive frames.
Step 9	<p>history interval <i>intervals-stored</i></p> <p>Example:</p> <pre>Device(config-sla-y1731-loss)# history interval 2</pre>	(Optional) Sets the number of statistics distributions kept during the lifetime of an IP SLAs Ethernet operation.

	Command or Action	Purpose
Step 10	owner <i>owner-id</i> Example: <pre>Device(config-sla-y1731-delay)# owner admin</pre>	(Optional) Configures the owner of an IP SLAs operation.
Step 11	exit Example: <pre>Device(config-sla-y1731-delay)# exit</pre>	Exits to IP SLA configuration mode.
Step 12	exit Example: <pre>Device(config-ip-sla)# exit</pre>	Exits to global configuration mode.
Step 13	exit Example: <pre>Device(config)# exit</pre>	Exits to privileged EXEC mode.

What to do next

When you are finished configuring this MEP, see the "Scheduling IP SLAs Operations" section to schedule the operation.

Configuration Examples for LMM

- The following example shows a sample output of LMM:

```
!
interface GigabitEthernet0/1/4
no ip address
negotiation auto
service instance 3 ethernet e3
encapsulation dot1q 3
service-policy input set-qos
xconnect 20.20.20.20 3 encapsulation mpls
cfm mep domain SSFP-3 mpid 3
monitor loss counter priority 1
!

!
ip sla 3
ethernet y1731 loss LMM domain SSFP-3 evc e3 mpid 30 cos 1 source mpid 3
history interval 1
aggregate interval 120
```

```
ip sla schedule 3 life 140 start-time after 00:00:05
!
```

Verifying LMM

- Use the **show ethernet cfm ma {local | remote}** command to display the loss on the MEP domain

```
Router# show ethernet cfm ma local
```

Local MEPs:

MPID	Domain Name	Lvl	MacAddress	Type	CC
Ofld	Domain Id	Dir	Port	Id	
	MA Name		SrvcInst	Source	
	EVC name				
3	SSFP-3	3	0000.5c50.36bf	XCON	Y
No	SSFP-3	Up	Gi0/1/4	N/A	
	s3		3	Static	
	e3				
2	SSFP-2	2	0000.5c50.36bf	XCON	Y
No	SSFP-2	Up	Gi0/1/4	N/A	
	s2		2	Static	
	e2				

Total Local MEPs: 2

```
Router# show ethernet cfm ma remote
```

MPID	Domain Name	MacAddress	IfSt	PtSt
Lvl	Domain ID	Ingress		
RDI	MA Name	Type Id	SrvcInst	
	EVC Name		Age	
	Local MEP Info			
20	SSFP-2	c471.fe02.9970	Up	Up
2	SSFP-2	Gi0/1/4:(20.20.20.20, 2)		
-	s2	XCON N/A	2	
	e2		0s	
	MPID: 2 Domain: SSFP-2 MA: s2			
30	SSFP-3	c471.fe02.9970	Up	Up
3	SSFP-3	Gi0/1/4:(20.20.20.20, 3)		
-	s3	XCON N/A	3	
	e3		0s	
	MPID: 3 Domain: SSFP-3 MA: s3			

Total Remote MEPs: 2

- Use the **show ip sla interval-statistics** command to view the statistics.

```
Router# show ip sla history 3 interval-statistics
```

```
Loss Statistics for Y1731 Operation 3
Type of operation: Y1731 Loss Measurement
Latest operation start time: 09:19:21.974 UTC Mon Jan 20 2014
Latest operation return code: OK
Distribution Statistics:
```

Interval 1

```
Start time: 09:19:21.974 UTC Mon Jan 20 2014
End time: 09:21:21.976 UTC Mon Jan 20 2014
```

```

Number of measurements initiated: 120
Number of measurements completed: 120
Flag: OK

Forward
Number of Observations 101
Available indicators: 101
Unavailable indicators: 0
Tx frame count: 1000000
Rx frame count: 1000000
  Min/Avg/Max - (FLR % ): 0:7225/000.00%/0:7225
Cumulative - (FLR % ): 000.0000%
Timestamps forward:
  Min - 09:21:08.703 UTC Mon Jan 20 2014
  Max - 09:21:08.703 UTC Mon Jan 20 2014
Backward
Number of Observations 99
Available indicators: 99
Unavailable indicators: 0
Tx frame count: 1000000
Rx frame count: 1000000
  Min/Avg/Max - (FLR % ): 0:1435/000.00%/0:1435
Cumulative - (FLR % ): 000.0000%
Timestamps backward:
  Min - 09:21:08.703 UTC Mon Jan 20 2014
  Max - 09:21:08.703 UTC Mon Jan 20 2014

```

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/mcl/allreleasemcl/all-book.html

Standards and RFCs

Standard/RFC	Title
No specific Standards and RFCs are supported by the features in this document.	—

MIBs

MB	MIBs Link
—	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

Technical Assistance

Description	Link
<p>The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies.</p> <p>To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds.</p> <p>Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.</p>	<p>http://www.cisco.com/cisco/web/support/index.html</p>

Feature Information for Loss Measurement Management (LMM) with Smart SFP

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Table 1: Feature Information for Loss Measurement Management (LMM) with Smart SFP

Feature Name	Releases	Feature Information
Loss Measurement Management (LMM) with Smart SFP	Cisco IOS XE Release 3.13.0S	This feature was introduced on the Cisco ASR 920 Series Aggregation Services Router (ASR-920-12CZ-A, ASR-920-12CZ-D, ASR-920-4SZ-A, ASR-920-4SZ-D).

