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.

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
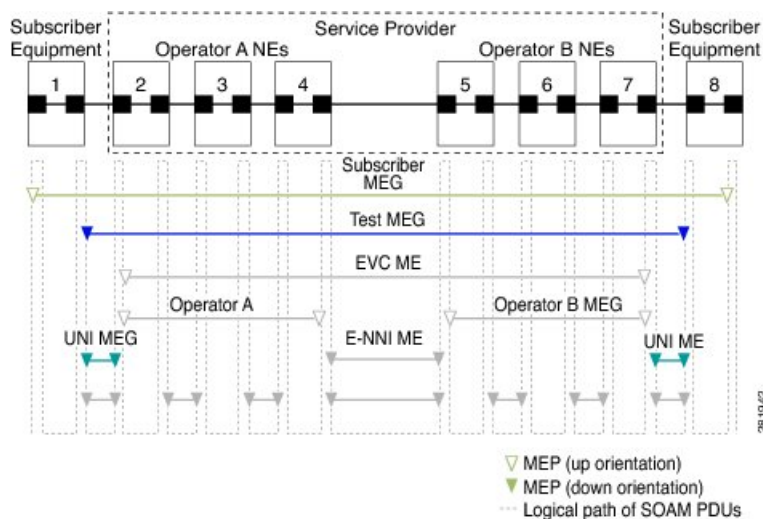
Overview of Smart SFP

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

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number*
4. **service instance** *id* **ethernet** *name*
5. **encapsulation** {**default** | **dot1q** | **priority-tagged** | **untagged**}
6. **bridge-domain** *bridge-id* [**split-horizon group** *group-id*]
7. **rewrite ingress tag pop** {**1** | **2**} **symmetric**
8. **xconnect** *peer-ip-address* *vc-id* {**encapsulation** {**l2tpv3** [**manual**] | **mpls** [**manual**]} | **pw-class** *pw-class-name*} [**sequencing** {**transmit** | **receive** | **both**}
9. **cfm mep domain** *domain-name* **mpid** *id*

10. **monitor loss counter priority** *value*
11. **end**

DETAILED STEPS

	Command or Action	**Purpose**
Step 1	**enable** **Example:** Router> **enable**	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** Router# **configure terminal**	Enters global configuration mode.
Step 3	**interface** *type number* **Example:** Device(config)# **interface gigabitethernet 0/0/0**	Specifies the Gigabit Ethernet interface for configuration and enters interface configuration mode.
Step 4	**service instance** *id* **ethernet** *name* **Example:** Device(config-if)# **service instance 333 ethernet**	Configure an EFP (service instance) and enter service instance configuration) mode. • *id*—Specifies the number is the EFP identifier, an integer from 1 to 4000 • **ethernet** *name*—Specifies the name of a previously configured EVC. **Note** You do not need to use an EVC name in a service instance. **Note** The name should be the same as the evc name configured under the CFM domain **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.
Step 5	**encapsulation** {**default** | **dot1q** | **priority-tagged** | **untagged**} **Example:** Router (config-if-srv)# **encapsulation dot1q 10**	Configure encapsulation type for the service instance. • **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.

	Command or Action	**Purpose**
Step 6	**bridge-domain** *bridge-id* [**split-horizon group** *group-id*] **Example:** Router (config-if-srv)# **bridge-domain 10**	Configure the bridge domain ID. The range is from 1 to 4000. You can use the **split-horizon** keyword to configure the port as a member of a split horizon group. The *group-id* 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. • **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. • **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   This task is not supported on Cisco ME 3600X Series and 3800X Series Ethernet Access Switches

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.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip sla** *operation-number*
4. **ethernet y1731 loss** {**LMM** | **SLM**} [**burst**] **domain** *domain-name* {**evc** *evc-id* | **vlan** *vlan-id*} {**mpid** *target-mp-id* | **mac-address** *target-address*} **CoS** *CoS* {**source** {**mpid** *source-mp-id* | **mac-address** *source-address*}}
5. **aggregate interval** *seconds*
6. **availability algorithm** {**sliding-window** | **static-window**}
7. **frame consecutive** *value*
8. **frame interval** *milliseconds*
9. **history interval** *intervals-stored*
10. **owner** *owner-id*
11. **exit**
12. **exit**

13. **ip sla reaction-configuration** *operation-number* {**react** {**unavailableDS** | **unavailableSD**} [**threshold-type** {**average** [*number-of-measurements*] | **consecutive** [*occurrences*] | **immediate**}] [**threshold-value** *upper-threshold lower-threshold*]

14. **ip sla logging traps**

15. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** Device> enable	Enables privileged EXEC mode. 　• 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** *target-address*} **CoS** *CoS* {**source** {**mpid** *source-mp-id*	**mac-address** *source-address*}} **Example:** Device(config-ip-sla)# ethernet y1731 loss LMM domain xxx vlan 12 mpid 34 CoS 4 source mpid 23	Begins configuring a single-ended Ethernet frame loss ratio operation and enters IP SLA Y.1731 loss configuration mode. 　• 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. **Note**　The session with mac-address will not be inactivated when there is CFM error.
Step 5	**aggregate interval** *seconds* **Example:** Device(config-sla-y1731-loss)# aggregate interval 900	(Optional) Configures the length of time during which performance measurements are conducted and the results stored.
Step 6	**availability algorithm** {**sliding-window**	**static-window**} **Example:**	(Optional) Specifies availability algorithm used.

	Command or Action	Purpose
	`Device(config-sla-y1731-loss)# availability algorithm static-window`	
Step 7	**frame consecutive** *value* **Example:** `Device(config-sla-y1731-loss)# frame consecutive 10`	(Optional) Specifies number of consecutive measurements to be used to determine availability or unavailability status.
Step 8	**frame interval** *milliseconds* **Example:** `Device(config-sla-y1731-loss)# frame interval 100`	(Optional) Sets the gap between successive frames.
Step 9	**history interval** *intervals-stored* **Example:** `Device(config-sla-y1731-loss)# history interval 2`	(Optional) Sets the number of statistics distributions kept during the lifetime of an IP SLAs Ethernet operation.
Step 10	**owner** *owner-id* **Example:** `Device(config-sla-y1731-delay)# owner admin`	(Optional) Configures the owner of an IP SLAs operation.
Step 11	**exit** **Example:** `Device(config-sla-y1731-delay)# exit`	Exits to IP SLA configuration mode.
Step 12	**exit** **Example:** `Device(config-ip-sla)# exit`	Exits to global configuration mode.
Step 13	**ip sla reaction-configuration** *operation-number* {**react** {**unavailableDS** | **unavailableSD**} [**threshold-type** {**average** [*number-of-measurements*] | **consecutive** [*occurrences*] | **immediate**}] [**threshold-value** *upper-threshold lower-threshold*] **Example:**	(Optional) Configures proactive threshold monitoring for frame loss measurements.

	Command or Action	Purpose
	`Device(config)# ip sla reaction-configuration 11 react unavailableDS`	
Step 14	**ip sla logging traps** **Example:** `Device(config)# ip sla logging traps`	(Optional) Enables IP SLAs syslog messages from CISCO-RTTMON-MIB.
Step 15	**exit** **Example:** `Device(config)# exit`	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-stastistics** 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

MIB	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
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. 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. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

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).