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.

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

- For Y.1731 performance monitoring to work, connectivity fault management (CFM) sessions should be up and running.

- Continuity check messages (CCM) database should be populated.

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

- Y.1731 performance monitoring supports only synthetic loss measurement (SLM) and two-way delay measurement (DMM).

- Y.1731 performance monitoring does not support one-way frame-delay measurement (1DM), loss measurement management (LMM) and clocksync.

- Y.1731 performance monitoring sessions cannot be initiated from port maintenance end points (port-MEP) and trunk ethernet flow points (trunk EFP).

- It is not recommended to change the default frame interval and frame sizes in Y.1731 performance monitoring. Default frame interval of only 1000 ms is supported.

- Maximum number of Y.1731 performance monitoring sessions supported is 100.

- While Y.1731 performance monitoring sessions are running, it is not recommneded to perform dynamic encapsulation modification.

- Y.1731 performance monitoring over CFM encapsulation default/untagged should have cos bit set to zero.

- Y1731 performance monitoring is not supported if the core dot1ad nni interface is configured as trunk.

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

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

- Transmission rate

- Total interval of ETH-DM

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 terminated 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
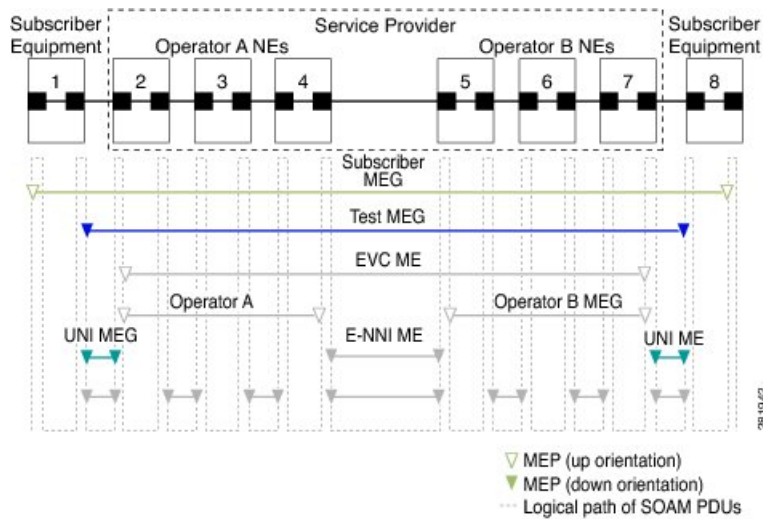
Frame Loss Ratio

Ethernet Frame Loss Ratio (ETH-LM: FLR), also known as frame loss, measures the availability of synthetic frames in the network. Availability is defined in terms of the ratio of frames lost to frames sent, or Frame Loss Ratio (FLR).

Ethernet Synthetic Loss Measurement (ETH-SLM) is used to collect counter values applicable for ingress and egress synthetic frames where the counters maintain a count of transmitted and received synthetic frames between a pair of MEPs.

ETH-SLM transmits synthetic frames with ETH-SLM information to a peer MEP and similarly receives synthetic frames with ETH-SLM information from the peer MEP. Each MEP performs frame loss measurements,

which contribute to unavailable time. A near-end frame loss refers to frame loss associated with ingress data frames. A far-end frame loss refers to frame loss associated with egress data frames. Both near-end and far-end frame loss measurements contribute to near-end severely errored seconds and far-end severely errored seconds, which together contribute to unavailable time. ETH-SLM is measured using SLM and SLR frames.

There are the two methods of frame loss measurement, defined by the ITU-T Y.1731 standard ETH-LM and ETH-SLM. However, the Cisco NCS 520 router supports only single-ended ETH-SLM.

Single-ended ETH-SLM

Each MEP transmits frames with the ETH-SLM request information to its peer MEP and receives frames with ETH-SLR reply information from its peer MEP to carry out synthetic loss measurements.

Benefits of ITU-T Y.1731 Performance Monitoring

Combined with IEEE-compliant connectivity fault management (CFM), Y.1731 performance monitoring provides a comprehensive fault management and performance monitoring solution for service providers. This comprehensive solution in turn lessens service providers' operating expenses, improves their service-level agreements (SLAs), and simplifies their operations.

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

Configuring Ethernet Two-Way Delay Measurement

Procedure

	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 10`	Begins configuring an IP SLAs operation and enters IP SLA configuration mode.

	Command or Action	**Purpose**
Step 4	**ethernet y1731 delay** {**DMM** | **DMMv1**} [**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 delay dmm domain xxx evc yyy mpid 101 cos 4 source mpid 100`	Configures a two-way delay measurement and enters IP SLA Y.1731 delay configuration mode. • **DMM**—Configures two-way delay measurement. • **DMMv1**—Configures two-way delay measurement version 1. • **EVC**—Specifies the ethernet virtual circuit name. • **domain** *domain-name*—Specifies the name of the Ethernet Connectivity Fault Management (CFM) maintenance domain. • **vlan** *vlan-id*—Specifies the VLAN identification number. The range is from 1 to 4094. • **mpid** *target-mp-id*—Specifies the maintenance endpoint identification numbers of the MEP at the destination. The range is from 1 to 8191. • **mac-address** *target-address*—Specifies the MAC address of the MEP at the destination. • **cos** *cos*—Specifies, for this MEP, the class of service (CoS) that will be sent in the Ethernet message. The range is from 0 to 7. • **source**—Specifies the source MP ID or MAC address. • **mpid** *source-mp-id*—Specifies the maintenance endpoint identification numbers of the MEP being configured. The range is from 1 to 8191. • **mac-address** *source-address*—Specifies the MAC address of the MEP being configured.
Step 5	**aggregate interval** *seconds* **Example:** `Device(config-sla-y1731-delay)#`	(Optional) Configures the length of time during which the performance measurements are conducted and the results stored.

	Command or Action	**Purpose**
	```aggregate interval 900```	
Step 6	**distribution** {**delay** | **delay-variation**} **two-way** *number-of-bins* *boundary*[**,...,***boundary*] **Example:** ```Device(config-sla-y1731-delay)# distribution delay-variation two-way 5 5000, 10000,15000,20000,-1```	(Optional) Specifies measurement type and configures bins for statistics distributions kept.
Step 7	**frame interval** *milliseconds* **Example:** ```Device(config-sla-y1731-delay)# frame interval 1000```	(Optional) Sets the gap between successive frames. • *milliseconds*—Specifies the length of time in milliseconds (ms) between successive synthetic frames. The default is 1000
Step 8	**frame offset** *offset-value* **Example:** ```Device(config-sla-y1731-delay)# frame offset 1```	(Optional) Sets value for calculating delay variation values.
Step 9	**frame size** *bytes* **Example:** ```Device(config-sla-y1731-delay)# frame size 64```	(Optional) Configures padding size for frames. • *bytes*—Specifies the padding size, in four-octet increments, for the synthetic frames. The default is 64.
Step 10	**history interval** *intervals-stored* **Example:** ```Device(config-sla-y1731-delay)# history interval 2```	(Optional) Sets the number of statistics distributions kept during the lifetime of an IP SLAs Ethernet operation. • *intervals-stored*—Specifies the number of statistics distributions. The range is from 1 to 10. The default is 2.
Step 11	**max-delay** *milliseconds* **Example:** ```Device(config-sla-y1731-delay)# max-delay 5000```	(Optional) Sets the amount of time an MEP waits for a frame.
Step 12	**end** **Example:**	Exits to privileged EXEC mode.

Command or Action	Purpose
Device(config-sla-y1731-delay)# end	

What to do next

Once the DMM is configured, you have to schedule an IP SLA operation.

Configuring an SLM

To configure an SLM, execute the following commands:

Procedure

Step 1   **enable**

Example:

```
Router > enable
```

Enables privileged EXEC mode.

- Enter your password if prompted.

Step 2   **configure terminal** *operation number*

—Identifies the IP SLAs' operation you want to configure.

Example:

```
Device# configure terminal
```

Enters global configuration mode.

Step 3   **ip sla** *operation number*

Example:

```
Router(config)# ip sla 11
```

Configures an IP SLA operation and enters IP SLA configuration mode.

- *operation-number*—Identifies the IP SLAs' operation you want to configure.

Step 4   **ethernet y1731 loss SLM 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:

```
Router(config-ip-sla)# ethernet y1731 loss SLM domain xxx evc yyy mpid 101 cos 4 source
mpid 100
```

Configures a single-ended synthetic loss measurement and enters IP SLA Y.1731 loss configuration mode.

- **EVC**—Specifies the ethernet virtual circuit name.

- **SLM**—Specifies that the frames sent are Synthetic Loss Measurement (SLM) frames.

- **domain** *domain-name*—Specifies the name of the Ethernet Connectivity Fault Management (CFM) maintenance domain.

- **vlan** *vlan-id*—Specifies the VLAN identification number. The range is from 1 to 4094.

- **mpid** *target-mp-id*—Specifies the maintenance endpoint identification numbers of the MEP at the destination. The range is from 1 to 8191.

- **mac-address** *target-address*—Specifies the MAC address of the MEP at the destination.

- **cos** *cos*—Specifies, for this MEP, the class of service (CoS) that will be sent in the Ethernet message. The range is from 0 to 7.

- **source**—Specifies the source MP ID or MAC address.

- **mpid** *source-mp-id*—Specifies the maintenance endpoint identification numbers of the MEP being configured. The range is from 1 to 8191.

- **mac-address** *source-address*—Specifies the MAC address of the MEP being configured.

Step 5   **aggregate interval** *seconds*

Example:

```
Router(config-sla-y1731-loss)# aggregate interval 900
```

(Optional) Configures the length of time during which the performance measurements are conducted and the results stored.

- *seconds*—Specifies the length of time in seconds. The range is from 1 to 65535. The default is 900.

Step 6   **availability algorithm** { **sliding-window** | **static-window 1** } **symmetric**

Example:

```
Router(config-sla-y1731-loss)# availability algorithm static-window
```

(Optional) Specifies availability algorithm used.

- **sliding-window**—Specifies a sliding-window control algorithm.

- **static-window**—Specifies static-window control algorithm.

Step 7   **frame consecutive** *value*

Example:

```
Router(config-sla-y1731-loss)# frame consecutive 10.
```

(Optional) Specifies number of consecutive measurements to be used to determine availability or unavailability status.

- *value*—Specifies the number of consecutive measurements. The range is from 1 to 10. The default is 10.

Step 8   **frame interval** *milliseconds*

Example:

```
Router(config-sla-y1731-loss)# frame interval 1000
```

(Optional) Sets the gap between successive frames.

- *milliseconds*—Specifies the length of time in milliseconds (ms) between successive synthetic frames. The default is 1000

Step 9   **frame size** *bytes*

Example:

```
Router(config-sla-y1731-loss)# frame size 64
```

(Optional) Configures padding size for frames.

- *bytes*—Specifies the padding size, in four-octet increments, for the synthetic frames. The default is 64.

Step 10   **history interval** *intervals-stored*

Example:
```
Router(config-sla-y1731-loss)# history interval 2
```

(Optional) Sets the number of statistics distributions kept during the lifetime of an IP SLAs Ethernet operation.

- *intervals-stored*—Specifies the number of statistics distributions. The range is from 1 to 10. The default is 2.

Step 11   **exit**

Example:
```
Router(config-sla-y1731-loss)# exit
```

Exits IP SLA Y.1731 loss configuration mode and enters IP SLA configuration mode.

Step 12   **ip sla reaction-configuration** *operation-number* [**react** {**unavailableDS** |**unavailableSD** | **loss-ratioDS** | **loss-ratioSD**}] [**threshold-type** {**average** [*number -of-measurements*] | **consecutive** [*occurences*] | **immediate**}] [**threshold-value** *upper -threshold lower-threshold*]

Example:
```
Router(config)# ip sla reaction-configuration 11 react unavailableDS
```

(Optional) Configures proactive threshold monitoring for frame loss measurements.

- *operation-number*—Identifies the IP SLAs operation for which reactions are to be configured.

- **react**—(Optional) Specifies the element to be monitored for threshold violations.

- **unavailableDS**—Specifies that a reaction should occur if the percentage of destination-to-source Frame Loss Ratio (FLR) violates the upper threshold or lower threshold.

- **unavailableSD**—Specifies that a reaction should occur if the percentage of source-to-destination FLR violates the upper threshold or lower threshold.

- **loss-ratioDS**—Specifies that a reaction should occur if the one-way destination-to-source loss-ratio violates the upper threshold or lower threshold.

- **loss-ratioSD**—Specifies that a reaction should occur if the one way source-to-destination loss-ratio violates the upper threshold or lower threshold.

- **threshold-type average**[*number-of-measurements*]—(Optional) When the average of a specified number of measurements for the monitored element exceeds the upper threshold or when the average of a specified number of measurements for the monitored element drops below the lower threshold, perform the action defined by the action-type keyword. The default number of 5 averaged measurements can be changed using the number-of-measurements argument. The range is from 1 to 16.

- **threshold-type consecutive**[*occurrences*] —(Optional) When a threshold violation for the monitored element is met consecutively for a specified number of times, perform the action defined by the action-type keyword. The default number of 5 consecutive occurrences can be changed using the occurrences argument. The range is from 1 to 16.

- **threshold-type immediate**—(Optional) When a threshold violation for the monitored element is met, immediately perform the action defined by the **action-type** keyword.

- **threshold-value***upper-threshold lower-threshold*—(Optional) Specifies the upper-threshold and lower-threshold values of the applicable monitored elements.

Step 13   **ip sla logging traps**

Example:

```
Router(config)# ip sla logging traps
```

(Optional) Enables IP SLAs syslog messages from CISCO-RTTMON-MIB.

Step 14   **exit**

Example:

```
Router(config)# exit
```

Exits global configuration mode and enters privileged EXEC mode.

What to do next

Once the SLM is configured, you have to schedule an IP SLA operation.

Scheduling an IP SLA Operation

To schedule an IP SLA operation, execute the following commands:

Procedure

Step 1   **enable**

Example:

```
Router> enable
```

Enables the privileged EXEC mode.

Enter your password if prompted.

Step 2   **configure terminal**

Example:

```
Router# configure terminal
```

Enters the global configuration mode.

Step 3   **ip sla schedule** *operation-number* [**life** { **forever** | *seconds* }] [**start-time** {*hh* **:** *mm* [**:** *ss*] [*month day* | *day month*] | **pending** | **now** | **after** *hh* **:** *mm* **:** *ss* | **random** *milliseconds*}]

Example:

```
Router(config)# ip sla schedule 10 start-time now life forever
```

Configures the scheduling parameters for an individual IP SLA operation or Specifies an IP SLA operation group number and the range of operation numbers to be scheduled for a multi-operation scheduler.

- *operation-number*—Identifies the IP SLAs operation for which reactions are to be configured.

- **life forever**— (Optional) Schedules the operation to run indefinitely.

- **life** *seconds* —(Optional) Number of seconds the operation actively collects information. The default is 3600 seconds (one hour).

- **start-time** —(Optional) Time when the operation starts.

- *hh***:***mm*[**:***ss*]—Specifies an absolute start time using hour, minute, and (optionally) second. Use the 24-hour clock notation. For example, start-time 01:02 means "start at 1:02 a.m.," and start-time 13:01:30 means "start at 1:01 p.m. and 30 seconds." The current day is implied unless you specify a month and day.

- *month* —(Optional) Name of the month to start the operation in. If month is not specified, the current month is used. Use of this argument requires that a day be specified. You can specify the month by using either the full English name or the first three letters of the month.

- *day* —(Optional) Number of the day (in the range 1 to 31) to start the operation on. If a day is not specified, the current day is used. Use of this argument requires that a month be specified.

- **pending** —(Optional) No information is collected. This is the default value.

- **now** —(Optional) Indicates that the operation should start immediately.

- **after** *hh***:***mm***:***ss*—(Optional) Indicates that the operation should start hh hours, mm minutes, and ss seconds after this command was entered.

- **random** *milliseconds*—(Optional) Adds a random number of milliseconds (between 0 and the specified value) to the current time, after which the operation will start. The range is from 0 to 10000.

Step 4   **exit**

Example:

```
Router(config)# exit
```

Exits the global configuration mode and enters the privileged EXEC mode.