Configuring Ethernet OAM, Connectivity Fault Management, and Y.1731

This chapter describes Ethernet OAM, Connectivity Fault Management (CFM), and Y.1731 features. This chapter also describes procedures to configure Ethernet OAM, CFM, and Y.1731.

This chapter includes the following topics:

Ethernet Link OAM Overview

Ethernet Link Operations, Administration, and Maintenance (OAM) is a protocol for installing, monitoring, and troubleshooting Ethernet metropolitan-area networks (MANs) and Ethernet WANs. It relies on an optional sublayer in the data link layer of the Open Systems Interconnection (OSI) model, as specified in IEEE 802.3ah-2004 Clause 57.

Ethernet Link OAM enables service providers to monitor and troubleshoot a single physical (or emulated) Ethernet link. It supports link level verification, monitoring, and troubleshooting between two Ethernet devices. It is particularly valuable in the 'first mile' connection to the customer demarcation.

Understanding Ethernet Link OAM

Ethernet link OAM can be implemented on any full-duplex point-to-point or emulated point-to-point Ethernet link. A system-wide implementation is not required; OAM can be deployed for part of a system; that is, on specific interfaces.

Normal link operation does not require Ethernet link OAM. OAM frames, called OAM protocol data units (PDUs), use the slow protocol destination MAC address 0180.c200.0002. They are intercepted by the MAC sublayer and cannot propagate beyond a single hop within an Ethernet network.

Ethernet link OAM is a relatively slow protocol with modest bandwidth requirements. The frame transmission rate is limited to a maximum of 10 frames per second; therefore, the impact of OAM on normal operations is negligible. However, when link monitoring is enabled, the CPU must poll error counters frequently. In this case, the required CPU cycles will be proportional to the number of interfaces that have to be polled.

Two major components, the OAM client and the OAM sublayer, make up Ethernet Link OAM. The following two sections describe these components.

OAM Client

The OAM client is responsible for establishing and managing Ethernet link OAM on a link. It also enables and configures the OAM sublayer. During the OAM discovery phase, the OAM client monitors OAM PDUs received from the remote peer and enables OAM functionality on the link based on the local and remote state as well as configuration settings. After the discovery phase (at steady state), the OAM client is also responsible for managing the rules of response to OAM PDUs and the OAM remote loopback mode.

OAM Sublayer

The OAM sublayer presents two standard IEEE 802.3 MAC service interfaces: one facing the superior sublayers, which include the MAC client (or link aggregation), and the other interface facing the subordinate MAC control sublayer. The OAM sublayer provides a dedicated interface for passing OAM control information and OAM PDUs to and from a client. The OAM sublayer is made up of three components: control block, multiplexer, and packet parser (p-parser).

The control block provides the interface between the OAM client and other blocks internal to the OAM sublayer. The control block runs the discovery process, which detects the existence and capabilities of remote

OAM peers. It also includes the transmit process that governs the transmission of OAM PDUs to the multiplexer and a set of rules that govern the receipt of OAM PDUs from the p-parser.

The multiplexer manages frames generated (or relayed) from the MAC client, control block, and p-parser. The multiplexer passes through frames generated by the MAC client untouched. It passes OAM PDUs generated by the control block to the subordinate sublayer; such as the MAC sublayer. Similarly, the multiplexer passes loopback frames from the p-parser to the same subordinate sublayer when the interface is in OAM remote loopback mode.

The p-parser classifies frames as OAM PDUs, MAC client frames, or loopback frames and then dispatches each class to the appropriate entity. OAM PDUs are sent to the control block; MAC client frames are passed to the superior sublayer; and loopback frames are dispatched to the multiplexer.

Benefits of Ethernet Link OAM

Ethernet Link OAM provides the following benefits:

- Competitive advantage for service providers.
- Standardized mechanism to monitor the health of a link and perform diagnostics.

NTP-J114 Configure EFM Using Cisco IOS Commands

Purpose	This procedure configures EFM using Cisco IOS commands.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Perform any of the following procedures as needed:

- DLP-J320 Enable or Disable Ethernet Link OAM on an Interface Using Cisco IOS Commands, on page 4
- DLP-J321 Enable or Disable Link Monitoring Support on an Interface Using Cisco IOS Commands, on page 8
- DLP-J322 Enable or Disable Link Monitoring on an Interface Using Cisco IOS Commands, on page 10
- DLP-J323 Configure Link Monitoring Parameters on an Interface Using Cisco IOS Commands, on page 12

- DLP-J325 Configure the Port for Remote Link Failure Indication Using Cisco IOS Commands, on page 17
- DLP-J367 Set Up Remote Loopback Timeout Period on an Interface Using Cisco IOS Commands, on page 20
- DLP-J324 Enable Remote Loopback on an Interface Using Cisco IOS Commands, on page 21

Stop. You have completed this procedure.

NTP-J115 Configure EFM Using CTC

Purpose	This procedure configures EFM using CTC.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Perform any of the following procedures as needed:

- DLP-J314 Enable or Disable Ethernet Link OAM on a Port Using CTC, on page 5
- DLP-J315 Enable or Disable Link Monitoring Support on an Interface Using CTC, on page 9
- DLP-J316 Enable or Disable Link Monitoring on an Interface Using CTC, on page 11
- DLP-J317 Configure Link Monitoring Parameters on an Interface Using CTC, on page 14
- DLP-J319 Configure the Port for Remote Link Failure Indication Using CTC, on page 18
- DLP-J318 Enable Remote Loopback on an Interface Using CTC, on page 22

Stop. You have completed this procedure.

DLP-J320 Enable or Disable Ethernet Link OAM on an Interface Using Cisco IOS Commands

Purpose	This procedure enables or disables Ethernet Link OAM on an interface using Cisco IOS commands.
Tools/Equipment	None

Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

	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:** Router(config)# interface TenGigabitEthernet4/1	Specifies the interface to configure and enters interface configuration mode.
Step 4	**ethernet oam** [**max-rate** *oampdus* | **min-rate** *num-seconds*| **mode** {**active** | **passive**} | **timeout** *seconds*] **Example:** Router(config-if)# ethernet oam	Enables Ethernet Link OAM on the interface. The **no** form of this command disables Ethernet Link OAM on the interface.
Step 5	**exit** **Example:** Router(config-if)# exit	Exits interface configuration mode and returns to global configuration mode.
Step 6	Return to your originating procedure (NTP).	

DLP-J314 Enable or Disable Ethernet Link OAM on a Port Using CTC

Purpose	This procedure enables or disables Ethernet link OAM on a port using CTC.
Tools/Equipment	None

Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Step 1 Complete the NTP-J22 Log into CTC procedure at a node where you want to enable or disable Ethernet link OAM on a port.

Step 2 Right-click the fabric or line card and choose **Open Packet Transport System View**.

Step 3 The Packet Transport System View dialog box appears. Click the **Provisioning** > **EFM** > **Configuration** tabs.

Step 4 In the Configuration area, expand the appropriate slot and select the port where you want to enable the Ethernet link OAM.

Step 5 From the EFM State drop-down list, choose **Enabled** to enable Ethernet link OAM on the selected port. Choose **Disabled** to disable Ethernet link OAM on the selected port.

Note Ethernet link OAM is disabled by default on a port.

Step 6 In the Configuration area, expand the appropriate slot and modify any of the parameters as described in the following table.

Table 1: Ethernet Link OAM Parameters

Parameter	Description	Options
Port	(Display only) Displays the port number (n-n) and rate.	—
Mode	(Optional) Sets the OAM client mode on the interface.	• Active—Sets the OAM client mode to active on the interface which was previously in passive mode. Active is the default mode. • Passive—Sets the OAM client mode to passive on the interface. In passive mode, a device cannot initiate discovery, inquire about variables, or set loopback mode.

Parameter	Description	Options
Transmission Rate Minimum	(Optional) Sets the minimum rate, in seconds, at which OAM PDUs are transmitted. That is, the number of seconds during which at least one OAM PDU must be transmitted.	The valid values range from 1 to 10 seconds.
Transmission Rate Maximum	(Optional) Sets the maximum rate, in seconds, at which OAM PDUs are transmitted. That is, the number of seconds during which OAM PDUs must be transmitted.	The valid values range from 1 to 10 seconds.The default is 10 seconds.
Session Timer	(Optional) Specifies the amount of time, in seconds, after which a device declares its OAM peer to be nonoperational and resets its state machine. That is, the number of seconds a device waits for its OAM peer to respond.	The valid values range from 2 to 30 seconds.The default is 5 seconds.

Step 7 Return to your originating procedure (NTP).

Ethernet Link OAM Features

The Cisco CPT supports the following Ethernet link OAM features:

- Discovery, on page 7
- Link Monitoring, on page 8
- Remote Failure Indication, on page 17
- Remote Loopback, on page 19

Discovery

Discovery is the first phase of Ethernet link OAM where it identifies the devices in the network and their OAM capabilities. Discovery uses information OAM PDUs. During the discovery phase, the following information is advertised within periodic information OAM PDUs:

- OAM mode—Conveyed to the remote OAM entity. The mode can be either active or passive and can be used to determine device functionality.

- OAM configuration (capabilities)—Advertises the capabilities of the local OAM entity. With this information a peer can determine what functions are supported and accessible; for example, loopback capability.
- OAM PDU configuration—Includes the maximum OAM PDU size for receipt and delivery. This information along with the rate limiting of 10 frames per second can be used to limit the bandwidth allocated to the OAM traffic.
- Platform identity—Specifies a combination of an organization unique identifier (OUI) and 32-bits of vendor-specific information. OUI allocation, controlled by the IEEE, is typically the first three bytes of a MAC address.

Discovery includes an optional phase in which the local station can accept or reject the configuration of the peer OAM entity. For example, a node may require its partner support loopback capability to be accepted in the management network. These policy decisions may be implemented as vendor-specific extensions.

Link Monitoring

Link monitoring in Ethernet Link OAM detects and indicates link faults under a variety of conditions. Link monitoring uses the event notification OAM PDU and sends events to the remote OAM entity when there are problems detected on the link. The error events include the following:

- Error Frame (error frames per second)—The number of frame errors detected during a specified period that exceed a threshold.
- Error Frame Period (error frames per *n* frames)—The number of frame errors within the last *n* frames that exceed a threshold.
- Error Frame Seconds Summary (error seconds per *m* seconds)—The number of error seconds (1-second intervals with at least one frame error) within the last *m* seconds that exceed a threshold.

Because IEEE 802.3ah OAM does not provide a guaranteed delivery of any OAM PDU, the event notification OAM PDU may be sent multiple times to reduce the probability of a lost notification. A sequence number is used to recognize duplicate events.

DLP-J321 Enable or Disable Link Monitoring Support on an Interface Using Cisco IOS Commands

Purpose	This procedure enables or disables link monitoring support on an interface using Cisco IOS Commands.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

	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:** Router(config)# interface TenGigabitEthernet4/1	Specifies the interface to configure and enters interface configuration mode.
Step 4	**ethernet oam link-monitor supported** **Example:** Router(config-if)# ethernet oam link-monitor supported	Enables link monitoring support on the interface. The **no** form of this command disables link monitoring support on the interface.
Step 5	**exit** **Example:** Router(config-if)# exit	Exits interface configuration mode and returns to global configuration mode.

DLP-J315 Enable or Disable Link Monitoring Support on an Interface Using CTC

Purpose	This procedure enables or disables support for link monitoring on an interface using CTC. This procedure helps establish an OAM session for performing OAM functions, such as remote loopback. For example, if the device is connected to a third-party device that does not support link monitoring, then link monitoring support must be disabled on the device to establish an OAM session with the third-party device.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed

Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Step 1 Complete the NTP-J22 Log into CTC procedure at a node where you want to enable or disable link monitoring support on an interface.

Step 2 Right-click the fabric or line card and choose **Open Packet Transport System View**.

Step 3 The Packet Transport System View dialog box appears. Click the **Provisioning** > **EFM** > **Link Monitoring** tabs

Step 4 In the Link Monitoring area, expand the appropriate slot and select the port where you want to enable link monitoring.

Step 5 From the Support drop-down list, choose **Support** to enable link monitoring support or choose **No support** to disable link monitoring support on the interface.

Step 6 Return to your originating procedure (NTP).

DLP-J322 Enable or Disable Link Monitoring on an Interface Using Cisco IOS Commands

Purpose	This procedure enables or disables link monitoring on an interface using Cisco IOS commands.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** Router> enable	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:**	Enters global configuration mode.

	Command or Action	Purpose
	Router# configure terminal	
Step 3	**interface** *type number* **Example:** Router(config)# interface TenGigabitEthernet4/1	Specifies the interface to configure and enters interface configuration mode.
Step 4	**ethernet oam** [**max-rate** *oampdus* | **min-rate** *num-seconds*| **mode** {**active** | **passive**} | **timeout** *seconds*] **Example:** Router(config-if)# ethernet oam	Enables Ethernet OAM on the interface.
Step 5	**ethernet oam link-monitor on** **Example:** Router(config-if)# ethernet oam link-monitor on	Enables link monitoring on the interface. The **no** form of this command disables link monitoring on the interface.
Step 6	**exit** **Example:** Router(config-if)# exit	Exits interface configuration mode and returns to global configuration mode.

DLP-J316 Enable or Disable Link Monitoring on an Interface Using CTC

Purpose	This procedure enables or disables link monitoring on an interface using CTC.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Note Link monitoring is enabled by default when Ethernet Link OAM is enabled on a interface.

When link monitoring is enabled, the interface sends event OAM PDUs when errors occur and interprets event OAM PDUs from the remote peer. Link monitoring can be effective only if both the local client and remote peer agree to support it.

Procedure

Step 1 Complete the NTP-J22 Log into CTC procedure at a node where you want to enable or disable link monitoring on an interface.

Step 2 Right-click the fabric or line card and choose **Open Packet Transport System View**.

Step 3 The Packet Transport System View dialog box appears. Click the **Provisioning** > **EFM** > **Link Monitoring** tabs

Step 4 In the Link Monitoring area, expand the appropriate slot and select the port where you want to enable link monitoring.

Step 5 From the Enable drop-down list, choose **Enable** to enable link monitoring or choose **Disable** to disable link monitoring on the interface.

Step 6 Return to your originating procedure (NTP).

DLP-J323 Configure Link Monitoring Parameters on an Interface Using Cisco IOS Commands

Purpose	This procedure configures link monitoring parameters on an interface using Cisco IOS Commands. **Note** Perform this optional task to specify link monitoring parameters. Steps 4 through 11 can be performed in any sequence.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

	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.

	Command or Action	Purpose
Step 3	**interface** *type number* **Example:** Router(config)# interface TenGigabitEthernet4/1	Specifies the interface to configure and enters interface configuration mode.
Step 4	**ethernet oam** [**max-rate** *oampdus* | **min-rate** *num-seconds*| **mode** {**active** | **passive**} | **timeout** *seconds*] **Example:** Router(config-if)# ethernet oam	Enables Ethernet link OAM on the interface.
Step 5	**ethernet oam link-monitor high-threshold action error-disable-interface** **Example:** Router(config-if)# ethernet oam link-monitor high-threshold action error-disable-interface	Sets the interface to the blocking or disabled state when a high threshold for an error is exceeded.
Step 6	**ethernet oam link-monitor frame** {**threshold** {**high** { **none** | *high-frames*} | **low** *low-frames*} | **window** *milliseconds*} **Example:** Router(config-if)# ethernet oam link-monitor frame window 399	Configures, in milliseconds, the number for error frames that trigger an action when reached.
Step 7	**ethernet oam link-monitor frame-period** {**threshold** {**high** {**none** | *high-frames*} | **low** *low-frames*} | **window** *frames*} **Example:** Router(config-if)# ethernet oam link-monitor frame-period threshold high 599	Configures the number of frames to be polled. The frame period is a user-defined parameter.
Step 8	**ethernet oam link-monitor frame-seconds** {**threshold** {**high** {**none** | *high-frames*} | **low** *low-frames*} | **window** *milliseconds*} **Example:** Router(config-if)# ethernet oam link-monitor frame-seconds window 699	Configures a period of time, in milliseconds, during which error frames are counted.
Step 9	**ethernet oam link-monitor receive-crc** {**threshold** {**high** {**none** | *high-frames*} | **low** *low-frames*} | **window** *milliseconds*} **Example:** Router(config-if)# ethernet oam link-monitor receive-crc window 99	Configures an Ethernet OAM interface to monitor ingress frames with cyclic redundancy check (CRC) errors for a period of time.

	Command or Action	Purpose
Step 10	**ethernet oam link-monitor transmit-crc** {**threshold** {**high** {**none** | *high-frames*} | **low** *low-frames*} | **window** *milliseconds*} **Example:** Router(config-if)# ethernet oam link-monitor transmit-crc threshold low 199	Configures an Ethernet OAM interface to monitor egress frames with CRC errors for a period of time (in milliseconds).
Step 11	**ethernet oam link-monitor symbol-period** {**threshold** {**high** {**none** | *high-symbols*} | **low** *low-symbols*} | **window** *symbols*} **Example:** Router(config-if)# ethernet oam link-monitor symbol-period threshold high 299	Configures a threshold or window for error symbols, in number of symbols.
Step 12	**exit** **Example:** Router(config-if)# exit	Exits interface configuration mode and returns to global configuration mode.

DLP-J317 Configure Link Monitoring Parameters on an Interface Using CTC

Purpose	This procedure configures the link monitoring parameters on an interface using CTC.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Step 1 Complete the NTP-J22 Log into CTC procedure at a node where you want to configure link monitoring parameters on an interface.

Step 2 Right-click the fabric or line card and choose **Open Packet Transport System View**.

Step 3 The Packet Transport System View dialog box appears. Click the **Provisioning** > **EFM** > **Link Monitoring** tabs

Step 4 In the Link Monitoring area, expand the appropriate slot and modify any of the parameters as described in the following table.

Table 2: Link Monitoring Parameters

Parameter	Description	Options
Port	(Display only) Displays the port number (n-n) and rate.	—
FT Min	Frame Threshold Minimum–Sets a low error frame threshold in number of frames.	The valid values range from 0 to 65535 seconds or frames per second. The default is 1 second.
FT Max	Frame Threshold Maximum–Sets a high error frame threshold in number of frames.	Integer in the range of 1 to 65535 that is the high threshold in number of frames.
Frame Window	Sets a window and period of time during which error frames are counted.	Sets a window and period of time during which error frames are counted. Integer in the range of 10 to 600 that represents a number of milliseconds in a multiple of 100. The default is 100.
FPT Min	Frame Period Threshold Minimum–Sets a low threshold for the error frame period in number of frames.	Integer in the range of 0 to 65535 that is the low threshold in number of frames. The default is 1.
FPT Max	Frame Period Threshold Maximum–Sets a high threshold for the error frame period in number of frames.	Integer in the range of 1 to 65535 that is the high threshold in number of frames. There is no default. The high threshold must be configured.
FP Window	Frame Period Window–Sets a polling window and window size.	Integer in the range of 1 to 65535 that is the window size in number of frames. Each value is a multiple of 10000. The default is 1000.
FST Min	Frame Seconds Threshold Minimum–Sets a low error frame-seconds threshold in number of seconds.	Integer in the range of 1 to 900 that sets the low threshold in number of frames. The default is 1.

Parameter	Description	Options
FST Max	Frame Seconds Threshold Maximum–Sets a high error frame-seconds threshold in number of seconds.	Integer in the range of 1 to 900 that is the high threshold in number of frames. There is no default. The high threshold must be configured.
FS Window	Frame Seconds Window–Sets a polling window during which error frames are counted.	Integer in the range of 100 to 9000 that represents a number of milliseconds in a multiple of 100. The default is 1000.
SPT Min	Symbol Period Threshold Minimum–Sets a low threshold for the period in number of error symbols.	Integer in the range of 0 to 65535 that is the low threshold in number of symbols.
SPT Max	Symbol Period Threshold Maximum–Sets a high threshold for the period in number of error symbols.	Integer in the range of 1 to 65535 that is the high threshold in number of symbols. There is no default. The high threshold must be configured.
SP Window	Symbol Period Window-Sets a window and window size.	Integer in the range of 1 to 65535 that is the window size in number of symbols. Each value represents one million.
RCRCT Min	Receive CRC Threshold Minimum–Sets a low threshold.	Integer in the range of 0 to 65535 that sets the low threshold in number of frames. The default is 10.
RCRCT Max	Receive CRC Threshold Maximum–Sets a high threshold in number of frames.	Integer in the range of 1 to 65535 that is the high threshold in number of frames.
RCRC Window	Receive CRC Window–Sets a window and period of time during which frames with CRC errors are counted.	Integer in the range of 10 to 1800 that represents a number of milliseconds in a multiple of 100. The default is 1000.
TCRCT Min	Transmit CRC Threshold Minimum–Sets a low threshold.	Integer in the range of 0 to 65535 that sets the low threshold in number of frames. The default is 10.
TCRCT Max	Transmit CRC Threshold Maximum-Sets a high threshold in number of frames.	Integer in the range of 1 to 65535 that is the high threshold in number of frames.
TCRC Window	Transmit CRC Window-Sets a window and period of time during which frames with transmit CRC errors are counted.	Integer in the range of 10 to 1800 that represents a number of milliseconds in a multiple of 100. The default is 100.

Parameter	Description	Options
HT Action	High Threshold Action–Provides an automatic failover of traffic from one port in an EtherChannel to another port in the same EtherChannel when one of the ports in the channel exceeds the high threshold for an error within the specified interval. The port failover occurs only if at least one operational port is in the EtherChannel. If the failed port is the last port in the EtherChannel, the port is moved into error-disable state and continues to pass traffic regardless of the types of errors received.	• NONE • Error Disable

Step 5 Return to your originating procedure (NTP).

Remote Failure Indication

Faults in Ethernet connectivity that are caused by slowly deteriorating quality are difficult to detect. Ethernet Link OAM provides a mechanism for an OAM entity to convey these failure conditions to its peer via specific flags in the OAM PDU. The following failure conditions can be communicated:

- Link Fault–Loss of signal is detected by the receiver. A link fault is sent every second in the information OAM PDU. Link fault applies only when the physical sublayer is capable of independently transmitting and receiving signals.
- Dying Gasp–An unrecoverable condition has occurred; for example, a power failure. This type of condition is vendor specific. A notification about the condition may be sent immediately and continuously.
- Critical Event–An unspecified critical event has occurred. This type of event is vendor specific. A critical event may be sent immediately and continuously.

DLP-J325 Configure the Port for Remote Link Failure Indication Using Cisco IOS Commands

Purpose	This procedure configures the port for remote link failure indication using Cisco IOS commands.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

	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:** Router(config)# interface TenGigabitEthernet4/1	Specifies the interface to configure and enters interface configuration mode.
Step 4	**ethernet oam remote-failure** {**critical-event** | **dying-gasp** | **link-fault**} **action** {**error-block-interface** | **error-disable-interface**} **Example:** Router(config-if)# ethernet oam remote-failure critical-event action error-block-interface	Sets the interface to the blocking state when a critical event occurs.
Step 5	**exit** **Example:** Router(config-if)# exit	Exits interface configuration mode and returns to global configuration mode.

DLP-J319 Configure the Port for Remote Link Failure Indication Using CTC

Purpose	This procedure configures the port for remote link failure indication using CTC.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Step 1 Complete the NTP-J22 Log into CTC procedure at a node where you want to configure the port for remote link failure indication.

Step 2 Right-click the fabric or line card and choose **Open Packet Transport System View**.

Step 3 The Packet Transport System View dialog box appears. Click the **Provisioning** > **EFM** > **Configuration** tabs

Step 4 In the Configuration area, expand the appropriate slot and modify any of the parameters as described in the following table.

Table 3: Remote Link Failure Indication Parameters

Parameter	Description	Options
Link Fault	Detects the loss of signal by the receiver.	• None • Error Block • Error Disable
Critical Event	Sends the critical event notification when an unspecified critical event has occurred.	• None • Error Disable
Dying Gasp	Sends the notification when an unrecoverable condition has occurred; for example, a power failure.	• None • Error Block • Error Disable

Step 5 Return to your originating procedure (NTP).

Remote Loopback

An OAM entity can put its remote peer into loopback mode using the loopback control OAM PDU. Loopback mode helps an administrator ensure the quality of links during installation or when troubleshooting. In loopback mode, every frame received is transmitted back on the same port except for OAM PDUs and pause frames. The periodic exchange of OAM PDUs must continue during the loopback state to maintain the OAM session.

The **loopback** command is acknowledged by responding with an information OAM PDU with the loopback state indicated in the State field. This acknowledgement allows an administrator, for example, to estimate if a network segment can satisfy a service-level agreement. Acknowledgement makes it possible to test delay, jitter, and throughput.

When an interface is set to the remote loopback mode the interface no longer participates in any other Layer 2 or Layer 3 protocols; for example Spanning Tree Protocol (STP) or Open Shortest Path First (OSPF). This is because when two connected ports are in a loopback session, no frames other than the OAM PDUs are sent to the CPU for software processing. The non-OAM PDU frames are either looped back at the MAC level or discarded at the MAC level.

From a user perspective, an interface in a loopback mode is in a link-up state.

DLP-J367 Set Up Remote Loopback Timeout Period on an Interface Using Cisco IOS Commands

Purpose	This procedure sets up remote loopback timeout period on an interface using Cisco IOS commands.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

	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:** Router(config)# interface TenGigabitEthernet 4/1	Specifies the interface to configure and enters interface configuration mode.
Step 4	**ethernet oam remote-loopback** {**supported** | **timeout** *seconds*} **Example:** Router(config-if)# ethernet oam remote-loopback supported	Sets a remote loopback timeout period, in seconds, on an interface.

	Command or Action	Purpose
Step 5	**exit** **Example:** Router(config-if)# exit	Exits interface configuration mode and returns to global configuration mode.

DLP-J324 Enable Remote Loopback on an Interface Using Cisco IOS Commands

Purpose	This procedure enables remote loopback on an interface using Cisco IOS commands.
Tools/Equipment	None
Prerequisite Procedures	DLP-J367 Set Up Remote Loopback Timeout Period on an Interface Using Cisco IOS Commands, on page 20
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

	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	**ethernet oam remote-loopback** {**start** | **stop**} {**interface** *type number*} **Example:** Router# ethernet oam remote-loopback start interface TenGigabitEthernet4/1	Enables remote loopback on an interface.
Step 4	**exit** **Example:**	Exits interface configuration mode and returns to EXEC mode.

	Command or Action	Purpose
	Router(config-if)# exit	

DLP-J318 Enable Remote Loopback on an Interface Using CTC

Purpose	This procedure enables remote loopback on an interface using CTC.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Step 1 Complete the NTP-J22 Log into CTC procedure at a node where you want to enable remote loopback on an interface.

Step 2 Right-click the fabric or line card and choose **Open Packet Transport System View**.

Step 3 The Packet Transport System View dialog box appears. Click the **Provisioning** > **EFM** > **Remote Loopback** tabs

Step 4 In the Remote Loopback area, expand the appropriate slot and modify any of the parameters as described in the following table.

Table 4: Remote Loopback Parameters

Parameter	Description	Options
Port	(Display only) Displays the port number (n-n) and rate.	—
Remote Loopback Type	Sets the remote loopback type.	• None • Remote Loopback

Parameter	Description	Options
Execution	Turns on or off the remote loopback operation. In CTC, the reason for the failure of remote loopback is not notified. It is not notified whether Start/Stop remote loopback is functional at the remote end. This occurs when the Ethernet Link OAM or remote loopback support (at remote end) is not enabled. Whereas in Cisco IOS, the reason for the failure of remote loopback is notified appropriately.	• Start—Starts the remote loopback operation. • Stop—Stops the remote loopback operation.
Timeout	Sets a master loopback timeout setting.	The valid timeout period ranges from 1 to 10 seconds.

Understanding Ethernet OAM Messages

Ethernet OAM messages or OAM PDUs are standard length, untagged Ethernet frames within the normal frame length bounds of 64 to 1518 bytes. The maximum OAM PDU frame size exchanged between two peers is negotiated during the discovery phase.

OAM PDUs always have the destination address of slow protocols (0180.c200.0002) and an Ethertype of 8809. OAM PDUs do not go beyond a single hop and have a hard-set maximum transmission rate of 10 OAM PDUs per second. Some OAM PDU types may be transmitted multiple times to increase the likelihood that they will be successfully received on a deteriorating link.

Four types of OAM messages are supported:

- Information OAM PDU—A variable-length OAM PDU that is used for discovery. This OAM PDU includes local, remote, and organization-specific information.
- Event notification OAM PDU—A variable-length OAM PDU that is used for link monitoring. This type of OAM PDU may be transmitted multiple times to increase the chance of a successful receipt; for example, in the case of high-bit errors. Event notification OAM PDUs also may include a time stamp when generated.
- Loopback control OAM PDU—An OAM PDU fixed at 64 bytes in length that is used to enable or disable the **remote loopback** command.
- Vendor-specific OAM PDU—A variable-length OAM PDU that allows the addition of vendor-specific extensions to OAM.

Understanding Connectivity Fault Management

Ethernet Connectivity Fault Management (CFM) is an end-to-end per-service Ethernet layer operations, administration, and maintenance (OAM) protocol. It includes proactive connectivity monitoring, fault verification, and fault isolation for large Ethernet metropolitan-area networks (MANs) and WANs.

CPT supports the IEEE 802.1ag standard implementation of CFM. It supports CFM over the following:

- Point–to–multipoint bridge domain associated with Ethernet Flow Points (EFP)
- Xconnect
- Port Maintenance End Point (MEP)

All the CFM configurations specific to point–to–multipoint EFPs also apply to Xconnect.

Understanding IEEE CFM

IEEE CFM is an end-to-end per-service Ethernet layer OAM protocol that supports provider edge-to-provider edge (PE-to-PE) and customer edge-to-customer edge (CE-to-CE) services. A service is identified as an Ethernet virtual circuit (EVC) service.

Troubleshooting carrier networks offering Ethernet Layer 2 services is challenging. Customers contract with service providers for end-to-end Ethernet service and service providers may subcontract with operators to provide equipment and networks. Compared to enterprise networks, where Ethernet traditionally has been implemented, these constituent networks belong to distinct organizations or departments, are substantially larger and more complex, and have a wider user base. Ethernet CFM provides a competitive advantage to service providers for which the operational management of link uptime and timeliness in isolating and responding to failures is crucial to daily operations.

Benefits of IEEE CFM

- End-to-end service-level OAM technology.
- Reduced operating expense for service provider Ethernet networks.
- Competitive advantage for service providers.
- Support for both distribution and access network environments with Down (toward the wire) MEPs.

CFM Limitations and Restrictions in CPT

- CFM over the point–to–point bridge domain is not supported.
- CFM over Virtual Private LAN Service (VPLS) is not supported.
- Maximum number of Maintenance End Points (MEPs) supported on a CPT system is 16000 depending on the Continuity Check (CC) interval.
- Maximum number of Maintenance Intermediate Points (MIPs) supported on a CPT system is 16000.

- CFM alarms in CTC is not supported.
- CFM over VLAN based forwarding is not supported.
- CFM is not supported on a bridge domain that has the split horizon configured.
- CFM handles blocked ports only for tagged packets as REP operates only on tagged packets.

The following table specifies the number of supported remote and local MEPs depending on the configured CC interval.

Table 5: Supported Remote and Local MEPs

CC Interval	Number of Remote MEPS	Number of Local MEPs
100 milliseconds	100	100
1 second	1000	1000
10 seconds	8000	8000
1 minute	16000	16000
10 minutes	16000	16000

NTP-J106 Configure CFM Using Cisco IOS Commands

Purpose	This procedure configures CFM using Cisco IOS commands.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Perform any of the following procedures as needed:

- DLP-J305 Enable or Disable CFM on the CPT System Using Cisco IOS Commands, on page 27
- DLP-J308 Enable or Disable CFM on an Interface Using Cisco IOS Commands, on page 29
- DLP-J312 Enable Caching of CFM Data Using Cisco IOS Commands, on page 32
- DLP-J309 Create a Maintenance Domain Using Cisco IOS Commands, on page 35

- DLP-J334 Create a Maintenance Association Using Cisco IOS Commands, on page 38
- DLP-J333 Configure CFM Encapsulation Using Cisco IOS Commands, on page 40
- DLP-J310 Create a Port MEP Using Cisco IOS Commands, on page 46
- DLP-J321 Create an MEP for an EFP Using Cisco IOS Commands, on page 47
- DLP-J319 Define MEPs Statically within a Maintenance Association Using Cisco IOS Commands, on page 49
- DLP-J318 Specify the Number of MEPs in a Maintenance Association Using Cisco IOS Commands, on page 50
- DLP-J323 Configure Cross-Check for an MEP Using Cisco IOS Commands, on page 52
- DLP-J311 Create an MIP Dynamically Using Cisco IOS Commands, on page 56
- DLP-J322 Create an MIP Manually Using Cisco IOS Commands, on page 57
- DLP-J316 Enable the Transmission of Continuity Check Messages Using Cisco IOS Commands, on page 60
- DLP-J324 Send CFM Loopback and Linktrace Messages Using Cisco IOS Commands, on page 63
- DLP-J314 Enable CFM Traps Using Cisco IOS Commands, on page 66
- DLP-J315 Enable SNMP Trap Generation for CFM Continuity Check Events Using Cisco IOS Commands, on page 67

Stop. You have completed this procedure.

NTP-J105 Configure CFM Using CTC

Purpose	This procedure configures CFM using CTC.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Perform any of the following procedures as needed:

- DLP-J299 Enable or Disable CFM on the CPT System Using CTC, on page 28
- DLP-J300 Enable or Disable CFM for Each Port or Channel Group Using CTC, on page 31
- DLP-J313 Enable Caching of CFM Data Using CTC, on page 33

- DLP-J301 Create and Modify a Maintenance Domain Profile Using CTC, on page 36
- DLP-J302 Delete a Maintenance Domain Profile Using CTC, on page 37
- DLP-J303 Create and Modify a Maintenance Association Profile Using CTC, on page 41
- DLP-J304 Delete a Maintenance Association Profile Using CTC, on page 43
- DLP-J306 Create an MEP Using CTC, on page 53
- DLP-J307 Create an MIP Using CTC, on page 59

Stop. You have completed this procedure.

DLP-J305 Enable or Disable CFM on the CPT System Using Cisco IOS Commands

Purpose	This procedure enables or disables Ethernet CFM globally on the CPT system using Cisco IOS commands.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

	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	**ethernet cfm global** **Example:** Router(config)# ethernet cfm global	Enables Ethernet CFM globally on the system. The **no** form of this command disables Ethernet CFM globally on the system.

	Command or Action	Purpose
Step 4	**end** **Example:** Router(config)# end	Returns to privileged EXEC mode.
Step 5	Return to your originating procedure (NTP).	—

Example: Enable or Disable CFM on the System

The following example shows how to enable CFM on the system using Cisco IOS commands:

```
Router> enable
Router# configure terminal
Router(config)# ethernet cfm global
```

The following example shows how to disable CFM on the system using Cisco IOS commands:

```
Router> enable
Router# configure terminal
Router(config)# no ethernet cfm global
```

DLP-J299 Enable or Disable CFM on the CPT System Using CTC

Purpose	This procedure enables or disables CFM on the CPT system using CTC.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Note CFM is disabled globally on the system by default. This indicates that the CFM frames are transparently forwarded in the system.

Procedure

Step 1 Complete the NTP-J22 Log into CTC procedure at a node where you want to enable or disable CFM on the CPT system.

Step 2 Right-click the fabric or line card and choose **Open Packet Transport System View**. The Packet Transport System View dialog box appears.

Step 3 Click the **Provisioning** tab.

Step 4 In the left pane, click **CFM**.

Step 5 Click the **Global Settings** tab.

Step 6 In the Global Settings area, check the **Enable CFM** check box to enable CFM on the CPT system. Uncheck the **Enable CFM** check box to disable CFM on the CPT system.

Step 7 Check the **MIP Filter Enable** check box to configure a CFM MIP filter that drops all the CFM frames at a lower level irrespective of whether they originate from the wire or the bridge relay.

Step 8 Enter a value in the MEP Cross Check Delay field to specify the number of seconds a device waits for remote MEPs to come up before the cross-check starts. The default value is 30. The range is from 1 to 65535.

Step 9 Click **Apply**.

Step 10 Return to your originating procedure (NTP).

DLP-J308 Enable or Disable CFM on an Interface Using Cisco IOS Commands

Purpose	This procedure enables or disables CFM on an interface using Cisco IOS commands.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** Router> enable	Enables privileged EXEC mode. • Enter your password if prompted.

	Command or Action	Purpose
Step 2	**configure terminal** **Example:** Router# configure terminal	Enters global configuration mode.
Step 3	**interface** *type number* **Example:** Router(config)# interface TenGigabitEthernet 4/1	Specifies the interface to configure and enters interface configuration mode.
Step 4	**ethernet cfm interface** **Example:** Router(config-if)# ethernet cfm interface	Enables the Ethernet CFM processing on the interface. The **no** form of this command disables Ethernet CFM processing on the interface.
Step 5	**exit** **Example:** Router(config-if)# exit	Returns to global configuration mode.
Step 6	**end** **Example:** Router(config)# end	Returns to privileged EXEC mode.
Step 7	Return to your originating procedure (NTP).	—

Example: Enable or Disable CFM on an Interface

The following example shows how to enable CFM on an interface using Cisco IOS commands:

```
Router> enable
Router# configure terminal
Router(config)# interface TenGigabitEthernet 4/1
Router(config-if)# ethernet cfm interface
```

The following example shows how to disable CFM on an interface using Cisco IOS commands:

```
Router> enable
Router# configure terminal
Router(config)# interface TenGigabitEthernet 4/1
Router(config-if)# no ethernet cfm interface
```

DLP-J300 Enable or Disable CFM for Each Port or Channel Group Using CTC

Purpose	This procedure enables or disables CFM for each port or channel group using CTC.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Note CFM is enabled on each port by default. If CFM is disabled on a port, the CFM packets on that port are dropped.

Procedure

Step 1 Complete the NTP-J22 Log into CTC procedure at a node where you want to enable or disable CFM for each port or channel group.

Step 2 Right-click the fabric or line card and choose **Open Packet Transport System View**. The Packet Transport System View dialog box appears.

Step 3 Click the **Provisioning** tab.

Step 4 In the left pane, click **CFM**.

Step 5 Click the **Global Settings** tab.

Step 6 In the Ethernet Interfaces area, expand the slot of the fabric card or the line card or the Fan–Out–Group (FOG) of the CPT 50 panel.

Step 7 If you want to enable CFM on a specific port, check the **Enable CFM** check box against that port.
Uncheck the **Enable CFM** check box against the port to disable CFM on the port.

Step 8 In the Channel Groups area, if you want to enable CFM on a specific channel group, check the **Enable** check box against that channel group.

Step 9 Click **Apply** to enable CFM on the port or the channel group.

Step 10 Return to your originating procedure (NTP).

DLP-J312 Enable Caching of CFM Data Using Cisco IOS Commands

Purpose	This procedure enables caching of CFM data using Cisco IOS commands.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

	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	**ethernet cfm traceroute cache** **Example:** Router(config)# ethernet cfm traceroute cache	Enables caching of CFM data learned through traceroute messages.
Step 4	**ethernet cfm traceroute cache size** *entries* **Example:** Router(config)# ethernet cfm traceroute cache size 200	Sets the size for the CFM traceroute cache table. The default value is 100 entries. The range is from 1 to 4095 entries.
Step 5	**ethernet cfm traceroute cache hold-time** *minutes* **Example:** Router(config)# ethernet cfm traceroute cache holdtime 60	Sets the amount of time (in minutes) that CFM traceroute cache entries are retained. The default value is 100 minutes. The range is from 1 to 65535 minutes.

	Command or Action	Purpose
Step 6	**end** **Example:** Router(config)# end	Returns to privileged EXEC mode.
Step 7	Return to your originating procedure (NTP).	—

Example: Enable Caching of CFM Data

The following example shows how to set the maximum number of entries in the CFM traceroute cache table to 2500 using Cisco IOS commands:

```
Router> enable
Router# configure terminal
Router(config)# ethernet cfm traceroute cache size 2500
```

The following example shows how to set the retention time for entries in the CFM traceroute cache table to 5 minutes using Cisco IOS commands:

```
Router> enable
Router# configure terminal
Router(config)# ethernet cfm traceroute cache hold-time 5
```

DLP-J313 Enable Caching of CFM Data Using CTC

Purpose	This procedure enables caching of CFM data using CTC.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Step 1 Complete the NTP-J22 Log into CTC procedure at a node where you want to enable caching of CFM data.

Step 2 Right-click the fabric or line card and choose **Open Packet Transport System View**. The Packet Transport System View dialog box appears.

Step 3 Click the **Provisioning** tab.

Step 4 In the left pane, click **CFM**.

Step 5 Click the **Global Settings** tab.

Step 6 In the Cache Configuration area, check the **Enable** check box to enable caching of CFM data learned through traceroute messages.

Step 7 Enter the time in minutes in the HoldTime field to set the amount of time that CFM traceroute cache entries are retained. The default value is 100 minutes. The range is from 1 to 65535 minutes.

Step 8 Enter the cache size in the Size field to set the maximum size for the CFM traceroute cache table. The default value is 100. The range is from 1 to 4095.

Step 9 Click **Apply** to enable caching of CFM data.

Step 10 Return to your originating procedure (NTP).

Understanding Maintenance Domain

A maintenance domain is an administrative domain for managing and administering a network. The maintenance domain allows CFM to support multiple independent operators, each supporting service instances from multiple independent customers.

A unique maintenance level in the range of 0 to 7 is assigned to each maintenance domain by a network administrator. Maintenance levels and domain names are useful for defining the hierarchical relationship that exists among domains. The hierarchical relationship of domains parallels the structure of customer, service provider, and operator. The higher the domain level, the broader the scope of the domain. For example, a customer domain would be larger than an operator domain. The customer domain may have a maintenance level of 7 and the operator domain may have a maintenance level of 0. Typically, operators would have the smallest domains and customers the largest domains, with service provider domains in between these domains, varying in size. All levels of the hierarchy must operate together.

Domains must not intersect because intersecting would mean management by more than one entity, which is not allowed. Domains may nest or touch but when two domains nest, the outer domain must have a higher maintenance level than the domain nested within it. Nesting maintenance domains is useful in the business model where a service provider contracts with one or more operators to provide Ethernet service to a customer. Each operator would have its own maintenance domain and the service provider would define its domain that is a superset of the operator domains. Furthermore, the customer has its own end-to-end domain, which is in turn is a superset of the service provider domain. Maintenance levels of various nesting domains must be communicated among the administering organizations. For example, one approach would be to have the service provider assign maintenance levels to operators.

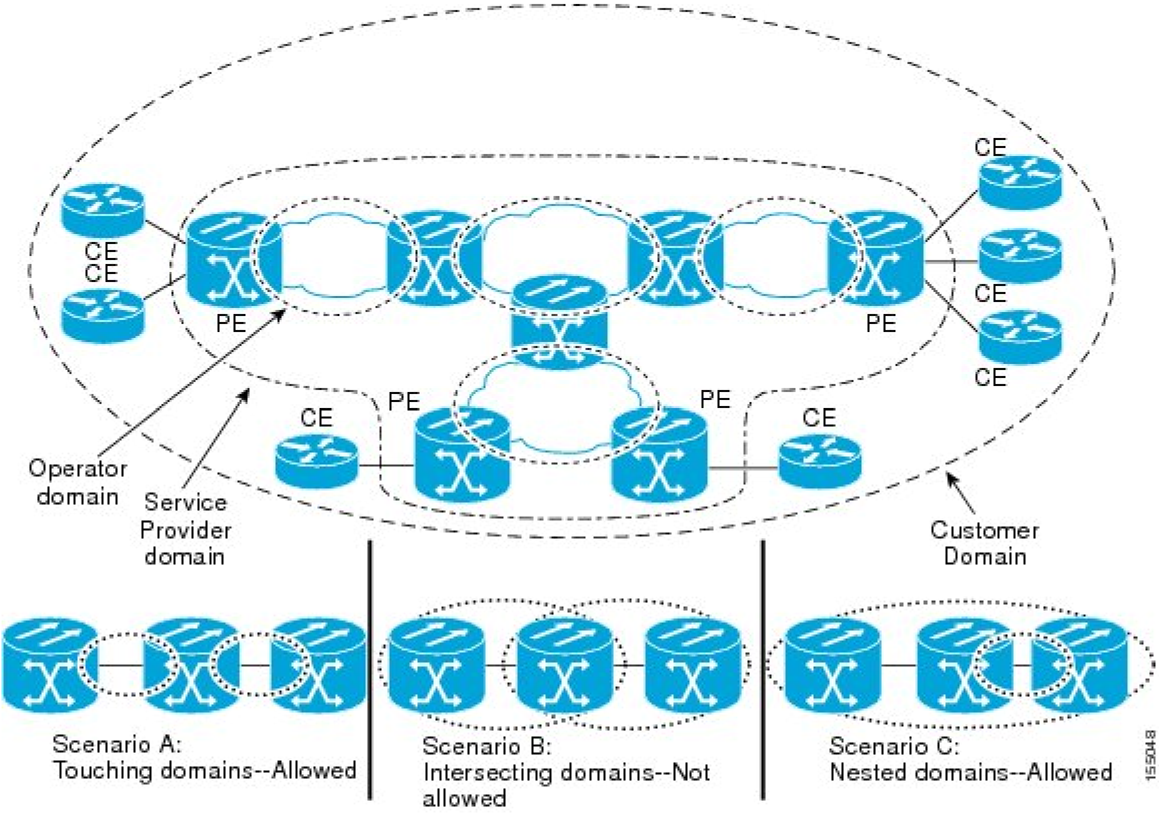
The following characteristics of maintenance domains are supported:

- Maintenance domains are identified by a unique domain name that can be up to 154 characters.
- The domain name as null is supported; the maintenance association name is used as the identifier.

- Domain configuration is not required for devices that have only Maintenance Intermediate Points (MIPs).
- Mix of Up (toward the bridge) and Down (toward the wire) Maintenance Association End Points (MEPs) is supported.

A domain can be removed when all the maintenance points within the domain have been removed and all the remote MEPs entries in the continuity check database (CCDB) for the domain have been purged.

The following figure illustrates a hierarchy of operator, service provider, and customer domains and also illustrates touching, intersecting, and nested domains.



DLP-J309 Create a Maintenance Domain Using Cisco IOS Commands

Purpose	This procedure creates a maintenance domain using Cisco IOS commands.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

	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	**ethernet cfm domain** *domain-name* **level** *level-id* **Example:** Router(config)# ethernet cfm domain customer level 7	Creates a CFM maintenance domain at a specific maintenance level and enters Ethernet CFM configuration mode. The range of the maintenance domain level is from 0 to 7. **Note** You can create several maintenance domains at the same maintenance level. However, you cannot create a maintenance domain at several maintenance levels.
Step 4	**end** **Example:** Router(config)# end	Returns to privileged EXEC mode.
Step 5	Return to your originating procedure (NTP).	—

Example: Create a Maintenance Domain

The following example shows how to define a domain named domain1 at level 6 and enters Ethernet CFM configuration mode:

```
Router> enable
Router# configure terminal
Router(config)# ethernet cfm domain domain1 level 6
Router(config-ecfm)#
```

DLP-J301 Create and Modify a Maintenance Domain Profile Using CTC

Purpose	This procedure creates or modifies a maintenance domain profile using CTC.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed

Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Step 1 Complete the NTP-J22 Log into CTC procedure at a node where you want to create or modify a maintenance domain profile.

Step 2 Right-click the fabric or line card and choose **Open Packet Transport System View**. The Packet Transport System View dialog box appears.

Step 3 Click the **Provisioning** tab.

Step 4 In the left pane, click **CFM**.

Step 5 Click the **Domain Profiles** tab.

Step 6 Click **Add row(s)**.

Step 7 Enter the name of the domain in the Domain Name field.

Step 8 Enter the level of the domain profile in the Level field. The domain profile level ranges from 0 to 7.

Step 9 Check the **Sender Id** check box to include the contents of the Sender ID time-length-value (TLV) field transmitted in CFM messages for members of a maintenance domain.

Step 10 Check the **Auto Create MIP** check box to allow the automatic creation of an MIP at this maintenance domain level.

Step 11 Check the **Lower MEP** check box. When this check box and **Auto Create MIP** check box are checked, auto MIPs are created at a specified level only where an MEP is configured at the next lower level for a maintenance domain.

Step 12 Enter a value in the Archive Hold Timer field to specify the number of minutes that data from a missing MEP is kept before it is purged. The default value is 100 minutes. The range is from 1 to 65535 minutes.

Step 13 Click **Store**.

Step 14 In the CFM Profile Storing dialog box, choose the node and shelf where you want to store this domain profile and click **OK**.

Step 15 To modify a maintenance domain profile, double-click the required parameters, change the values, and click **Apply**.

Step 16 Return to your originating procedure (NTP).

DLP-J302 Delete a Maintenance Domain Profile Using CTC

Purpose	This procedure deletes a maintenance domain profile using CTC.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed

Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Step 1 Complete the NTP-J22 Log into CTC procedure at a node where you want to delete a maintenance domain profile.

Step 2 Right-click the fabric or line card and choose **Open Packet Transport System View**. The Packet Transport System View dialog box appears.

Step 3 Click the **Provisioning** tab.

Step 4 In the left pane, click **CFM**.

Step 5 Click the **Domain Profiles** tab.

Step 6 Click **Load** to load the maintenance domain profiles from the system. The CFM Profile Loading dialog box appears.

Step 7 Choose the shelf and click **OK**. The domain profiles appear in the Domain Profiles tab.

Step 8 Choose a domain profile to delete.

Step 9 Check the **On Node** check box.

Step 10 Click **Delete Sel row(s)**. The CFM Profile Deleting dialog box appears.

Step 11 Choose the shelf to delete the domain profile from and click **OK**.

Step 12 Click **Yes** in the confirmation dialog box.

Step 13 Return to your originating procedure (NTP).

Understanding Maintenance Association

There can be any number of maintenance associations (MA) within a maintenance domain. A maintenance association identifies a service that can be uniquely identified within the maintenance domains. The CFM protocol runs within a specific maintenance association.

The MA direction is specified when the MA is configured. The MA name must be configured on a domain before MEPs can be configured. Configuring an MA is not required for devices that have only MIPs.

DLP-J334 Create a Maintenance Association Using Cisco IOS Commands

Purpose	This procedure creates a maintenance association using Cisco IOS commands.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed

Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

	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	**ethernet cfm domain** *domain-name* **level** *level-id* **Example:** Router(config)# ethernet cfm domain Customer level 7	Creates a maintenance domain at a specified level and enters Ethernet CFM configuration mode.
Step 4	**service** {*ma-name* | **number** *ma-num*} {**evc** *evc-name* | **port** } [**direction down**] **Example:** Router(config-ecfm)# service Customer1 port	Creates a maintenance association within a maintenance domain and enters CFM service configuration mode.
Step 5	**exit** **Example:** Router(config-ecfm)# exit	Returns to global configuration mode.
Step 6	Return to your originating procedure (NTP).	—

Example: Create a Maintenance Association

The following example shows how to create a maintenance association using Cisco IOS commands:

```
Router> enable
Router# configure terminal
Router(config)# ethernet cfm domain operator level 5
Router(config-ecfm)# service operatorA port
Router(config-ecfm)# exit
```

DLP-J333 Configure CFM Encapsulation Using Cisco IOS Commands

Purpose	This procedure configures CFM encapsulation using Cisco IOS commands.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

	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:** Router(config)# interface TenGigabitEthernet 4/1	Specifies the interface to configure and enters interface configuration mode.
Step 4	**service instance** *id* **ethernet** [*evc-id*] **Example:** Router(config-if)# service instance 101 ethernet	Configures an Ethernet service instance on an interface and enters service instance configuration mode.
Step 5	**encapsulation dot1q** {*any* | *vlan-id* [*vlan-id* [-*vlan-id*]]} **second-dot1q** {*any* | *vlan-id* [*vlan-id* [-*vlan-id*]]} **Example:** Router(config-if-srv)# encapsulation dot1q 100-110 second dot1q 200	Defines the matching criteria that maps the ingress dot1q, QinQ, or untagged frames on an interface to the appropriate service instance.

	Command or Action	Purpose
Step 6	**bridge-domain** *bridge-id* [**split-horizon**] **Example:** Router(config-if-srv)# bridge-domain 12	Binds the Ethernet service instance to a bridge domain instance where *bridge-id* is the identifier for the bridge domain instance.
Step 7	**cfm encapsulation** {**dot1ad** *vlan-id* | **dot1q** *vlan-id*} [**dot1q** *vlan-id* | **second-dot1q** *vlan-id*] **Example:** Router(config-if-srv)# cfm encapsulation dot1q 105 second dot1q 200	Defines the matching criteria that maps the ingress dot1q, QinQ, or untagged frames on an interface to the appropriate service instance.
Step 8	**exit** **Example:** Router(config-if-srv)# exit	Exits the service instance configuration mode.
Step 9	**exit** **Example:** Router(config-if)# exit	Returns to global configuration mode.
Step 10	**end** **Example:** Router(config)# end	Returns to privileged EXEC mode.
Step 11	Return to your originating procedure (NTP).	—

DLP-J303 Create and Modify a Maintenance Association Profile Using CTC

Purpose	This procedure creates or modifies a maintenance association profile using CTC.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Step 1 Complete the NTP-J22 Log into CTC procedure at a node where you want to create or modify a maintenance association profile.

Step 2 Right-click the fabric or line card and choose **Open Packet Transport System View**. The Packet Transport System View dialog box appears.

Step 3 Click the **Provisioning** tab.

Step 4 In the left pane, click **CFM**.

Step 5 Click the **MA Profiles** tab.

Step 6 Click **Add row(s)**.

Step 7 Enter the name of the maintenance association profile in the Maintenance Profile Name field.

Step 8 Enter the unique ID used to represent a service in the Service ID field.
Service IDs identify customers within a domain. A service ID must be unique within a single maintenance domain.

Step 9 Check the **CC Enable** check box to globally enable transmission of Continuity Check Messages (CCMs).

Step 10 From the CC Interval drop-down list, choose the interval to transmit CCMs.
The valid values are as follows:

- 100 ms—100 milliseconds
- 1 sec—1 second
- 10 sec—10 seconds
- 1 min—1 minute
- 10 min—10 minutes

Step 11 Enter the number of CCMs that must be missed before declaring that a remote MEP is down, in the CC Threshold field.
The range is from 2 to 255. The default value is 3.

Step 12 Check the **Direction Down** check box to configure the service direction toward the LAN.

Step 13 Enter the maintenance domain name in the Domain Name field to attach this maintenance association profile to a maintenance domain profile.

Step 14 Check the **Auto Create MIP** check box to dynamically create an MIP.

Step 15 Check the **Port** check box to create a port MEP.

Step 16 Check the **Lower MEP Only** check box. When this check box and **Auto Create MIP** check box are checked, auto MIPs are created at a specified level only where an MEP is configured at the next lower level for a maintenance domain.

Step 17 Check the **CFM EFM Interaction** check box to enable the CFM and EFM protocols to interoperate.
CFM and EFM can interoperate together and can co-exist on the same port. CFM and EFM cannot interoperate together if CFM MEP is configured on the channel group. Use the **oam protocol cfm domain** *domain-name* to configure CFM and EFM to interoperate together using Cisco IOS commands.

Step 18 Enter the static MEP ID or a list of static MEP IDs in the Static MEP Id field to statically specify the MEP IDs. The range is from 1 to 8191.

Step 19 Check the **MEP Cross Check Enable** check box to enable cross-checking between the list of configured remote MEPs of a domain and MEPs learned through CCMs.

Step 20 Enter the outer dot1q encapsulation tag value in the Outer CFM Encapsulation field.

Step 21 Enter the inner dot1q encapsulation tag value in the Inner CFM Encapsulation field.

Step 22 Click **Store**.

Step 23 Choose the node and shelf where you want to store this maintenance association profile and click **OK**.

Step 24 To modify a maintenance association profile, double-click the required parameters, change the values, and click **Apply**.

Step 25 Return to your originating procedure (NTP).

DLP-J304 Delete a Maintenance Association Profile Using CTC

Purpose	This procedure deletes a maintenance association profile using CTC.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Step 1 Complete the NTP-J22 Log into CTC procedure at a node where you want to delete a maintenance association profile.

Step 2 Right-click the fabric or line card and choose **Open Packet Transport System View**. The Packet Transport System View dialog box appears.

Step 3 Click the **Provisioning** tab.

Step 4 In the left pane, click **CFM**.

Step 5 Click the **MA Profiles** tab.

Step 6 Click **Load** to load the maintenance association profiles from the system. The CFM Profile Loading dialog box appears.

Step 7 Choose the shelf and click **OK**. The maintenance association profiles appear in the MA Profiles tab.

Step 8 Choose an association profile to delete.

Step 9 Check the **On Node** check box.

Step 10 Click **Delete Sel row(s)**. The CFM Profile Deleting dialog box appears.

Step 11 Choose the shelf to delete the association profile from and click **OK**.

Step 12 Click **Yes** in the confirmation dialog box.

Step 13 Return to your originating procedure (NTP).

Understanding Maintenance Point

Any port of a bridge is referred to as a Maintenance Point. A maintenance point is a demarcation point on an interface or port that participates in CFM within a maintenance domain. Maintenance points must be explicitly configured on Cisco devices.

There are two classes of maintenance points:

- Maintenance End Points (MEPs)
- Maintenance Intermediate Points (MIPs)

Understanding Maintenance End Points

MEPs reside at the edge of a maintenance domain and are active elements of CFM. They confine CFM messages within the domain through the maintenance domain level. MEPs periodically transmit and receive continuity check messages (CCMs) from other MEPs within the domain. MEPs also transmit linktrace and loopback messages at the request of the administrator.

MEP ID uniquely identifies each MEP along with those configured on a single MA. The MEP IDs range from 1 to 8191.

There are two types of MEPs:

- Up (inwards, toward the bridge). This is the default.

- Down (outwards, toward the wire).

MEP supports multicast loopbacks and pings. When a multicast ping is initiated for a particular domain or service, all the related remote MEPs reply to the ping.

MEP configurations can be removed after all pending loopback and linktrace replies are removed and the service on the interface is set to transparent mode. To set the service to transparent mode, MIP filtering must not be configured.

Understanding Up MEPs

An Up MEP is an MEP that resides in a bridge and transmits to and receives CFM messages from the direction of the bridge relay entity.

An Up MEP performs the following functions:

- Sends and receives CFM frames at its level through the bridge relay and not through the wire connected to the port on which the MEP is configured.
- Drops all CFM frames at its level (or lower level) that come from the direction of the wire.
- Processes all CFM frames at its level coming from the direction of the bridge.
- Drops all CFM frames at a lower level coming from the direction of the bridge.
- Forwards all CFM frames transparently at a higher level, independent of whether they came in from the bridge or wire.

Understanding Down MEPs

A Down MEP is an MEP that resides in a bridge and transmits to and receives CFM messages from the direction of the wire.

A Down MEP performs the following functions:

- Sends and receives CFM frames at its level through the wire connected to the port where the MEP is configured.
- Drops all CFM frames at its level (or at a lower level) that come from the direction of the bridge.
- Processes all CFM frames at its level coming from the direction of the wire.
- Drops all CFM frames at a lower level coming from the direction of the wire.
- Forwards all CFM frames transparently at a higher level, independent of whether they came in from the bridge or wire.

Understanding Port MEPs

CPT also supports Port MEP at the physical port. A port MEP can be created either on the physical port or on the port of a channel group. The port MEP takes higher precedence if both the port MEP and the Down MEP on untagged EFP is created on the same port.

Understanding the Cross-Check Function

The cross-check function is a timer-driven post-provisioning service verification between dynamically discovered MEPs (through CCMs) and expected MEPs (through configuration) for a service. The cross-check function verifies that all the endpoints of a multipoint or point-to-point service are operational. The function supports notifications when the service is operational; otherwise it provides alarms and notifications for unexpected or missing endpoints.

You must initiate the cross-check function each time you want a service verification. See DLP-J323 Configure Cross-Check for an MEP Using Cisco IOS Commands, on page 52.

DLP-J310 Create a Port MEP Using Cisco IOS Commands

Purpose	This procedure creates a port MEP using Cisco IOS commands.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

	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:** Router(config)# interface TenGigabitEthernet 4/1	Specifies the interface to configure and enters interface configuration mode.
Step 4	**ethernet cfm mep domain** *domain-name* **mpid** *mpid* {**port**} **Example:**	Sets a port as internal to a maintenance domain and creates a port MEP. A port MEP can be created only on a physical port or on a port of a channel group.

	Command or Action	Purpose
	Router(config-if)# ethernet cfm mep domain Customer mpid 701 port	
Step 5	**exit** **Example:** Router(config-if)# exit	Returns to global configuration mode.
Step 6	**end** **Example:** Router(config)# end	Returns to privileged EXEC mode.
Step 7	Return to your originating procedure (NTP).	—

Example: Create a Port MEP

The following example shows how to set a port as internal to a maintenance domain and creates a port MEP:

```
Router> enable
Router# configure terminal
Router(config)# interface TenGigabitEthernet 4/1
Router(config-if)# ethernet cfm mep domain CustomerB mpid 5 port
```

DLP-J321 Create an MEP for an EFP Using Cisco IOS Commands

Purpose	This procedure creates an MEP for an EFP using Cisco IOS commands.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** Router> enable	Enables privileged EXEC mode. • Enter your password if prompted.

	Command or Action	Purpose
Step 2	**configure terminal** **Example:** Router# configure terminal	Enters global configuration mode.
Step 3	**interface** *type number* **Example:** Router(config)# interface TenGigabitEthernet 4/1	Specifies the interface to configure and enters interface configuration mode.
Step 4	**service instance** *id* **ethernet** [*evc-id*] **Example:** Router(config-if)# service instance 101 ethernet	Configures an Ethernet service instance on an interface and enters service instance configuration mode.
Step 5	**encapsulation dot1q** {*any* | *vlan-id* [*vlan-id* [-*vlan-id*]]} **second-dot1q** {*any* | *vlan-id* [*vlan-id* [-*vlan-id*]]} **Example:** Router(config-if-srv)# encapsulation dot1q 100 second dot1q 200	Defines the matching criteria that maps the ingress dot1q, QinQ, or untagged frames on an interface to the appropriate service instance.
Step 6	**bridge-domain** *bridge-id* [**split-horizon**] **Example:** Router(config-if-srv)# bridge-domain 12	Binds the Ethernet service instance to a bridge domain instance where *bridge-id* is the identifier for the bridge domain instance.
Step 7	**cfm mep domain** *domain-name* **mpid** *mpid-value* **Example:** Router(config-if-srv)# cfm mep domain Customer mpid 701	Creates an MEP under the Ethernet service instance.
Step 8	**exit** **Example:** Router(config-if-srv)# exit	Exits the service instance configuration mode.
Step 9	**exit** **Example:** Router(config-if)# exit	Returns to global configuration mode.
Step 10	**end** **Example:** Router(config)# end	Returns to privileged EXEC mode.

	Command or Action	Purpose
Step 11	Return to your originating procedure (NTP).	—

Example: Create an MEP for an EFP

The following example shows how to create an MEP for an EFP using Cisco IOS commands:

```
Router> enable
Router# configure terminal
Router(config)# interface TenGigabitEthernet 4/1
Router(config-if)# service instance 101 ethernet
Router(config-if-srv)# encapsulation  dot1q 100
Router(config-if-srv)# bridge-domain 12
Router(config-if-srv)# cfm mep domain CustomerB mpid 5
Router(config-if-srv)# exit
```

DLP-J319 Define MEPs Statically within a Maintenance Association Using Cisco IOS Commands

Purpose	This procedure statically defines MEPs within a maintenance association using Cisco IOS commands.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

	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	**ethernet cfm domain** *domain-name* **level** *level-id*	Defines a CFM domain at a specified level and enters Ethernet CFM configuration mode. The

	Command or Action	Purpose
	Example: Router(config)# ethernet cfm domain Customer level 7	range of maintenance domain level is from 0 to 7.
Step 4	**service** {*ma-name* | **number** *ma-num*} {**evc** *evc-name* | **port** } [**direction down**] **Example:** Router(config-ecfm)# service Customer1 port	Configures a maintenance association within a maintenance domain for a port MEP or MEP for an EFP and enters CFM service configuration mode.
Step 5	**mep mpid** *mpid* **Example:** Router(config-ecfm-srv)# mep mpid 702	Statically defines the MEPs within a maintenance association.
Step 6	**exit** **Example:** Router(config-ecfm-srv)# exit	Returns to Ethernet CFM configuration mode.
Step 7	**exit** **Example:** Router(config-ecfm)# exit	Returns to global configuration mode.
Step 8	Return to your originating procedure (NTP).	—

Example: Define the MEPs Statically within a Maintenance Association

The following example shows how to configure an MEP with an ID of 25 using Cisco IOS commands:

```
Router> enable
Router# configure terminal
Router(config)# ethernet cfm domain operator level 5
Router(config-ecfm)# service operatorA port
Router(config-ecfm-srv)# mep mpid 25
Router(config-ecfm-srv)# exit
Router(config-ecfm)# exit
```

DLP-J318 Specify the Number of MEPs in a Maintenance Association Using Cisco IOS Commands

Purpose	This procedure allows you to specify the number of MEPs in a maintenance association using Cisco IOS commands.
Tools/Equipment	None

Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

	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	**ethernet cfm domain** *domain-name* **level** *level-id* **Example:** Router(config)# ethernet cfm domain Customer level 7	Defines a CFM domain at a specified level and enters Ethernet CFM configuration mode. The range of maintenance domain level is from 0 to 7.
Step 4	**service** {*ma-name* | **number** *ma-num*} {**evc** *evc-name* | **port**} [**direction down**] **Example:** Router(config-ecfm)# service Customer1 port	Configures a maintenance association within a maintenance domain for a port MEP or MEP for an EFP and enters CFM service configuration mode.
Step 5	**maximum meps** *max-num* **Example:** Router(config-ecfm-srv)# maximum meps 50	Specifies the maximum number of MEPs in a maintenance association. The default is 100. The range is from 1 to 65535.
Step 6	**exit** **Example:** Router(config-ecfm-srv)# exit	Returns the CLI to Ethernet CFM configuration mode.
Step 7	**exit** **Example:** Router(config-ecfm)# exit	Returns to global configuration mode.
Step 8	Return to your originating procedure (NTP).	—

Example: Specify the Number of MEPs in a Maintenance Association

The following example shows how to configure a maximum of 50 MEPs using Cisco IOS commands:

```
Router> enable
Router# configure terminal
Router(config)# ethernet cfm domain operator level 5
Router(config-ecfm)# service operatorA port
Router(config-ecfm-srv)# maximum meps 50
Router(config-ecfm-srv)# exit
Router(config-ecfm)# exit
```

DLP-J323 Configure Cross-Check for an MEP Using Cisco IOS Commands

Purpose	This procedure configures cross-checking for an MEP using Cisco IOS commands.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

	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	**ethernet cfm domain** *domain-name* **level** *level-id* **Example:** Router(config)# ethernet cfm domain ServiceProvider level 4	Creates a maintenance domain at a specified level and enters Ethernet CFM configuration mode. The range of maintenance domain level is from 0 to 7.

	Command or Action	Purpose
Step 4	**service** {*ma-name* | **number** *ma-num*} {**evc** *evc-name* | **port** } [**direction down**] **Example:** Router(config-ecfm)# service Customer1 port	Configures a maintenance association within a maintenance domain and enters CFM service configuration mode.
Step 5	**mep mpid** *mpid* **Example:** Router(config-ecfm-srv)# mep mpid 702	Statically defines the MEPs within a maintenance association.
Step 6	**exit** **Example:** Router(config-ecfm-srv)# exit	Returns to Ethernet CFM configuration mode.
Step 7	**exit** **Example:** Router(config-ecfm)# exit	Returns to global configuration mode.
Step 8	**ethernet cfm mep crosscheck start-delay** *delay* **Example:** Router(config)# ethernet cfm mep crosscheck start-delay 60	Configures the maximum amount of time that the device waits for remote MEPs to come up before the cross-check operation is started. The default value is 30 seconds. The range is from 1 to 65535 seconds.
Step 9	**exit** **Example:** Router(config)# exit	Returns to privileged EXEC mode.
Step 10	**ethernet cfm mep crosscheck** {**enable** | **disable**} **domain** *domain-name* **port** **Example:** Router# ethernet cfm mep crosscheck enable domain cust4 port	Enables cross-checking between the list of configured remote MEPs of a domain and MEPs learned through CCMs.
Step 11	Return to your originating procedure (NTP).	—

DLP-J306 Create an MEP Using CTC

Purpose	This procedure creates a maintenance end point using CTC.

Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Step 1 Complete the NTP-J22 Log into CTC procedure at a node where you want to create a maintenance end point.

Step 2 Right-click the fabric or line card and choose **Open Packet Transport System View**. The Packet Transport System View dialog box appears.

Step 3 Click the **Provisioning** tab.

Step 4 In the left pane, click **CFM**.

Step 5 Click the **MEP** tab.

Step 6 Click **Create**. The Create MEP dialog box appears.

Step 7 To create an MEP on an EFP:

a) Choose the **Service Id** option.

b) From the Domain drop-down list, choose a maintenance domain.

c) Enter the service id in the Service ID field.

d) Enter the maintenance point ID (MPID) in the MPID field.
The MPID ranges from 1 to 8191. The MPID must not be the same between the maintenance end points.

e) Enter the class-of-service (CoS) for CFM packets in the COS field.
The range of CoS is from 0 to 7.

Step 8 To create an MEP on a port:

Note A port MEP can be created only on a physical port or on a port of a channel group.

a) Choose the **Port** option.

b) From the Slot drop-down list, choose a fabric card or a line card slot.

c) From the Port drop-down list, choose a port.

d) From the Domain drop-down list, choose a maintenance domain.

e) Enter the maintenance point ID (MPID) in the MPID field.
The MPID ranges from 1 to 8191. The MPID must not be the same between the maintenance end points.

f) Enter the class-of-service (CoS) for CFM packets in the COS field.
The range of CoS is from 0 to 7.

Step 9 To create an MEP on a channel group:

a) Check the **MEP on Ch.Grp** check box.

b) From the Domain drop-down list, choose a maintenance domain.

c) Enter the service id in the Service ID field.

d) Enter the maintenance point ID (MPID) in the MPID field.
The MPID ranges from 1 to 8191. The MPID must not be the same between the maintenance end points.

e) Enter the class-of-service (CoS) for CFM packets in the COS field.
The range of CoS is from 0 to 7.

f) From the Ch Grp drop-down list, choose a channel group.

Step 10 Click **OK** in the Create MEP dialog box to create an MEP.

Step 11 To delete an MEP:

a) Choose an MEP to delete in the MEP tab.
b) Click **Delete**.
c) Click **Yes** in the Delete MEP dialog box.

Step 12 Return to your originating procedure (NTP).

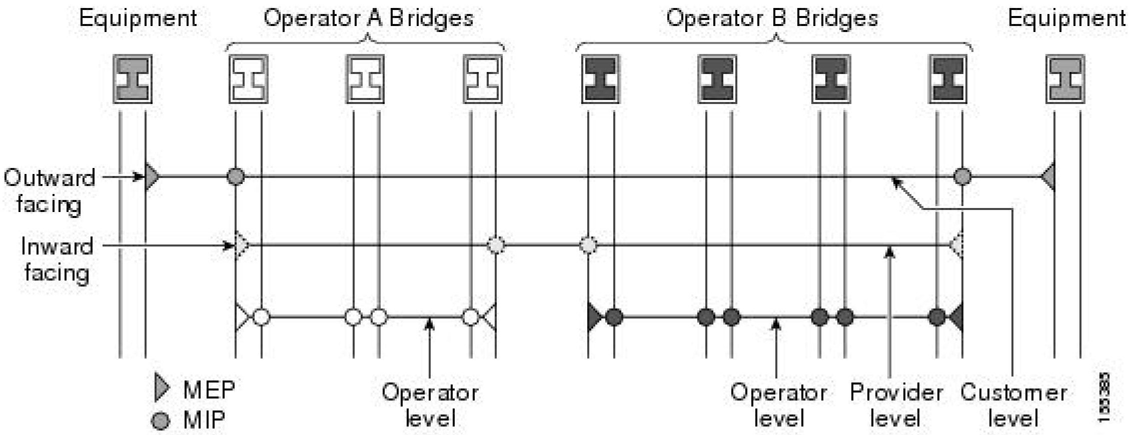
Understanding Maintenance Intermediate Points

Maintenance intermediate points (MIPs) are internal to the maintenance domain and are passive elements of CFM. They store information received from MEPs and other MIPs and respond only to CFM linktrace and loopback messages. An MIP has only one level associated with it. MIPs forward CFM messages within a maintenance domain.

MIPs are defined as two MIP half functions (MHFs)—An Up MHF that resides above the port filtering entities and a Down MHF that resides below the port filtering entities. The same configuration parameters and characteristics apply to both MHFs of an MIP:

- Can be created manually or dynamically (auto MIPs).
- Dynamically created depending on configured policies at managed objects (MA, maintenance domain, or the default domain level).
- Manual MIPs can be created under an interface and under a service instance within an interface.
- Auto MIP commands can be issued globally or under a domain or service.
- Can be created per MA, which means that an MIP in the MA can be lower level than an MEP in another MA.
- CFM frames received from MEPs and other MIPs are cataloged and forwarded, using both the wire and the bridge relay.
- When MIP filtering is enabled, all CFM frames at a lower level are stopped and dropped, independent of whether they originate from the wire or the bridge relay.
- All CFM frames at a higher level are forwarded, independent of whether they arrive from the wire or from the bridge relay.
- Passive points respond only when triggered by CFM linktrace and loopback messages.

The following figure illustrates MEPs and MIPs at the operator, service provider, and customer levels.



DLP-J311 Create an MIP Dynamically Using Cisco IOS Commands

Purpose	This procedure creates an MIP dynamically using Cisco IOS commands.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Note **ethernet cfm mip auto-create** command has lower precedence than the **ethernet cfm mip level** manual MIP command. For example, if you manually configure an MIP for a particular maintenance association, that configuration overrides the MIP created by the global **ethernet cfm mip auto-create** command for that maintenance association.

Procedure

	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.

	Command or Action	Purpose
Step 3	**ethernet cfm mip** {**auto-create level** *level-id* [**lower-mep-only**] [**sender-id chassis**] | **filter**} **Example:** Router(config)# ethernet cfm mip auto-create level 1	Dynamically creates an MIP and provisions it globally at a specified maintenance level and enables level filtering.
Step 4	**end** **Example:** Router(config)# end	Returns to privileged EXEC mode.
Step 5	Return to your originating procedure (NTP).	—

Example: Create an MIP Dynamically

The following example shows how to dynamically create an MIP at maintenance level 6 using Cisco IOS commands:

```
Router> enable
Router# configure terminal
Router(config)# ethernet cfm mip auto-create level 6
```

DLP-J322 Create an MIP Manually Using Cisco IOS Commands

Purpose	This procedure creates an MIP manually using Cisco IOS commands.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Note You cannot configure an MIP at a level lower than the level of already configured maintenance endpoints (MEPs) on an interface. Configuring an MIP using this command is known as a manual MIP and has precedence over the **ethernet cfm mip auto-create** command.

Procedure

	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:** Router(config)# interface TenGigabitEthernet 4/1	Specifies the interface to configure and enters interface configuration mode.
Step 4	**ethernet cfm mip level** *level-id* **Example:** Router(config-if)# ethernet cfm mip level 1	Creates an MIP manually at a specified maintenance level on an interface. The range of level is from 0 to 7.
Step 5	**exit** **Example:** Router(config-if)# exit	Returns to global configuration mode.
Step 6	**end** **Example:** Router(config)# end	Returns to privileged EXEC mode.
Step 7	Return to your originating procedure (NTP).	—

Example: Create an MIP Manually

The following example shows how to provision an MIP manually at maintenance level 5 using Cisco IOS commands.

```
Router> enable
Router# configure terminal
Router(config)# interface TenGigabitEthernet 4/1
Router(config-if)# ethernet cfm mip level 5
Router(config-if)# exit
```

DLP-J307 Create an MIP Using CTC

Purpose	This procedure creates a maintenance intermediate point with a specific maintenance level using CTC.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Step 1 Complete the NTP-J22 Log into CTC procedure at a node where you want to create a maintenance intermediate point.

Step 2 Right-click the fabric or line card and choose **Open Packet Transport System View**. The Packet Transport System View dialog box appears.

Step 3 Click the **Provisioning** tab.

Step 4 In the left pane, click **CFM**.

Step 5 Click the **MIP** tab.

Step 6 Click **Create**. The Create MIP dialog box appears.

Step 7 To create an MIP on an EFP:

a) Choose the **service Id** option.
b) From the Slot drop-down list, choose a fabric card or a line card slot.
c) From the Port drop-down list, choose a port.
d) From the Level drop-down list, choose a maintenance level. The maintenance level ranges from 0 to 7.
e) Enter the service id in the ServiceId field.

Step 8 To create an MIP on a channel group:

a) Check the **MIP on Ch.Grp** check box.
b) From the Level drop-down list, choose a maintenance level. The maintenance level ranges from 0 to 7.
c) Enter the service id in the ServiceId field.
d) From the Ch Grp drop-down list, choose a channel group.

Step 9 Click **OK** in the Create MIP dialog box to create an MIP.

Step 10 To delete an MIP:

a) Choose an MIP to delete in the MIP tab.
b) Click **Delete**.
c) Click **Yes** in the Delete MIP dialog box.

Step 11 Return to your originating procedure (NTP).

Understanding CFM Messages

CFM uses standard Ethernet frames that can be distinguished by their EtherType and for multicast messages by their MAC address. CFM frames are sourced, terminated, processed, and relayed by bridges.

Bridges that cannot interpret CFM messages forward them as normal data frames. All CFM messages are confined to a maintenance domain and to a maintenance association. Three types of messages are supported:

- Continuity Check
- Linktrace
- Loopback

Understanding Continuity Check Messages

CFM continuity check messages (CCMs) are multicast heartbeat messages exchanged periodically among MEPs. They allow MEPs to discover other MEPs within a domain and allow MIPs to discover MEPs. CCMs are confined to a domain.

CFM CCMs have the following characteristics:

- Transmitted at a periodic interval by MEPs. The interval can be one of the following configurable values. The default is 10 seconds.
    - 100 milliseconds
    - 1 second
    - 10 seconds
    - 1 minute
    - 10 minutes
- Cataloged by MIPs at the same maintenance level.
- Terminated by remote MEPs at the same maintenance level.
- Unidirectional and do not solicit a response.
- Indicate the status of the bridge port on which the MEP is configured.

DLP-J316 Enable the Transmission of Continuity Check Messages Using Cisco IOS Commands

Purpose	This procedure enables the transmission of continuity check messages (CCM) using Cisco IOS commands.
Tools/Equipment	None
Prerequisite Procedures	None

Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

	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	**ethernet cfm domain** *domain-name* **level** *level-id* **Example:** Router(config)# ethernet cfm domain Customer level 7	Creates a CFM maintenance domain at a specified maintenance level and enters Ethernet CFM configuration mode. The range of maintenance domain level is from 0 to 7.
Step 4	**service** {*ma-name* | **number** *ma-num*} {**evc** *evc-name* | **port** } [**direction down**] **Example:** Router(config-ecfm)# service Customer1 port	Configures a maintenance association within a maintenance domain for a port MEP or MEP for an EFP and enters CFM service configuration mode.
Step 5	**continuity-check** [**interval** *time* | **loss-threshold** *threshold* | **static rmep**] **Example:** Router(config-ecfm-srv)# continuity-check	Enables the transmission of CCMs.
Step 6	**continuity-check** [**interval** *time* | **loss-threshold** *threshold* | **static rmep**] **Example:** Router(config-ecfm-srv)# continuity-check interval 10s	Configures the time period between CCM transmissions.
Step 7	**continuity-check** [**interval** *time* | **loss-threshold** *threshold* | **static rmep**] **Example:** Router(config-ecfm-srv)# continuity-check lossthreshold 10	Sets the number of CCMs that must be missed before declaring that a remote MEP is down.

	Command or Action	Purpose
Step 8	**exit** **Example:** Router(config-ecfm-srv)# exit	Returns to Ethernet CFM configuration mode.
Step 9	**mep archive-hold-time** *minutes* **Example:** Router(config-ecfm)# mep archive-hold-time 60	Sets the amount of time that data from a missing MEP is kept in the continuity check database or that entries are held in the error database before they are purged. The default value is 100 minutes. The range is from 1 to 65535 minutes.
Step 10	**exit** **Example:** Router(config-ecfm)# exit	Returns to global configuration mode.
Step 11	Return to your originating procedure (NTP).	—

Example: Enable the Transmission of Continuity Check Messages

The following example shows how to configure a loss threshold of 50 CCMs using Cisco IOS commands:

```
Router> enable
Router# configure terminal
Router(config)# ethernet cfm domain operator level 5
Router(config-ecfm)# service operatorA port
Router(config-ecfm-srv)# continuity-check loss-threshold 50
Router(config-ecfm-srv)# exit
Router(config-ecfm)# exit
```

Understanding Loopback Messages

CFM loopback messages (LBMs) are unicast frames that an MEP transmits, at the request of an administrator, to verify connectivity to a specific maintenance point. A loopback message reply (LBR) indicates whether a destination is reachable but does not allow hop-by-hop discovery of the path. A loopback message is similar in concept to an Internet Control Message Protocol (ICMP) Echo (ping) message.

Since LBMs are unicast messages, they are forwarded like normal data frames except with the maintenance level restriction. If the outgoing port is known in the forwarding database of the bridge and allows CFM frames at the maintenance level of the image to pass through, the frame is sent out on that port. If the outgoing port is unknown, the message is broadcast on all the ports in that domain.

A CFM LBM can be generated on demand using the CLI. The source of a loopback message must be an MEP; the destination may be an MEP or MIP. Both CFM LBMs and LBRs are unicast. CFM LBMs specify the destination MAC address or MPID, VLAN, and maintenance domain.

Understanding Linktrace Messages

CFM linktrace messages (LTMs) are multicast frames that an MEP transmits, at the request of an administrator, to track the path (hop-by-hop) to a destination MEP. They are similar to Layer 3 traceroute messages. LTMs allow the transmitting node to discover vital connectivity data about the path and allow the discovery of all MIPs along the path that belong to the same maintenance domain. LTMs are intercepted by maintenance points along the path and processed, transmitted, or dropped. At each hop where there is a maintenance point at the same level, a linktrace message reply (LTR) is transmitted back to the originating MEP. For each visible MIP, linktrace messages indicate ingress action, relay action, and egress action. LTMs are multicast and LTRs are unicast.

DLP-J324 Send CFM Loopback and Linktrace Messages Using Cisco IOS Commands

Purpose	This procedure allows you to send CFM loopback and traceroute messages to a destination MAC address using Cisco IOS commands.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** Router> enable	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**ping ethernet** {**mpid** *mpid* | *mac-address*} {**domain** *domain-name*} {**port** | **evc** *evc-name*} [**source** *source-mpid*] [**cos** *cos-value*] **Example:** Router(config)# ping ethernet 1010.pcef.1010 level 2 evc evc5	Sends CFM loopback messages to the destination MEP through MAC address or MPID.

	Command or Action	Purpose
Step 3	**traceroute ethernet** {**mpid** *mpid* | *mac-address*} {**domain** *domain-name*} {**port** | **evc** *evc-name*} [**cos** *cos-value*] [**fdb-only**] **Example:** Router(config)# traceroute ethernet aabb.cc00.1010 level 4 evc evc_100	Sends CFM traceroute messages to the destination MEP through MAC address or MPID.
Step 4	Return to your originating procedure (NTP).	—

Example: Send CFM Loopback and Traceroute Messages

The following example shows how to send an Ethernet CFM loopback message to MAC address 1010.pcef.1010 on evc5:

```
Router> enable
Router# ping ethernet 1010.pcef.1010 domain domain1 evc evc5
```

The following example shows how to send an Ethernet CFM traceroute message to MAC address aabb.cc00.1010 at maintenance level 4 on evc_100

```
Router> enable
Router# traceroute ethernet aabb.cc00.1010 domain domain1 evc evc_100
```

NTP-J107 Perform ping and traceroute Operations on Services Using CTC

Purpose	This procedure performs ping and traceroute operations on services using CTC.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Step 1 Complete the NTP-J22 Log into CTC procedure at a node on the network where you want to perform ping and traceroute operations.

Step 2 Right-click the fabric or line card and choose **Open Packet Transport System View**. The Packet Transport System View dialog box appears.

Step 3 Click the **Maintenance** tab.

Step 4 In the left pane, click **OAM**.

Step 5 From the Service drop-down list, choose **TP Tunnel**, **TE Tunnel**, **Pseudowire**, or **EVC**.

Step 6 From the Command drop-down list, choose **Ping** or **Traceroute**.

Step 7 If you choose TP Tunnel as the service, complete the following:

a) Enter the tunnel ID in the Tunnel No field.
b) From the LSP drop-down list, choose **Active**, **Working**, or **Protect**.

Step 8 If you choose TE Tunnel as the service, complete the following:

a) Enter the tunnel ID in the Tunnel No field.

Step 9 If you choose Pseudowire as the service, complete the following:

a) Enter the IP address in the IP field.
b) Enter the virtual circuit ID in the VC ID field.

Step 10 If you choose EVC as the service, complete the following:

a) From the drop-down list, choose **MPID**, **MacAddr**, or **Multicast**.
The Multicast option appears only when you selected the Ping operation.

b) If you choose MPID, enter the remote MEP ID in the field.
If you choose MacAddr, enter the unicast remote MAC address in the field.

c) Enter the MEP domain name in the Domain Name field.
d) Check the **Port** check box for port MEP.
e) Enter the EVC service ID in the ID field.
f) Enter the local MEP ID in the Source field.
The range is from 1 to 8191. This ID is required when there are multiple MEPs in a domain.

g) Enter the class-of-service (CoS) for CFM packets in the COS field.
h) (Only for ping) Check the **de** check box for drop eligibility.
i) (Only for traceroute) Check the **Fdb-Only** check box to look up the destination MAC address in the forwarding database table to proceed with the traceroute operation.

Step 11 Click **Execute** to run the OAM operation for the specified service.
Stop. You have completed this procedure.

Understanding Continuity Check Traps and Cross-Check Traps

MEPs generate two types of Simple Network Management Protocol (SNMP) traps. They are Continuity Check (CC) traps and Cross-Check traps.

Continuity Check Traps

- MEP up—Sent when a new MEP is discovered, the status of a remote port changes, or connectivity from a previously discovered MEP is restored after interruption.
- MEP down—Sent when a timeout or last gasp event occurs.
- Cross-connect—Sent when a service ID does not match the VLAN.
- Loop—Sent when an MEP receives its own CCMs.
- Configuration error—Sent when an MEP receives a continuity check with an overlapping MPID.

Cross-Check Traps

- Service up—Sent when all the expected remote MEPs are up in time.
- MEP missing—Sent when an expected MEP is down.
- Unknown MEP—Sent when a CCM is received from an unexpected MEP.

DLP-J314 Enable CFM Traps Using Cisco IOS Commands

Purpose	This procedure enables CFM traps using Cisco IOS commands.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

	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	**snmp-server enable traps ethernet cfm alarm** **Example:**	Enables CFM fault alarms (traps).

	Command or Action	Purpose
	Router(config)# snmp-server enable traps ethernet cfm alarm	
Step 4	**end** **Example:** Router(config)# end	Returns to privileged EXEC mode.
Step 5	Return to your originating procedure (NTP).	—

Example: Enable CFM Traps

The following example shows how to enable CFM traps using Cisco IOS commands:

```
Router> enable
Router# configure terminal
Router(config)# snmp-server enable traps ethernet cfm alarm
Router(config)# end
```

DLP-J315 Enable SNMP Trap Generation for CFM Continuity Check Events Using Cisco IOS Commands

Purpose	This procedure enables SNMP trap generation for CFM Continuity Check events using Cisco IOS commands.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** Router> enable	Enables privileged EXEC mode. • Enter your password if prompted.

	Command or Action	Purpose
Step 2	**configure terminal** **Example:** Router# configure terminal	Enters global configuration mode.
Step 3	**snmp-server enable traps ethernet cfm cc [mep-up][mepdown][config] [loop] [cross-connect]** **Example:** Router(config)# snmp-server enable traps ethernet cfm cc mep-up mep-down config loop cross-connect	Enables SNMP trap generation for CFM mep-up, mep-down, config, loop, and cross-connect continuity check events.
Step 4	**snmp-server enable traps ethernet cfm crosscheck [mepunknown|mep-missing| service-up]** **Example:** Router(config)# snmp-server enable traps ethernet cfm crosscheck mep-unknown	Enables SNMP trap generation for CFM mepunknown, mep-missing, and service-up continuity check events in relation to the cross-check operation between statically configured MEPs and those learned through CCMs.
Step 5	**end** **Example:** Router(config)# end	Returns to privileged EXEC mode.
Step 6	Return to your originating procedure (NTP).	—

Example: Enable SNMP Trap Generation for CFM Continuity Check Events

The following example shows how to enable SNMP trap generation for CFM continuity checks when a new remote MEP is discovered and learned by the device:

```
Router> enable
Router# configure terminal
Router(config)# snmp-server enable traps ethernet cfm cc mep-up
```

The following example shows how to enable SNMP trap generation for CFM continuity check events when an unconfigured MEP comes up:

```
Router> enable
Router# configure terminal
Router(config)# snmp-server enable traps ethernet cfm crosscheck mep-unknown
```

Understanding Y.1731

Y.1731 Fault Management and Performance Monitoring

Y.1731 is an extension of the Connectivity Fault Management (CFM). The ITU-T Y.1731 feature provides operations, administration, and maintenance (OAM) functions for fault management and performance monitoring to serve the needs of service providers in a large network.

CPT supports Ethernet Alarm Indication Signal (ETH-AIS), Ethernet Remote Defect Indication (ETH-RDI), and Ethernet Locked Signal (ETH-LCK) functionality for fault detection and isolation.

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. To measure Service Level Agreement (SLA) parameters such as frame delay or frame delay variation, a small number of synthetic frames are transmitted along with the service to the maintenance end point (MEP).

CPT supports only two–way Ethernet frame Delay Measurement (ETH-DM) in Y.1731 performance monitoring. The CPT system sends, receives, and processes PM frames in intervals of 100 ms (10 frames per second) and 1 second.

Note CFM must be enabled in the network for Y.1731 to become operational.

Y.1731 Limitations and Restrictions in CPT

- CPT supports only Ethernet Alarm Indication Signal (ETH-AIS), Ethernet Remote Defect Indication (ETH-RDI), and Ethernet Locked Signal (ETH-LCK) functionality for fault detection, verification, and isolation.
- ETH-LCK is supported on a channel group only at the MEP level and not at the interface level.
- CPT supports only two–way Ethernet frame Delay Measurement (ETH-DM) in Y.1731 performance monitoring.
- CPT does not support retransmission intervals of less than 100ms for delay measurement.
- Port MEP is not supported for both fault management and delay measurement.
- Y.1731 delay measurement is supported on UP MEP on xconnect configuration, and DOWN MEP on both xconnect and EVC configurations.
- All the members of the channel group must be present on the same card to support delay measurement. After the delay measurement session is configured on the channel group, the members cannot be moved to a different card. The delay measurement session on the channel group must be unconfigured before moving the members to a different card.
- Y.1731 is not supported for EVC encapsulation default and encapsulation untagged.

Understanding Y.1731 Fault Management

CPT supports Ethernet Alarm Indication Signal (ETH-AIS), Ethernet Remote Defect Indication (ETH-RDI), and Ethernet Locked Signal (ETH-LCK) functionality for fault detection and isolation.

ETH-AIS

The Ethernet Alarm Indication Signal function (ETH-AIS) is used to suppress alarms after defects are detected at an MEP. An MEP that receives a frame with ETH-AIS information suppresses alarms for all the peer MEPs, whether or not they are connected.

When an MEP detects a connectivity fault at a specific maintenance association level, it multicasts AIS frames in the direction away from the detected failure at the client maintenance association level. The frequency of AIS frame transmission is based on the AIS transmission period. The first AIS frame is always sent immediately following the detection of the defect condition.

When an MEP receives an AIS frame, it examines the AIS frame to ensure that the Maintenance Entity Group (MEG) level matches its own MEG and then detects the AIS default condition. After this detection, if AIS frames are not received for an interval of 3.5 times the AIS transmission period, the MEP clears the AIS defect condition. For example, if the AIS timer is set for 60 seconds, the AIS timer period expires after 3.5 times 60, or 210 seconds.

The AIS condition is terminated when a valid Continuity Check Message (CCM) is received with all the error conditions cleared or when the AIS period timer expires (the default time is 60 seconds).

ETH-RDI

When a downstream MEP detects a defect condition, such as receive signal failure or AIS , it sends Ethernet Remote Defect Indication (ETH–RDI) in the opposite upstream direction to its peer MEPs. RDI serves in informing the upstream MEPs that there has been a downstream failure and can be used as input to far-end performance monitoring.

When Ethernet OAM continuity check (ETH-CC) transmission is enabled, the Ethernet Remote Defect Indication (ETH-RDI) function uses a bit in the CFM CC message to communicate defect conditions to the MEP peers. For ETH-RDI functionality, you must configure the MEP MEG level, the ETH-CC transmission period, and the ETH-CC frame priority.

When an MEP receives frames with ETH-RDI information, it determines that its peer MEP has encountered a defect condition and sets the RDI files in the CCM frames for the duration of the defect condition. When the defect condition clears, the MEP clears the RDI field.

When an MEP receives a CCM frame, it examines the CCM frame to ensure that its MEG level is the same and if the RDI field is set, it detects an RDI condition. For point-to-point Ethernet connections, an MEP can clear the RDI condition when it receives the first frame from its peer MEP with the RDI field cleared. However, for multipoint Ethernet connectivity, the MEP cannot determine the associated subset of peer MEPs with which the sending MEP has seen the defect condition. It can clear the RDI condition after it receives CCM frames with the RDI field cleared from its entire list of peer MEPs.

ETH-LCK

The Ethernet Locked Signal (ETH-LCK) function communicates the administrative locking of an MEP and interruption of data traffic being forwarded to the MEP expecting the traffic. An MEP that receives frames with ETH-LCK information can differentiate between a defect condition and an administrative locking.

ETH-LCK relies on loopback information (local, remote, port, and terminal loopback). The default timer for ETH-LCK is 60 seconds and the default level is the MIP level.

When an MEP is administratively locked, it sends LCK frames in a direction opposite to its peer MEPs, based on the LCK transmission period. The LCK transmission period is the same as the AIS transmission period. The first LCK frame is sent immediately following the administrative lock.

An MEP receiving a LCK frame verifies that the maintenance level matches its configured maintenance level and detects a LCK condition. When LCK frames are not received for an interval of 3.5 times the LCK transmission period, the MEP clears the LCK condition.

NTP-J116 Configure Y.1731 Fault Management Parameters

Purpose	This procedure configures Y.1731 fault management parameters.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Perform any of the following procedures as needed:

- DLP-J349 Configure ETH-AIS Parameters Using Cisco IOS Commands, on page 71
- DLP-J350 Clear AIS Alarms Using CTC, on page 74
- DLP-J351 Configure ETH-LCK Parameters Using Cisco IOS Commands, on page 75
- DLP-J352 Lock an MEP or an Interface Using CTC, on page 78
- DLP-J353 Enable Y.1731 Fault Management Parameters Using CTC, on page 79

Stop. You have completed this procedure.

DLP-J349 Configure ETH-AIS Parameters Using Cisco IOS Commands

Purpose	This procedure configures ETH-AIS using Cisco IOS commands.
Tools/Equipment	None
Prerequisite Procedures	NTP-J106 Configure CFM Using Cisco IOS Commands, on page 25

Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

	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	**ethernet cfm ais link-status global** **Example:** Router(config)# ethernet cfm ais link-status global	Configures AIS specific commands for source MEP and enters config-ais-link-cfm mode.
Step 4	**level** *level-id* **Example:** Router(config-ais-link-cfm)# level 3	Configures the maintenance level to send AIS frames transmitted by the source MEP. The range is from 0 to 7.
Step 5	**period** *value* **Example:** Router(config-ais-link-cfm)# period 1	Configures the AIS transmission period interval for the source MEP. The allowable values are 1 second or 60 seconds.
Step 6	**exit** **Example:** Router(config-ais-link-cfm)# exit	Returns to global configuration mode.
Step 7	**ethernet cfm domain** *domain-name* **level** *level-id* **Example:** Router(config)# ethernet cfm domain customer level 7	Creates a CFM maintenance domain at a specific maintenance level and enters Ethernet CFM configuration mode. The range of the maintenance domain level is from 0 to 7.
Step 8	**service** {*ma-name* | **number** *ma-num*} {**evc** *evc-name* [**direction down**]} **Example:**	Creates a maintenance association within a maintenance domain and enters CFM service configuration mode.

	Command or Action	Purpose
	Router(config-ecfm)# service Customer1 port	
Step 9	**ais period** *value* **Example:** Router(config-ecfm-srv)# ais period 1	Configures the specific AIS transmission period interval for the source MEP. The allowable values are 1 second or 60 seconds.
Step 10	**ais level** *level-id* **Example:** Router(config-ecfm-srv)# ais level 4	Configures the maintenance level to send AIS frames transmitted by the MEP. The range is from 0 to 7.
Step 11	**ais expiry-threshold** *value* **Example:** Router(config-ecfm-srv)# ais expiry-threshold 20	Sets the expiry threshold for the maintenance association. The range is from 2 to 255. The default value is 3.5.
Step 12	**ais suppress-alarms** **Example:** Router(config-ecfm-srv)# ais suppress-alarms	Suppresses the AIS alarm on the MEP.
Step 13	**exit** **Example:** Router(config-ecfm-srv)# exit	Returns to global configuration mode.
Step 14	**interface** *type number* **Example:** Router(config)# interface TenGigabitEthernet 4/1	Specifies the interface to configure and enters interface configuration mode.
Step 15	**ethernet cfm ais link-status** **Example:** Router(config-if)# ethernet cfm ais link-status	Enables or disables sending AIS frames from the source MEP on the interface.
Step 16	**ethernet cfm ais link-status period** *value* **Example:** Router(config-if)# ethernet cfm ais link-status period 60	Configures the ETH-AIS transmission period generated by the source MEP on the interface. The allowable values are 1 second or 60 seconds.
Step 17	**ethernet cfm ais link-status level** *level-id* **Example:** Router(config-if)# ethernet cfm ais link-status level 5	Configures the maintenance level for sending AIS frames transmitted by the source MEP on the interface. The range is from 0 to 7.

	Command or Action	Purpose
Step 18	**end** **Example:** Router(config-if)# end	Returns to privileged EXEC mode.
Step 19	**show ethernet cfm smep** [**interface** *type number*] **Example:** Router# show ethernet cfm smep interface TenGigabitEthernet 4/1	Displays CFM information for the source MEP.
Step 20	**show ethernet cfm errors** **Example:** Router(config)# show ethernet cfm errors	Displays ETH-AIS frames that are received and other errors.
Step 21	Return to your originating procedure (NTP).	—

DLP-J350 Clear AIS Alarms Using CTC

Purpose	This procedure enables you to clear the AIS alarm on an MEP or an interface using CTC.
Tools/Equipment	None
Prerequisite Procedures	DLP-J353 Enable Y.1731 Fault Management Parameters Using CTC, on page 79
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Step 1 Complete the NTP-J22 Log into CTC procedure at a node where you want to clear the AIS alarm on an MEP or an interface.

Step 2 Right-click the fabric or line card and choose **Open Packet Transport System View**. The Packet Transport System View dialog box appears.

Step 3 Click the **Provisioning** tab.

Step 4 In the left pane, click **Y1731**.

Step 5 Click the **Configuration > Execute Commands > Command Execution AIS** tab.

Step 6 Complete the following steps to clear the AIS alarm on an MEP.

a) Click the **MEP** option.
b) Enter the MEP ID in the MEP ID field.
c) Enter the maintenance domain name in the Domain Name field.
d) Enter the service ID in the Service ID field.
e) Click **Clear** to clear the AIS alarm on an MEP.

Step 7 Complete the following steps to clear the AIS alarm on an interface.

a) Click the **Interface** option.
b) From the Slot drop-down list, choose a slot.
c) From the Port drop-down list, choose a port to specify the interface on which to clear the AIS alarm.
d) Click **Clear** to clear the AIS alarm on an interface.

Step 8 Return to your originating procedure (NTP).

What to Do Next

- DLP-J352 Lock an MEP or an Interface Using CTC, on page 78

DLP-J351 Configure ETH-LCK Parameters Using Cisco IOS Commands

Purpose	This procedure configures ETH-LCK using Cisco IOS commands.
Tools/Equipment	None
Prerequisite Procedures	NTP-J106 Configure CFM Using Cisco IOS Commands, on page 25
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

	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	**ethernet cfm lck link-status global** **Example:** Router(config)# ethernet cfm lck link-status global	Configures LCK specific commands for source MEP and enters config-lck-link-cfm mode.
Step 4	**level** *level-id* **Example:** Router(config-lck-link-cfm)# level 3	Configures the maintenance level to send ETH-LCK frames transmitted by the source MEP. The range is from 0 to 7.
Step 5	**period** *value* **Example:** Router(config-lck-link-cfm)# period 1	Configures the ETH-LCK transmission period interval for the source MEP. The allowable values are 1 second or 60 seconds.
Step 6	**exit** **Example:** Router(config-lck-link-cfm)# exit	Returns to global configuration mode.
Step 7	**ethernet cfm domain** *domain-name* **level** *level-id* **Example:** Router(config)# ethernet cfm domain customer level 7	Creates a CFM maintenance domain at a specific maintenance level and enters Ethernet CFM configuration mode. The range of the maintenance domain level is from 0 to 7.
Step 8	**service** {*ma-name* | **number** *ma-num*} {**evc** *evc-name* [**direction down**]} **Example:** Router(config-ecfm)# service Customer1 port	Creates a maintenance association within a maintenance domain and enters CFM service configuration mode.
Step 9	**lck level** *level-id* **Example:** Router(config-ecfm-srv)# lck level 3	Configures the maintenance level for sending ETH-LCK frames transmitted by the MEP. The range is from 0 to 7.

	Command or Action	Purpose
Step 10	**lck period** *value* **Example:** Router(config-ecfm-srv)# lck period 60	Configure the MEP ETH-LCK frame transmission period interval. The allowable values are 1 second or 60 seconds.
Step 11	**lck expiry-threshold** *value* **Example:** Router(config-ecfm-srv)# expiry-threshold 20	Sets the expiry threshold for the maintenance association. The range is from 2 to 255. The default value is 3.5.
Step 12	**exit** **Example:** Router(config-ecfm-srv)# exit	Returns to global configuration mode.
Step 13	**interface** *type number* **Example:** Router(config)# interface TenGigabitEthernet 4/1	Specifies the interface to configure and enters interface configuration mode.
Step 14	**ethernet cfm lck link-status** **Example:** Router(config-if)# ethernet cfm lck link-status	Enables or disables sending ETH-LCK frames from the source MEP on the interface.
Step 15	**ethernet cfm lck link-status period** *value* **Example:** Router(config-if)# ethernet cfm lck link-status period 60	Configures the ETH-LCK transmission period generated by the source MEP on the interface. The allowable values are 1 second or 60 seconds.
Step 16	**ethernet cfm lck link-status level** *level-id* **Example:** Router(config-if)# ethernet cfm lck link-status level 5	Configures the maintenance level for sending ETH-LCK frames transmitted by the source MEP on the interface. The range is from 0 to 7.
Step 17	**end** **Example:** Router(config-if)# end	Returns to privileged EXEC mode.
Step 18	**ethernet cfm lck start mpid** *local-mpid* **domain** *domain-name* **evc** *evc name* [**drop l2-bpdu**] **Example:** Router# ethernet cfm lck start mpid test domain customer evc evc1	Places an MEP in ETH-LCK condition. To put a MEP out of ETH-LCK condition, enter the **ethernet cfm lck stop mpid** *local-mpid* **domain** *domain-name* **evc** *evc name* privileged EXEC command.

	Command or Action	Purpose
Step 19	**ethernet cfm lck start interface** *type number* **direction** {**up** | **down**} [**drop l2-bpdu**] **Example:** Router# ethernet cfm lck start interface TenGigabitEthernet 4/1 direction down	Places an interface in ETH-LCK condition. To put an interface out of ETH-LCK condition, enter the **ethernet cfm lck stop interface** *type number* **direction** {**up** | **down**} privileged EXEC command.
Step 20	**show ethernet cfm smep** [**interface** *type number*] **Example:** Router# show ethernet cfm smep interface TenGigabitEthernet 4/1	Displays CFM information for the source MEP.
Step 21	**show ethernet cfm errors** **Example:** Router(config)# show ethernet cfm errors	Displays ETH-LCK frames that are received.
Step 22	Return to your originating procedure (NTP).	—

DLP-J352 Lock an MEP or an Interface Using CTC

Purpose	This procedure enables you to start the ETH-LCK fault management function on an MEP or an interface using CTC.
Tools/Equipment	None
Prerequisite Procedures	DLP-J353 Enable Y.1731 Fault Management Parameters Using CTC, on page 79
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Step 1 Complete the NTP-J22 Log into CTC procedure at a node where you want to start the ETH-LCK fault management function on an MEP or an interface.

Step 2 Right-click the fabric or line card and choose **Open Packet Transport System View**. The Packet Transport System View dialog box appears.

Step 3 Click the **Provisioning** tab.

Step 4 In the left pane, click **Y1731**.

Step 5 Click the **Configuration > Execute Commands > Command Execution LCK** tab.

Step 6 Complete the following steps to place an MEP in ETH-LCK condition.

a) Click the **MEP** option.
b) Enter the MEP ID in the MEP ID field.
c) Enter the maintenance domain name in the Domain Name field.
d) Enter the service ID in the Service ID field.
e) Check the **Drop L2 Bpdu** check box to specify that all the data frames, Layer 3 control traffic, and Layer 2 bridge protocol data units (BPDUs) be dropped except the CFM frames for that MEP.
f) Click **Start** to lock an MEP.
Click **Stop** to unlock an MEP.

Step 7 Complete the following steps to place an interface in ETH-LCK condition.

a) Click the **Interface** option.
b) From the Slot drop-down list, choose a slot.
c) From the Port drop-down list, choose a port to specify the interface to be put in ETH-LCK condition.
d) From the Direction drop-down list, choose **Down** or **Up** to specify the direction of the ETH-LCK operation.
e) Check the **Drop L2 Bpdu** check box to specify that all the data frames, Layer 3 control traffic, and Layer 2 BPDUs be dropped except the CFM frames for that interface.
f) Click **Start** to lock an interface.
Click **Stop** to unlock an interface.

Step 8 Return to your originating procedure (NTP).

What to Do Next

- DLP-J350 Clear AIS Alarms Using CTC, on page 74

DLP-J353 Enable Y.1731 Fault Management Parameters Using CTC

Purpose	Y.1731 fault management in CPT consists of ETH-LCK and ETH-AIS. This procedure enables ETH-LCK and ETH-AIS fault management functions using CTC.
Tools/Equipment	None

Prerequisite Procedures	NTP-J105 Configure CFM Using CTC, on page 26
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Note ETH-AIS and ETH-LCK are enabled by default when CFM is enabled.

Procedure

Step 1 Complete the NTP-J22 Log into CTC procedure at a node where you want to enable ETH-LCK and ETH-AIS fault management functions.

Step 2 Right-click the fabric or line card and choose **Open Packet Transport System View**. The Packet Transport System View dialog box appears.

Step 3 Click the **Provisioning** tab.

Step 4 In the left pane, click **Y1731**.

Step 5 Click the **Configuration** tab.

Step 6 Complete the following steps to enable ETH-LCK and ETH-AIS configurations globally.

a) Click the **Global Configuration** tab.
b) In the LCK area, check the **LCK Config Enable** check box to enable ETH-LCK configuration globally.
c) Enter the maintenance level for sending ETH-LCK frames transmitted by the source MEP in the LCK Level field. The range is from 0 to 7.
d) From the LCK Period drop-down list, choose **One Second** or **One Minute** to configure the ETH-LCK frame transmission period generated by the source MEP.
e) Check the **Disable LCK Transmission** check box to disable generation of ETH-LCK frames.
f) In the AIS area, check the **AIS Config Enable** check box to enable ETH-AIS configuration globally.
g) Enter the maintenance level for sending ETH-AIS frames transmitted by the source MEP in the AIS Level field. The range is from 0 to 7.
h) From the AIS Period drop-down list, choose **One Second** or **One Minute** to configure the ETH-AIS transmission period generated by the source MEP.
i) Check the **Disable AIS Transmission** check box to disable generation of ETH-AIS frames.
j) Click **Apply**.

Step 7 Complete the following steps to enable ETH-LCK and ETH-AIS configurations on an interface.

a) Click the **Interface Configuration** tab.
b) In the Ethernet Interfaces area, expand the slot or Fan-Out-Group (FOG) to view the interfaces.
c) Check the **LCK LS Enable** check box to enable sending ETH-LCK frames from the source MEP on the interface.
d) Enter the maintenance level for sending ETH-LCK frames transmitted by the source MEP on the interface in the LCK LS Level field. The range is from 0 to 7.
e) From the LCK LS Period drop-down list, choose **One Second** or **One Minute** to configure the ETH-LCK transmission period generated by the source MEP on the interface.

f) Check the **AIS LS Enable** check box to enable sending ETH-AIS frames from the source MEP on the interface.
g) Enter the maintenance level for sending ETH-AIS frames transmitted by the source MEP on the interface in the AIS LS Level field.
h) From the AIS LS Period drop-down list, choose **One Second** or **One Minute** to configure the ETH-AIS transmission period generated by the source MEP on the interface.
i) Click **Apply**.

Step 8 Complete the following steps to enable ETH-LCK and ETH-AIS configurations at the MEP level.

a) Click the **MEP Configuration** tab.
The list of maintenance association profiles created in CFM appear in this tab.
b) Enter the LCK expiry threshold parameter value for the maintenance association in the LCK Ex Threshold field. The range is from 2 to 255. The default value is 3.5.
c) Enter the maintenance level for sending ETH-LCK frames transmitted by the local MEP in the LCK Level field. The range is from 0 to 7.
d) From the LCK Period drop-down list, choose **One Second** or **One Minute** to configure the ETH-LCK transmission period generated by the local MEP.
e) Enter the AIS expiry threshold parameter value for the maintenance association in the AIS Ex Threshold field. The range is from 2 to 255. The default value is 3.5.
f) Enter the maintenance level for sending ETH-AIS frames transmitted by the local MEP in the AIS Level field. The range is from 0 to 7.
g) From the AIS Period drop-down list, choose **One Second** or **One Minute** to configure the ETH-AIS transmission period generated by the local MEP.
h) Check the **AIS Suppress Alarms** check box to suppress the AIS alarm on the MEP.
i) Click **Apply**.

Step 9 Return to your originating procedure (NTP).

What to Do Next

- DLP-J352 Lock an MEP or an Interface Using CTC, on page 78
- DLP-J350 Clear AIS Alarms Using CTC, on page 74

Understanding Y.1731 Performance Monitoring

When service providers sell connectivity services to a subscriber, a Service Level Agreement (SLA) is reached between the buyer and seller of the service. The SLA defines the attributes offered by a provider and serves as a legal obligation on the service provider. As the level of performance required by subscribers increases, service providers need to monitor the performance parameters being offered. To capture the needs of service providers, organizations have defined various standards such as IEEE 802.1ag and ITU-T Y.1731 that define the methods and frame formats used to measure performance parameters.

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. To measure SLA parameters such as frame delay or frame delay variation, a small number of synthetic frames are transmitted along with the service to the MEP.

Note CPT supports only two–way Ethernet frame Delay Measurement (ETH-DM) in Y.1731 performance monitoring. The CPT system sends, receives, and processes PM frames in intervals of 100ms (10 frames per second) and 1 second.

The SLA delay measurement sessions are removed after the Stateful Switchover (SSO) of the fabric card. These sessions must be manually restarted after SSO.

Frame Delay and Frame Delay Variation

Ethernet frame Delay Measurement (ETH-DM) is used for on-demand Ethernet OAM to measure frame delay and frame delay variation. Ethernet frame delay and frame delay variation are measured by:

- Sending periodic frames with Ethernet Delay Measurement Message (ETH-DMM) information to the peer MEP.
- Receiving frames with Ethernet Delay Measurement Reply (ETH-DMR) information from the peer MEP.

During the interval, one or both MEPs in a maintenance association measures the frame delay and frame delay variation. Ethernet frame delay measurement also collects useful information, such as minimum and maximum delay over a fixed time, average delay, and average delay variation. Ethernet frame delay measurement supports hardware-based time stamping in the ingress direction. It provides a runtime display of delay statistics during a two-way delay measurement.

In two–way delay measurement, MEP transmits frames with ETH-DM request information to its peer MEP and receives frames with ETH-DM reply information from its peer MEP. Two–way frame delay and frame delay variation is measured using ETH-DMM and ETH-DMR frame combination.

NTP-J117 Configure and Schedule Two-Way Delay Measurement

Purpose	This procedure configures and schedules two-way delay measurement.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Perform any of the following procedures as needed:

- DLP-J354 Configure and Schedule Two-Way Delay Measurement Using Cisco IOS Commands, on page 83

- DLP-J355 Configure and Schedule Two-Way Delay Measurement Using CTC, on page 86
- DLP-J356 Display IP SLA Configuration and Statistics Using CTC, on page 88
- Troubleshooting an IP SLA Session, on page 89

Stop. You have completed this procedure.

DLP-J354 Configure and Schedule Two-Way Delay Measurement Using Cisco IOS Commands

Purpose	This procedure configures and schedules two-way delay measurement using Cisco IOS commands.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

	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	**ip sla** *n* **Example:** Router(config)# ip sla 1	Enables the IP SLA configuration.
Step 4	**ethernet y1731 delay dmm domain** *domain-name* {**evc** *evc-name*} {**mpid** | **mac-address** *target-address*} **cos** *cos-value* {**source mpid** | **mac-address** *source-address*} **Example:**	Configures a two-way delay measurement on the sender. • **evc** – Specifies the Ethernet Virtual Circuit (EVC) identifier. • **cos** – Specifies the Class of Service (CoS). The values range from 0 to 7.

	Command or Action	Purpose
	Router(config-ip-sla)# ethernet y1731 delay dmm domain r3 evc e3 mpid 500 cos 3 source mpid 400	• **mpid –** Specifies the destination MP ID. The values range from 1 to 8191. • **mac-address –** Specifies the destination MAC address. • **source –** Specifies the source MP ID or MAC address.
Step 5	**frame** {**interval** | **offset** | **size**} *bytes* **Example:** Router(config-sla-y1731-delay)# frame interval 100	Configures the following Y.1731 frame parameters: • **interval –** Specifies the retransmission period for DMM. The allowable values are 100 milliseconds or 1 second. • **offset –** Specifies the frame offset to be used for calculations. The values range from 1 to 10. • **size –** Specifies the frame size. The values range from 64 to 384.
Step 6	**history** {**interval**} *intervals-stored* **Example:** Router(config-sla-y1731-delay)# history interval 5	Configures the following Y.1731 history parameters: • **interval –** Specifies the number of historical aggregated interval statistics to be retained. The number of intervals range from 1 to 10.
Step 7	**aggregate** {**interval**} *seconds* **Example:** Router(config-sla-y1731-delay)# aggregate interval 5	Configures the following Y.1731 aggregation parameters: • **interval –** Specifies the duration for which individual delay measurements are aggregated into cumulative statistics. The aggregation period ranges from 1 to 65535 seconds.
Step 8	**distribution** {**delay** | **delay-variation**} **two-way** *number_of_bins comma_separated_values* **Example:** Router(config-sla-y1731-delay)# distribution delay 5 10,30,500,700,1000	Configures the following Y.1731 distribution parameters: • **delay –** Specifies the delay distribution parameters. • **delay-variation –** Specifies the delay variation distribution parameters.
Step 9	**max-delay** *milliseconds* **Example:** Router(config-sla-y1731-delay)# max-delay 1000	Configures maximum delay which is allowed as a valid delay measurement. The values range from 1 to 65535 milliseconds.

	Command or Action	Purpose
Step 10	**owner** *owner-id* **Example:** Router(config-sla-y1731-delay)#owner john	Specifies the operation owner.
Step 11	**exit** **Example:** Router(config-sla-y1731-delay)# exit	Exits the Y.1731 submode and enters the global configuration mode.
Step 12	**ip sla schedule** *n* [**life** {**forever** | *seconds*}] [**start-time** {*hh*:*mm*[:*ss*] [*month day* | *day month*] | **now** | **after** *hh*:*mm*:*ss*}] [**ageout** *seconds*] [**recurring**] **Example:** Router(config)# ip sla schedule 10 start-time now life forever	Schedules the two-way delay measurement on the sender. • **life forever –** Schedules the operation to run indefinitely. • **start-time –** Specifies the time to start the entry. • **now –** Specifies that the operation must start immediately. • **after –** Specifies that the operation must start *hh* hours, *mm* minutes, and *ss* seconds after this command was entered. • **ageout –** Specifies the period to retain an inactive SLA instance. The range is from 0 to 2073600 seconds. • **recurring –** Specifies that the operation will start automatically at the specified time and for the specified duration every day. See the Troubleshooting an IP SLA Session, on page 89 section if the IP SLA delay measurement session does not start.
Step 13	**exit** **Example:** Router(config)# exit	Exits the global configuration mode.
Step 14	**show ip sla configuration** **Example:** Router# show ip sla configuration	Displays the IP SLA configuration details.
Step 15	**show ip sla statistics** [**details**] **Example:** Router# show ip sla statistics	Displays the IP SLA statistics.

	Command or Action	Purpose
Step 16	Return to your originating procedure (NTP).	—

Example: Configure Two-Way Delay Measurement

The following example configures a two-way delay measurement using Cisco IOS commands:

```
Router# enable
Router# configure terminal
Router(config)# ip sla 1
Router(config-ip-sla)# ethernet y1731 delay DMM domain ifm_400 evc e1 mpid 401 cos 4 source
 mpid 1
Router(config-sla-y1731-delay)# frame interval 100
Router(config-sla-y1731-delay)# history interval 5
Router(config-sla-y1731-delay)# aggregate interval 60
Router(config-sla-y1731-delay)# exit
Router(config)# ip sla schedule 1 start-time now life forever
Router(config)# exit
```

DLP-J355 Configure and Schedule Two-Way Delay Measurement Using CTC

Purpose	This procedure configures and schedules two-way delay measurement using CTC.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Step 1 Complete the NTP-J22 Log into CTC procedure at a node where you want to configure and schedule two-way delay measurement.

Step 2 Right-click the fabric or line card and choose **Open Packet Transport System View**. The Packet Transport System View dialog box appears.

Step 3 Click the **Provisioning** tab.

Step 4 In the left pane, click **Y1731**.

Step 5 Click the **Delay Measurement > Configuration** tab.

Step 6 Click **Create**.

Step 7 In the Basic area of the Create DM Config dialog box, specify the following mandatory parameters:

a) Enter the SLA instance ID in the IP SLA ID field.

b) From the Domain drop-down list, choose a maintenance domain.
c) Enter the service ID in the Service ID field.
d) Enter the Class of Service (CoS) value in the CoS field. The values range from 0 to 7.
The user must reconfigure the IP SLA session if the QoS configurations relating to the CoS value change.
e) Specify the source MP ID or source MAC address in the Source MPID or Source MAC ID field. The values of source MP ID range from 1 to 8191.
f) Specify the destination MP ID or destination MAC address in the Destination MPID or Destination MAC ID field. The values of destination MP ID range from 1 to 8191.

Step 8 In the Advanced area of the Create DM Config dialog box, specify the following optional delay measurement parameters:

a) Enter the frame size in the Frame Size field. The values range from 64 to 384.
b) From the Frame Interval drop-down list, choose **100 msec** or **1 sec** for the retransmission period for DMM.
c) Enter the duration for which individual delay measurements are aggregated into cumulative statistics in the Aggregation Interval field. The values range from 1 to 65535 seconds.
d) Enter the number of historical aggregated interval statistics to be retained in the History Interval field. The values range from 1 to 10.
e) Enter the maximum delay in the Maximum Delay field. The values range from 1 to 65535 milliseconds.
f) Enter the delay distribution parameters in the Delay Distribution field.
g) Enter the delay variation distribution parameters in the Delay Variation List field.
h) Enter the IP SLA operation owner name in the Owner Name field.
i) From the Reaction Type drop-down list, choose **Immediate**.
When the measured delay exceeds or meets the threshold, an alarm is raised or cleared.
j) Enter the low threshold value in the Falling Threshold field.
The falling threshold is the value below which the alarm is cleared.
k) Enter the high threshold value in the Rising Threshold field.
The rising threshold is the value above which the alarm is raised.

Step 9 Click **OK** in the Create DM Config dialog box to configure a two-way delay measurement.

Step 10 Complete the following steps to schedule a two-way delay measurement.

a) Click the **Schedule** tab.
b) Enter the SLA instance ID in the IP SLA ID field.
c) Enter the period to retain an inactive SLA instance in the Age-out field.
d) Click the **Forever** option to schedule the operation to run indefinitely or enter the time interval for the operation to run in the Secs field.
e) Check the **Recurring** check box to specify that the operation will start automatically at the specified time and for the specified duration every day.
f) From the Start time drop-down list, choose **After** or **Now** to specify the time to start the IP SLA operation.

  - **After—**Specifies that the operation must start hh hours, mm minutes, and ss seconds after this command was entered.
  - **Now—**Specifies that the operation must start immediately.

g) From the Time drop-down list, choose hour, minute, and second.
h) Click **Schedule** to schedule a two-way delay measurement.

See the Troubleshooting an IP SLA Session, on page 89 section if the IP SLA delay measurement session does not start.

Step 11 Complete the following steps to start the IP SLA operation immediately.

a) Enter the SLA instance ID in the IP SLA ID field.
b) Click **Start now** to start the IP SLA operation immediately.

Step 12 (Optional) Complete the following steps to delete the IP SLA instance(s).

a) Enter the SLA instance ID in the IP SLA ID field and click **Delete** to delete the specific IP SLA instance.
b) Click **Delete All** to delete all the current IP SLA statistics and configuration information from the router and to reset the IP SLA engine.

Step 13 (Optional) Check the **Enable IP SLA Trap** check box to enable IP SLA traps.
The traps need to be enabled only if SLA alarm needs to be configured.

Step 14 Click **Apply**.

Step 15 Return to your originating procedure (NTP).

DLP-J356 Display IP SLA Configuration and Statistics Using CTC

Purpose	This procedure enables you to display configuration values and statistics of IP SLA operations using CTC.
Tools/Equipment	None
Prerequisite Procedures	DLP-J355 Configure and Schedule Two-Way Delay Measurement Using CTC, on page 86
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Step 1 Complete the NTP-J22 Log into CTC procedure at a node where you want to display configuration values and statistics of IP SLA operations.

Step 2 Right-click the fabric or line card and choose **Open Packet Transport System View**. The Packet Transport System View dialog box appears.

Step 3 Click the **Maintenance** tab.

Step 4 In the left pane, click **OAM**.

Step 5 From the Command drop-down list, choose **Show IP-SLA**.

Step 6 Enter the IP SLA instance in the IP SLA ID field. The range is from 1 to 2147483647.

Step 7 Complete the following steps to display the statistics of IP SLA operations.

a) Click the **Statistics** option.

b) Check the **Aggregated** check box to display the aggregated statistical errors and distribution information for IP SLA operations.

c) Check the **Details** check box to display the current operational status and statistics of all IP SLAs operations.

Step 8 Click the **Configuration** option to display the configuration values including all defaults for the IP SLA operations.

Step 9 Click the **Interval Statistics** option to display the interval statistics of IP SLA operations.

Step 10 Click **Execute**.

Step 11 Return to your originating procedure (NTP).

Troubleshooting an IP SLA Session

The IP SLA sessions must have a delayed start of at least 10 minutes to allow adequate time for sessions to restart on node power cycle.

To start IP SLA automatically, check the following:

- IP SLA aggregate interval should be above 300 seconds.
- IP SLA start time should be equal to the time taken by all the cards of the node, to come up after node reload.

If an IP SLA delay measurement session does not start, check the following:

- There are no CFM errors such as AIS and RDI on the source MEP or local MEP.
- The remote MEP is visible locally.
- If the local MEP is on a channel group, all its members are present on the same card.
- MEPs between which the SLA session is configured do not have another SLA session for the same pair of MEP.

The following table describes the commands that can used to troubleshoot issues for an IP SLA delay measurement session.

Command	Purpose
show ethernet cfm pm	Displays mapping of SLA ID to delay measurement session ID. If there is no output from this command, it indicates that the session was not created or the ETH-DMR was not received.
show ethernet cfm pm session *dm_session_id*	Displays the database of delay measurement.
clear ethernet cfm pm session *dm_session_id*	Clears the database of delay measurement.

Command	Purpose
• **debug ethernet cfm pm diagnostics** • **debug ethernet cfm pm events** • **debug ethernet cfm pm errors** • **debug ethernet cfm pm packets** • **debug ethernet cfm pm monitor**	Enables delay measurement engine logs. The **debug ethernet cfm pm monitor** command is applicable only on the fabric card.

Show Commands

This section describes several show commands that can be used with IP SLA.

Display IP SLA Configuration

This command displays the configuration values including all defaults for all IP SLA operations or a specified operation.

```
Router# show ip sla configuration [operation-number]
```

```
IP SLAs Infrastructure Engine-III
Entry number: 1
Owner:
Tag:
Operation timeout (milliseconds): 5000
Ethernet Y1731 Delay Operation
Frame Type: DMM
Domain: Level1
Evc: PWEVC
Target Mpid: 10
Source Mpid: 11
CoS: 7
   Max Delay: 5000
   Request size (Padding portion): 64
   Frame Interval: 1000
   Clock: Not In Sync
Threshold (milliseconds): 5000
Schedule:
   Operation frequency (seconds): 900  (not considered if randomly
scheduled)
   Next Scheduled Start Time: Start Time already passed
   Group Scheduled : FALSE
   Randomly Scheduled : FALSE
   Life (seconds): Forever
   Entry Ageout (seconds): never
   Recurring (Starting Everyday): FALSE
   Status of entry (SNMP RowStatus): Active
Statistics Parameters
  Aggregation Period: 900
  Frame offset: 1
  Distribution Delay Two-Way:
   Number of Bins 10
  Bin Boundaries: 5000,10000,15000,20000,25000,30000,35000,40000,45000,-1

  Distribution Delay-Variation Two-Way:
   Number of Bins 10
  Bin Boundaries: 5000,10000,15000,20000,25000,30000,35000,40000,45000,-1
History
  Number of intervals: 2
```

Display IP SLA Statistics

This command displays the current operational status and statistics of all IP SLAs operations or a specified operation.

```
Router# show ip sla statistics [operation-number] [details]
```

```
IPSLAs Latest Operation Statistics

IPSLA operation id: 1
Delay Statistics for Y1731 Operation 1
Type of operation: Y1731 Delay Measurement
Latest operation start time: 05:50:54.467 PDT Sat Jul 8 2000
Latest operation return code: OK
Distribution Statistics:

Interval
 Start time:  05:50:54.467 PDT Sat Jul 8 2000
 Elapsed time: 610 seconds
 Number of measurements initiated: 608
 Number of measurements completed: 608
 Flag: OK
```

Display IP SLA Aggregated Statistics

This command displays the aggregated statistical errors and distribution information for all IP SLAs operations or a specified operation.

```
Router# show ip sla statistics aggregated [operation-number] [details]
```

```
IPSLAs aggregated statistics

IPSLA operation id: 1
Delay Statistics for Y1731 Operation 1
Type of operation: Y1731 Delay Measurement
Latest operation start time: 05:50:54.467 PDT Sat Jul 8 2000
Latest operation return code: OK
Distribution Statistics:


Interval
 Start time:  05:50:54.467 PDT Sat Jul 8 2000
 Elapsed time: 787 seconds
 Number of measurements initiated: 777
 Number of measurements completed: 777
 Flag: OK
```

```
Delay:
  Number of TwoWay observations: 773
    Min/Avg/Max TwoWay: 58/66/98 (microsec)
  Time of occurrence TwoWay:
    Min - 06:03:39.978 PDT Sat Jul 8 2000
    Max - 06:02:54.975 PDT Sat Jul 8 2000

Delay Variance:
  Number of TwoWay positive observations: 367
    Min/Avg/Max TwoWay positive: 0/3/38 (microsec)
  Time of occurrence TwoWay positive:
    Min - 06:02:04.967 PDT Sat Jul 8 2000
    Max - 06:02:54.975 PDT Sat Jul 8 2000
  Number of TwoWay negative observations: 405
    Min/Avg/Max TwoWay negative: 0/3/34 (microsec)
  Time of occurrence TwoWay negative:
    Min - 05:59:19.937 PDT Sat Jul 8 2000
    Max - 05:53:49.821 PDT Sat Jul 8 2000
```

Display IP SLA Global Information

This command displays global information about IP SLAs.

```
Router# show ip sla application
```

```
IP Service Level Agreements
Version: Round Trip Time MIB 2.2.0, Infrastructure Engine-III

Supported Operation Types:
        icmpEcho, path-echo, path-jitter, udpEcho, tcpConnect, http
        dns, udpJitter, dhcp, ftp, 802.1agEcho VLAN, EVC, Port
        802.1agJitter VLAN, EVC, Port, y1731Delay, y1731Loss, udpApp
        wspApp

Supported Features:
        IPSLAs Event Publisher

IP SLAs low memory water mark: 260261241
Estimated system max number of entries: 190621

Estimated number of configurable operations: 190620
Number of Entries configured  : 1
Number of active Entries      : 1
Number of pending Entries     : 0
Number of inactive Entries    : 0
Time of last change in whole IP SLAs: 09:23:56.488 PDT Sun Jul 2 2000
```

Display IP SLA Threshold Settings

This command displays the configured proactive threshold monitoring settings for all IP SLA operations or a specified operation.

```
Router# show ip sla reaction-configuration [operation-number]
```

```
Entry number: 1
```

```
Index: 1
Reaction: rtt
Threshold Type: Immediate
Rising (milliseconds): 10
Falling (milliseconds): 10
Action Type: None
```