CHAPTER 1

CE-Series Ethernet Cards

Note The terms "Unidirectional Path Switched Ring" and "UPSR" may appear in Cisco literature. These terms do not refer to using Cisco ONS 15xxx products in a unidirectional path switched ring configuration. Rather, these terms, as well as "Path Protected Mesh Network" and "PPMN," refer generally to Cisco's path protection feature, which may be used in any topological network configuration. Cisco does not recommend using its path protection feature in any particular topological network configuration.

This chapter describes the operation of the CE-Series Ethernet cards supported on the Cisco ONS 15454 and Cisco ONS 15454 SDH. The following cards are supported on these platforms:

CE-1000-4 Ethernet Card

This section describes the operation of the CE-1000-4 (Carrier Ethernet) card supported on the Cisco ONS 15454 and Cisco ONS 15454 SDH. A CE-1000-4 card installed in an ONS 15454 SONET is restricted to SONET operation, and a CE-1000-4 card installed in an ONS 15454 SDH is restricted to SDH operation.

Use Cisco Transport Controller (CTC) or Transaction Language One (TL1) to provision the CE-1000-4 card. Cisco IOS is not supported on the CE-1000-4 card.

For Ethernet card specifications, refer to the *Cisco ONS 15454 Reference Manual* or the *Cisco ONS 15454 SDH Reference Manual*. For step-by-step Ethernet card circuit configuration procedures, refer to the *Cisco ONS 15454 Procedure Guide* or the *Cisco ONS 15454 SDH Procedure Guide*. For TL1 provisioning commands, refer to the *Cisco ONS SONET TL1 Command Guide* or the *Cisco ONS SDH TL1 Command Guide*.

Section topics include:

CE-1000-4 Overview

The CE-1000-4 is a Layer 1 mapper card with four Gigabit Ethernet ports. It maps each port to a unique SONET/SDH circuit in a point-to-point configuration. Figure 1-4 illustrates a sample CE-1000-4 application. In this example, data traffic from the Gigabit Ethernet port of a switch travels across the point-to-point circuit to the Gigabit Ethernet port of another switch.

Figure 1-1 CE-1000-4 Point-to-Point Circuit

The CE-1000-4 cards allow you to provision and manage an Ethernet private line service like a traditional SONET/SDH line. The CE-1000-4 card provides carrier-grade Ethernet private line services and high-availability transport.

The CE-1000-4 card carries any Layer 3 protocol that can be encapsulated and transported over Ethernet, such as IP or IPX. The Ethernet frame from the data network is transmitted into the gigabit interface converter (GBIC) on a CE-1000-4 card. The CE-1000-4 card transparently maps Ethernet frames into the SONET/SDH payload using packet-over-SONET/SDH (POS) encapsulation. The POS circuit with encapsulated Ethernet is then multiplexed onto an optical card like any other SONET synchronous transport signal (STS) or SDH synchronous transport mode (STM). When the payload reaches the destination node, the process is reversed and the data is transmitted from the GBIC in the destination CE-1000-4 card onto the Ethernet of the data network. The POS process is covered in detail in Appendix A, "POS on ONS Ethernet Cards."

The CE-1000-4 card supports ITU-T G.707 and Telcordia GR-253 based standards. It allows an errorless soft reset. An exception to the errorless soft reset occurs when there is a provisioning change during the reset, or if the firmware is replaced during the software upgrade process. In these cases, the reset is equivalent to a hard reset. To perform a soft reset on a CE-1000-4 card using CTC, refer to the *Cisco ONS 15454 Procedure Guide* or the *Cisco ONS 15454 SDH Procedure Guide*.

CE-1000-4 Ethernet Features

The CE-1000-4 card has four front-end Ethernet ports which use standard GBIC connectors for Gigabit Ethernet. Ethernet Ports 1 through 4 each map to a POS port with a corresponding number. These Ethernet ports can be daisy chained.

At the Ethernet port level, a user can configure several characteristics:

- Port name
- Administrative state
- Automatic in-service (AINS) soak time
- Flow control
- Flow control watermark levels
- Auto negotiation

The CE-1000-4 card forwards valid Ethernet frames unmodified over the SONET/SDH network. Information in the headers is not affected by the encapsulation and transport. For example, IEEE 802.1Q information will travel through the process unaffected.

The CE-1000-4 supports Jumbo frames up to a total maximum of 10004 bytes, including Ethernet cyclic redundancy check (CRC), by default. In CTC you can also configure a total maximum frame size of 1548 bytes, including Ethernet CRC.

Note Many Ethernet attributes are also available through the network element (NE) defaults feature. For more information on NE defaults, refer to the "Network Element Defaults" appendix in the *Cisco ONS 15454 Reference Manual* or the *Cisco ONS 15454 SDH Reference Manual*.

Autonegotiation and Frame Buffering

On the CE-1000-4 card, Ethernet link autonegotiation is on by default. You can also enable and disable autonegotiation under the card-level Provisioning tab in CTC.

The CE-1000-4 supports field-programmable gate array (FPGA) buffering to reduce data traffic congestion. FPGA buffering supports SONET/SDH oversubscription. When the buffer nears capacity, the CE-1000-4 card uses IEEE 802.3x flow control to transmit a pause frame to the attached Ethernet device. Flow control and autonegotiation frames are local to the Gigabit Ethernet interfaces and the attached Ethernet devices. These frames do not continue through the POS ports.

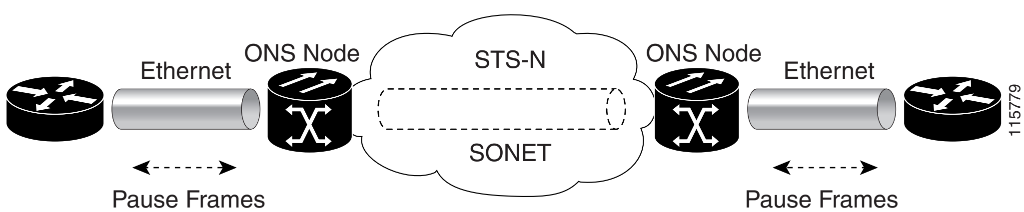
Flow Control

The CE-1000-4 supports IEEE 802.3x flow control and allows you to enable symmetric flow control, enable asymmetric flow control, or to disable flow control. The configuration is done in CTC at the port level.

By default the CE-1000-4 card uses symmetric flow control and only proposes symmetric flow control when autonegotiating flow control with attached Ethernet devices. Symmetric flow control allows the CE-1000-4 cards to respond to pause frames sent from external devices and to send pause frames to external devices.

The pause frame instructs the source to stop sending packets for a specific period of time. The sending station waits the requested amount of time before sending more data. Figure 1-5 illustrates pause frames being sent and received by CE-1000-4 cards and attached switches.

Figure 1-2 Flow Control



This flow-control mechanism matches the sending and receiving device throughput to that of the bandwidth of the STS circuit. For example, a router might transmit to the Gigabit Ethernet port on the CE-1000-4 card. This particular data rate might occasionally exceed 51.84 Mbps, but the SONET circuit assigned to the CE-1000-4 port might be only STS-1 (51.84 Mbps). In this example, the CE-1000-4 card sends out a pause frame and requests that the router delay its transmission for a certain period of time. With flow control and a substantial per-port buffering capability, a private line service provisioned at less than full line rate capacity (STS-1) is efficient because frame loss can be controlled to a large extent.

Asymmetric enables the CE-1000-4 to receive flow control pauses, but not generate flow control pauses. This mode supports a link partner that cannot receive flow control pauses but can send flow control pauses. The CE-1000-4 does not have a mode where it would send flow control pauses but not be able to receive flow control pauses.

In pass-through mode, transmit flow control frames are not generated by the Ethernet port interfaces, and received flow control frames pass through transparently. Pass-through mode supports end-to-end flow control between clients using Ethernet over SONET/SDH transport.

Flow Control Threshold Provisioning

The CE-1000-4 card has flow control threshold provisioning, which allows a user to select one of three watermark (buffer size) settings; default, low latency, or custom. Default is the best setting for general use. Low latency is good for sub-rate applications, such as voice-over-IP (VoIP) over an STS-1. For attached devices with insufficient buffering, best effort traffic, or long access line lengths, set a higher latency.

The flow control high setting is the watermark for sending the Pause On frame to the attached Ethernet device; this frame signals the device to temporarily stop transmitting. The flow control low setting is the watermark for sending the Pause Off frame, which signals the device to resume transmitting. The default watermark setting values are 485 for the high threshold and 25 for the low threshold. Low latency watermark setting values are10 for the high threshold and 5 for the low threshold.

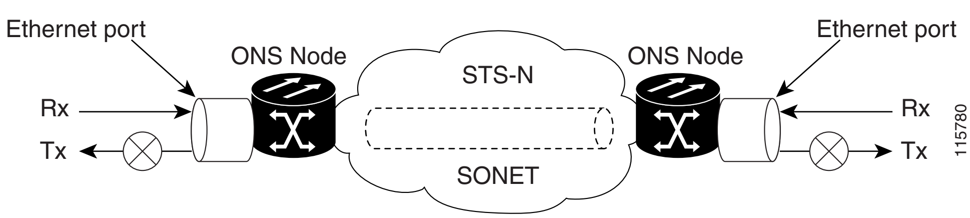
The custom setting allows you to specify the buffer size of Flow Ctrl Lo and Flow Ctrl Hi thresholds. The range is 1 to 511 units, where 1 unit is equal to 192 bytes. Make sure that the value of Flow Ctrl Lo is lesser than Flow Ctrl Hi with a difference of at least 160 units between the two values to ensure packets are not dropped.

Ethernet Link Integrity Support

The CE-1000-4 card supports end-to-end Ethernet link integrity (Figure 1-6). This capability is integral to providing an Ethernet private line service and correct operation of Layer 2 and Layer 3 protocols on the attached Ethernet devices. Link Integrity is implemented so that the Ethernet over SONET/SDH connection behaves more like an Ethernet cable from the viewpoint of the attached Ethernet devices.

End-to-end Ethernet link integrity means that if any part of the end-to-end path fails, the entire path fails. It disables the Ethernet port transmitter on the CE-1000-4 card when the remote Ethernet port does not have a receive signal or when the SONET/SDH near end of a far-end failure is detected. The failure of the entire path is ensured by turning off the transmit pair at each end of the path. The attached Ethernet devices recognize the disabled transmit pair as a loss of carrier and consequently an inactive link or link fail. The transport fail alarm is also raised when the port transmitter is disabled. Link integrity will support a double fault, which is when both Ethernet ports do not receive a signal.

Figure 1-3 End-to-End Ethernet Link Integrity Support



Some network devices can be configured to ignore a loss of carrier condition. If a device configured to ignore a loss of carrier condition attaches to a CE-1000-4 card at one end, alternative techniques (such as use of Layer 2 or Layer 3 keep-alive messages) are required to route traffic around failures. The response time of such alternate techniques is typically much longer than techniques that use link state as indications of an error condition.

Administrative and Service States with Soak Time for Ethernet and SONET/SDH Ports

The CE-1000-4 card supports the administrative and service states for the Ethernet ports and the SONET/SDH circuit. For more information about card and circuit service states, refer to the "Administrative and Service States" appendix in the *Cisco ONS 15454 Reference Manual* or the *Cisco ONS 15454 SDH Reference Manual*.

Ethernet ports can be set to the In-Service, Automatic In-Service (IS,AINS) administrative state. IS,AINS initially puts the port in the Out-of-Service and Autonomous, Automatic In-Service (OOS-AU,AINS) state. In this service state, alarm reporting is suppressed, but traffic is carried and loopbacks are allowed. After the soak time passes, the port changes to In-Service and Normal (IS-NR).

The default soak time is eight hours and zero minutes. The user can also configure the AINS soak time under the Provisioning tab > Ether Ports tab or under the Provisioning tab > POS Ports tab. The user can view the AINS soak time and the time remaining until IS under the Maintenance tab > AINS Soak tabs.

Raised fault conditions, whether their alarms are reported or not, can be retrieved on the CTC Conditions tab or by using the TL1 RTRV-COND command.Two Ethernet port alarms/conditions, CARLOSS and TPTFAIL, can prevent the port from going into service. This occurs even though alarms are suppressed when a CE-1000-4 circuit is provisioned with the Ethernet ports set to the IS,AINS state, because the CE-1000-4 link integrity function is active and ensures that the links at both ends are not enabled until all SONET/SDH and Ethernet errors along the path are cleared. If the link integrity function keeps the end-to-end path down, both ports will have at least one of the two conditions needed to suppress the AINS-to-IS transition. Therefore, the ports will remain in the AINS state with alarms suppressed.

ESM also applies to the SONET/SDH circuits of the CE-1000-4 card. If the SONET/SDH circuit is set up in IS,AINS state and the Ethernet error occurs before the circuit transitions to IS, then link integrity will also prevent the circuit transition to the IS state until the Ethernet port errors are cleared at both ends. The service state will be OOS-AU,AINS as long as the administrative state is IS,AINS. When there are no Ethernet or SONET errors, link integrity enables the Ethernet port at each end. Simultaneously, the AINS countdown begins as normal. If no additional conditions occur during the time period, each port transitions to the IS-NR state. During the AINS countdown, the soak time remaining is available in CTC and TL1. The AINS soaking logic restarts from the beginning if a condition appears again during the soak period.

A SONET/SDH circuit provisioned in the IS,AINS state remains in the initial Out-of-Service (OOS) state until the Ethernet ports on each end of the circuit transition to the IS-NR state. The SONET/SDH circuit transports Ethernet traffic and counts statistics when link integrity turns on the Ethernet port, regardless of whether this AINS-to-IS transition is complete.

RMON and SNMP Support

The CE-1000-4 card features remote monitoring (RMON) and simple network management protocol (SNMP) that allows network operators to monitor the health of the network with a network management system (NMS). The CE-1000-4 uses ONG RMON. ONG RMON contains the statistics, history, alarms, and events MIB groups from the standard RMON MIB. A user can access RMON threshold provisioning through TL1 or CTC. For RMON threshold provisioning with CTC, refer to the *Cisco ONS 15454 Procedure Guide* or the *Cisco ONS 15454 SDH Procedure Guide*.

Statistics and Counters

The CE-1000-4 has a full range of Ethernet and POS statistics information under the Performance > Ether Ports tabs or the Performance > POS Ports tabs.

CE-1000-4 SONET/SDH Circuits and Features

The CE-1000-4 card has four POS ports, numbered one through four, which can be managed with CTC or TL1. Each POS port is statistically mapped to a matching Ethernet port. The CE-1000-4 card provides a total bandwidth of STS-48c in any compatible slot within an ONS 15454 or a total bandwidth of STM-16 in any compatible slot within an ONS 15454 SDH.

At the POS port level, you can configure several characteristics:

- Port name
- Administrative state
- Automatic in-service (AINS) soak time
- Framing type
- Encapsulation CRC

Note Encapsulation CRC can only be turned on and off (CRC or no CRC), when the framing type is configured for GFP. When the framing type is set to HDLC, CRC is always on.

Click the card-level Provisioning > POS Ports tabs to configure the Administrative State, Framing Type, and Encapsulation Type. Click the card-level Performance > POS Ports tab to view the statistics, utilization, and history for the POS ports.

For specific circuit sizes and compatible card slots for the CE-1000-4 card, refer to the "Ethernet Cards" chapter in the *Cisco ONS 15454 Reference Manual* or the *Cisco ONS 15454 SDH Reference Manual*.

CE-1000-4 VCAT Characteristics

The CE-1000-4 card supports the software link capacity adjustment scheme (SW-LCAS). This makes the CE-1000-4 card compatible with the Cisco ONS 15454 SONET and Cisco ONS 15454 SDH ML-Series cards, which also supports SW-LCAS. The CE-1000-4 card does not support standard LCAS, which is hardware-based. The CE-1000-4 also operates with no SW-LCAS enabled. In this mode, it is compatible with the Cisco ONS 15454 SONET and Cisco ONS 15454 SDH G-Series card, CE-100T-8 card, and ML-Series card, when the ML-Series card is not configured with SW-LCAS. For more information on Ethernet card compatibility, see Appendix A, "POS on ONS Ethernet Cards."

To enable end-to-end connectivity in a VCAT circuit that traverses through a third-party network, you must create a server trail between the ports. For more details, refer to the "Create Circuits and VT Tunnels" chapter in the *Cisco ONS 15454 Procedure Guide* and *Cisco ONS 15454 SDH Procedure Guide*.

The CE-1000-4 card supports flexible VCAT groups (VCGs) and fixed (pure or non-flexible) VCGs. Flexible VCG corresponds to SW-LCAS, fixed VCG corresponds to no LCAS. With flexible VCGs, the CE-1000-4 can perform these operations:

- Add or remove members from groups
- Put members into or out of service, which also adds/removes them from the group

- Add or remove cross-connect circuits from VCGs
- Automatically remove error members from the group

Adding or removing members from the VCG is service-affecting. Adding or removing cross-connect circuits is not service-affecting, if the associated members are not in the group

The CE-1000-4 card also supports fixed (pure or non-flexible) VCGs. With non-flexible VCGs, the CE-1000-4 is more limited an can only perform these operations:

- Put members into or out of service
- Add or remove cross-connect circuits associated with members

With non-flexible VCGs, the limitations of the CE-1000-4 include:

- Cannot add or remove members from groups
- Cannot automatically remove error members from the group

The CE-1000-4 card allows independent routing and protection preferences for each member of a VCAT circuit. The user can also control the amount of VCAT circuit capacity that is fully protected, unprotected, or uses Protection Channel Access (PCA) (when PCA is available). Alarms are supported on a per-member as well as per virtual concatenation group (VCG) basis.

The CE-1000-4 card supports VCAT common fiber routing and VCAT split fiber (diverse) routing. Common fiber routing is compatible with two-fiber bidirectional line switched ring (BLSR) protection schemes and APS. It does not support path protection and four-fiber BLSR protection schemes. Split fiber routing supports all protection types; path protection, two-fiber BLSR, four-fiber BLSR, and linear switching (1+1).

With VCAT split fiber routing, each member can be routed independently through the SONET or SDH network instead of having to follow the same path as required by CCAT and VCAT common fiber routing. This allows a more efficient use of network bandwidth, but the different path lengths and different delays encountered may cause slightly different arrival times for the individual members of the VCG. The VCAT differential delay is this relative arrival time measurement between members of a VCG. The maximum tolerable VCAT split fiber routing differential delay for the CE-1000-4 card is approximately 120 milliseconds. A loss of alignment alarm is generated if the maximum differential delay supported is exceeded.

The differential delay compensation function is automatically enabled when the user chooses split fiber routing during the CTC circuit configuration process. CCAT and VCAT common fiber routing do not enable or need differential delay support.

Caution Protection switches of less than 60 ms are not guaranteed with the differential delay compensation function enabled. The compensation time is added to the switching time.

Note For TL1, EXPBUFFERS parameter must be set to ON in the ENT-VCG command to enable support for split fiber routing.

CE-1000-4 POS Encapsulation, Framing, and CRC

The CE-1000-4 card uses Cisco EoS LEX (LEX). LEX is the primary encapsulation of ONS Ethernet cards. In this proprietary HDLC-based encapsulation, the protocol field is set to the values specified in Internet Engineering Task Force (IETF) Request For Comments (RFC) 1841.

The user can provision framing on the CE-1000-4 as either the default frame-mapped generic framing procedure framing (GFP-F) or high-level data link control (HDLC) framing.

With GFP-F framing, the user can also configure a 32-bit CRC (default) or no CRC (none). When LEX is used over GFP-F it is standard Mapped Ethernet over GFP-F according to ITU-T G.7041.

HDLC framing provides a set 32-bit CRC.On CTC go to CE card view and click the Provisioning > POS ports tab, to see the various parameters that can be configured on the POS ports, see "CTC Display of POS Port Provisioning Status". Various parameters like, admin state, framing type, CRC, and soak time for a port can be configured here.

For more details about the interoperability of ONS Ethernet cards, including information on encapsulation, framing, and CRC, see the Appendix A, "POS on ONS Ethernet Cards," chapter.

CE-1000-4 Loopback, J1 Path Trace, and SONET/SDH Alarms

The CE-1000-4 card supports terminal and facility loopbacks. It also reports SONET/SDH alarms and transmits and monitors the J1 Path Trace byte in the same manner as OC-N/STM-N cards. Support for path termination functions include:

- H1 and H2 concatenation indication
- Bit interleaved parity 3 (BIP-3) generation
- G1 path status indication
- C2 path signal label (read only)
- Path level alarms and conditions, including loss of pointer (LOP), unequipped, payload mismatch, alarm indication signal (AIS) detection, and remote defect indication (RDI)
- J1 path trace for high-order circuit paths
- Extended signal label for the low-order paths

CE-100T-8 Ethernet Card

This section describes the operation of the CE-100T-8 (Carrier Ethernet) card supported on the ONS 15454 and ONS 15454 SDH. A CE-100T-8 card installed in an ONS 15454 SONET is restricted to SONET operation, and a CE-100T-8 card installed in an ONS 15454 SDH is restricted to SDH operation. Another version of the CE-100T-8 card is supported on the ONS 15310-CL.

Provisioning is done through CTC or Transaction Language One TL1. Cisco IOS is not supported on the CE-100T-8 card.

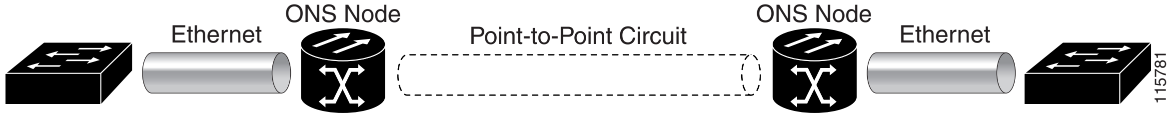
For Ethernet card specifications, refer to the *Cisco ONS 15454 Reference Manual* or the *Cisco ONS 15454 SDH Reference Manual*. For step-by-step Ethernet card circuit configuration procedures, refer to the *Cisco ONS 15454 Procedure Guide* or the *Cisco ONS 15454 SDH Procedure Guide*. For TL1 provisioning commands, refer to the *Cisco ONS SONET TL1 Command Guide* or the *Cisco ONS SDH TL1 Command Guide*.

Section topics include:

CE-100T-8 Overview

The CE-100T-8 is a Layer 1 mapper card with eight 10/100 Ethernet ports. It maps each port to a unique SONET/SDH circuit in a point-to-point configuration. Figure 1-4 illustrates a sample CE-100T-8 application. In this example, data traffic from the Fast Ethernet port of a switch travels across the point-to-point circuit to the Fast Ethernet port of another switch.

Figure 1-4 CE-100T-8 Point-to-Point Circuit



The CE-100T-8 cards allow you to provision and manage an Ethernet private line service like a traditional SONET/SDH line. CE-100T-8 card applications include providing carrier-grade Ethernet private line services and high-availability transport.

The CE-100T-8 card carries any Layer 3 protocol that can be encapsulated and transported over Ethernet, such as IP or IPX. The Ethernet frame from the data network is transmitted on the Ethernet cable into the standard RJ-45 port on a CE-100T-8 card. The CE-100T-8 card transparently maps Ethernet frames into the SONET/SDH payload using packet-over-SONET/SDH (POS) encapsulation. The POS circuit with its encapsulated Ethernet inside is then multiplexed onto an optical card like any other SONET synchronous transport signal (STS) or SDH synchronous transport mode (STM). When the payload reaches the destination node, the process is reversed and the data is transmitted from the standard RJ-45 port in the destination CE-100T-8 card onto the Ethernet cable and data network. The POS process is covered in detail in Appendix A, "POS on ONS Ethernet Cards."

The CE-100T-8 card supports ITU-T G.707 and Telcordia GR-253 based standards. It allows a soft reset, which is errorless in most cases. During the soft reset if there is a provisioning change, or if the firmware is replaced during the software upgrade process, the reset is equivalent to a hard reset. For more information on a soft reset of a CE-100T-8 card using CTC, refer to the *Cisco ONS 15454 Procedure Guide* or the *Cisco ONS 15454 SDH Procedure Guide*.

CE-100T-8 Ethernet Features

The CE-100T-8 card has eight front-end Ethernet ports which use standard RJ-45 connectors for 10BASE-T Ethernet/100BASE-TX Ethernet media. Ethernet Ports 1 through 8 each map to a POS port with a corresponding number. The console port on the CE-100T-8 card is not functional.

The CE-100T-8 cards forward valid Ethernet frames unmodified over the SONET/SDH network. Information in the headers is not affected by the encapsulation and transport. For example, included IEEE 802.1Q information will travel through the process unaffected.

The ONS 15454 SONET/SDH CE-100T-8 card supports maximum Ethernet frame sizes of 1548 bytes including the Cyclic Redundancy Check (CRC). The Maximum Transmission Unit (MTU) size is not configurable and is set at a 1500 byte maximum (standard Ethernet MTU). Baby giant frames in which the standard Ethernet frame is augmented by IEEE 802.1 Q-tags or Multiprotocol Label Switching (MPLS) tags are also supported. Full Jumbo frames are not supported.

The CE-100T-8 cards discard certain types of erroneous Ethernet frames rather than transport them over SONET/SDH. Erroneous Ethernet frames include corrupted frames with CRC errors and undersized frames that do not conform to the minimum 64-byte length Ethernet standard.

Note Many Ethernet attributes are also available through the network element (NE) defaults feature. For more information on NE defaults, refer to the "Network Element Defaults" appendix in the *Cisco ONS 15454 Reference Manual* or the *Cisco ONS 15454 SDH Reference Manual*.

Autonegotiation, Flow Control, and Frame Buffering

On the CE-100T-8 card, Ethernet link autonegotiation is on by default when the speed or duplex of the port is set to auto. The user can also set the link speed, duplex, selective autonegotiation, and flow control manually under the card-level Provisioning tab of CTC.

The CE-100T-8 card supports selective autonegotiation on the Ethernet ports. If selective autonegotiation is enabled, the port attempts to autonegotiate only to a specific speed and duplex. The link will come up if both the speed and duplex of the attached autonegotiating device matches that of the port. You cannot enable selective autonegotiation if either the speed or duplex of the port is set to auto.

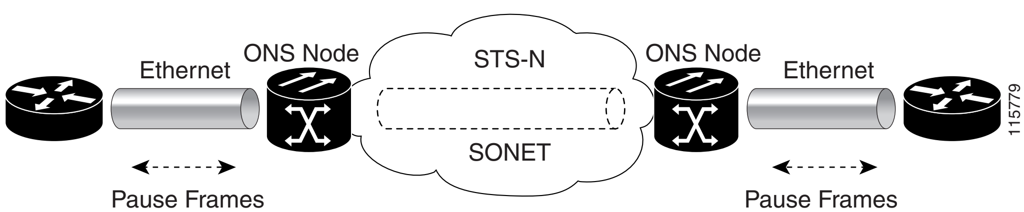
The CE-100T-8 card supports IEEE 802.3x flow control and frame buffering to reduce data traffic congestion. Flow control is on by default.

To prevent over-subscription, buffer memory is available for each port. When the buffer memory on the Ethernet port nears capacity, the CE-100T-8 card uses IEEE 802.3x flow control to transmit a pause frame to the attached Ethernet device. Flow control and autonegotiation frames are local to the Fast Ethernet interfaces and the attached Ethernet devices. These frames do not continue through the POS ports.

The CE-100T-8 card has symmetric flow control and proposes symmetric flow control when autonegotiating flow control with attached Ethernet devices. Symmetric flow control allows the CE-100T-8 cards to respond to pause frames sent from external devices and to send pause frames to external devices.

The pause frame instructs the source to stop sending packets for a specific period of time. The sending station waits the requested amount of time before sending more data. Figure 1-5 illustrates pause frames being sent and received by CE-100T-8 cards and attached switches.

Figure 1-5 Flow Control



This flow-control mechanism matches the sending and receiving device throughput to that of the bandwidth of the STS circuit. For example, a router might transmit to the Ethernet port on the CE-100T-8 card. This particular data rate might occasionally exceed 51.84 Mbps, but the SONET circuit assigned to the CE-100T-8 port might be only STS-1 (51.84 Mbps). In this example, the CE-100T-8 sends out a pause frame and requests that the router delay its transmission for a certain period of time. With flow control and a substantial per-port buffering capability, a private line service provisioned at less than full line rate capacity (STS-1) is efficient because frame loss can be controlled to a large extent.

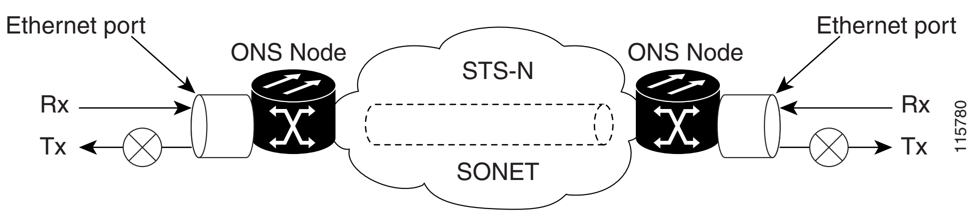
Ethernet Link Integrity Support

The CE-100T-8 supports end-to-end Ethernet link integrity (Figure 1-6). This capability is integral to providing an Ethernet private line service and correct operation of Layer 2 and Layer 3 protocols on the attached Ethernet devices.

End-to-end Ethernet link integrity means that if any part of the end-to-end path fails, the entire path fails. It disables the Ethernet port on the CE-100T-8 card if the remote Ethernet port is unable to transmit over the SONET/SDH network or if the remote Ethernet port is disabled.

Failure of the entire path is ensured by turning off the transmit pair at each end of the path. The attached Ethernet devices recognize the disabled transmit pair as a loss of carrier and consequently an inactive link or link fail.

Figure 1-6 End-to-End Ethernet Link Integrity Support



Note Some network devices can be configured to ignore a loss of carrier condition. If a device configured to ignore a loss of carrier condition attaches to a CE-100T-8 card at one end, alternative techniques (such as use of Layer 2 or Layer 3 keep-alive messages) are required to route traffic around failures. The response time of such alternate techniques is typically much longer than techniques that use link state as indications of an error condition.

Administrative and Service States with Soak Time for Ethernet and SONET/SDH Ports

The CE-100T-8 card supports the administrative and service states for the Ethernet ports and the SONET/SDH circuit. For more information about card and circuit service states, refer to the "Administrative and Service States" appendix in the *Cisco ONS 15454 Reference Manual* or the *Cisco ONS 15454 SDH Reference Manual*.

The Ethernet ports can be set to the ESM service states including the In-Service, Automatic In-Service (IS,AINS) administrative state. IS,AINS initially puts the port in the Out-of-Service and Autonomous, Automatic In-Service (OOS-AU,AINS) state. In this service state, alarm reporting is suppressed, but traffic is carried and loopbacks are allowed. After the soak period passes, the port changes to In-Service and Normal (IS-NR). Raised fault conditions, whether their alarms are reported or not, can be retrieved on the CTC Conditions tab or by using the TL1 RTRV-COND command.

Two Ethernet port alarms/conditions, CARLOSS and TPTFAIL, can prevent the port from going into service. This occurs even though alarms are suppressed when a CE-100T-8 circuit is provisioned with the Ethernet ports set to the IS,AINS state, because the CE-100T-8 link integrity function is active and ensures that the links at both ends are not enabled until all SONET and Ethernet errors along the path are cleared. As long as the link integrity function keeps the end-to-end path down, both ports will have at least one of the two conditions needed to suppress the AINS-to-IS transition. Therefore, the ports will remain in the AINS state with alarms suppressed.

ESM also applies to the SONET/SDH circuits of the CE-100T-8 card. If the SONET/SDH circuit is set up in IS,AINS state and the Ethernet error occurs before the circuit transitions to IS, then link integrity will also prevent the circuit transition to the IS state until the Ethernet port errors are cleared at both ends. The service state will be OOS-AU,AINS as long as the administrative state is IS,AINS. When there are no Ethernet or SONET errors, link integrity enables the Ethernet port at each end. Simultaneously, the AINS countdown begins as normal. If no additional conditions occur during the time period, each port transitions to the IS-NR state. During the AINS countdown, the soak time remaining is available in CTC and TL1. The AINS soaking logic restarts from the beginning if a condition appears again during the soak period.

A SONET/SDH circuit provisioned in the IS,AINS state remains in the initial Out-of-Service (OOS) state until the Ethernet ports on each end of the circuit transition to the IS-NR state. The SONET/SDH circuit transports Ethernet traffic and counts statistics when link integrity turns on the Ethernet port, regardless of whether this AINS-to-IS transition is complete.

IEEE 802.1Q CoS and IP ToS Queuing

The CE-100T-8 references IEEE 802.1Q class of service (CoS) thresholds and IP type of service (ToS) (IP Differentiated Services Code Point [DSCP]) thresholds for priority queueing. CoS and ToS thresholds for the CE-100T-8 are provisioned on a per port level. This allows the user to provide priority treatment based on open standard quality of service (QoS) schemes already existing in the data network attached to the CE-100T-8. The QoS treatment is applied to both Ethernet and POS ports.

Any packet or frame with a priority greater than the set threshold is treated as priority traffic. This priority traffic is sent to the priority queue instead of the normal queue. When buffering occurs, packets on the priority queue preempt packets on the normal queue. This results in lower latency for the priority traffic, which is often latency-sensitive traffic such as voice-over-IP (VoIP).

Because these priorities are placed on separate queues, the priority queuing feature should not be used to separate rate-based CIR/EIR marked traffic (sometimes done at a Metro Ethernet service provider edge). This could result in out-of-order packet delivery for packets of the same application, which would cause performance issues with some applications.

For an IP ToS-tagged packet, the CE-100T-8 can map any of the 256 priorities specified in IP ToS to priority or best effort. The user can configure a different ToS in CTC at the card-level view under the Provisioning > Ether Ports tabs. Any ToS class higher than the class specified in CTC is mapped to the priority queue, which is the queue geared towards low latency. By default, the ToS is set to 255, which is the highest ToS value. This results in all traffic being treated with equal priority by default.

Table 1-3 shows which values are mapped to the priority queue for sample IP ToS settings. (ToS settings span the full 0 to 255 range, but only selected settings are shown.)

Table 1-1 IP ToS Priority Queue Mappings

ToS Setting in CTC	ToS Values Sent to Priority Queue
255 (default)	None
250	251–255
150	151–255
100	101–255
50	51–255
0	1–255

For a CoS-tagged frame, the CE-100T-8 can map the eight priorities specified in CoS to priority or best effort. The user can configure a different CoS in CTC at the card-level view under the Provisioning > Ether Ports tabs. Any CoS class higher than the class specified in CTC is mapped to the priority queue, which is the queue geared towards low latency. By default, the CoS is set to 7, which is the highest CoS value. This results in all traffic being treated with equal priority by default.

Table 1-3 shows which values are mapped to the priority queue for CoS settings.

Table 1-2 CoS Priority Queue Mappings

CoS Setting in CTC	CoS Values Sent to Priority Queue
7 (default)	None
6	7
5	6, 7
4	5, 6, 7
3	4, 5, 6, 7
2	3, 4, 5, 6, 7
1	2, 3, 4, 5, 6, 7
0	1, 2, 3, 4, 5, 6, 7

Ethernet frames without VLAN tagging use ToS-based priority queueing if both ToS and CoS priority queueing is active on the card. The CE-100T-8 card's ToS setting must be lower than 255 (default) and the CoS setting lower than 7 (default) for CoS and ToS priority queueing to be active. A ToS setting of 255 (default) disables ToS priority queueing, so in this case the CoS setting would be used.

Ethernet frames with VLAN tagging use CoS-based priority queueing if both ToS and CoS are active on the card. The ToS setting is ignored. CoS based priority queueing is disabled if the CoS setting is 7 (default), so in this case the ToS setting would be used.

If the CE-100T-8 card's ToS setting is 255 (default) and the CoS setting is 7 (default), priority queueing is not active on the card, and data gets sent to the default normal traffic queue. If data is not tagged with a ToS value or a CoS value before it enters the CE-100T-8 card, it also gets sent to the default normal traffic queue.

Note Priority queuing has no effect when flow control is enabled (default) on the CE-100T-8. When flow control is enabled, a 6-kilobyte, single-priority, first-in first-out (FIFO) buffer fills, then a PAUSE frame is sent. This results in the packet ordering priority becoming the responsibility of the external device, which is buffering as a result of receiving the PAUSE flow-control frames.

Note Priority queuing has no effect when the CE-100T-8 card is provisioned with STS-3C circuits. The STS-3c circuit has more data capacity than Fast Ethernet, so CE-100T-8 buffering is not needed. Priority queuing only takes effect during buffering.

RMON and SNMP Support

The CE-100T-8 card features remote monitoring (RMON) that allows network operators to monitor the health of the network with a network management system (NMS). The CE-100T-8 uses the ONG RMON. The ONG RMON contains the statistics, history, alarms, and events MIB groups from the standard

RMON MIB. A user can access RMON threshold provisioning through TL1 or CTC. For RMON threshold provisioning with CTC, refer to the *Cisco ONS 15454 Procedure Guide* and the *Cisco ONS 15454 Troubleshooting Guide*, or the *Cisco ONS 15454 SDH Procedure Guide* and the *Cisco ONS 15454 SDH Troubleshooting Guide*.

Statistics and Counters

The CE-100T-8 card has a full range of Ethernet and POS statistics information under Performance > Ether Ports or Performance > POS Ports.

CE-100T-8 SONET/SDH Circuits and Features

The CE-100T-8 card has eight POS ports, numbered one through eight, which can be managed with CTC or TL1. Each POS port is statically mapped to a matching Ethernet port. By clicking the card-level Provisioning > POS Ports tab, the user can configure the administrative state, framing type, and encapsulation type. By clicking the card-level Performance > POS Ports tab, the user can view the statistics, utilization, and history for the POS ports.

Available Circuit Sizes and Combinations

Each POS port terminates an independent contiguous concatenation (CCAT) or virtual concatenation (VCAT) circuit. The SONET/SDH circuit is created for these ports through CTC or TL1 in the same manner as a SONET/SDH circuit for a non-Ethernet line card. Table 1-3 and Table 1-4 show the circuit sizes available for the CE-100T-8 card.

Table 1-3 Supported SONET Circuit Sizes of CE-100T-8 card on ONS 15454

CCAT	VCAT High Order	VCAT Low Order
STS-1	STS-1-1v	VT1.5-*n*V (*n*= 1 to 64)
STS-3c	STS-1-2v	
	STS-1-3v	

Table 1-4 Supported SDH Circuit Sizes of CE-100T-8 on ONS 15454 SDH

CCAT	VC-3 VCAT	VC-12 VCAT
VC-3	VC-3-1v	VC-12-*n*V (*n*= 1 to 63)
VC-4	VC-3-2v	
	VC-3-3v	

A single circuit provides a maximum of 100 Mbps of throughput, even when a larger STS-3c or VC-4 circuit, which has a bandwidth equivalent of 155 Mbps, is provisioned. This is due to the hardware restriction of the Fast Ethernet port. A VCAT circuit is also restricted in this manner. Table 1-5 shows the minimum SONET circuit sizes required for wire speed service delivery.

Table 1-5 Minimum SONET Circuit Sizes for Ethernet Speeds

Ethernet Wire Speed	CCAT High Order	VCAT High Order	VCAT Low Order
Line Rate 100BASE-T	STS-3c	STS-1-3v, STS-1-2v[1]	VT1.5-*xv* (x=56-64)
Sub Rate 100BASE-T	STS-1	STS-1-1v	VT1.5-*xv* (x=1-55)
Line Rate 10BASE-T	STS-1	Not applicable	VT1.5-7v
Sub Rate 10BASE-T	Not applicable	Not applicable	VT1.5-xv (x=1-6)

1. STS-1-2v provides a total transport capacity of 98 Mbps.

Table 1-6 shows the minimum SDH circuit sizes required for 10 Mbps and 100 Mbps wire speed service.

Table 1-6 SDH Circuit Sizes and Ethernet Services

Ethernet Wire Speed	CCAT	VC-3 VCAT	VC-12 VCAT
Line Rate 100BASE-T	VC-4	VC-3-3v, VC-3-2v[1]	VC-12-*xv* (x=50-63)
Sub Rate 100BASE-T	VC-3	VC-3-1v	VC-12-*xv* (x=1-49)
Line Rate 10BBASE-T	VC-3	VC-3-1v	VC-12-*5v*
Sub Rate 10BASE-T	Not applicable	Not applicable	VC-12-x*v* (x=1-4)

1. VC-3-2v provides a total transport capacity of 98 Mbps.

The number of available circuits and total combined bandwidth for the CE-100T-8 card depends on the combination of circuit sizes configured. Table 1-7 shows the CCAT high-order circuit size combinations available for the CE-100T-8 card on the ONS 15454.

Table 1-7 CCAT High-Order Circuit Size Combinations for SONET

Number of STS-3c Circuits	Maximum Number of STS-1 Circuits
None	8
1	7
2	6
3	3
4	None

Table 1-8 shows the CCAT high-order circuit size combinations available for the CE-100T-8 on the Cisco ONS 15454 SDH.

Table 1-8 CCAT High-Order Circuit Size Combinations for SDH

Number of VC-4 Circuits	Maximum Number of VC-3 Circuits
None	8
1	7
2	6
3	3
4	None

Table 1-9 shows the VCAT high-order circuit size combinations available for the CE-100T-8 card on the Cisco ONS 15454.

Table 1-9 VCAT High-Order Circuit Combinations for STS-1-3v and STS-1-2v SONET

Number of STS-1-3v Circuits	Maximum Number of STS-1-2v Circuits
None	4
1	3
2	2
3	1
4	None

Table 1-10 shows VC-3-3v and VC-3-2v circuit size combinations available for the CE-100T-8 card on the Cisco ONS 15454 SDH.

Table 1-10 VCAT Circuit Combinations for VC-3-3v and VC-3-2v for SDH

Number of VC-3-3v Circuits	Maximum Number of VC-3-2v Circuits
None	4
1	3
2	2
3	1
4	None

A user can combine CCAT high-order, VCAT high-order and VCAT low-order circuits. The CE-100T-8 card supports up to eight low-order VCAT circuits.

The available SONET circuit sizes are VT1.5-*X*v, where *X* is the range from 1 to 64. A maximum of four circuits are available at the largest low-order VCAT SONET circuit size, VT1.5-64v. Table 1-11 details the maximum density service combinations for SONET.

The available SDH circuit sizes are VC-12-*X*v, where *X* is the range from 1 to 63. A maximum of four circuits are available at the largest low-order VCAT SDH circuit size, VC-12-63v. Table 1-12 details the maximum density service combinations for SDH.

Table 1-11 CE-100T-8 Illustrative Service Densities for SONET

Service Combination	STS-3c or STS-1-3v	STS-1-2v	STS-1	VT1.5-xV	Number of Active Service
1	4	0	0	0	4
2	3	1	1	0	5
3	3	0	3	0	6
4	3	0	0	4 (x=1–21)[1]	7[1]
5	2	2	2	0	6
6	2	1	4	0	7
7	2	1	1	4 (x=1–21)[1]	8[1]

Table 1-11 CE-100T-8 Illustrative Service Densities for SONET (continued)

Service Combination	STS-3c or STS-1-3v	STS-1-2v	STS-1	VT1.5-xV	Number of Active Service
8	2	0	6	0	8
9	2	0	3	3 (x=1–28)	8
10	2	0	0	6 (x=1–28)	8
11	1	3	3	0	7
12	1	2	5	0	8
13	1	2	2	3 (x=1–28)	8
14	1	1	1	5 (x=1–28)	8
15	1	0	7	0	8
16	1	0	3	4 (x=1–42)	8
17	1	0	0	7 (x=1–42)	8
18	0	4	4	0	8
19	0	3	3	2 (x=1–42)	8
20	0	0	8	0	8
21	0	0	4	4 (x=1–42)	8
22	0	0	0	8 (x=1–42)	8

1. This low-order VCAT circuit combination is achievable if one of the first two circuits created on the card is a low-order VCAT circuit. If the first two circuits created on the card are high-order VCAT or CCAT circuits, then a maximum of three low-order VCAT circuits can be created on the card.

Table 1-12 CE-100T-8 Sample Service Densities for SDH

Service Combination	VC-4 or VC-3-3v	VC-3-2v	VC-3	VC-12-xv	Number of Active Service
1	4	0	0	0	4
2	3	1	1	0	5
3	3	0	3	0	6
4	3	0	0	3 (x=1–21)	6
5	2	2	2	0	6
6	2	1	4	0	7
7	2	1	1	3 (x=1–21)	7[2]
8	2	0	6	0	8
9	2	0	3	3 (x=1–21)	8
10	2	0	0	6 (x=1–21)	8
11	1	3	3	0	7
12	1	2	5	0	8
13	1	2	2	3 (x=1–21)	8[2]
14	1	1	1	5 (x=1–21)	8[2]

Table 1-12 CE-100T-8 Sample Service Densities for SDH (continued)

Service Combination	VC-4 or VC-3-3v	VC-3-2v	VC-3	VC-12-xv	Number of Active Service
15	1	0	7	0	8
16	1	0	3	2 (x=1–32) plus 2 (x=1–31)	8
17	1	0	0	7 (x=1–28)	8
18	0	4	4	0	8
19	0	3	3	1 (x=1–32) plus 1 (x=1–31)	8
20	0	0	8	0	8
21	0	0	4	2 (x=1–32) plus 2 (x=1–31)	8
22	0	0	0	4 (x=1–32) plus 4 (x=1–31)	8

These service combinations require creating the VC-12-xv circuit before you create the VC-3 circuits

CE-100T-8 Pools

The CE-100T-8 card total circuit capacity is divided among four pools. Each pool has a maximum capacity of three STS-1s with SONET or three VC-3s with SDH.

Displaying CE-100T-8 Pool Information with the STS/VT Allocation or VC4/VC LO Allocation Tab

At the CTC card-level view under the Maintenance tab, the STS/VT Allocation tab on the ONS 15454 SONET and the VC4/VC LO Allocation tab on the ONS 15454 SDH display how the provisioned circuits populate the four pools. On both screens, the POS Port table has a row for each port with three columns. They show the port number, the circuit size and type, and the pool it is drawn from. The Pool Utilization table has four columns and shows the pool number, the type of circuits in that pool, how much of the pool's capacity is being used, and whether additional capacity is available.

Figure 1-7 displays an SDH version of the tab, and Figure 1-8 displays the SONET version of the tab.

Figure 1-7 CE-100T-8 Allocation Tab for SDH

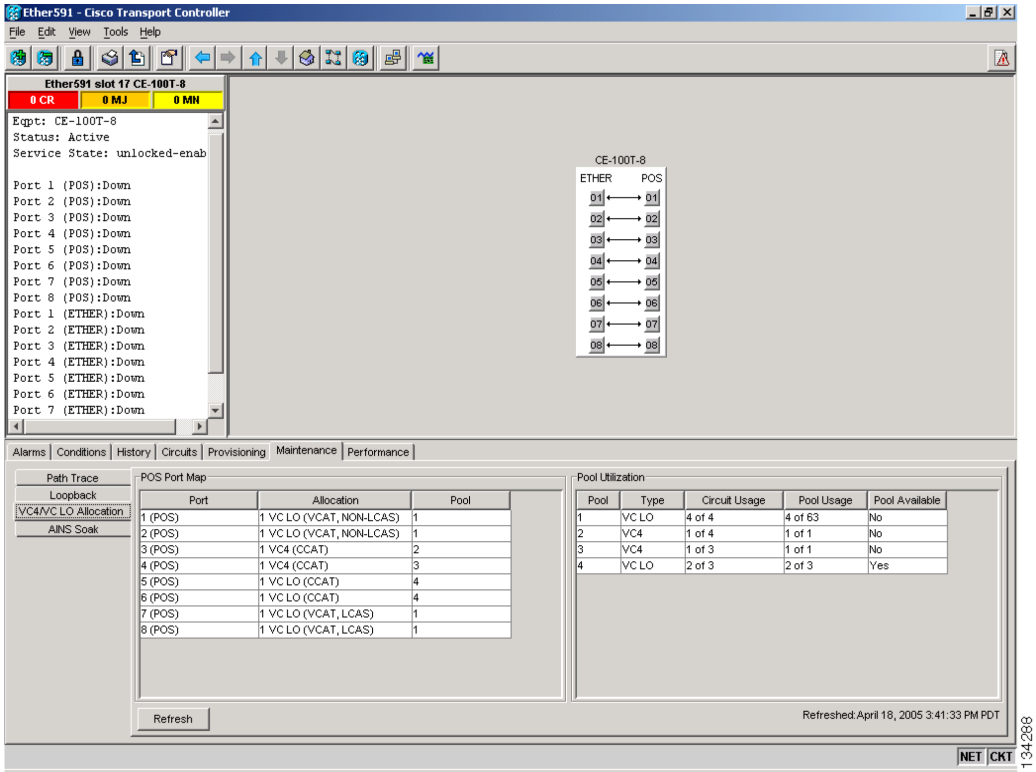
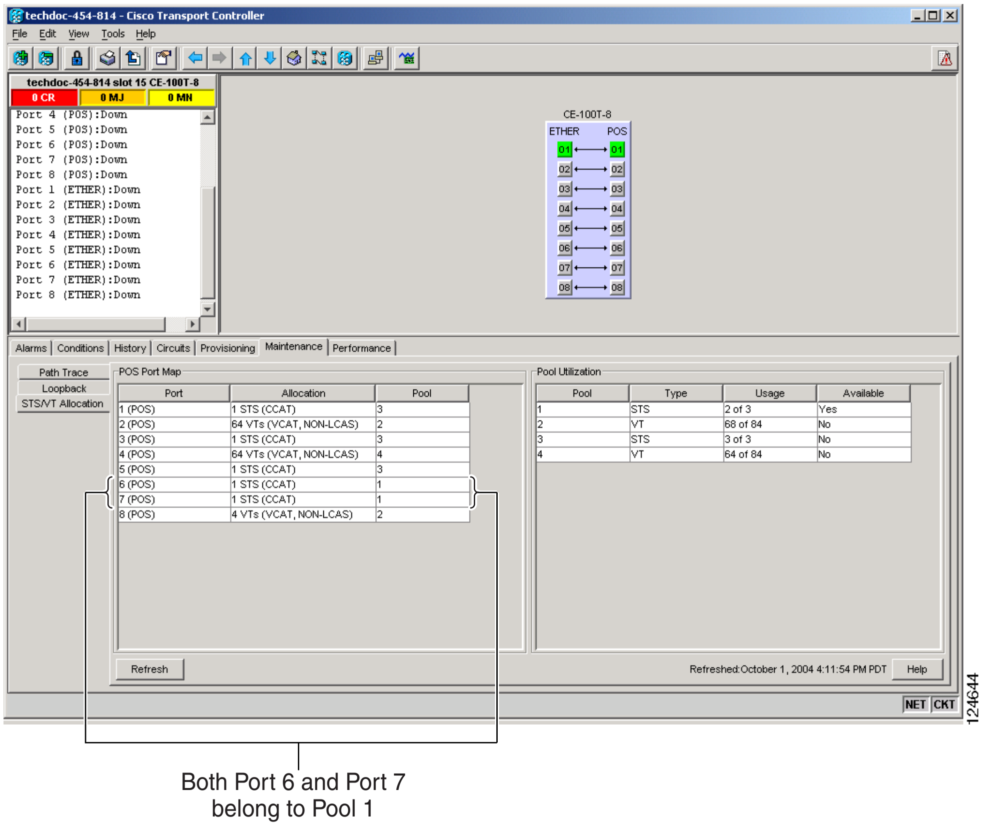


Figure 1-8 CE-100T-8 STS/VT Allocation Tab



CE-100T-8 Pool Allocation Example

This information can be useful in freeing up the bandwidth required for provisioning a circuit if there is not enough existing capacity in any one pool for provisioning the desired circuit. The user can look at the distribution of the existing circuits among the four pools and decide which circuits to delete in order to free space for the desired circuit.

For example if a user needs to provision an STS-3c or STS-1-3v on the SONET CE-100T-8 card shown in Figure 1-8, an STS-3c or STS-1-3v worth of bandwidth is not available from any of the four pools. The user needs to delete circuits from the same pool to free bandwidth. If the bandwidth is available but scattered among the pools, the circuit cannot be provisioned. Looking at the POS Port Map table, the user can determine which circuits belong to which pools. The Pool and Port columns in Figure 1-8 show that Port 6 and Port 7 are both drawn from Pool 1, and that no other circuits are drawn from Pool 1. Deleting these two STS-1 circuits will free an STS-3c or STS-1-3v worth of bandwidth from a single pool.

If the user did not determine what circuits to delete from the table information, he might delete the STS-1 circuits on Port 3, Port 5 and Port 6. This frees an STS-3c or STS-1-3v worth of bandwidth, but the required bandwidth is not available from a single pool and the STS-3c or STS-1-3v circuit is not provisionable.

CE-100T-8 Pool Provisioning Rules

All VCAT circuit members must be from the same pool. One of the four memory pools is reserved for the low-order VCAT circuits if sufficient bandwidth exists to support the high-order circuits in the remaining three pools. The high-order CCAT circuits use all the available capacity from a single memory pool before beginning to use the capacity of a new pool. The memory pools are allocated alternatively for the first three high-order VCAT circuits if the pools have the sufficient bandwidth to support the requested circuit size. To help prevent stranding bandwidth, provision your high-order VCAT circuits first to distribute them evenly.

CE-100T-8 VCAT Characteristics

The CE-100T-8 card have hardware-based support for the ITU-T G.7042 standard Link Capacity Adjustment Scheme (LCAS). This allows the user to dynamically resize a high order or low order VCAT circuit through CTC or TL1 without affecting other members of the VCG (errorless).

To enable end-to-end connectivity in a VCAT circuit that traverses through a third-party network, you must create a server trail between the ports. For more details, refer to the “Create Circuits and VT Tunnels” chapter in the *Cisco ONS 15454 Procedure Guide*.

The CE-100T-8 card has a software-based LCAS (SW-LCAS) scheme. This scheme is supported by the CE-100T-8 card only for circuits with the other end terminating on a ONS 15454 SONET/SDH ML-Series card.

The SW-LCAS is not supported on CE-100T-8 cards for interoperation with the CE-MR-10, CE-MR-6, and ML-MR-10 cards.

The CE-100T-8 card allows independent routing and protection preferences for each member of a VCAT circuit. The user can also control the amount of VCAT circuit capacity that is fully protected, unprotected, or uses Protection Channel Access (PCA); when PCA is available. Alarms are supported on a per-member and per-virtual concatenation group (VCG) basis.

Note The maximum tolerable VCAT differential delay for the CE-100T-8 card is 48 milliseconds. The VCAT differential delay is the relative arrival-time measurement between members of a VCG.

On the CE-100T-8 card, members of a HW-LCAS circuit must be moved to the OOS,OOG (locked, outOfGroup) state before you delete them.

A traffic hit is seen under the following conditions:

- A hard reset of the card containing the trunk port.
- Trunk port moved to OOS,DSBLD(locked,disabled) state.
- Trunk fiber pull.
- Deletion of members of the HW-LCAS circuit in IG (In Group) state.

CE-100T-8 POS Encapsulation, Framing, and CRC

The CE-100T-8 card uses Cisco EoS LEX (LEX). LEX is the primary encapsulation of ONS Ethernet cards. In this encapsulation, the protocol field is set to the values specified in Internet Engineering Task Force (IETF) Request For Comments (RFC) 1841. The user can provision frame-mapped GFP-F framing (default) or HDLC framing. With GFP-F framing, the user can also configure a 32-bit CRC (the default) or no CRC (none). When LEX is used over GFP-F it is standard Mapped Ethernet over GFP-F according to ITU-T G.7041. HDLC framing provides a set 32-bit CRC.

To configure GFP-F and HDLC, got to the CE-100T-8 card view in CTC and click the Provisioning > Pos Ports tab. To see the parameters that can be configured on the POS ports, see "ONS 15454, ONS 15454 SDH, ONS 15310-CL, and ONS 15310-MA CE-Series Cards Encapsulation and Framing" section of Chapter 9, POS on Ethernet Cards. Parameters that can be configured include administrative state, framing type, CRC, and soak time.

On CTC go to CE card view and click the Provisioning >pos ports tab, to see the various parameters that can be configured on the POS ports, see "CTC Display of POS Port Provisioning Status". Various parameters like, admin state, service state, framing type, CRC, MTU and soak time for a port can be configured here. For more details about the interoperability of ONS Ethernet cards, including information on encapsulation, framing, and CRC, see the Appendix A, "POS on ONS Ethernet Cards."

The CE-100T-8 card supports GFP-F null mode. GFP-F CMFs are counted and discarded.

CE-100T-8 Loopback, J1 Path Trace, and SONET/SDH Alarms

The CE-100T-8 card supports terminal and facility loopbacks. It also reports SONET/SDH alarms and transmits and monitors the J1 Path Trace byte in the same manner as OC-N/STM-N cards. Support for path termination functions includes:

- H1 and H2 concatenation indication
- C2 signal label
- Bit interleaved parity 3 (BIP-3) generation
- G1 path status indication
- C2 path signal label read/write
- Path level alarms and conditions, including loss of pointer (LOP), unequipped, payload mismatch, alarm indication signal (AIS) detection, and remote defect indication (RDI)
- J1 path trace for high-order CCAT paths
- J2 path trace for high-order VCAT circuits at the member level
- J2 path trace for low-order VCAT circuits at the member level
- Extended signal label for the low-order paths

CE-MR-10 Ethernet Card

This section describes the operation of the CE-MR-10 card supported on the ONS 15454 and ONS 15454 SDH. A CE-MR-10 card installed in an ONS 15454 SONET is restricted to SONET operation, and a CE-MR-10 card installed in an ONS 15454 SDH is restricted to SDH operation.

Provisioning is done through CTC or TL1. Configurations through Cisco IOS terminal/console is not supported on the CE-MR-10 card.

For Ethernet card specifications, refer to the *Cisco ONS 15454 Reference Manual* or the *Cisco ONS 15454 SDH Reference Manual*. For step-by-step Ethernet card circuit configuration procedures, refer to the *Cisco ONS 15454 Procedure Guide* or the *Cisco ONS 15454 SDH Procedure Guide*. Refer to the *Cisco ONS SONET TL1 Command Guide,* or the *Cisco ONS SDH TL1 Command Guide* for TL1 provisioning commands.

Section topics include:

CE-MR-10 Overview

The CE-MR-10 card is a 20 Gbps data module for use in the Cisco ONS 15454 and ONS 15454 SDH platforms. It provides support for L1 packet mapping functions (Ethernet to SONET/SDH). The 10/100/1000 Mbps Ethernet encapsulated traffic is mapped into SONET/SDH circuits. Each circuit has three main attributes:

- Low order, or high order
- CCAT or VCAT
- GFP, LEX, HDLC, or PPP based framing.
- CE-MR-10 cards support LCAS that allows hitless dynamic adjustment of SONET/SDH link bandwidth.

The CE-MR-10 is a Layer 1 (Ethernet Private Line) and Layer 1+ (Virtual Private Wire Services) mapper card with ten IEEE 802 compliant 10/100/1000 Mbps Ethernet ports that provide 1:1 mapping of Ethernet ports to circuits. It maps each port to a unique SONET/SDH circuit in a point-to-point configuration. Figure 1-9 illustrates a sample CE-MR-10 application. In this example, data traffic from the Fast Ethernet port of a switch travels across the point-to-point circuit to the Fast Ethernet port of another switch.

Figure 1-9 CE-MR-10 Point-to-Point Circuit

The CE-MR-10 card allows you to provision and manage an Ethernet private line service like a traditional SONET/SDH line. CE-MR-10 card applications include providing carrier-grade Ethernet private line services and high-availability transport.

The CE-MR-10 card carries any Layer 3 protocol that can be encapsulated and transported over Ethernet, such as IP or IPX. The Ethernet frame from the data network is transmitted on the Ethernet cable into the 10/100/1000 Mbps Ethernet ports on a CE-MR-10 card. The CE-MR-10 card transparently maps Ethernet frames into the SONET/SDH payload using packet-over-SONET/SDH (POS) encapsulation. The POS circuit with its encapsulated Ethernet inside is then multiplexed onto an optical card like any other SONET (STS) or SDH (STM). When the payload reaches the destination node, the process is reversed and the data is transmitted from the 10/100/1000 Mbps Ethernet ports in the destination CE-MR-10 card onto the Ethernet cable and data network. The POS process is covered in detail in Appendix A, "POS on ONS Ethernet Cards."

The CE-MR-10 card supports ITU-T G.707-based standards. It allows a soft reset, which is errorless in most cases. During the soft reset if there is a provisioning change, or if the firmware is replaced during a software upgrade process, the reset is equivalent to a hard reset. For more information on a soft reset of a CE-MR-10 card using CTC, refer to the *Cisco ONS 15454 Procedure Guide* or the *Cisco ONS 15454 SDH Procedure Guide*.

CE-MR-10 Ethernet Features

The Ethernet interface of the CE-MR-10 card comprises ten front-end SFP slots. For each slot, the interface speed and media type is determined by the installed SFP module. The SFP slots support 10 Mbps, 100 Mbps, and 1000 Mbps (Gigabit Ethernet) operation. The SFP modules supporting the intended rate can be copper (10/100/1000 Mbps) or optical (100/1000 Mbps). SFP modules are offered as separate orderable products for flexibility. For SFP details, refer to the *Cisco ONS 15454 Reference Manual*, *Cisco ONS 15454 SDH Reference Manual,* or Installing the GBIC, SFP, SFP+, XFP, CXP, and CFP Optical Modules in Cisco ONS Platforms. Ethernet Ports 1 through 10 each map to a POS port with a corresponding number. The console port on the CE-MR-10 card is not functional.

The CE-MR-10 card forwards valid Ethernet frames without modifying it over the SONET/SDH network. Information in the headers is not affected by encapsulation and transport. IEEE 802.1Q information travels through the process unaffected.

The CE-MR-10 supports jumbo frames with MTU sizes of 64 to 9600 bytes.

The CE-MR-10 card discards certain types of erroneous Ethernet frames rather than transport them over SONET/SDH. Erroneous Ethernet frames include corrupted frames with CRC errors and undersized frames that do not conform to the minimum 64-byte length, or oversized frames greater than 9600 bytes Ethernet standard.

Note Many Ethernet attributes are also available through the NE defaults feature. For more information on NE defaults, refer to the "Network Element Defaults" appendix in the *Cisco ONS 15454 Reference Manual* or the *Cisco ONS 15454 SDH Reference Manual*.

Autonegotiation, Flow Control, and Frame Buffering

On the CE-MR-10 card, Ethernet link autonegotiation is on by default when the duplex or speed of the port is set to auto. The user can also set the link speed, duplex, selective autonegotiation, and flow control manually under the card-level Provisioning tab in CTC.

The CE-MR-10 card supports selective autonegotiation on the Ethernet ports. If selective autonegotiation is enabled, the port attempts to autonegotiate only to a specific speed and duplex. The link will come up if both the speed and duplex of the attached autonegotiating device matches that of the port. You cannot enable selective autonegotiation if either the speed or duplex of the port is set to auto.

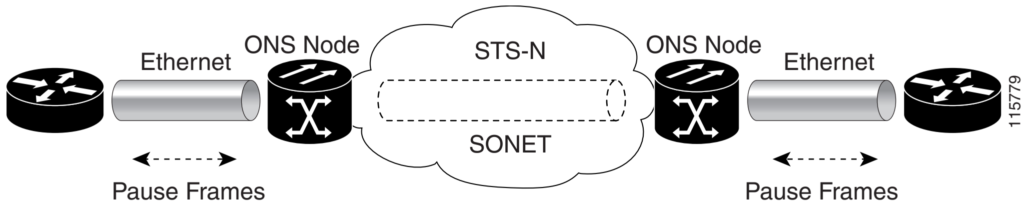
The CE-MR-10 card supports IEEE 802.3x flow control and frame buffering to reduce data traffic congestion. Flow control is on by default.

To prevent over-subscription, buffer memory is available for each port. When the buffer memory on the Ethernet port nears capacity, the CE-MR-10 card uses IEEE 802.3x flow control to transmit a pause frame to the attached Ethernet device. Flow control and autonegotiation frames are local to the Ethernet (10 Mbps), Fast Ethernet (100 Mbps), Gigabit Ethernet (1000 Mbps) interfaces and attached Ethernet devices. These frames do not continue through the POS ports.

The CE-MR-10 card has symmetric flow control and proposes symmetric flow control when autonegotiating flow control with attached Ethernet devices. Symmetric flow control allows the CE-MR-10 cards to respond to pause frames sent from external devices and to send pause frames to external devices.

The pause frame instructs the source to stop sending packets for a specific period of time. The sending station waits the requested amount of time before sending more data. Figure 1-10 illustrates pause frames being sent and received by CE-MR-10 cards and attached switches.

Figure 1-10 Flow Control



This flow-control mechanism matches the sending and receiving device throughput the bandwidth of the STS circuit. For example, a router might transmit to the Ethernet port on the CE-MR-10 card. This particular data rate might occasionally exceed 51.84 Mbps, but the SONET circuit assigned to the CE-MR-10 port might be only STS-1 (51.84 Mbps). Under this condition, the CE-MR-10 card sends out a pause frame and requests that the router delay its transmission for a certain period of time. With flow control and a substantial per-port buffering capability, a private line service provisioned at less than full line rate capacity (STS-1) is efficient because frame loss is controlled to a large extent.

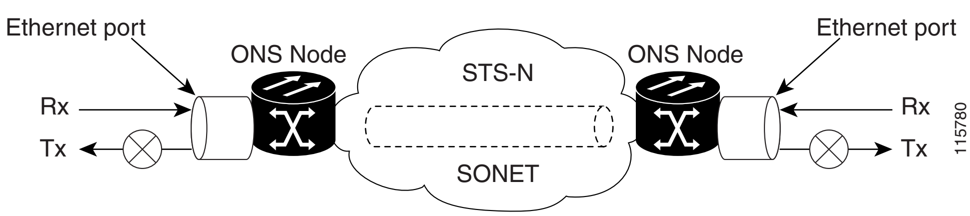
Ethernet Link Integrity Support

The CE-MR-10 card supports end-to-end Ethernet link integrity (Figure 1-11). This capability is integral to providing an Ethernet private line service and correct operation of Layer 2 and Layer 3 protocols on the attached Ethernet devices. Link integrity is implemented so that the Ethernet over SONET/SDH connection behaves more like an Ethernet cable from the viewpoint of the attached Ethernet devices.

End-to-end Ethernet link integrity means that if any part of the end-to-end path fails, the entire path fails. It disables the Ethernet port transmitter on the CE-MR-10 card when the remote Ethernet port does not have a receive signal or when the SONET/SDH near end or far-end failure is detected. The failure of the entire path is ensured by turning off the transmit pair at each end of the path. The attached Ethernet devices recognize the disabled transmit pair as a loss of carrier and consequently an inactive link or link fail.

Note Only bidirectional link integrity is supported on the CE-MR-10 card.

Figure 1-11 End-to-End Ethernet Link Integrity Support



Note Some network devices can be configured to ignore a loss of carrier condition. If a device configured to ignore a loss of carrier condition attaches to a CE-MR-10 card at one end, alternative techniques (such as use of Layer 2 or Layer 3 keep-alive messages) are required to route traffic around failures. The response time of such alternate techniques is typically much longer than techniques that use link state as indications of an error condition.

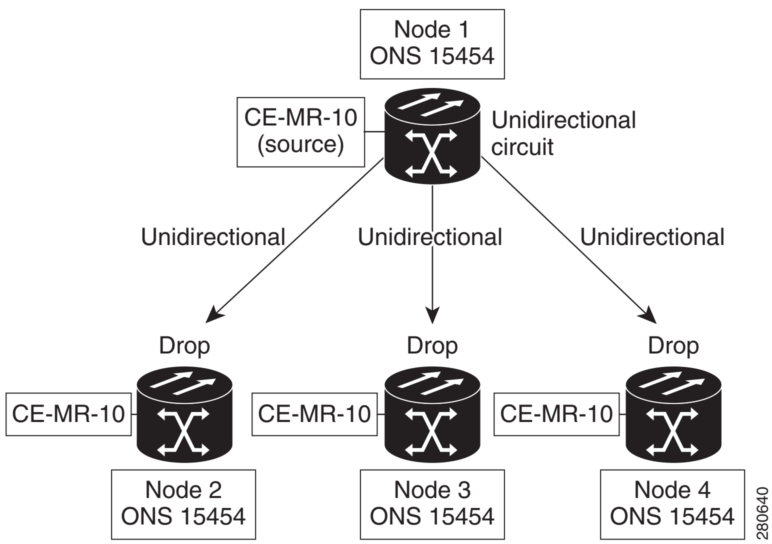
In certain network configurations, the restoration time, for example, after a protection switch can be more than 200 ms. Such disruptions necessitates that the link integrity be initiated at an interval greater than 200 ms To allow link integrity to be initiated at an interval greater than 200 ms, set the link integrity timer in the range between 200 and 10000 ms, in multiples of 100 ms.

Note The accuracy of the Link Integrity timer is less on CE-MR-10 card compared to the G1000 or CE-1000 cards. The accuracy of Link Integrity timer is within 200 ms for the CE-MR-10 card.

Ethernet Drop and Continue Circuit

The CE-MR-10 card supports Ethernet drop and continue in CCAT circuits. Ethernet drop and continue (unidirectional) circuits have multiple destinations for use in broadcast circuit schemes. In broadcast scenarios, one source transmits traffic to multiple destinations, but traffic is not returned to the source.

Figure 1-12 Unidirectional Drop from a CE-MR-10 card on Node 1 to Nodes 2, 3, and 4

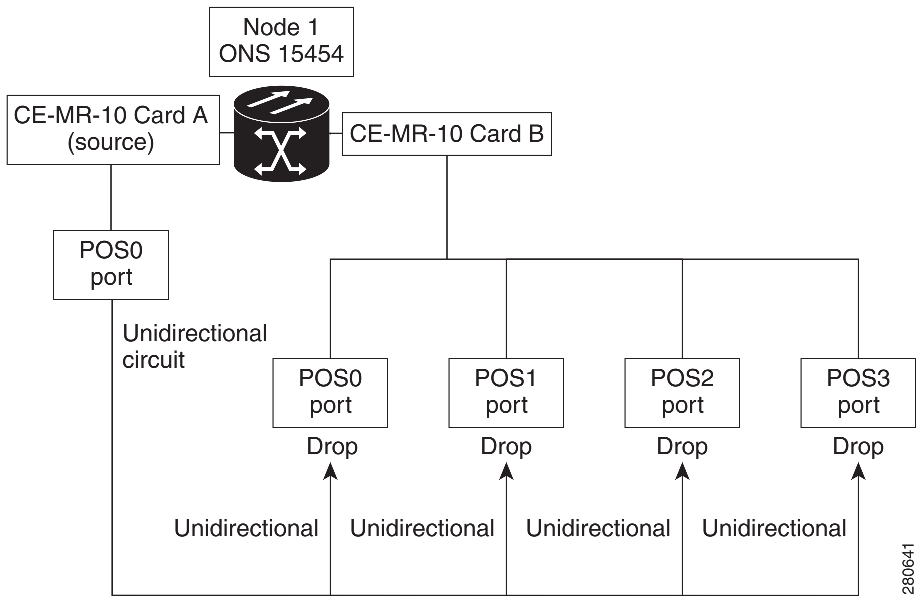


This circuit is supported only on CCAT circuit sizes of STS-48c, STS-24c, STS-12c, STS-9c, STS-6c, STS-3c, and STS-1. The creation of Ethernet drop and continue (unidirectional) circuits is supported on protected (path protected/SNCP, BLSR/MS-SPRing, and 1+1 protection) schemes and unprotected circuits with multiple drop points.

Note The Ethernet drop and continue feature is supported on all cross-connect cards except XC and XCVT.

.The ONS 15454 configuration determines the maximum drop points supported—multiple drops on ports of the same card or different cards in the chassis. Figure 1-13 shows unidirectional drop from POS0 port on CE-MR-10 A to ports POS0, POS1, POS2, POS3 of the CE-MR-10 B.

Figure 1-13 Unidirectional Drop from CE-MR-10 Card A to CE-MR-10 Card B



The Ethernet drop and continue feature supports unidirectional link integrity and performance management.

Alarms are monitored in the forward direction for the Ethernet drop and continue circuits and suppressed in the reverse direction, that is, STS alarms will not be detected at the source port. These unidirectional circuits are configured through CTC and TL1. To create an Ethernet drop and continue circuit, see "Chapter 6, Create Circuits and VT Tunnels" of the *Cisco ONS 15454 Procedure Guide* or "Chapter 6, Create Circuits and Low-Order Tunnels" of the *Cisco ONS 15454 SDH Procedure Guide*. For TL1 provisioning commands, refer to the *Cisco ONS SONET TL1 Command Guide* or the *Cisco ONS SDH TL1 Command Guide*. For information on Alarms, see "Chapter 2, Alarm Troubleshooting" of the *Cisco ONS 15454 Troubleshooting Guide* or *Cisco ONS 15454 SDH Troubleshooting Guide*.

Administrative and Service States with Soak Time for Ethernet and SONET/SDH Ports

The CE-MR-10 card can be managed by TL1, SNMP, CTC, or CTM. The card supports the administrative and service states for the Ethernet ports and the SONET/SDH circuit. For more information about card and circuit service states, refer to the "Administrative and Service States" appendix in the *Cisco ONS 15454 Reference Manual* or the *Cisco ONS 15454 SDH Reference Manual*.

The Ethernet ports can be set to the ESM service states including the IS, AINS administrative states. IS, AINS initially puts the port in the OOS-AU, AINS state. In this service state, alarm reporting is suppressed, but traffic is carried and loopbacks are allowed. After the soak period passes, the port changes to In-Service and Normal (IS-NR). Raised fault conditions, whether their alarms are reported or not, can be retrieved from the CTC Conditions tab or by using the TL1 RTRV-COND command.

Two Ethernet port alarms/conditions, CARLOSS and TPTFAIL, can prevent the port from going into service. This occurs even though alarms are suppressed when a CE-MR-10 circuit is provisioned with the Ethernet ports set to the IS,AINS state, because the CE-MR-10 link integrity function is active and ensures that the links at both ends are not enabled until all SONET and Ethernet errors along the path are cleared. As long as the link integrity function keeps the end-to-end path down, both ports will have at least one of the two conditions needed to suppress the AINS-to-IS transition. Therefore, the ports will remain in the AINS state with alarms suppressed.

ESM also applies to the SONET/SDH circuits of the CE-MR-10 card. If the SONET/SDH circuit is set up in IS,AINS state and the Ethernet error occurs before the circuit transitions to IS, then link integrity will also prevent the circuit transition to the IS state until the Ethernet port errors are cleared at both ends. The service state will be OOS-AU,AINS as long as the administrative state is IS,AINS. When there are no Ethernet or SONET errors, link integrity enables the Ethernet port at each end. Simultaneously, the AINS countdown begins as normal. If no additional conditions occur during the time period, each port transitions to the IS-NR state. During the AINS countdown, the soak time remaining is available in CTC and TL1. The AINS soaking logic restarts from the beginning if a condition appears again during the soak period.

A SONET/SDH circuit provisioned in the IS,AINS state remains in the initial Out-of-Service (OOS) state until the Ethernet ports on each end of the circuit transition to the IS-NR state. The SONET/SDH circuit transports Ethernet traffic and counts statistics when link integrity turns on the Ethernet port, regardless of whether this AINS-to-IS transition is complete.

IEEE 802.1Q CoS and IP ToS Queuing

The CE-MR-10 card references IEEE 802.1Q CoS thresholds and IP thresholds for priority queueing. CoS and ToS thresholds for the CE-MR-10 card are provisioned on a per port level. This allows the user to provide priority treatment based on open standard QOS schemes already existing in the data network attached to the CE-MR-10 card. The QOS treatment is applied to both Ethernet and POS ports.

Any packet or frame with a priority greater than the set threshold is treated as priority traffic. This priority traffic is sent to the priority queue instead of the normal queue. When buffering occurs, packets on the priority queue preempt packets on the normal queue. This results in lower latency for the priority traffic, which is often latency-sensitive traffic such as VoIP.

Because these priorities are placed on separate queues, the priority queuing feature should not be used to separate rate-based CIR/EIR marked traffic (sometimes done at a Metro Ethernet service provider edge). This could result in out-of-order packet delivery for packets of the same application, which would cause performance issues with some applications.

For an IP ToS-tagged packet, the CE-MR-10 can map any of the 256 priorities specified in IP ToS to priority or best effort. The user can configure a different ToS in CTC at the card-level view under the Provisioning > Ether Ports tabs. Any ToS class higher than the class specified in CTC is mapped to the priority queue, which is the queue geared towards low latency. By default, the ToS is set to 255, which is the highest ToS value. This results in all traffic being treated with equal priority by default.

Table 1-13 shows which values are mapped to the priority queue for sample IP ToS settings. (ToS settings span the full 0 to 255 range, but only selected settings are shown in Table 1-13.)

Table 1-13 IP ToS Priority Queue Mappings

ToS Setting in CTC	ToS Values Sent to Priority Queue
255 (default)	None
250	251–255
150	151–255
100	101–255
50	51–255
0	1–255

For a CoS-tagged frame, the CE-MR-10 can map the eight priorities specified in CoS to priority or best effort. The user can configure a different CoS in CTC at the card-level view under the Provisioning > Ether Ports tabs. Any CoS class higher than the class specified in CTC is mapped to the priority queue, which is the queue geared towards low latency. By default, the CoS is set to 7, which is the highest CoS value. This results in all traffic being treated with equal priority by default.

Table 1-14 shows values that are mapped to the priority queue for CoS settings.

Table 1-14 CoS Priority Queue Mappings

CoS Setting in CTC	CoS Values Sent to Priority Queue
7 (default)	None
6	7
5	6, 7
4	5, 6, 7
3	4, 5, 6, 7
2	3, 4, 5, 6, 7
1	2, 3, 4, 5, 6, 7
0	1, 2, 3, 4, 5, 6, 7

Ethernet frames without VLAN tagging use ToS-based priority queueing if both ToS and CoS priority queueing is active on the card. The CE-MR-10 card's ToS setting must be lower than 255 (default) and the CoS setting lower than 7 (default) for CoS and ToS priority queueing to be active. A ToS setting of 255 (default) disables ToS priority queueing, so in this case the CoS setting would be used.

Ethernet frames with VLAN tagging use CoS-based priority queueing if both ToS and CoS are active on the card. The ToS setting is ignored. CoS based priority queueing is disabled if the CoS setting is 7 (default), so in this case the ToS setting would be used.

If the CE-MR-10 card's ToS setting is 255 (default) and the CoS setting is 7 (default), priority queueing is not active on the card, and data gets sent to the default normal traffic queue. If data is not tagged with a ToS value or a CoS value before it enters the CE-MR-10 card, it also gets sent to the default normal traffic queue.

Note Priority queuing has no effect when flow control is enabled (default) on the CE-MR-10 card. When flow control is enabled, a 6KB, single-priority, first-in first-out (FIFO) buffer fills, then a PAUSE frame is sent. This results in the packet ordering priority becoming the responsibility of the external device, which is buffering as a result of receiving the PAUSE flow-control frames.

Note Priority queuing takes effect only when there is congestion at the egress POS. For example, priority queuing has no effect when the CE-MR-10 card is provisioned with STS-3C circuits and the front-end is 100 Mbps. The STS-3c circuit has more data capacity than Fast Ethernet, so CE-MR-10 buffering is not needed. Priority queuing only takes effect during buffering.

RMON and SNMP Support

The CE-MR-10 card features RMON that allows network operators to monitor the health of the network with a NMS. The CE-MR-10 uses ONG RMON. ONG RMON contains statistics, history, alarms, and events MIB groups from the standard RMON MIB as well as SNMP. A user can access RMON threshold provisioning through TL1 or CTC. For RMON threshold provisioning with CTC, see the *Cisco ONS 15454 Procedure Guide* and the *Cisco ONS 15454 Troubleshooting Guide*, or the *Cisco ONS 15454 SDH Procedure Guide* and the *Cisco ONS 15454 SDH Troubleshooting Guide*.

SNMP MIBs Supported

The following SNMP MIBs are supported by the CE-MR-10 card:

- RFC2819-MIB
  - etherStatsOversizePkts
  - etherStatsUndersizePkts
  - etherStatsJabbers
  - etherStatsCollisions
  - etherStatsDropEvents
  - etherStatsOctets
  - etherStatsBroadcastPkts
  - etherStatsMulticastPkts
  - etherStatsCRCAlignErrors
  - etherStatsFragments
  - etherStatsPkts64Octets.
  - etherStatsPkts65to127Octets
  - etherStatsPkts128to255Octets
  - etherStatsPkts256to511Octets
  - etherStatsPkts512to1023Octets
  - etherStatsPkts1024to1518Octets
  - Rx Utilization
  - Tx Utilization
- RFC2233-MIB
  - ifInUcastPkts
  - ifOutUcastPkts
  - ifInMulticastPkts
  - ifInBroadcastPkts
  - ifInDiscards
  - ifInOctets
  - ifOutOctets
  - ifInErrors
  - ifOutDiscards

- ifOutMulticastPkts
- ifOutBroadcastPkts

- RFC2358-MIB
  - dot3StatsFCSErrors
  - dot3StatsSingleCollisionFrames
  - dot3StatsFrameTooLong

Statistics and Counters

The CE-MR-10 card has a full range of Ethernet and POS statistics information under Performance > Ether Ports or Performance > POS Ports.

Supported Cross-connects

There is no restriction on the number of CE-MR-10 cards that could be added in one chassis or the slot where the CE-MR-10 cards can be placed. CE-MR-10 card is supported with cross connect cards.

Table 1-15 shows the modes of operation exhibited by the cross connect card on ONS 15454.

Table 1-15 Modes of Operation on an ONS 15454 Chassis

Cross Connect Card	High speed slots—5, 6, 12, and 13	Low speed slots—1, 2, 3, 4, 14, 15, 16, and 17
XC-VXL	STS-48	STS-48
XC-10G XC-VXL-10G XC-VXC-10G	STS-192	STS-48

CE-MR-10 SONET/SDH Circuits and Features

The CE-MR-10 card has 10 POS ports, numbered 1 through 10, which can be managed via CTC or TL1. Each POS port is statically mapped to a matching Ethernet port. By clicking the card-level Provisioning > POS Ports tab, the user can configure the administrative state, and encapsulation type. By clicking the card-level Performance > POS Ports tab, the user can view the statistics, utilization, and history of the POS ports.

Provisioning Modes

The CE-MR-10 card can be provisioned through an automatic or manual mode.

Note The automatic mode is recommended if you use Trunks Integrated Records Keeping System (TIRKS)[1] for provisioning. The manual mode which is the default mode is recommended if you use a non-OSMINE-compliant provisioning model such as CTC or CTM.

Automatic Mode

Automatic mode automatically allocates STSs or VTs for an Ethernet port from available Cisco ONS 15454 SONET bandwidth on a CE-MR-10 card. The automatic mode makes several assumptions and places restrictions to simplify the OSMINE model. The CE-MR-10 card is flexible, and the number of provisioning combinations high. However, TIRKS is not as flexible and cannot support all the possible provisioning combinations.

In the automatic mode, the GigbitEthernet front ports are assigned to a pool of ports. All ports in a pool only allow similar sized circuits to be created. All ports in a pool share a bandwidth, although this varies based on whether slots are (1 to 4, 14 to17) or trunk slots (5, 6, 12, 13).

Manual Mode

Manual mode does not place the restrictions that the automatic mode does. It is more flexible with respect to provisioning the circuit sizes and port usage. If you use CTC or CTM for provisioning, you can use either automatic or manual mode. However, the manual mode is recommended because it is more flexible.

The manual mode allows you to manually allocate STSs or VTs for an Ethernet port from available SONET/SDH bandwidth on a CE-MR-10 card. From a list of STSs/VTs available, you can pick up any STSs or VTs that best addresses your requirement. This way you can plan bandwidth usage and eliminate consequent fragmentation and get the best out of the CE-MR-10 card. For more information on how to provision using the manual provisioning mode, refer to the *Cisco ONS 15454 Procedure Guide* or the *Cisco ONS 15454 SDH Procedure Guide*.

Note TIRKS is an Operating Support System used for circuit order control, circuit provisioning and inventory management of facilities and equipment. One of the key elements of the circuit provisioning process is the use of a Function Code to select the correct equipment to be used on special services, message circuit, or a carrier system.

Available Circuit Sizes and Combinations

Each POS port terminates an independent contiguous concatenation (CCAT) or virtual concatenation (VCAT) circuit. The SONET/SDH circuit is created for these ports through CTC or TL1 in the same manner as a SONET/SDH circuit for a non-Ethernet line card.

Note If a CE-MR-10 card with a 1 Gbps SFP is installed and cross connected to another card that supports only 10 or 100 Mbps, (for example, CE-100T-8 cards in the ONS 15310-MA) packet loss may occur if the SONET circuit between the two cards is more than 100 Mbps. In the CE-100T-8 example, a STS-1-2v circuit is errorless; however, if a STS-1-3v is used there will be a packet loss in the CE-MR-10 to CE-100T-8 direction.

Table 1-16 show the circuit sizes available for CE-MR-10 card on ONS 15454 SONET.

1.

Table 1-16 Supported SONET Circuit Sizes of CE-MR-10 on ONS 15454

CCAT	VCAT High Order	VCAT Low Order
STS-1	STS-1-*n*v (*n*=1 to 21)	(Release 9.0) VT1.5-*n*v (*n*=1 to 64) (Release 9.1 and later) VT1.5-*n*v (*n*=1 to 63)
STS-3c	STS-3C-*n*v (*n*=1 to 7)	
STS-6c		
STS-9c		
STS-12c		
STS-24c		
STS-48c		

Table 1-17 shows the circuit sizes available for CE-MR-10 card on ONS 15454 SDH.

Table 1-17 Supported SDH Circuit Sizes of CE-MR-10 on ONS 15454

CCAT	VCAT High Order	VC-3 VCAT	VC-12 VCAT
VC3	VC-4-nv (n=1 to 7)	VC-3-nv (n=1 to 21)	VC-12-nv (n=1 to 63)
VC-4			
VC-4-2c			
VC-4-3c			
VC-4-4c			
VC-4-8c			
VC-4-16c			

Table 1-18 shows the minimum SONET circuit sizes required for wire speed service delivery.

Table 1-18 Minimum SONET Circuit Sizes for Ethernet Speeds

Ethernet Wire Speed	CCAT High Order	VCAT High Order	VCAT Low Order
Line Rate 1000 Mbps	STS-48c or STS-24c	STS-1-21v or STS-3-7v	Not applicable
Sub Rate 1000 Mbps	STS-12c, STS-9c, STS-6c, STS-3c, and STS-1	STS-1-1v to STS-1-20v	(Release 9.0) VT1.5-*xv* (x=1-64) (Release 9.1 and later) VT1.5-*xv* (x=1-63)
Line Rate 100 Mbps	STS-3c	STS-1-3v or STS-1-2v[1]	(Release 9.0) VT1.5-*xv* (x=56-64) (Release 9.1 and later) VT1.5-*xv* (x=56-63)
Sub Rate 100 Mbps	STS-1	STS-1-1v	VT1.5-*xv* (x=1-55)

Table 1-18 Minimum SONET Circuit Sizes for Ethernet Speeds (continued)

Ethernet Wire Speed	CCAT High Order	VCAT High Order	VCAT Low Order
Line Rate 10 Mbps	STS-1		VT1.5-7v
Sub Rate 10 Mbps			VT1.5-xv (x=1-6)

1. STS-1-2v provides a total transport capacity of 98 Mbps.

Table 1-19 shows the minimum SDH circuit sizes required for 10 Mbps, 100 Mbps, and 1000 Mbps wire speed service.

Table 1-19 Minimum SDH Circuit Sizes for Ethernet Speeds

Ethernet Wire Speed	CCAT	VC-3 VCAT	VC-4 VCAT	VC-12 VCAT
Line Rate 1000 Mbps	VC-4-16c or VC-4-8c	VC-3-21v	VC-4-7v	Not applicable
Sub Rate 1000 Mbps	VC-4-4c, VC-4-3c, VC-4-2c, VC-4, and VC-3	VC-3-1v to VC-3-20v	VC-4-1v to VC-4-6v	VC-12-xv (x=1-63)
Line Rate 100 Mbps	VC-4	VC-3-3v or VC-3-2v	VC-4-1v	VC-12-*xv* (x=50-63)
Sub Rate 100 Mbps	VC-3	VC-3-1v		VC-12-*xv* (x=1-49)
Line Rate 10 Mbps	VC-3	VC-3-1v		VC-12-*5v*
Sub Rate 10 Mbps	Not applicable			VC-12-x*v* (x=1-4)

Table 1-20 shows VCAT high-order circuit size combinations available for the CE-MR-10 card on ONS 15454 SONET for Slots 1 to 4 and 14 to 17.

Table 1-20 VCAT High-Order Circuit Combinations for STS on ONS 15454 SONET (Slots 1 to 4 and 14 to 17)

STS Circuit Combinations	VT Circuits
Any combination of STS-1, STS-3c, STS-6c, STS-9c, STS-12c, STS-24c, STS-48c, or STS-nv circuits up to a maximum of 10 circuits or maximum of: • CCAT—48 STSs • STS-1 VCAT—47 STSs • STS-3c VCAT—45 STSs	No VTs
Any combination of STS-1, STS-3c, STS-6c, STS-9c, STS-12c, STS-24c circuits up to a maximum of 9 circuits or maximum of: • CCAT—46 STSs • STS-1 VCAT—45 STSs • STS-3c VCAT—39 STSs	1 VT1.5-48v circuit
Any combination of STS-1, STS-3c, STS-6c, STS-9c, STS-12c, STS-24c circuits up to a maximum of 9 circuits or maximum of: • CCAT—44 STSs • STS-1 VCAT—43 STSs • STS-3c VCAT—33 STSs	(Release 9.0) 1 VT1.5-64v circuit (Release 9.1 and later) 1 VT1.5-63v circuit
Any combination of STS-1, STS-3c, STS-6c, STS-9c, STS-12c, STS-24c circuits up to a maximum of 8 circuits or maximum of: • CCAT—44 STSs • STS-1 VCAT—43 STSs • STS-3c VCAT—33 STSs	2 VT1.5-48v circuits
Any combination of STS-1, STS-3c, STS-6c, STS-9c, STS-12c, STS-24c circuits up to a maximum of 8 circuits or maximum of: • CCAT—42 STSs • STS-1 VCAT—41 STSs • STS-3c VCAT—27 STSs	(Release 9.0) 2 VT1.5-64v circuits (Release 9.1 and later) 2 VT1.5-63v circuits
Any combination of STS-1, STS-3c, STS-6c, STS-9c, STS-12c, STS-24c circuits up to a maximum of 7 circuits or maximum of: • CCAT—42 STSs • STS-1 VCAT—41 STSs • STS-3c VCAT—27 STSs	3 VT1.5-48v circuits

Note You can replace STSs for VTs at the following rates:
Add 48 VT 1.5s at the cost of two STS-1 circuits. If all the high order (HO) circuits are VCAT, one additional STS-1 is lost. Alternatively, you can add 48 VT 1.5 circuits at the cost of two STS-3c circuits. If all the HO circuits are VCAT, one additional STS-3c is lost.
In some cases, circuits can be added by reducing the circuits for other concatenation rates.

Table 1-21 shows VCAT high-order circuit size combinations available for CE-MR-10 cards on ONS 15454 SONET for Slots 5, 6, 12, and 13.

Table 1-21 VCAT High-Order Circuit Combinations of STS for SONET (Slots 5, 6, 12, and 13)

STS Circuit Combinations	VT Circuits
Any combination of STS-1, STS-3c, STS-6c, STS-9c, STS-12c, STS-24c, STS-48c, or STS-nv circuits up to a maximum of 10 circuits or maximum of: • CCAT—192 STSs • STS-1 VCAT—191 STSs • STS-3c VCAT—189 STSs	No VTs
Any combination of STS-1, STS-3c, STS-6c, STS-9c, STS-12c, STS-24c, STS-48c, or STS-nv circuits up to a maximum of 9 circuits or maximum of: • CCAT—144 STSs • STS-1 VCAT—143 STSs • STS-3c VCAT—141 STSs	1 VT1.5-48v circuits
Any combination of STS-1, STS-3c, STS-6c, STS-9c, STS-12c, STS-24c, STS-48c, or STS-nv circuits up to a maximum of 9 circuits or maximum of: • CCAT—96 STSs • STS-1 VCAT—95 STSs • STS-3c VCAT—93 STSs	(Release 9.0) 1 VT1.5-64v circuits (Release 9.1 and later) 1 VT1.5-63v circuits
Any combination of STS-1, STS-3c, STS-6c, STS-9c, STS-12c, STS-24c, STS-48c, or STS-nv circuits up to a maximum of 8 circuits or maximum of: • CCAT—96 STSs • STS-1 VCAT—95 STSs • STS-3c VCAT—93 STSs	2 VT1.5-48v circuits
Any combination of STS-1, STS-3c, STS-6c, STS-9c, STS-12c, STS-24c, STS-48c, or STS-nv circuits up to a maximum of 8 circuits or maximum of: • CCAT:—48 STSs • STS-1 VCAT:—47 STSs • STS-3c VCAT—45 STSs	(Release 9.0) 2 VT1.5-64v circuits (Release 9.1 and later) 2 VT1.5-63v circuits
Any combination of STS-1, STS-3c, STS-6c, STS-9c, STS-12c, STS-24c, STS-48c, or STS-nv circuits up to a maximum of 7 circuits or maximum of: • CCAT—48 STSs • STS-1 VCAT—47 STSs • STS-3c VCAT—45 STSs	3 VT1.5-48v circuits
No STS circuits	4 VT1.5-48v circuits

Note You can replace STSs for VTs at the following rates:
Add 48 VT 1.5 circuits at the cost of 48 STS-1 circuits. If all HO circuits are VCAT, one additional STS-1 is lost. Alternatively, you can add 48 VT 1.5 circuits at the cost of 16 STS-3c circuits. If all HO circuits are VCAT, one additional STS-3c is lost.
In some cases, circuits can be added by reducing the circuits of other concatenation rates.

Table 1-22 shows VCAT circuits combinations available for CE-MR-10 cards on ONS 15454 SDH for slots 1 to 4 and 14 to 17.

Table 1-22 VCAT Circuit Combinations of STS for SDH (Slots 1 to 4 and 14 to 17)

VC4 Circuit Combinations	VC-12 Circuits	VC-3 Circuits
VC-4s only		
Any combination of VC-4, VC-4-2c, VC-4-3c, VC-4-4c, VC-4-8c, VC-4-16c, or VC-4-nv circuits up to a maximum of 10 circuits or maximum of: • CCAT—16 VC-4s • VC-4 VCAT—15 VC-4s	No VC-12	No VC-3
Mixed VC-4s and VC-12s		
Any combination of VC-4, VC-4-2c, VC-4-3c, VC-4-4c, VC-4-8c, or VC-4-nv circuits up to a maximum of 9 circuits or maximum of: • CCAT—14 VC-4s • VC-4 VCAT—13 VC-4s	1 VC12-42v	No VC-3
Any combination of VC-4, VC-4-2c, VC-4-3c, VC-4-4c, VC-4-8c, or VC-4-nv circuits up to a maximum of 9 circuits or maximum of: • CCAT—12 VC-4s • VC-4 VCAT—11 VC-4s	1 VC12-63v	No VC-3
Any combination of VC-4, VC-4-2c, VC-4-3c, VC-4-4c, VC-4-8c, or VC-4-nv circuits up to a maximum of 8 circuits or maximum of: • CCAT—12 VC-4s • VC-4 VCAT—11 VC-4s	2 VC12-42v	No VC-3
Any combination of VC-4, VC-4-2c, VC-4-3c, VC-4-4c, VC-4-8c, or VC-4-nv circuits up to a maximum of 8 circuits or maximum of: • CCAT—10 VC-4s • VC-4 VCAT—9 VC-4s	2 VC12-63v	No VC-3
Any combination of VC-4, VC-4-2c, VC-4-3c, VC-4-4c, VC-4-8c, or VC-4-nv circuits up to a maximum of 7 circuits or maximum of: • CCAT—10 VC-4s • VC-4 VCAT—9 VC-4s	3 VC12-42v	No VC-3
Mixed VC-4 and VC-3s		

Table 1-22 VCAT Circuit Combinations of STS for SDH (Slots 1 to 4 and 14 to 17) (continued)

VC4 Circuit Combinations	VC-12 Circuits	VC-3 Circuits
Any combination of VC-4, VC-4-2c, VC-4-3c, VC-4-4c, VC-4-8c, or VC-4-nv circuits up to a maximum of 9 circuits or maximum of: • CCAT—8 VC-4s • VC-4 VCAT—8 VC-4s	No VC-12	1 VC3-21v
Any combination of VC-4, VC-4-2c, or VC-4-nv circuits up to a maximum of 2 circuits or maximum of: • CCAT—2 VC-4s • VC-4 VCAT—2 VC-4s	No VC-12	2 VC3-21v
Mixed VC-4, VC-3, and VC-12s		
Any combination of VC-4, VC-4-2c, VC-4-3c, VC-4-4c, VC-4-8c, or VC-4-nv circuits up to a maximum of 8 circuits or maximum of: • CCAT—12 VC-4s • VC-4 VCAT—11 VC-4s	1 VC12-42v	1 VC3-6v
Any combination of VC-4, VC-4-2c, or VC-4-nv circuits up to a maximum of 2 circuits or maximum of: • CCAT—2 VC-4s • VC-4 VCAT—2 VC-4s	1 VC12-42v	1 VC3-21v 1 VC3-14v
Any combination of VC-4, VC-4-2c, VC-4-3c, VC-4-4c, VC-4-8c, or VC-4-nv circuits up to a maximum of 7 circuits or maximum of: • CCAT—10 VC-4s • VC-4 VCAT—9 VC-4s	2 VC12-42v	1 VC3-6v
Any combination of VC-4, VC-4-2c, or VC-4-nv circuits up to a maximum of 2 circuits or maximum of: • CCAT—2 VC-4s • VC-4 VCAT—2 VC-4s	2 VC12-42v	1 VC3-21v 1 VC3-8v

Note You can replace VC-4 circuits with VC-3 circuits at the rate of two VC-4 circuits for six VC-3 circuits. The VC-4 circuits for VC-12 circuits can be replaced by adding 42 VC-12circuits at the cost of two VC-4 circuits. With use of VC-12 you might lose one additional VC-4 or one VC-3 if VCAT is used for VC-4 or VC-3. The VC-3 circuits for the VC-12 circuits can be replaced by adding six VC-3 circuits for each 42 VC-12 circuits. With use of VC-12 you might loose one additional VC-4 or one VC-3 if VCAT is used for VC-4 or VC-3. In some cases, circuits can be added by reducing the circuits of other concatenation rates.

Table 1-23 shows VCAT high-order circuit size combinations available for CE-MR-10 cards on ONS 15454 SDH for Slots 5, 6, 12, and 13.

Table 1-23 VCAT Circuit Combinations of STS for SDH (Slots 5, 6, 12, and 13)

VC-4 Circuit Combinations	VC-12 Circuits	VC-3 Circuits
VC-4s only		
Any combination of VC-4, VC-4-2c, VC-4-3c, VC-4-4c, VC-4-8c, VC-4-16c, or VC-4-nv circuits up to a maximum of 10 circuits or maximum of: • CCAT—64 VC-4s • VC-4 VCAT—63 VC-4s	No VC-12	No VC-3
Mixed VC-4s and VC-12s		
Any combination of VC-4, VC-4-2c, VC-4-3c, VC-4-4c, VC-4-8c, VC-4-16c, or VC-4-nv circuits up to a maximum of 9 circuits or maximum of: • CCAT—48 VC-4s • VC-4 VCAT—47 VC-4s	1 VC12-42v	No VC-3
Any combination of VC-4, VC-4-2c, VC-4-3c, VC-4-4c, VC-4-8c, VC-4-16c, or VC-4-nv circuits up to a maximum of 9 circuits or maximum of: • CCAT—32 VC-4s • VC-4 VCAT—31 VC-4s	1 VC12-63v	No VC-3
Any combination of VC-4, VC-4-2c, VC-4-3c, VC-4-4c, VC-4-8c, VC-4-16c, or VC-4-nv circuits up to a maximum of 8 circuits or maximum of: • CCAT—32 VC-4s • VC-4 VCAT—31 VC-4s	2 VC12-42v	No VC-3
Any combination of VC-4, VC-4-2c, VC-4-3c, VC-4-4c, VC-4-8c, VC-4-16c, or VC-4-nv circuits up to a maximum of 8 circuits or maximum of: • CCAT—16 VC-4s • VC-4 VCAT—15 VC-4s	2 VC12-63v	No VC-3
Any combination of VC-4, VC-4-2c, VC-4-3c, VC-4-4c, VC-4-8c, VC-4-16c, or VC-4-nv circuits up to a maximum of 7 circuits or maximum of: • CCAT—16 VC-4s • VC-4 VCAT—15 VC-4s	3 VC12-42v	No VC-3
No VC-4 circuits	4 VC12-42v	No VC-3
No VC-4 circuits	2 VC12-63vand 1 VC12-42v	No VC-3
Mixed VC-4 and VC-3s		

Table 1-23 VCAT Circuit Combinations of STS for SDH (Slots 5, 6, 12, and 13) (continued)

VC-4 Circuit Combinations	VC-12 Circuits	VC-3 Circuits
Any combination of VC-4, VC-4-2c, VC-4-3c, VC-4-4c, VC-4-8c, VC-4-16c, or VC-4-nv circuits up to a maximum of 7 circuits or maximum of: • CCAT—48 VC-4s • VC-4 VCAT—47 VC-4s	No VC-12	2 VC3-21v 1 VC3-6v
Any combination of VC-4, VC-4-2c, VC-4-3c, VC-4-4c, VC-4-8c, VC-4-16c, or VC-4-nv circuits up to a maximum of 5 circuits or maximum of: • CCAT—32 VC-4s • VC-4 VCAT—31 VC-4s	No VC-12	4 VC3-21v 1 VC3-12v
Any combination of VC-4, VC-4-2c, VC-4-3c, VC-4-4c, VC-4-8c, VC-4-16c, or VC-4-nv circuits up to a maximum of 3 circuits or maximum of: • CCAT—16 VC-4s • VC-4 VCAT—15 VC-4s	No VC-12	6 VC3-21v 1 VC3-18v
No VC-4 circuits	No VC-12	9 VC3-21v 1 VC3-2v
Mixed VC-4, VC-3, and VC-12s		
Any combination of VC-4, VC-4-2c, VC-4-3c, VC-4-4c, VC-4-8c, VC-4-16c, or VC-4-nv circuits up to a maximum of 6 circuits or maximum of: • CCAT—32 VC-4s • VC-4 VCAT—31 VC-4s	1 VC12-42v	2 VC3-21v 1 VC3-6v
Any combination of VC-4, VC-4-2c, VC-4-3c, VC-4-4c, VC-4-8c, VC-4-16c, or VC-4-nv circuits up to a maximum of 5 circuits or maximum of: • CCAT—16 VC-4s • VC-4 VCAT—15 VC-4s	2 VC12-42v	2 VC3-21v 1 VC3-6v
Any combination of VC-4, VC-4-2c, VC-4-3c, VC-4-4c, VC-4-8c, VC-4-16c, or VC-4-nv circuits up to a maximum of 4 circuits or maximum of: • CCAT—16 VC-4s • VC-4 VCAT—15 VC-4s	1 VC12-42v	4 VC3-21v 1 VC3-12v

Note You can replace VC-4 circuits for VC-3 circuits at the rate of 16 VC-4 circuits for 48 VC3 circuits. The VC-4 circuits for VC-12 circuits can be replaced by adding 42 VC12 circuits at a cost of 16 VC-4 circuits. With use of VC-12 you might lose one additional VC-4 or one VC-3 if VCAT is used for VC-4 or VC3.

The VC-3 circuits for VC-12 circuits can be replaced by adding 48 VC3 circuits for each 42 VC-12 circuits. With use of VC-12 you might lose one additional VC-4 or one VC-3 if VCAT is used for VC-4 or VC3. In some cases, circuits can be added by reducing the circuits of other concatenation rates.

CE-MR-10 Pool Allocation

Note The CE-MR card pool allocation can be set for ONS 15454 SONET only and can be provisioned only when the card is in automatic provisioning mode.

The CE-MR-10 card in low speed mode has the following characteristics:

- One pool can support only one circuit (from any front port), and must be a STS-48c circuit only. Two pools of 24 STSs each can be independently allocated.
- Front ports 1 to5 and 1 to 4 assigned to pool 1 and pool 2 ports on 6 to 10 and 5 to 6.
- Each pool can support only one circuit type at a time. The circuit types are:
  - 1 STS-24c
  - Up to 2 STS-12cs
  - Up to 2 STS-9cs
  - Up to 4 STS-6cs
  - Up to 5 or 4 CCATs/ VCATs made up of STS-1s
  - Up to 5 or 4 CCATs/VCATs made up of STS-3cs
  - Number of members available for VCAT is subject to the total limit of 24 STSs in pool 1 and 23 STSs (or 21 STSs in case of STS-3c/VC4) in pool 2 (per VCG limit 21 STSs)
  - Pool 1 can also support low order circuits (but not pool 2)
  - VT1.5 based VCATs are subject to a total limit of 144 VT1.5s
    (For Release 9.0, per VCG limit is 64. For Release 9.1 and later, per VCG limit is 63.)
- 1 pool versus two pool operation is decided dynamically by the first circuit provisioned
- If two pool exists, then the mode of each pool is decided dynamically by the circuit types provisioned

The CE-MR-10 card in a high speed mode has the following characteristics:

Four pools of 48 STSs each of which can be independently allocated in the following way:

- Ports 1to 2 on pool 1, 3 to 4 on pool 2, 5 to 7 on pool 3, and 8 to 10 on pool 4
- Each pool can support only one circuit type at a time. The circuit types are:
  - Two STS-24cs
  - Up to three STS-12cs
  - Up to three STS-9cs
  - Up to three STS-6cs
  - CCATs/ VCATs made up of STS-1s
  - CCATs/VCATs made up of STS-3cs
  - VT1.5 based VCATs

- HO VCAT—Subject to the total per pool limit of 48 STSs in pools 2, 3, and 4 and 47 STSs (or 45 STSs in case of STS-3c/VC4) in pool 1 (per VCG limit 21 STSs or 7 STS-3Cs/VC4s)
- LO VCAT—Subject to the total per pool limit of 48 VT1.5s

All pools are equivalent in this case, with the exception of pool 1 where some STSs are not available for VCAT. The mode of each pool is decided dynamically by the circuit types provisioned.

CE-MR-10 VCAT Characteristics

The CE-MR-10 card has hardware-based support for the ITU-T G.7042 standard LCAS. This allows the user to dynamically resize a high order or low order VCAT circuit through CTC or TL1 without affecting other members of the virtual concatenation group (VCG) (errorless).

The ONS 15454 SONET/SDH ML1000-2, ML100T-12, and ML100X-8 cards have a software-based LCAS (SW-LCAS) scheme. Software LCAS is supported on CE-MR-10/GT3 cards for interoperation with these cards.

The SW-LCAS is not supported on CE-MR-10 cards for interoperation with the CE-100T-8 and ML-MR-10 cards.

Note The CE-MR-10 card does not support interoperation between the LCAS and non-LCAS circuits.

The CE-MR-10 card allows independent routing and protection preferences for each member of a VCAT circuit. The user can also control the amount of VCAT circuit capacity that is fully protected, unprotected, or uses (PCA) (when PCA is available). Alarms are supported on a per-member as well as per VCG basis.

Note In the trunk slots of an ONS 15454, a differential delay of 55 milliseconds is supported for high order circuits and 176 milliseconds for low order circuits. On drop slots, the supported differential delay is 136 milliseconds for both high and low order circuits.
VC3 is grouped with high order circuits.
The VCAT differential delay is the relative arrival-time measurement between members of a VCG.

On the CE-MR-10 card, members of a HW-LCAS circuit must be moved to the OOS,OOG (locked, outOfGroup) state before:

- Creating or deleting HW-LCAS circuits.
- Adding or deleting HW-LCAS circuit members.
- Changing the state to OOS,DSBLD.
- Changing the state from OOS,DSBLD to any other state.

A traffic hit is seen under the following conditions:

- A hard reset of the card containing the trunk port.
- Trunk port moved to OOS,DSBLD(locked,disabled) state.
- Trunk fiber pull.
- Deletion of members of the HW-LCAS circuit in IG (In Group) state.

Note CE-MR-10 cards display symmetric bandwidth behavior when an AIS, UNEQ, LOP, SF, SD, PLM, ENCAP, OOF, or PDI alarm is raised at the near-end member of the HW-LCAS circuit. The LCAS-SINK-DNU alarm and the RDI condition are raised at the far-end member of the circuit. The LCAS-SINK-DNU alarm changes the member state to outOfGroup (OOG) and hence, the traffic goes down in both directions. For more information about alarms, refer to the "Alarm Troubleshooting" chapter in the *Cisco ONS 15454 Troubleshooting Guide* or the *Cisco ONS 15454 SDH Troubleshooting Guide*.

Caution Packet losses might occur when an optical fiber is reinserted or when a defect is cleared on members of the HW-LCAS split fiber routed circuits.

CE-MR-10 POS Encapsulation, Framing, and CRC

The CE-MR-10 card uses Cisco EoS LEX (LEX). LEX is the primary encapsulation of ONS Ethernet cards. In this encapsulation, the protocol field is set to the values specified in IETF and RFC 1841. The user can provision frame-mapped GFP-F framing (default) or HDLC framing. With GFP-F framing, the user can also configure a 32-bit CRC (the default) or no CRC (none). When LEX is used over GFP-F it is standard Mapped Ethernet over GFP-F according to ITU-T G.7041. HDLC framing provides a set 32-bit CRC. For more details about the interoperability of ONS Ethernet cards, including information on framing and CRC, see Appendix A, "POS on ONS Ethernet Cards."

The CE-MR-10 card supports GFP-F null mode. GFP-F CMFs are counted and discarded.

CE-MR-10 Loopback, J1 Path Trace, and SONET/SDH Alarms

The CE-MR-10 card supports terminal and facility loopbacks. It also reports SONET/SDH alarms and transmits and monitors the J1 Path Trace byte in the same manner as OC-N cards. Support for path termination functions includes:

- H1 and H2 concatenation indication
- C2 signal label
- Bit interleaved parity 3 (BIP-3) generation
- G1 path status indication
- C2 path signal label read/write
- Path level alarms and conditions, including loss of pointer (LOP), unequipped, payload mismatch, alarm indication signal (AIS) detection, and remote defect indication (RDI)
- J1 path trace for high-order CCAT paths
- J2 path trace for high-order VCAT circuits at the member level
- J2 path trace for low-order VCAT circuits at the member level
- Extended signal label for the low-order paths

Terminal and Facility Loopback on LCAS Circuits In Split Fibre Routing

The following section lists guidelines to follow when the CE-MR-10 card includes a split fiber routing in a terminal and facility loopback on SW-LCAS circuits:

Note Make sure that you follow the guidelines and tasks listed in the following section. Not doing so will result in traffic going down on members passing through optical spans that do not have loopbacks.

- SW-LCAS circuit members must have J1 path trace set to manual.
- Transmit and receive traces must be unique.
- SW-LCAS circuits on CE-MR-10 must allow our of group (OOG) members on Trace Identifier Mismatch - Path (TIM-P).
- For members on split fiber routes, facility loopback must select the AIS option in CTC.
- Traffic hit is expected when loopback is applied. This is due to asynchronous detection of VCAT defects and TIM-P detection on the other end of the circuit. This is acceptable since loopbacks are intrusive and affect traffic.

Note Place members of an HW-LCAS circuit traversing an optical interface under maintenance in OOS,OOG (locked, outOfGroup) state before applying terminal/facility loopbacks. Alternately, place members of an HW-LCAS circuit traversing an optical interface under maintenance in OOS,OOG (locked, outOfGroup) state and create a test access circuit on intermediate optical interfaces to troubleshoot the maintenance span.

VCAT Circuit Provisioning Time Slot Limitations

The CTC provides different time slots for creating or provision the VCAT circuits for SONET and SDH alarms on the CE-MR-6 and CE-MR-10 cards.The time slots vary for different circuits depending on wether the data card present in a high speed slot or low speed slot.

Table 1-24 displays the time slots available for a particular circuit in a particular slot type (high speed or low speed) for SONET alarm.

Table 1-24 VCAT Circuit Provisioning Time Slot Limitations (SONET)

Card Mode	Circuit Type	Time Slot Limitation	No. of Members per Circuit
STS-192	STS3c-nv	STS-25 is not available. All others available.	7
STS-192	STS1-nv	STS-26 is not available. All others available.	21
STS-192	VT1.5-nv	Only STS-1,4,49,52,97,100,145,148 are available. All others not available.(Each can hold 24 VT1.5s and hence total is 192)	64 (Release 9.0) 63 (Release 9.1 and later)
STS-48	STS3c-nv	STS-25 is not available. All others available till STS-48.	7

Table 1-24 VCAT Circuit Provisioning Time Slot Limitations (SONET)

Card Mode	Circuit Type	Time Slot Limitation	No. of Members per Circuit
STS-48	STS1-nv	STS-26 is not available. All others available till STS-48.	21
STS-48	VT1.5-nv	Only STS-7,10,13,16,19,22 are available, All others not available.(Each can hold 24 VT1.5s and hence total is144)	64 (Release 9.0) 63 (Release 9.1 and later)

Table 1-25 displays the time slots available for a particular circuit in a particular slot type (high speed or low speed) for SDH alarm.

Table 1-25 VCAT Circuit Provisioning Time Slot Limitations (SDH)

Card Mode	Circuit Type	Time Slot Limitation	No. of Members per Circuit
STM-64	VC4-nv	VC4-9 is not available. All others available.	7
STM-64	VC3-nv	VC4-9-2 is not available. All others available.	21
STM-64	VC12-nv	Only VC4-1,2,17,18,33,34,49,50 are available. All others not available.(Each can hold 21 VC12s and hence total is 168).	63
STM-16	VC4-nv	VC4-9 is not available. All others available till VC4-16.	7
STM-16	VC3-nv	VC4-1 and VC4-2 completely and VC4-9-2 are not available. All others available till VC4 16.(Each VC4 can hold 3 VC3s).	21
STM-16	VC12-nv	Only VC4-3,4,5,6,7,8 are available. All others not available.(Each can hold 21 VC12s and hence total is 126).	63

Table 1-26 displays the XC switch timings for various VCAT/CCAT circuits on the CE-MR cards.

Table 1-26 XC Switch Timings for Various VCAT Circuit Types on the CE-MR-6 and CE-MR-10 card

VCAT/CCAT Circuit Type	Maximum Switch Time Allowed (in millisecond)
HO-CCAT	60
LO-CCAT	60
HO-VCAT	90
LO-VCAT	202
HO-HW-LCAS	148
LO-HW-LCAS	256
SW-LCAS	500

Note For the CCAT circuits there are no Limitations applicable. All time slots are available.