Overview

This chapter provides an overview of the ML1000-2 and ML100T-12 cards for the ONS 15454 SONET and ONS 15454 SDH. It lists Ethernet and SONET/SDH capabilities and Cisco IOS and Cisco Transport Controller (CTC) software features, with brief descriptions of selected features.

This chapter contains the following major sections:

ML-Series Card Description

The ML-Series cards are Gigabit Ethernet (ML1000-2) and Fast Ethernet (ML100T-12) multilayer switches integrated into the ONS 15454 SONET/SDH platform. An ONS 15454 SONET with a 10 Gigabit Cross-Connect card (XC10G) can host the card in any traffic card slot, but an ONS 15454 SONET with a Cross-Connect card (XC) or Cross Connect Virtual Tributary card (XCVT) can only host the ML-Series card in the four high-speed traffic slots. An ONS 15454 SDH can host the card in any traffic card slot with any cross-connect card.

Each card is an independent data switch that processes up to 5.7 Mpps of Layer 2 and Layer 3 switching. The card ships loaded with Cisco IOS Release 12.1(19)EO, which controls the data functions of the card. Users can access Cisco IOS in three ways: the console port on the faceplate of the card, the Ethernet ports on the ML-Series card assigned to a management VLAN, or a Telnet session. The Telnet sessions can be initiated through a terminal program on the PC or through CTC, the standard ONS 15454 SONET/SDH graphical user interface (GUI).

The Cisco IOS software image used by the ML-Series card is not permanently stored on the ML-Series card but in the flash memory of the TCC+/TCC2 card. During a hard reset, when a card is physically removed and reinserted, the Cisco IOS software image is downloaded from the flash memory of the TCC+/TCC2 to the memory cache of the ML-Series card. The cached image is then decompressed and initialized for use by the ML-Series card.

During a soft reset, when the ML-Series card is reset through CTC or Cisco IOS CLI commands, the ML-Series card checks its cache for an IOS image. If a valid and current IOS image exists, the ML-Series card decompresses and initializes the image. If the image does not exist, the ML-Series requests a new copy of the IOS image from the TCC. Caching the IOS image provides a significant time savings when a warm reset is performed.

The Cisco IOS CLI is the primary user interface for the ML-Series card. Most configuration for the card, such as Ethernet port, bridging and VLAN, can only be done via the Cisco IOS CLI. But CTC, the ONS 15454 SONET/SDH GUI, also supports the ML-Series. CTC offers ML-Series status information, SONET/SDH alarm management, Cisco IOS Telnet session initialization, Cisco IOS configuration file management and SONET/SDH circuit provisioning. SONET/SDH circuits cannot be provisioned through IOS, but must be configured through CTC. SONET circuits can also be provisioned with TL1 on the ONS 15454.

The ML100T-12 features 12 RJ-45 interfaces, and the ML1000-2 features two Small Form Factor Pluggable (SFP) slots supporting short wavelength (SX) and long wavelength (LX) optical modules. The ML100T-12 and the ML1000-2 use the same hardware and software base and offer the same feature sets.

When installed in an ONS 15454 SONET, the card features two virtual ports with a combined STS-48 maximum. The STS circuits are provisioned through the ONS 15454 GUI (CTC) in the same manner as standard OC-N card STS circuits. CTC also provides provisioning, inventory, SONET alarm reporting, and other standard ONS 15454 card functions for the ML-Series.

When installed in an ONS 15454 SDH, the card features two virtual ports with a combined VC4-16c maximum. The STS circuits are provisioned through the ONS 15454 SDH GUI (CTC) in the same manner as standard STM circuits. CTC also provides provisioning, inventory, SDH alarm reporting, and other standard ONS 15454 SDH card functions for the ML-Series.

For detailed card specifications, refer to the "Ethernet Cards" chapter of the *Cisco ONS 15454 Reference Guide* or the *Cisco ONS 15454 SDH Reference Guide*. For step-by-step instructions on configuring an ML-Series SONET STS circuit, refer to the "Creating Circuits and VT Tunnels" chapter of the *Cisco ONS 15454 Procedure Guide* or the "Creating Circuits and Tunnels" chapter of the *Cisco ONS 15454 SDH Procedure Guide.*

Note   When a process makes unusually heavy demands on the CPU of the ML-Series card, it may impair CPU response time and cause a CPUHOG error message to appear on the console. This message indicates which process used a large number of CPU cycles, such as the updating of the routing table with a large number of routes due to an event. Seeing this message as a result of card reset or other infrequent events should not be a cause for concern.

ML-Series Feature List

This section lists the features of the ML100T-12 and the ML1000-2 cards.

- Layer 1 features
    - 10/100BASE-TX half-duplex and full-duplex data transmission
    - 1000BASE-SX, 1000BASE-LX full-duplex data transmission
    - Two SONET virtual ports with maximum bandwidth of STS-48c per card on ONS 15454 SONET
    - Two SDH virtual ports with maximum bandwidth of VC4-16c per card on ONS 15454 SDH
    - Cisco high-level data link control (HDLC) SONET/SDH port encapsulation (no VLAN trunking support)
    - Point-to-Point Protocol/Bridge Control Protocol (PPP/BCP) SONET/SDH port encapsulation (VLAN trunking supported via BCP)
    - LEX SONET/SDH port encapsulation (G-Series card protocol, which supports VLAN trunking)
    - Packet-over-SONET/SDH (POS)

- POS channel (with LEX encapsulation only)

- PPP

- G-Series card compatible

- PPP over SONET/SDH (IP POS and bridging with VLANs)

- Layer 2 bridging features

  - Layer 2 transparent bridging

  - Layer 2 MAC learning, aging, and switching by hardware

  - Spanning Tree Protocol (IEEE 802.1D) per bridge group

  - Protocol tunneling

  - A maximum of 255 active bridge groups

  - Up to 60,000 MAC addresses per card, with a supported limit of 8,000 per bridge group

  - Integrated routing and bridging (IRB)

  - VLAN features

  - 802.1P/Q-based VLAN trunking

  - 802.1Q VLAN tunneling

  - 802.1D Spanning Tree and 802.1W Rapid Spanning Tree

  - Resilient Packet Ring (RPR)

  - Dual Resilient Packet Ring Interconnect (DRPRI)

- Layer 3 routing, switching, and forwarding

  - Default routes

  - IP unicast and multicast forwarding support

  - Reverse Path Forwarding (RPF) multicast (not RPF unicast)

  - Simple IP access control lists (ACLs) (both Layer 2 and Layer 3 forwarding path)

  - Extended IP ACLs in software (control-plane only)

  - IP and IP multicast routing and switching between Ethernet ports

  - Load balancing among equal cost paths based on source and destination IP addresses

  - Up to 18,000 IP routes

  - Up to 20,000 IP host entries

  - Up to 40 IP multicast groups

- Supported routing protocols

  - Virtual Private Network (VPN) Routing and Forwarding Lite (VRF Lite)

  - Intermediate System-to-Intermediate System (IS-IS) Protocol

  - Routing Information Protocol (RIP and RIP II)

  - Enhanced Interior Gateway Routing Protocol (EIGRP)

  - Open Shortest Path First (OSPF) Protocol

  - Protocol Independent Multicast (PIM)—Sparse, sparse-dense and dense modes

  - Secondary addressing

  - Static routes

- Local proxy ARP

- Border Gateway Protocol (BGP)

- Classless interdomain routing (CIDR)

- Fast EtherChannel (FEC) features (ML100T-12)

  - Bundling of up to four Fast Ethernet ports

  - Load sharing based on source and destination IP addresses of unicast packets

  - Load sharing for bridge traffic based on MAC addresses

  - IRB on the Fast EtherChannel

  - IEEE 802.1Q trunking on the Fast EtherChannel

  - Up to 6 active FEC port channels

- Gigabit EtherChannel (GEC) features (ML1000-2)

  - Bundling the two Gigabit Ethernet ports

  - Load sharing for bridge traffic based on MAC addresses

  - IRB on the Gigabit EtherChannel

  - IEEE 802.1Q trunking on the Gigabit EtherChannel

- ACL features

  - IP standard ACL

  - IP extended ACL

- VLAN features

  - IEEE 802.1Q-based VLAN routing and bridging

- QoS features

  - Service Level Agreements (SLAs) with 1-Mbps granularity

  - Input policing

  - Guaranteed bandwidth (weighted round-robin [WDRR] plus strict priority scheduling)

  - Classification based on Layer 2 priority, VLAN ID, Layer 3 TOS/DSCP, and port

  - Low latency queuing support for unicast VoIP

- CTC

  - Standard STS circuit provisioning for SONET virtual ports

  - Standard STM circuit provisioning for SDH virtual ports

  - SONET alarm reporting for path alarms and other ML-Series specific alarms on ONS 15454 SONET

  - SDH alarm reporting for path alarms and other ML-Series specific alarms on ONS 15454 SDH

  - Raw port statistics

  - Standard inventory and card management functions

  - Cisco IOS command-line interface (CLI) Telnet sessions from CTC

  - IOS startup configuration file management

- Additional protocols and features

  - Cisco Discovery Protocol (CDP) support on Ethernet ports

– Dynamic Host Configuration Protocol (DHCP) relay

– Hot Standby Router Protocol (HSRP) over 10/100 Ethernet, Gigabit Ethernet, FEC, GEC, and Bridge Group Virtual Interface (BVI)

– Internet Control Message Protocol (ICMP)

– IRB routing mode support

– Simple Network Management Protocol (SNMP)

– Transaction Language 1 (TL1)

– Cisco IOS

– NEBS3 compliant

Key ML-Series Features

This section describes selected key features of the ML-Series.

SONET/SDH Port Encapsulation (HDLC, PPP/BCP, and LEX)

The ML-Series supports three forms of SONET/SDH port encapsulation: Cisco HDLC, PPP/BCP and LEX. Cisco HDLC is standard on most Cisco data devices. It does not offer VLAN trunking support. PPP/BCP is a popular standard linked to RFC 2878. It supports VLAN trunking via BCP. LEX is a protocol used by the G-Series cards. This protocol supports VLAN trunking and is based on PPP over HDLC.

The SONET/SDH port encapsulation allows the ML-Series to connect to the OC-N ports of switches and routers supporting POS, as well as the G-Series Ethernet cards on the Cisco ONS 15454 SONET, ONS 15454 SDH, and ONS 15327. All three formats support bridging and routing, standard SONET/SDH payload scrambling, and HDLC frame check sequence.

Link Aggregation (FEC, GEC, and POS)

The ML-Series offers Fast EtherChannel, Gigabit EtherChannel, and Packet-over-SONET/SDH (POS) channel link aggregation. Link aggregation groups multiple ports into a larger logical port and provides resiliency during the failure of any individual ports. The ML-Series supports a maximum of four Ethernet ports in Fast EtherChannel, two Ethernet ports in Gigabit EtherChannel, and two SONET/SDH virtual ports in the POS channel. The POS channel is only supported with LEX encapsulation.

Traffic flows map to individual ports based on MAC source address (SA)/destination address (DA) for bridged packets and IP SA/DA for routed packets. There is no support for policing or class-based packet priorities when link aggregation is configured.

SONET Circuits

On the ONS 15454 SONET, ML-Series cards feature two SONET virtual ports with a maximum combined bandwidth of STS-48. Each port carries an STS circuit with a size of STS-1, STS-3c, STS-6c, STS-9c, STS-12c, or STS-24c.

SDH Circuits

On the ONS 15454 SDH, ML-Series cards feature two SDH virtual ports with a maximum combined bandwidth of VC4-16c. Each port carries an STM circuit with a size of VC3, VC4, VC4-2C, VC4-3C, VC4-4C or VC4-8C.

SONET Alarms

On the ONS 15454 SONET, the ML-Series card reports Telcordia GR-253 SONET alarms on the Alarms panel of CTC and in the Cisco IOS CLI. The card reports SONET Path alarms, including AIS-P, LOP-P, UNEQ-P, RFI-P, TIM-P, PLM-P, PDI-P, BER-SF-B3, and BER-SD-B3. It also reports other alarms, including BPU/COM Fail, Board Fail, port link-down, and no-config. The ML-Series also supports path trace, path, and raw port statistics on CTC. For more information on alarms and alarm definitions, refer to the "Alarm Troubleshooting" chapter of the *Cisco ONS 15454 Troubleshooting Guide* and the "Manage Alarms" chapter of the *Cisco ONS 15454 Procedure Guide*.

SDH Alarms

On the ONS 15454 SDH, the ML-Series card reports SDH alarms on the Alarms panel of CTC and other alarms, including BPU/COM Fail, Board Fail, port link-down, and no-config. The ML-Series also supports path trace, path, and raw port statistics on CTC. For more information on alarms, refer to the "Alarm Troubleshooting" chapter of the *Cisco ONS 15454 SDH Troubleshooting Guide* and the "Manage Alarms" chapter of the *Cisco ONS 15454 SDH Procedure Guide*.

VRF Lite

VPN Routing/Forwarding Lite (VRF Lite) is an ML-Series specific implementation of a VPN routing/forwarding instance (VRF). Unlike standard VRF, VRF Lite does not contain Multi-Protocol internal BGP (MP-iBGP).

Standard VRF is an extension of IP routing that provides multiple routing instances and separate IP routing and forwarding tables for each VPN. VRF is used in concert with internal MP-iBGP. MP-iBGP distributes the VRF information between routers to provide Layer 3 Multiprotocol Label Switching (MPLS)-VPN.

VRF Lite stores VRF information locally and does not distribute the VRF information to connected equipment. VRF information directs traffic to the correct interfaces and subinterfaces when the traffic is received from customer routers or from service provider router(s).

VRF Lite allows an ML-Series card, acting as customer equipment, to have multiple interfaces and subinterfaces with service provider equipment. The customer ML-Series card can then service multiple customers. Normal customer equipment serves a single customer.

RPR

RPR is an emerging network architecture designed for metro fiber ring networks. This new MAC protocol is designed to overcome the limitations of STP, RSTP and SONET in packet-based networks. RPR convergence times are comparable to SONET and much faster than STP or RSTP. RPR operates at the Layer 2 level and is compatible with Ethernet and protected or unprotected SONET circuits.

DRPRI

The bridge-group protocol DRPRI is an RPR mechanism that interconnects rings for protection from ONS node failure. The protocol provides two parallel connections of the rings linked by a special instance of RSTP. One connection is the active node and the other is the standby node. During a failure of the active node, link or card, a proprietary algorithm detects the failure and causes a switchover to the standby node.

TL1

On the ONS 15454 SONET, the Transaction Language 1 (TL1) on the ML-Series can be used for card inventory, fault or alarm management, card provisioning, and retrieval of status information for both data and SONET ports. TL1 can also be used to provision SONET STS circuits and transfer a Cisco IOS startup configuration file to the Timing Communications and Control+ Card (TCC+) or Timing Communications and Control 2 Card (TCC2) memory. For specific TL1 commands and general TL1 information, refer to the *Cisco ONS 15454 and Cisco ONS 15327 TL1 Command Guide*.

SNMP

Both the ONS 15454 SONET/SDH and the ML-Series have Simple Network Management Protocol (SNMP) agents and support SNMP Version 1 (SNMPv1) and SNMP Version 2c (SNMPv2c) sets and traps. The ONS 15454 accepts, validates, and forwards get/getNext/set requests to the ML-Series through a proxy agent. The ML-Series requests contain the slot identification of the ML-Series card to distinguish the request from a general ONS 15454 SNMP request. Responses from the ML-Series are relayed by the ONS 15454 to the requesting SNMP agents.

The ML-Series supports SNMP traps, including Spanning Tree Protocol (STP) traps from Bridge-MIB (management information base) (RFC 1493), the authentication traps from RFC 1157, and the Link-up and Link-down traps for Ethernet ports from IF-MIB (RFC 1573). For more information on how the ONS 15454 implements SNMP, refer to the "SNMP" chapter of the *Cisco ONS 15454 Reference Guide*.

Cisco IOS

Cisco IOS controls the data functions of the ML-Series card and comes preloaded on the ONS 15454 TCC+/TCC2 card.

Users cannot update the ML-Series Cisco IOS image in the same manner as the Cisco IOS system image on a Cisco Catalyst Series. An ML-Series Cisco IOS image upgrade is accomplished only through the ONS 15454 SONET/SDH CTC, and Cisco IOS images for the ML-Series card are available only as part of an ONS 15454 software release. This Cisco IOS image is included on the standard ONS 15454 SONET/SDH System Software CD under the package file name M_I.bin and full file name ons15454m-i7-mz. The images are not available for download or shipped separately.