Cisco Remote-PHY Solution Guide

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Audience

This guide is intended for network or hardware technicians responsible for installing, connecting, and configuring the Cisco Remote-PHY solution and associated equipment at the cable head end or distribution hub. The network or hardware technicians should be familiar with the base operating parameters and service offerings of the cable plant where they intend to install this equipment.

Warning **Only trained and qualified personnel should be allowed to install, replace, or service this equipment.** Statement 1030

Purpose

This document describes in detail the Cisco Coaxial Media Converter and the Cisco uBR-MC3GX60V-RPHY line card in the Cisco Remote-PHY solution.

This document does not provide detailed information on the other network components in the Cisco Remote-PHY solution.

Document Conventions

This document uses the following conventions:

Convention	Description
^ or Ctrl	Both the ^ symbol and Ctrl represent the Control (Ctrl) key on a keyboard. For example, the key combination **^D** or **Ctrl-D** means that you hold down the Control key while you press the D key. (Keys are indicated in capital letters but are not case sensitive.)
bold font	Commands and keywords and user-entered text appear in **bold** font.
Italic font	Document titles, new or emphasized terms, and arguments for which you supply values are in *italic* font.
`Courier font`	Terminal sessions and information the system displays appear in `courier` font.
`Bold Courier font`	Bold Courier font indicates text that the user must enter.
[x]	Elements in square brackets are optional.
...	An ellipsis (three consecutive nonbolded periods without spaces) after a syntax element indicates that the element can be repeated.
|	A vertical line, called a pipe, indicates a choice within a set of keywords or arguments.
[x | y]	Optional alternative keywords are grouped in brackets and separated by vertical bars.
{x | y}	Required alternative keywords are grouped in braces and separated by vertical bars.
[x {y | z}]	Nested set of square brackets or braces indicate optional or required choices within optional or required elements. Braces and a vertical bar within square brackets indicate a required choice within an optional element.
string	A nonquoted set of characters. Do not use quotation marks around the string or the string will include the quotation marks.
< >	Nonprinting characters such as passwords are in angle brackets.
[ ]	Default responses to system prompts are in square brackets.
!, #	An exclamation point (!) or a pound sign (#) at the beginning of a line of code indicates a comment line.

Reader Alert Conventions

This document uses the following conventions for reader alerts:

Note Means *reader take note*. Notes contain helpful suggestions or references to material not covered in the manual.

Tip Means *the following information will help you solve a problem.*

Caution Means *reader be careful*. In this situation, you might do something that could result in equipment damage or loss of data.

Timesaver Means *the described action saves time.* You can save time by performing the action described in the paragraph.

Warning **Means *reader be warned.* In this situation, you might perform an action that could result in bodily injury.**

Related Documentation

In addition to this document, the following documents and resources provide additional information related to the Cisco Remote-PHY solution.

Release Notes

- Release Notes for Cisco Coaxial Media Converter
- Cisco Remote-PHY Solution Release Notes for Cisco IOS Release 12.2(33)CX

Regulatory Compliance and Safety Information

- Regulatory Compliance and Safety Information for Cisco Coaxial Media Converter
- Regulatory Compliance and Safety Information for the Cisco uBR10012 Universal Broadband Router

Installation Guide

- Cisco uBR10012 Universal Broadband Router Hardware Installation Guide

Command Reference

- Cisco Coaxial Media Converter Command Reference
- Cisco CMTS Command Reference

Configuration Guide

- Cisco IOS CMTS Cable Software Configuration Guide, Release 12.2SC

Licensing Information

- Software License Activation on Cisco CMTS Routers

MIB Information

- Cisco CMTS Universal Broadband Router Series MIB Specifications Guide

Obtaining Documentation and Submitting a Service Request

For information on obtaining documentation, using the Cisco Bug Search Tool (BST), submitting a service request, and gathering additional information, see *What's New in Cisco Product Documentation*, at: http://www.cisco.com/c/en/us/td/docs/general/whatsnew/whatsnew.html.

Subscribe to *What's New in Cisco Product Documentation*, which lists all new and revised Cisco technical documentation as an RSS feed and delivers content directly to your desktop using a reader application. The RSS feeds are a free service.

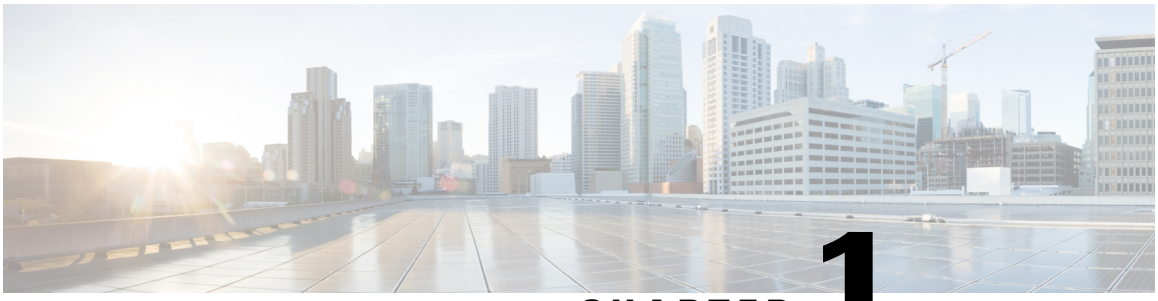
Feature Information for the Cisco Remote-PHY Solution

Use Cisco Feature Navigator to find information about platform support and software image support. Cisco Feature Navigator enables you to determine which software images support a specific software release, feature set, or platform. To access Cisco Feature Navigator, go to http://tools.cisco.com/ITDIT/CFN/. An account on http://www.cisco.com/ is not required.

Note The below table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Table 1: Feature Information for the Cisco Remote-PHY Solution

Feature Name	Release	Feature Information
Cisco Remote-PHY Solution	Cisco IOS Release 12.2(33)CX	The Cisco uBR-MC3GX60V-RPHY line card and Cisco CMC were introduced.



CHAPTER 1

Cisco Remote-PHY Solution Overview

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Introduction

Driven by market evolution towards triple-play services, cable operators in emerging markets are seeking standardized and digital fiber-based solutions for economical and future proof access technologies. Much of the demand is driven by the need to provide higher bandwidth packet transport for Internet connectivity, video and voice services.

Data Over Cable Systems Interface Standard (DOCSIS®) is a standardized technology for services over cable and thus has strong interoperability between system providers. It also provides robust Quality of Service (QoS) methods, ensuring packet delivery during periods of network congestion. Traditionally, DOCSIS runs on linear fiber (or HFC) to provide service and is not naturally applicable for digital fiber. Cisco has bridged the gap by introducing a new access technology called the Remote-PHY.

Existing Architecture

In the emerging markets, most triple-play consumers live in multi-tenant buildings (referred to as Multi Dwelling Units or MDU) with the number of residents usually being less than 500 residents per building or cluster. These buildings are typically served by fiber with one of several “final 100 meter” technologies installed in the buildings. These technologies include fiber, twisted pair, Ethernet, and coaxial. Cable operators have

access to the cable in the building and use this cable for their services. Several technologies exist for enabling two-way services over cable. These include a number of proprietary and vendor-specific methods. However, a standards-based approach to using cable is typically preferred by operators, since this ensures vendor interoperability.

Need for the Cisco Remote-PHY Solution

DOCSIS and EuroDOCSIS are standards that define two-way operation over a cable network. DOCSIS provides the necessary Quality of Service (QoS) tools for ensuring voice call connectivity during periods of network congestion that are anticipated in triple-play networks. DOCSIS is a robust and mature technology for voice, video, and IP video services.

The Cisco Remote-PHY solution leverages existing IP technologies like Ethernet PON (EPON), Gigabit-capable Passive Optical Networks (GPON), and Metro Ethernet (MetroE) equipment; it deploys DOCSIS in MDUs over digital fiber to enable two-way services over cable.

Benefits

The Cisco Remote-PHY solution provides a cost-effective digital fiber-based DOCSIS solution that uses Ethernet PON (EPON), Gigabit-capable Passive Optical Networks (GPON), or Metro Ethernet (MetroE) as the transmission network between the Cisco CMTS and CM. Both the PON technology and DOCSIS is used in the same network.

- Simple and low cost PON transmission as opposed to costly HFC transformation.
- Reduced investment cost including capital and operational expenditure.
- Low-cost yet highly stable Cisco CMC (includes only the PHY layer).
- Reduced CMTS hardware complexity.
- No restriction on Converged Interconnect Network (CIN) network.
- Futureproof architecture. Easy to migrate as the hardware and control functions are on separate layers.
- End-to-end QoS assurance provided by DOCSIS.
- Support for all DOCSIS services.
- Support for existing DOCSIS network provisioning system.
- High access bandwidth.
- With deep fiber, the optical noise contribution to SNR is eliminated. As a result, the remote QAM modulator runs at higher orders of modulation as compared to a centralized QAM modulator.

Architecture Overview

Modular Headend Architecture version 2 (MHAv2) is a set of specifications for the Cisco Remote-PHY solution. It uses digital fiber compatible baseband networking technology, such as Ethernet, EPON, or GPON to drive the fiber portion of the HFC plant. The coaxial portion of the plant remains the same. In MHAv2, the upstream PHY is located on the remote side and acts as the remote PHY system together with the downstream PHY. This is a device called the Coaxial Media Converter (CMC), which connects the digital fiber and the coaxial portions of the plant together. The CMC resides near or in buildings and has both RFI and Gigabit

Ethernet interfaces. The CMC provides layer 1 PHY (downstream and upstream PHY) functionality, layer 2 MAC functionality, and layer 3 tunneling and forwarding support. The CMTS remains unchanged with the exception of the upstream PHY being moved to the remote CMC. The Cisco uBR-MC3GX60V-RPHY line card installed in the Cisco CMTS does not have the RFI interfaces for downstream and upstream, instead, it has Gigabit Ethernet interfaces for both downstream and upstream.

Protocols that form this architecture include:

- Downstream External PHY Interface Decapsulation—Downstream External PHY Interface (DEPI) is a L2TPv3-based protocol defined for downstream DOCSIS MAC management and data packets decapsulation. It is unidirectional, that is, from CMTS to CMC.

  DEPI supports:

  - IP/User Datagram Protocol (UDP)
  - DOCSIS MPT Mode (D-MPT)/Packet Streaming Protocol (PSP)

- Upstream External PHY Interface Encapsulation—Upstream External PHY Interface (UEPI) is a L2TPv3-based protocol defined for upstream DOCSIS MAC management and data packets encapsulation. It is unidirectional, that is, from CMC to CMTS.

  UEPI:

  - Does not support UDP
  - Supports PSP mode only
  - Supports multiple pseudowires for RNG/BW-REQ/SPECTRUM-MGMT/MAP

- GCP—Generic Control Protocol, sets up a control plane tunnel over a generic transport protocol such as TCP or UDP. GCP is used to program CMC upstream PHY parameters from the CMTS. It is also used to control the CMC.

  GCP supports:

  - TCP/UDP
  - DS/US PHY configuration and CMC provisioning/configuration
  - Register mode and type, length, value (TLV) mode
  - Notification

Cisco Cable Modem Termination System

The Cisco uBR10012 universal broadband router acts as the Cable Modem Termination System (CMTS) core for the Cisco Remote-PHY architecture.

Following are its functions:

- Assigns downstream and upstream channels of the Cisco uBR-MC3GX60V-RPHY line card to the Cisco CMC.
- Performs MAC classification, forwarding, and management functions.
- Handles the Cisco CMC configuration and management.

For more information on the Cisco CMTS, see the following documents:

- Cisco uBR10012 Universal Broadband Router Hardware Installation Guide
- Cisco IOS CMTS Cable Software Configuration Guide, Release 12.2SC

Cisco Coaxial Media Converter

The Cisco Coaxial Media Converter (CMC) acts as the edge QAM in the Cisco Remote-PHY architecture. It is located between the Cisco CMTS and the cable modem, and controlled by the Cisco CMTS. The Cisco CMC has network interfaces on one side connecting to the fiber (digital and linear) portion of the Hybrid Fiber Coaxial (HFC) plant, and RF interfaces on the other side connecting to the coaxial portion of the HFC plant. The Cisco CMC can be mounted either on a wall or strand (aerial installation). The RF output of the Cisco CMC can be combined with other services, such as, analog or digital video services. The Cisco CMC uses the linux operating system. Most of the Cisco CMC configurations are performed on the Cisco CMTS.

The Cisco CMC terminates the Ethernet Passive Optical Network (EPON) protocol with an embedded Optical Network Unit (ONU) and originates the DOCSIS protocol using the DOCSIS MAC and PHY layer technology used in the Cisco CMTS. The Cisco CMC has built-in downstream PHY and upstream PHY, and a small FPGA for DEPI decapsulation and UEPI encapsulation. The Cisco CMC supports up to 16 downstream QAM channels and four upstream channels.

For more information on the Cisco CMC product identifiers (PIDs), see Product Identifiers, on page 19.

The Cisco CMC has a hinged lid to allow access to the internal electrical and optical components. It also has a waterproof rubber on the base and an EMI gasket on the lid to seal the equipment. The table below lists the dimensions of the Cisco CMC

Table 2: Physical Specifications of the Cisco CMC

Unit	Value
Depth	12.48 in (31.7 cm)
Width	15.86 in (40.3 cm)
Height	6.69 in (17 cm)
Weight	26 lbs (11.8 kg)

The figures below show the external housing dimensions of the Cisco CMC.

Figure 1: Physical Dimensions of the Cisco CMC

Ports on the Cisco CMC

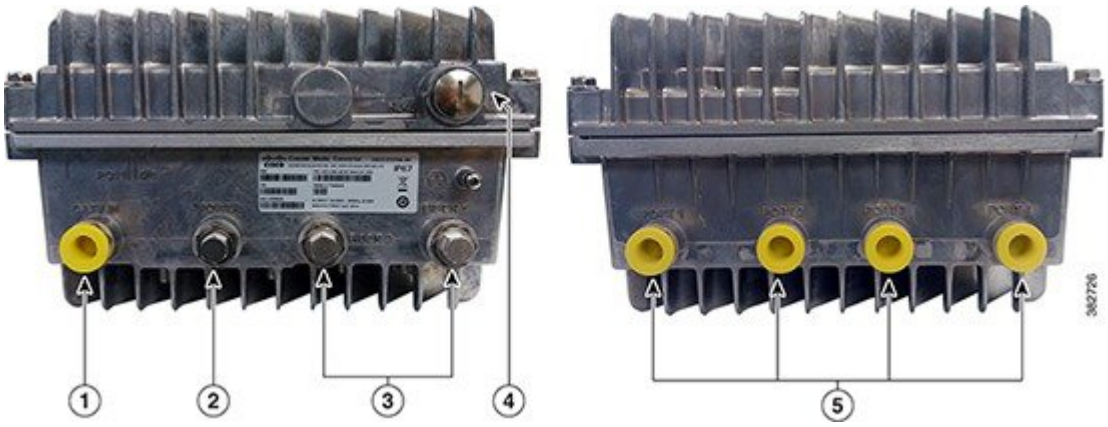
The Cisco CMC has the following ports or external interfaces:

- One RF input port (CATV IN)
- Four RF output ports
- Two SFP ports (1+1 redundancy)
- Two RJ-45 Gigabit Ethernet ports (1+1 redundancy)
- One power input port
- Two fiber input ports

- One console port

The figure below shows the ports on the external housing of the Cisco CMC.

Figure 2: Cisco CMC (closed)



1	CATV input (RF input port)	4	RJ-45 port
2	Power port	5	RF output ports
3	Fiber input ports		—

The figure below shows the ports that are located inside the Cisco CMC.

Figure 3: Cisco CMC (open)

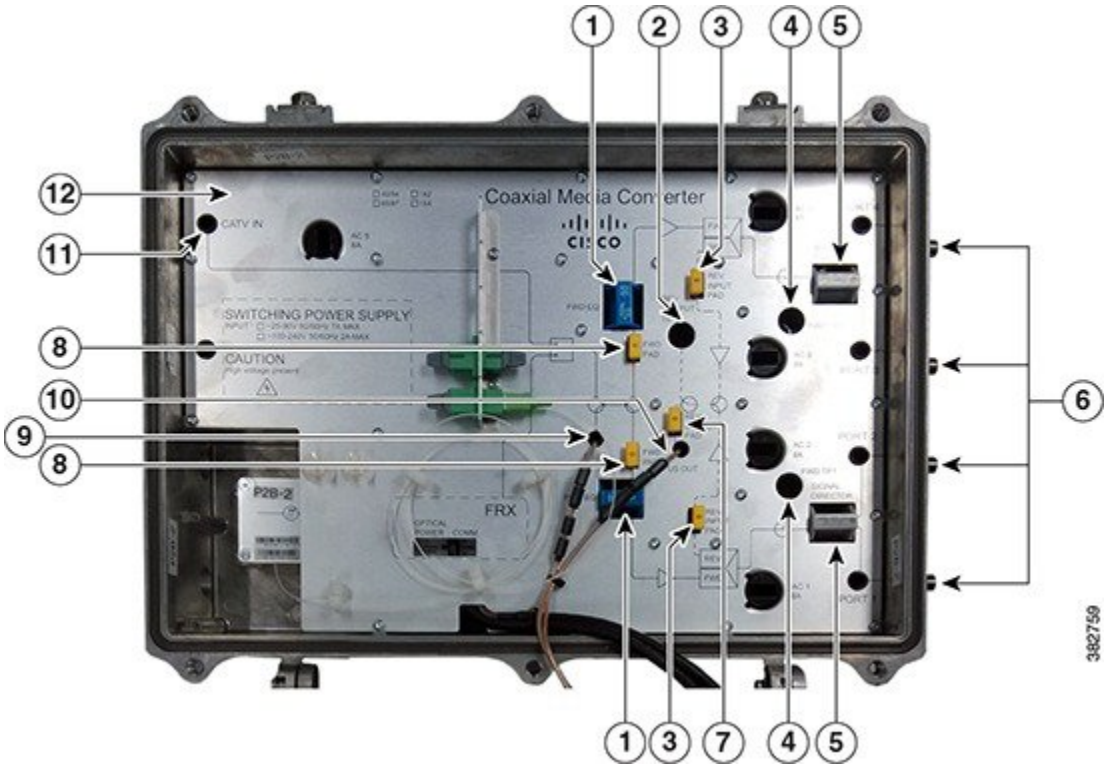
1	RJ-45 Gigabit Ethernet ports	3	SFP ports
2	Console port		—

The Cisco CMC contains the following modules:

RF I/O Module

The RF I/O module on the Cisco CMC can split the CATV input or one downstream into four RF outputs on the downstream. The RF I/O module can also combine four RF outputs into one upstream. The figure below shows the RF I/O module on the Cisco CMC.

Figure 4: RF I/O Module on the Cisco CMC



1	Forward equalizers	7	Reverse output attenuator pads
2	Reverse test point	8	Forward pads
3	Reverse input attenuator pad	9	Downstream RF input port
4	Forward test point	10	Upstream RF output port
5	Signal directors	11	RF input (CATV IN) port
6	RF output ports	12	Base cover

The RF I/O module consists of the following components. Some of the components on the Cisco CMC (attenuator pads, equalizers, and signal directors) can be removed and replaced with the same components of different values during the setup procedures.

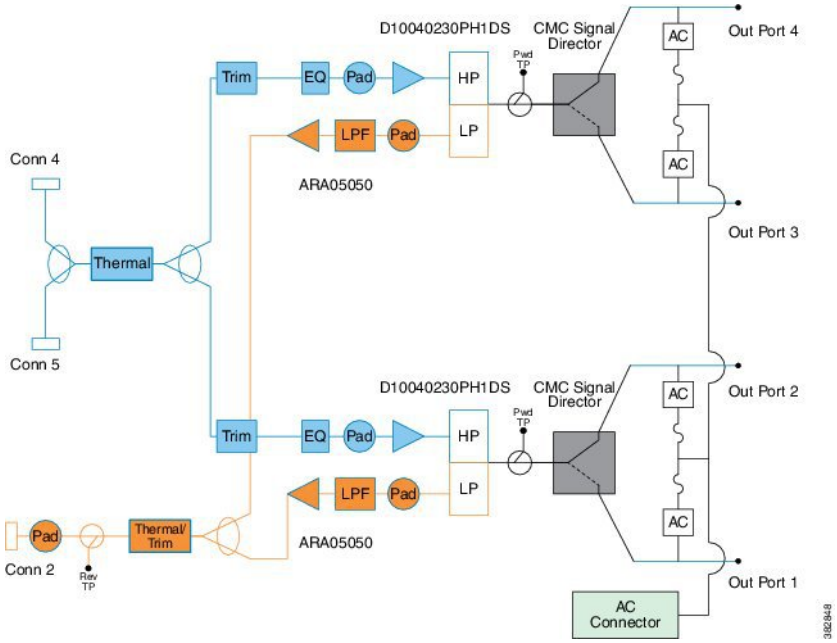
Table 3: Components of the RF I/O Module

Component	Description
RF input port	The Cisco CMC has one RF input port, which provides the CATV input from an external node or amplifier.
RF output ports	The Cisco CMC has four RF output ports, which are used for forward signal output and reverse signal input.
Test points	The Cisco CMC has three test points, which are used for monitoring the signals. It consists of the following types of test points: • Reverse test point—The Cisco CMC has one reverse test point, which is used for monitoring the reverse signal. • Forward test point—The Cisco CMC has two forward test points, which are used for monitoring the forward signal.
Downstream RF input port	The Cisco CMC has one downstream RF input port from the motherboard module.
Upstream RF output port	The Cisco CMC has one upstream RF output port to the motherboard module.
Equalizers	The Cisco CMC has two forward equalizers.
Signal directors	A signal director routes or splits the RF input signal to the RF output ports. The Cisco CMC has two signal directors. The Cisco CMC supports the following components as a signal director: • Splitter • Jumper
Attenuator pads	The Cisco CMC has the following attenuator pads: • Two forward attenuator pads • One reverse input attenuator pad • Two reverse output attenuator pads

Block Diagram

The figure below shows the block diagram of the Cisco CMC RF I/O module:

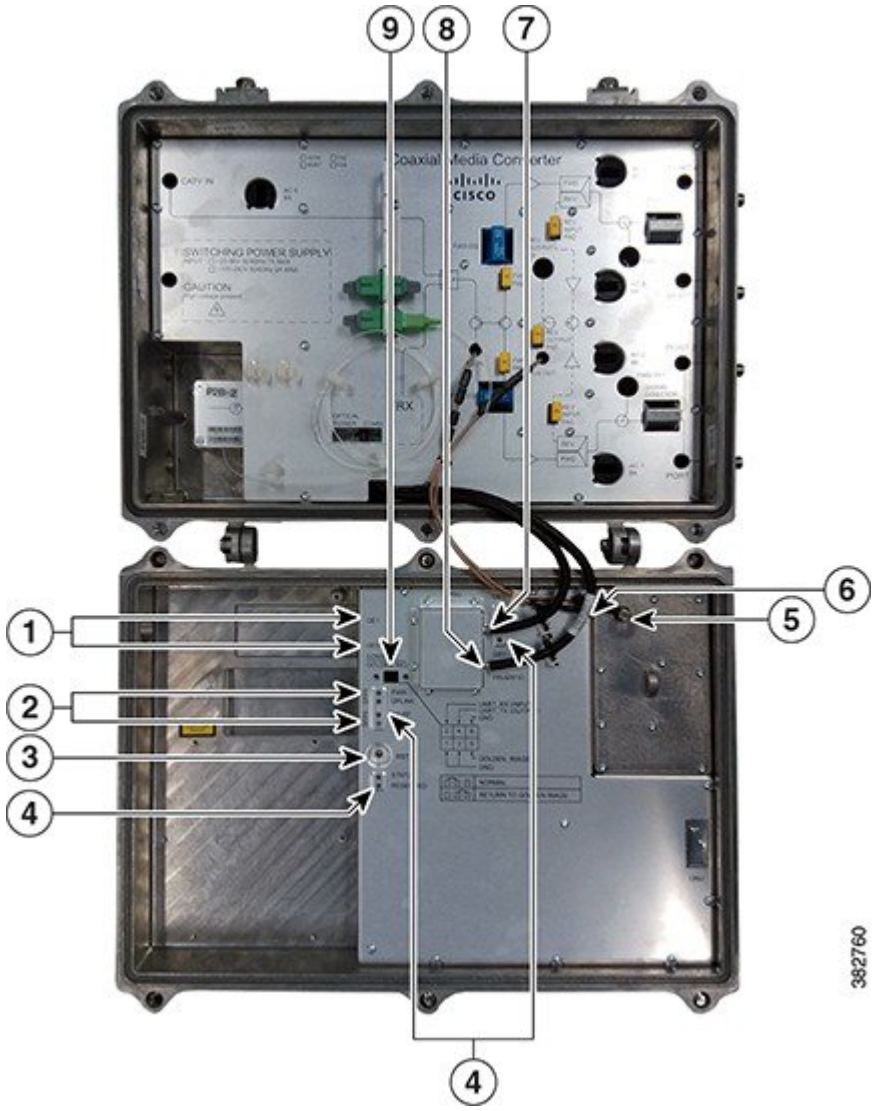
Figure 5: Block Diagram of the Cisco CMC RF I/O Module



Motherboard Module

The figure below shows the motherboard module of the Cisco CMC:

Figure 6: Motherboard Module of the Cisco CMC



1	RJ-45 Gigabit Ethernet ports	6	Upstream RF input port
2	SFP ports	7	Power connector
3	Reset button	8	FRx and RF I/O connector
4	LEDs	9	Console port and golden image jumper
5	Downstream RF output port		—

The Cisco CMC motherboard module consists of the following components:

Table 4: Components of the Motherboard Module

Component	Description
RJ-45 ports	The Cisco CMC has two RJ-45 Gigabit Ethernet ports, which are used to connect it to the switch or OLT. The Cisco CMC supports 1+1 redundancy for the RJ-45 Gigabit Ethernet ports.
SFP ports	The Cisco CMC has two SFP ports, which are used to connect it to the switch or OLT. The Cisco CMC supports 1+1 redundancy for the SFP ports. The Cisco CMC supports Gigabit Ethernet SFP and EPON SFP.
Reset button	The Cisco CMC has a reset button, which is used to power-cycle the motherboard module (that is, power it down and then power it up).
LEDs	The Cisco CMC has the following LEDs on the motherboard module for monitoring the Cisco CMC: • PWR—Power LED • UPLINK—Uplink LED • DS RF—Downstream RF LED • ALARM—Alarm LED • STATUS—Status LED • RESERVED—Reserved LED • GE0 and GE1—RJ-45 Gigabit Ethernet LEDs
Console port	The Cisco CMC has one console port, which is used to connect it to a PC. This port has three pins. You must use a 3-pin connector to connect to this port.
Golden image jumper	The golden image jumper has three pins, two ground-pins and one golden image-pin. When the golden image-pin is shorted with the ground-pin, the Cisco CMC boots with the golden image.
Power connector	The Cisco CMC has an 8-pin 12 V power connector, which provides power to the motherboard module.
FRx and RF I/O connector	The Cisco CMC has one FRx and RF I/O connector, which provides the Universal Asynchronous Receiver and Transmitter (UART) signals to the FRx.
Downstream RF output port	The Cisco CMC has one downstream RF output port, which is connected to the downstream RF input port on the RF I/O module through a connector.
Upstream RF input port	The Cisco CMC has one upstream RF input port, which is connected to the upstream RF output port on the RF I/O module through a connector.

Power Supply Unit

The Power Supply Unit (PSU) provides power to the Cisco CMC. The Cisco CMC is available in the following variants of the PSUs:

- Cisco CMC With the 220VAC PSU
- Cisco CMC With the 60VAC PSU

Cisco CMC With the 220VAC PSU

The Cisco CMC with 220VAC power supply does not support the pass-through capability. The figure below shows the rating label for the Cisco CMC with the 220VAC PSU:

Figure 7: Rating Label of the 100-240VAC Mains Power Supply

Cisco CMC With the 60VAC PSU

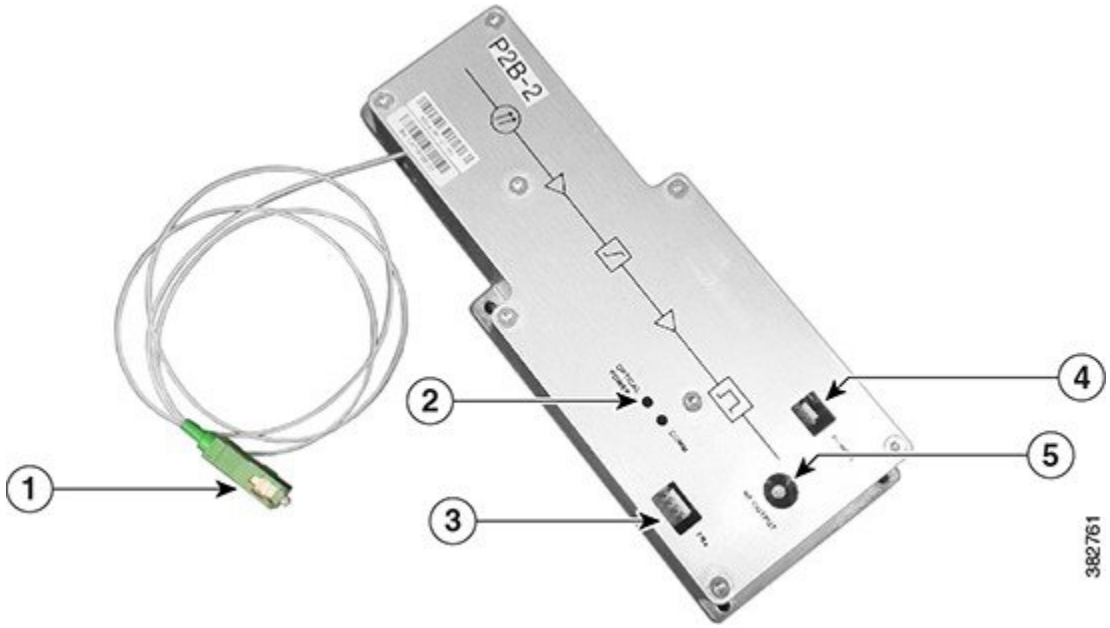
The Cisco CMC with 60VAC power supply supports the pass-through capability. The figure below shows the rating label for the Cisco CMC with the 60VAC PSU:

Figure 8: Rating Label of the 60VAC Network Power Supply

FRx

The Forward Optical Receiver Module (FRx) is a 52 to 1002 MHz forward path optical to electrical conversion module. It receives the intensity modulated optical signals incident to the optical connector and provides the corresponding electrical signals as output. The figure below shows the FRx used for the Cisco CMC:

Figure 9: FRx



1	Optical input port	4	Power port
2	LEDs	5	RF output port
3	Universal Asynchronous Receiver and Transmitter (UART) port		—

The FRx consists of the following components:

Table 5: Components of the FRx

Component	Description
Optical input port	This port is used for providing the input optical signal to the FRx. This port is connected to the SC/APC adapter on the Cisco CMC.
Power port	This port is used for providing power input to the FRx. The FRx supports 12.6 V and 5 V power inputs. Use a 3-pin connector to provide power to the FRx from the power supply unit.

Component	Description
LEDs	LEDs are used for monitoring if the optical input level and communication are operational on the FRx. The FRx contains two LEDs: • OPTICAL POWER—Optical input power LED • COMM—Communication status LED
RF output port	This port is used for providing the RF output signal to the Cisco CMC.
UART port	This port is used for connecting the control cable from the Cisco CMC to the FRx. Use a 4-pin connector for the UART port.

Cisco uBR-MC3GX60V-RPHY Line Card

The Cisco uBR-MC3GX60V-RPHY line card transmits and receives RF signals between the subscriber and headend over the hybrid fiber-coaxial (HFC) system and is DOCSIS 3.0-compliant. The Cisco uBR-MC3GX60V-RPHY line card is designed specifically for the Cisco uBR10012 router and conforms to the Modular CMTS (M-CMTS) architecture.

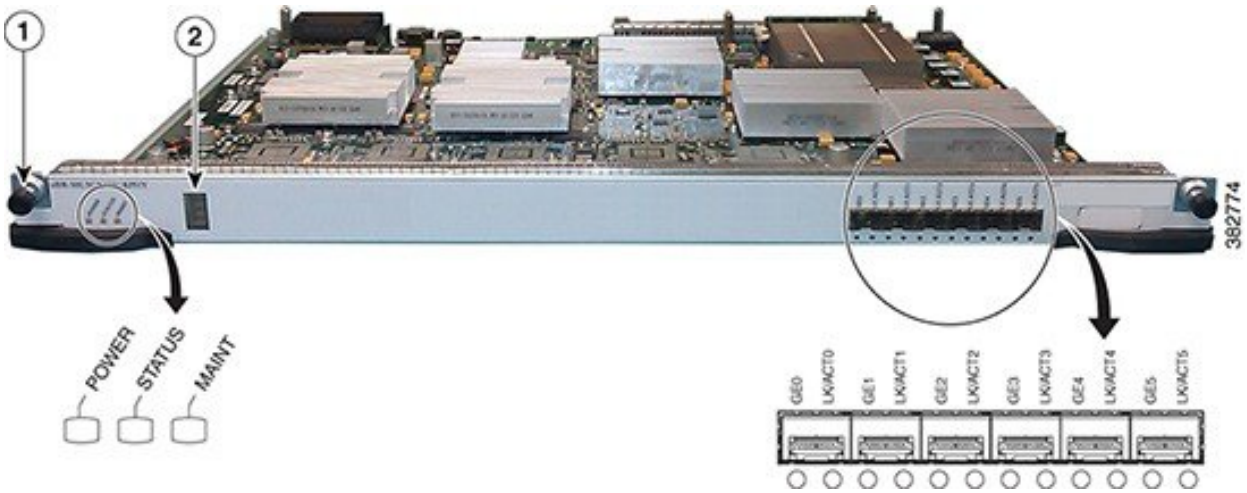
The Cisco uBR-MC3GX60V-RPHY line card is installed in the CMTS and connected to the Cisco CMC via the EPON, GPON, or Metro Ethernet. The Cisco uBR-MC3GX60V-RPHY line card supports both downstream and upstream traffic. The Cisco uBR-MC3GX60V-RPHY line card has three pairs of Gigabit Ethernet (GE) ports as external interfaces and 1 + 1 redundancy for the Metro Ethernet ports. Both the downstream and upstream traffic share the same ports.

The Cisco uBR-MC3GX60V-RPHY line card supports 24 downstream RF channels and 20 upstream RF channels per Gigabit Ethernet port. Hence, a total of 72 downstream RF channels and 60 upstream RF channels across the Gigabit Ethernet ports.

Table 6: Physical Specifications of the Cisco uBR-MC3GX60V-RPHY Line Card

Unit	Dimensions
Width	21.65 in (55 cm)
Height	14.17 in (3.6 cm)
Depth	172.44 in (43.8 cm)
Weight	12.99 lbs (5.895 kg)

Figure 10: Cisco uBR-MC3GX60V-RPHY Line Card



1	Captive Screw	2	Front panel display (FPD)

Cisco uBR-MC3GX60V-RPHY line card contains the following components:

- LEDs—The LEDs are located on the front panel of the line card and indicates the status of the line card.

  The line card has the following LEDs for monitoring its status:

  - POWER—Power LED
  - STATUS—Status LED
  - MAINT—Maintenance LED
  - GE0 through GE5—Gigabit Ethernet port LED
  - LK/ACT0 through LK/ACT5—Link LED for the Gigabit Ethernet port

- Gigabit Ethernet ports—The Cisco uBR-MC3GX60V-RPHY line card has three pairs of Gigabit Ethernet ports as external interfaces and the SFP modules are inserted into the Gigabit Ethernet ports to connect to a switch or an OLT. For more information on SFP modules, see SFP Modules for the Cisco uBR-MC3GX60V-RPHY Line Card, on page 17.
- Front panel display—The Front panel four-character alphanumeric display shows the licensing status information of the US and DS channels.

Software License for the Cisco uBR-MC3GX60V-RPHY Line Card

The Cisco uBR-MC3GX60V-RPHY line card requires software licensing to restrict the number of US and DS channels used. The Cisco uBR-MC3GX60V-RPHY line card supports 16 to 60 US channels and 16 to 72 DS channels.

The Cisco uBR-MC3GX60V-RPHY line card uses a smart chip authentication device to prevent counterfeit line cards. A digital signature is embedded in the line card, and the Public Key Encryption techniques are used to verify the authenticity of the digital signature. The software licenses are physically stored on the line cards. You cannot transfer the software licenses between different types of line cards.

The front panel four-character alphanumeric display on the line card shows the licensing status information of the US and DS channels. The first two characters of the display represent the DS license count and the last two characters represent the US license count.

The table below shows some of the US and DS channel combinations supported on the Cisco uBR-MC3GX60V-RPHY line card and their corresponding license type.

Table 7: Software License for the Cisco uBR-MC3GX60V-RPHY Line Card

Front Panel Display	Downstream	Upstream
3G60	72	60
2G40	48	40
1G20	24	20
3314	33	14

Compatibility Matrix for the Cisco uBR-MC3GX60V-RPHY Line Card

Table 8: Software and Hardware Compatibility Matrix for the Cisco uBR-MC3GX60V-RPHY Line Card

Cisco CMTS Platform	Processor Engine	Cisco IOS Release
Cisco uBR10012 router	PRE4	12.2(33)CX and later releases
Cisco uBR10012 router	PRE5	12.2(33)CX and later releases

Onboard Failure Logging

The Onboard Failure Logging (OBFL) feature enables the storage and collection of critical failure information in the nonvolatile memory of a Field Replaceable Unit (FRU), like a route processor (RP) or line card. The Cisco uBR10000 series universal broadband router supports OBFL on PRE4, the Cisco SIP-600 jacket card, Cisco uBR-MC3GX60V-RPHY, Cisco uBR-MC3GX60V, Cisco UBR-MC20X20V, and the Cisco uBR-MC5X20H line cards.

The data stored through OBFL assists in understanding and debugging the field failures upon Return Material Authorization (RMA) of a RP or line card at repair and failure analysis sites. OBFL records operating temperatures, voltages, hardware uptime, and any other important events that assist board diagnosis in case of hardware failures.

For more information about the feature, see Onboard Failure Logging.

Note The sample output provided in the Onboard Failure Logging guide may vary slightly for the Cisco CMTS routers.

SFP Modules for the Cisco uBR-MC3GX60V-RPHY Line Card

The Small Form-factor Pluggable (SFP) modules are I/O devices that are inserted into the Gigbit Ethernet ports, linking the ports to an OLT or a switch through a network cable.

The table below lists the SFP modules that are supported on the Cisco uBR-MC3GX60V-RPHY line card. The only restriction is that each SFP module must match the wavelength specifications on the other end of the cable and the cable must meet the stipulated cable length range for reliable communications.

Table 9: SFP Modules supported on the Cisco uBR-MC3GX60V-RPHY Line Card

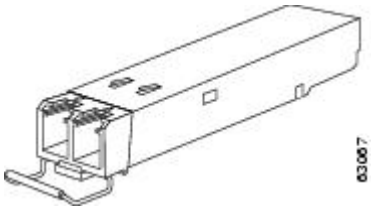
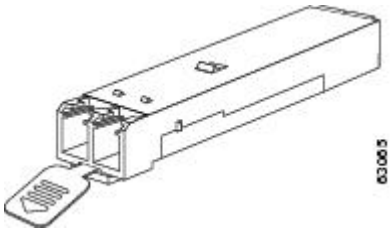
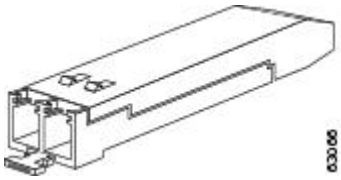
SFP Part Number	SFP Module	Description	Supported Connector	Supported Cable Type
SFP-GE-T	RJ-45 copper (1000BASE-T)	Provides full-duplex Gigbit Ethernet connectivity to high-end workstations, and between wiring closets over an existing copper network infrastructure.	RJ-45 connector	Copper
GLC-SX-MMD	Short wavelength (1000BASE-SX)	Contains a Class 1 laser of 850 nm for 1000BASE-SX (short-wavelength) applications.	LC Fiber-Optic connector	Multimode fiber (MMF)[1]
GLC-LH-SMD	Long wavelength/long haul (1000BASE-LX/LH)	Contains a Class 1 laser of 1310 nm for 1000BASE-LX/LH (long-wavelength) applications.	LC Fiber-Optic connector	Single-mode fiber (SMF) Multimode fiber (MMF)
GLC-ZX-SMD[2]	Extended distance (1000BASE-ZX)	Contains a Class 1 laser of 1550 nm for 1000BASE-ZX (extended-wavelength) applications.	LC Fiber-Optic connector	Single-mode fiber (SMF)

1 A mode-conditioning patch cord is required at all times as per IEEE specifications.

2 For the GLC-ZX-SM, the minimum attenuation between the transmit bore (TX) and the receive bore (RX) is 8 dB. When using shorter distances of single-mode fiber cable, you might need to insert an inline optical attenuator in the link to avoid overloading the receiver.

The SFP modules can have three types of latches to secure it in a port socket. Determine the type of latch your SFP module uses before you complete the installation and removal procedures.

Table 10: Supported SFP Latch Types

SFP Module	Description	Illustration
Bale clasp SFP module	The bale clasp SFP module has a clasp that you use to remove or install the SFP module in a Gigbit Ethernet port.	
Mylar tab SFP module	The mylar tab SFP module has a tab that you pull to remove the module from a Gigbit Ethernet port.	
Actuator button SFP module	The actuator button SFP module includes a button that you push to remove the SFP module from a Gigbit Ethernet port.	

For more information on SFP modules, see Cisco Small Form-Factor Pluggable Modules for Gigabit Ethernet Applications Data Sheet.

Optical Line Terminal

Optical Line Terminal (OLT) equipment supports:

- Packet classification
- Switching functions that tag packets with their order of priority and the port on the CMC that must receive the packet

Product Identifiers

The tables below list the component product identifiers (PID) for the Cisco CMC and the Cisco uBR-MC3GX60V-RPHY line card.

Table 11: Cisco CMC Component PIDs

Component	PID
Cisco CMC	
Cisco CMC, 60 V, 6 downstream (DS) and 4 upstream (US) channels, 42/54MHz	CMC-L-L-16X4
Cisco CMC, 60 V, 16 DS and 4 US channels, 65/87MHz	CMC-L-M-16x4
Cisco CMC, 60 V, 16 DS and 4 US channels, 42/54MHz, with node	CMC-L-L-16X4-N
Cisco CMC, 60 V,16 DS and 4 US channels, 65/87MHz, with node	CMC-L-M-16x4-N
Cisco CMC, 110/220 V, 16 DS and 4 US channels, 42/54 MHz, US power cord	CMC-M-L-16X4-US
Cisco CMC, 110/220 V, 16 DS and 4 US channels, 42/54 MHz, JP power cord	CMC-M-L-16X4-JP
Cisco CMC, 110/220 V, 16 DS and 4 US channels, 42/54 MHz, EU power cord	CMC-M-L-16X4-EU
Cisco CMC, 110/220 V, 16 DS and 4 US channels, 42/54 MHz, UK power cord	CMC-M-L-16X4-UK
Cisco CMC, 110/220 V, 16 DS and 4 US channels, 42/54 MHz, India power cord	CMC-M-L-16X4-ID
Cisco CMC, 110/220 V, 16 DS and 4 US channels, 65/87 MHz, CH power cord	CMC-M-M-16x4-CH
Cisco CMC, 110/220 V, 16 DS and 4 US channels, 65/87 MHz, JP power cord	CMC-M-M-16x4-JP
Cisco CMC, 110/220 V, 16 DS and 4 US channels, 65/87 MHz, US power cord	CMC-M-M-16x4-US
Cisco CMC, 110/220 V, 16 DS and 4 US channels, 65/87 MHz, EU power cord	CMC-M-M-16x4-EU
Cisco CMC, 110/220 V, 16 DS and 4 US channels, 65/87 MHz, UK power cord	CMC-M-M-16x4-UK
Cisco CMC, 110/220 V, 16 DS and 4 US channels, 65/87 MHz, AU power cord	CMC-M-M-16x4-AU
Cisco CMC, 110/220 V, 16 DS and 4 US channels, 42/54 MHz, US power cord, with node	CMC-M-L-16X4-USN
Cisco CMC, 110/220 V, 16 DS and 4 US channels, 42/54 MHz, EU power cord, with node	CMC-M-L-16X4-EUN

Component	PID
Cisco CMC, 110/220 V, 16 DS and 4 US channels, 42/54 MHz, JP power cord, with node	CMC-M-L-16X4-JPN
Cisco CMC, 110/220 V, 16 DS and 4 US channels, 42/54 MHz, UK power cord, with node	CMC-M-L-16X4-UKN
Cisco CMC, 110/220 V, 16 DS and 4 US channels, 42/54 MHz, ID power cord, with node	CMC-M-L-16X4-IDN
Cisco CMC, 110/220 V, 16 DS and 4 US channels, 65/87 MHz, CH power cord, with node	CMC-M-M-16x4-CHN
Cisco CMC, 110/220 V, 16 DS and 4 US channels, 65/87 MHz, JP power cord, with node	CMC-M-M-16x4-JPN
Cisco CMC, 110/220 V,16 DS 4 US channels, 65/87 MHz, US power cord, with node	CMC-M-M-16x4-USN
Cisco CMC, 110/220 V, 16 DS and 4 US channels, 65/87 MHz, EU power cord, with node	CMC-M-M-16x4-EUN
Cisco CMC, 110/220 V, 16 DS and 4 US channels, 65/87 MHz, UK power cord, with node	CMC-M-M-16x4-UKN
Cisco CMC, 110/220 V, 16 DS and 4 US channels, 65/87 MHz, AU power cord, with node	CMC-M-M-16x4-AUN
Cisco CMC, 110/220 V, 16 DS and 4 US channels, 65/87 MHz, ID power cord, with node	CMC-M-M-16x4-IDN
Gigabit Ethernet SFP	
1000BASE-BX10 10KM distance	GLC-BX-U
1000BASE-SX 550M distance; rugged SFP	GLC-SX-MM-RGD
1000BASE-LX/LH 10KM distance; rugged SFP	GLC-LX-SM-RGD
1000BASE-EX long-wavelength; with DOM	GLC-EX-SMD
1000BASE-ZX 80KM distance; rugged SFP	GLC-ZX-SM-RGD
Ethernet Passive Optical Network (EPON) SFP Optical Network Unit (ONU)	
EPON ONU, SFP type, Gigabit Ethernet throughput; industrial grade	SFP-EPON-ONU-GE=
FRx	

Component	PID
Optical Forward Receiver, 1 GHz, 50 dBmV, 9 dB tilt, with SC/APC, with Automatic Gain Control (AGC), spare	FRX-1G-RF50-T9=
RJ-45 Waterproof Glands	
PG16 gland for RJ-45 with one hole	GLND-PG16-RJ-1H
PG16 gland for RJ-45 with two holes	GLND-PG16-RJ-2H
Port Plug	
Port plug with O-Ring, 5/8" brass nickel plate	PLUG-CMC-RF=
RF Connectors	
Assembly 5/8" F-connector, metric	FCONTOR-CMC-RF-M=
Assembly 5/8" F-connector, standard	FCONTOR-CMC-RF-S=
AC Shunt	
Plastic jumper, 0.8"C for the Cisco Remote-PHY solution	JUMPER-CMC=
Console Cable	
Cisco CMC console cable, converter between DB9 and PCB	CAB-CONSOLE-DB9=
Fiber Adapters	
Optical fiber adapter for SC/APC to SC/APC	OPT-ADP-SC-SC=
Optical fiber adapter for SC/APC to FC/APC	OPT-ADP-SC-FC=
1 GHz Attenuator Pads	
0 dB	589693
0.5 dB	589694
1.0 dB	589695
1.5 dB	589696
2.0 dB	589697
2.5 dB	589698
3.0 dB	589699

Component	PID
3.5 dB	589700
4.0 dB	589701
4.5 dB	589702
5.0 dB	589703
5.5 dB	589704
6.0 dB	589705
6.5 dB	589706
7.0 dB	589707
7.5 dB	589708
8.0 dB	589709
8.5 dB	589710
9.0 dB	589711
9.5 dB	589712
10.0 dB	589713
10.5 dB	589714
11.0 dB	589715
11.5 dB	589716
12.0 dB	589717
12.5 dB	589718
13.0 dB	589719
13.5 dB	589720
1 GHz Forward Linear Equalizers	
0 dB	4007228
1.5 dB	4008778

Component	PID
3.0 dB	4008779
4.5 dB	4008780
6.0d B	4008781
7.5 dB	4008782
9.0 dB	4008783
10.5 dB	4008784
12.0 dB	4008785
13.5 dB	4008786
15.0 dB	4008787
16.5 dB	4009258
18.0 dB	4009259
19.5 dB	4009260
21.0 dB	4009261
Jumper	
Signal director jumper	4011907

Table 12: Cisco uBR-MC3GX60V-RPHY Line Card Component PIDs

Component	Part Number
Cisco uBR-MC3GX60V-RPHY Line Card for uBR10K supporting remote PHY; Base HW	UBR-MC3GX60V-RPHY
Spare Cisco uBR-MC3GX60V-RPHY Line Card for uBR10K supporting remote PHY; Base HW	UBR-MC3GX60V-RPHY=
Spare 3G60V-RPHY w/ 0x0 License	UBR-MC3GX60V-R-SP=
Blank card slot cover	UBR10-MC-COVER=
Small Form-Factor Pluggable (SFP)	
Cisco 1000BASE-T	SFP-GE-T, Cisco Systems

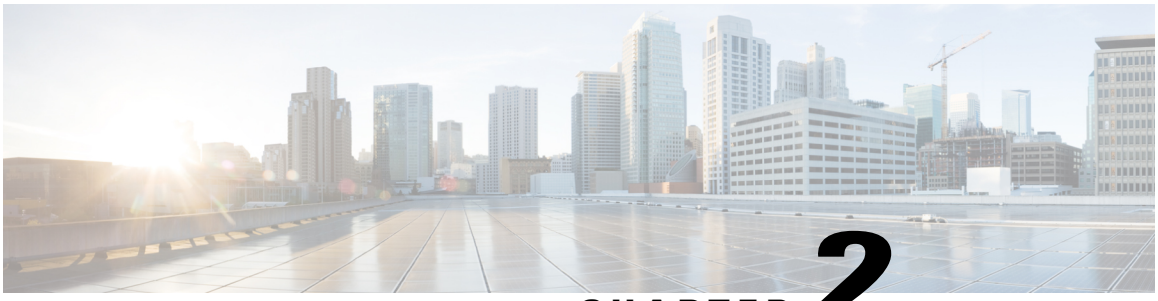
Component	Part Number
1000BASE-SX	GLC-SX-MMD
1000BASE-LX/LH	GLC-LH-SMD
1000BASE-ZX	GLC-ZX-SMD

License Information

For information on license, see the Software License Activation on Cisco CMTS Routers document.

How to Order

For information on how to order, see the http://www.cisco.com/web/ordering/root/index.html page.



CHAPTER 2

Cisco Remote-PHY Solution Deployment

- Design Considerations, page 25
- Network Architecture, page 26
- Network Topologies, page 26
- Network Cables, page 29

Design Considerations

This section helps you prepare for deploying the Cisco Remote-PHY solution.

Prerequisites

- Ensure that a digital optical network is deployed between the Cisco Coaxial Media Converter (Cisco CMC) and Cisco CMTS. The supported digital optical networks are EPON, GPON, and Metro Ethernet.
- Ensure that the data path is guaranteed between the Cisco CMTS and the Cisco CMC.
- Reserve sufficient bandwidth for the DOCSIS traffic.
- Network must support IPv4 multicast forwarding.
- Ensure that the maximum latency is as low as possible.
- Based on the input type in the network, deploy or use the appropriate type of Cisco CMC. For RF input, deploy the Cisco CMC with coaxial cable input. For optical input, deploy the Cisco CMC with the FRx.

Memory Requirements

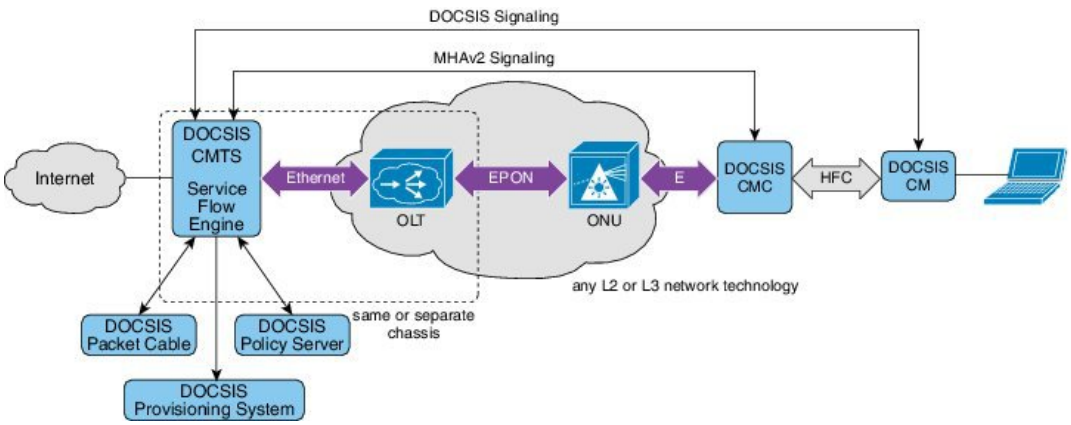
Component	Recommended Memory Requirement
Cisco uBR10012 Router with PRE4	Flash—128 MB DRAM—2 GB
Cisco uBR10012 Router with PRE5	Flash—256 MB DRAM—4 GB

Component	Recommended Memory Requirement
Cisco Coaxial Media Converter	Flash—96 MB DRAM—256 MB

Network Architecture

The Cisco Remote-PHY solution supports the *Single Controller Sharing* architecture. In this architecture, multiple Cisco CMC equipments share the downstream and upstream channels of a Cisco uBR-MC3GX60V-RPHY line card.

Figure 11: Single Controller Sharing Architecture



Network Topologies

This section describes some network topologies supported by the Cisco Remote-PHY solution.

Topology 1—Metro Ethernet Topology

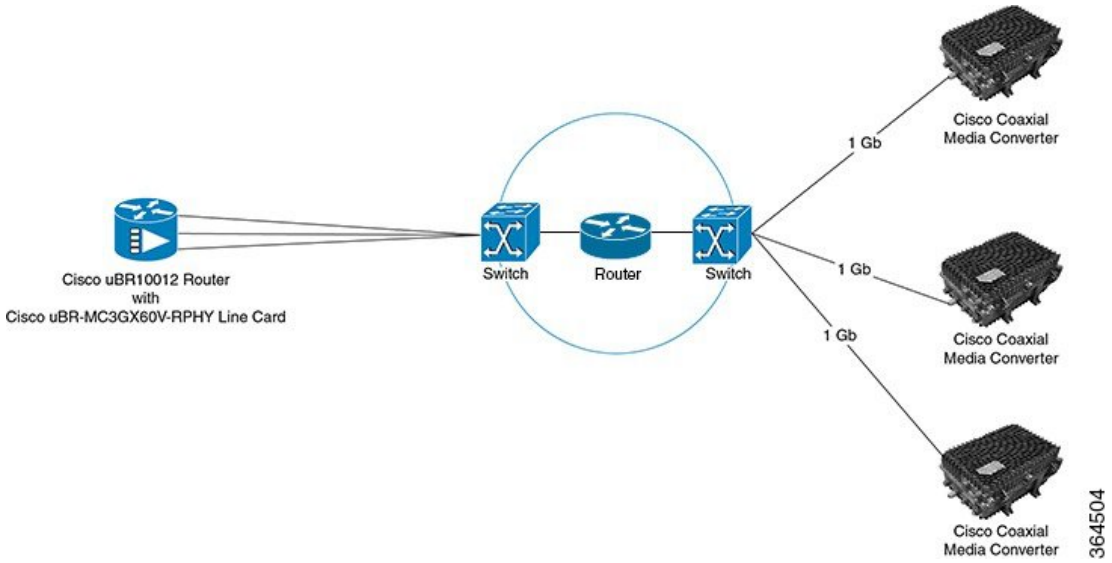
Network Elements:

- One Cisco uBR10012 Router
- Hundreds of Cisco CMC devices
- Maximum of eight Cisco uBR-MC3GX60V-RPHY line cards
- Multiple switches

Capacity:

Maximum of 24 Gb on the downstream and 14 Gb on the upstream for one Cisco uBR10012 Router.

Figure 12: Metro Ethernet Topology



Topology 2—Switch and PON Topology

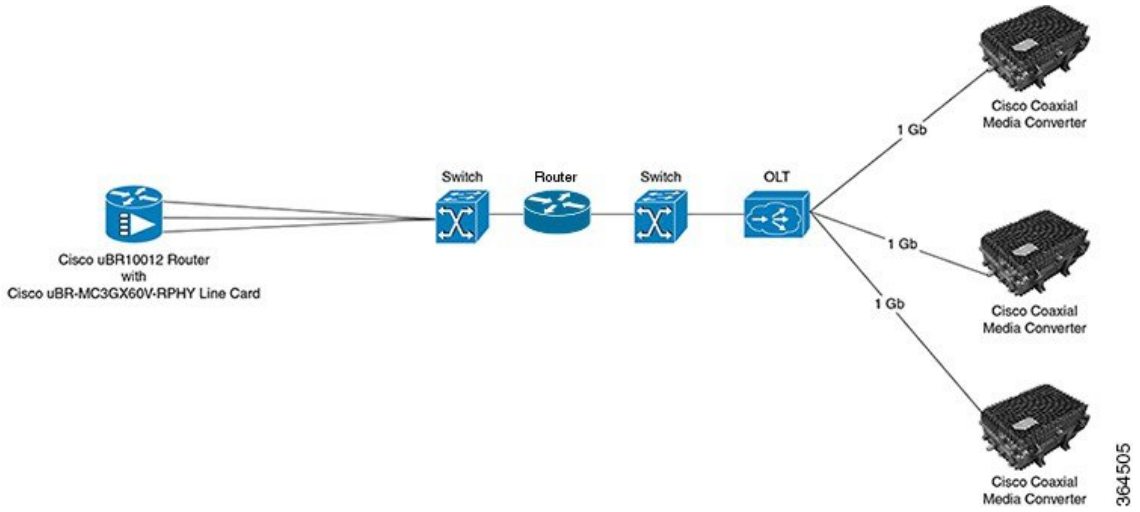
Network Elements:

- One Cisco uBR10012 Router
- Hundreds of Cisco CMC devices with internal ONU
- Maximum of eight Cisco uBR-MC3GX60V-RPHY line cards
- Multiple PON OLTs
- Multiple switches

Capacity:

Maximum of 24 Gb on the downstream and 14 Gb on the upstream for one Cisco uBR10012 Router.

Figure 13: Switch and PON Topology



Topology 3—Pure PON Topology

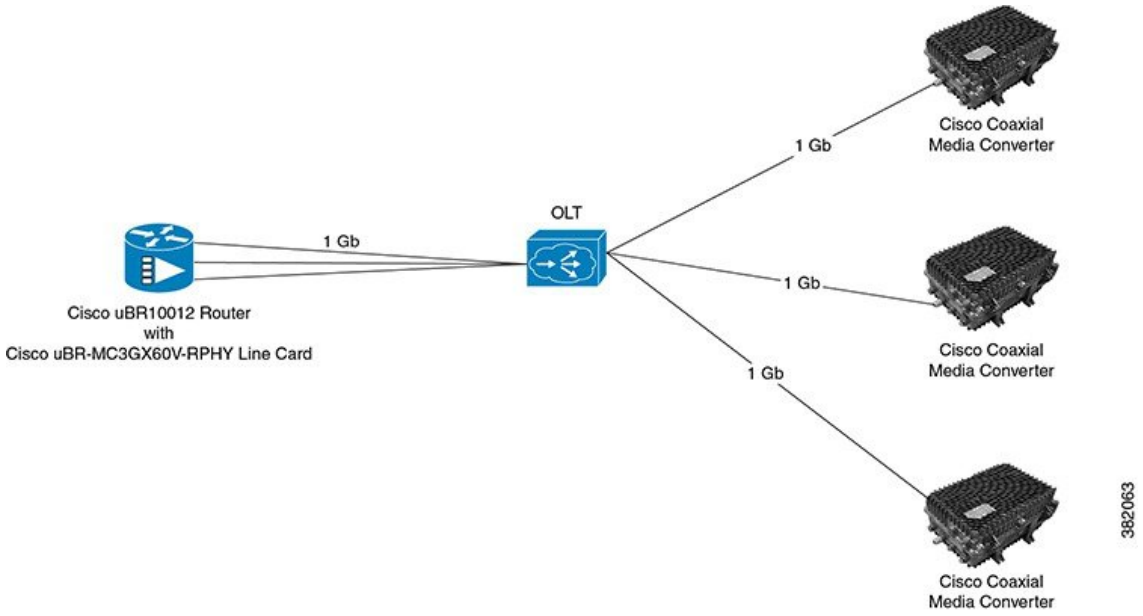
Network Elements:

- One Cisco uBR10012 Router
- Hundreds of Cisco CMC devices with internal ONU
- Maximum of eight Cisco uBR-MC3GX60V-RPHY line cards
- Multiple PON OLTs

Capacity:

Maximum of 24 Gb on the downstream and 14 Gb on the upstream for one Cisco uBR10012 Router.

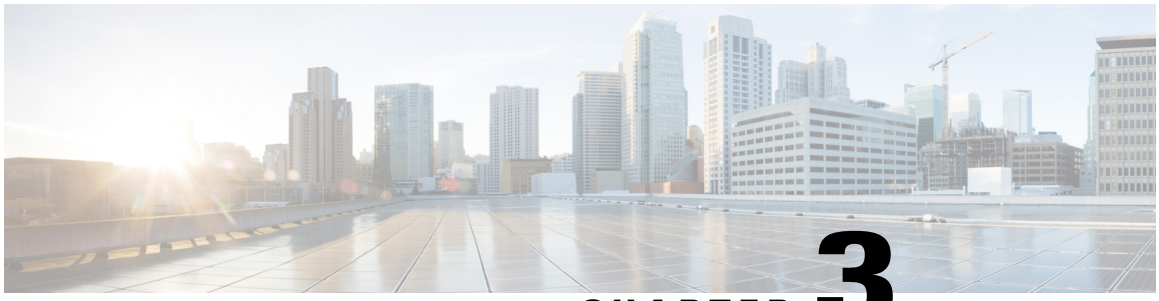
Figure 14: Pure PON Topology



Network Cables

Table 13: Cable Types Supported for the Cisco Remote-PHY Solution

Originating Device	Target Device	Cable Type	Connector Type
CMTS (Gigabit Ethernet SFP module on the Cisco uBR-MC3GX60V-RPHY line card)	Switch or OLT	Ethernet cables	RJ-45 connector
		Copper cables	RJ-45 connector
		Optical fiber	LC Fiber-Optic connector
OLT	ONU	Optical fiber	SC Fiber-Optic connector
	External ONU	Optical fiber	SC Fiber-Optic connector
Switch	Cisco CMC	Optical fiber	LC Fiber-Optic connector
ONU	Cisco CMC	Optical fiber	SC Fiber-Optic connector
External ONU	Cisco CMC	Copper cables	RJ-45 connector



CHAPTER 3

Installing the Cisco Remote-PHY Solution

This chapter provides information on how to install the hardware components of the Cisco Remote-PHY solution.

- Preparing for the Installation, page 31
- Installing the Cisco CMC, page 38
- Installing the Cisco uBR-MC3GX60V-RPHY Line Card, page 77

Preparing for the Installation

Before you install the Cisco Remote-PHY solution, consider the following:

- Power and cabling requirements that must be in place at your installation sites
- Equipment required to install the Cisco Remote-PHY solution
- Environmental conditions your installation site must meet to maintain normal operation

Note Do not unpack the equipment until you are ready to install it. Keep the equipment in the shipping container to prevent accidental damage until you determine an installation site.

This section provides information on:

General Safety Guidelines

When you install a component, observe all caution and warning statements mentioned in this section.

The following guidelines will help ensure your safety and protect the equipment. However, these guidelines may not cover all potentially hazardous situations you may encounter during system installation, *so be alert*.

- Install your product in compliance with the national and local electrical codes. In the United States, this means the National Fire Protection Association (NFPA) 70, United States National Electrical Code. In Canada, Canadian Electrical Code, part I, CC22.1. In other countries, International Electrotechnical Commission (IEC) 364, part 1 through part 7.

- Review the safety warnings listed in the regulatory compliance and safety documentation before installing, configuring, or performing maintenance on the product.
- Disconnect power at the source before you install or remove a chassis.
- Do not attempt to lift an object you might find too heavy to lift safely.
- Keep the equipment area clear and as dust free as possible during and after installation.
- Keep tools and equipment components away from walk areas.
- Do not wear loose clothing, jewelry (including rings and chains), or other items that could get caught in the equipment.
- Use the product in accordance with its marked electrical ratings and product usage instructions.

Warning **Only trained and qualified personnel should be allowed to install, replace, or service this equipment.** Statement 1030.

Electrical Equipment Guidelines

- Before beginning any procedures requiring access to the chassis interior, locate the emergency power-off switch for the room in which you are working.
- Disconnect all power and external cables before moving a chassis.
- Do not work alone in potentially hazardous conditions.
- Never assume that power has been disconnected from a circuit; always check.
- Do not perform any action that creates a potential hazard to people or makes the equipment unsafe.
- Carefully examine your work area for possible hazards such as moist floors, ungrounded power extension cables, and missing safety grounds.

Preventing Electrostatic Discharge Damage

Electrostatic discharge (ESD) damage occurs when electronic cards or components are improperly handled, and can result in complete or intermittent failures. All line cards consist of a printed circuit card that is fixed in a metal carrier. Electromagnetic interference (EMI) shielding and connectors are integral components of the carrier. Although the metal carrier helps to protect the cards from ESD, use an antistatic strap each time you handle the modules. Handle the carriers by the edges only; never touch the cards or connector pins.

Caution Always tighten the captive installation screws on all system components when you are installing them. These screws prevent accidental removal of the module, provide proper grounding for the system, and help to ensure that the line card connectors are properly seated in the backplane. Captive screws should be torqued to 6-8 in-lbs to ensure proper grounding and mechanical support. Never use cordless or corded drills to tighten screws; power screwdrivers and hand tools are acceptable.

Static electricity can harm delicate components inside your system. To prevent static damage, discharge static electricity from your body before you touch any of your system components. As you continue to work on your system, periodically touch an unpainted metal surface on the computer chassis.

The following guidelines can prevent ESD damage:

- Always use an ESD-preventive wrist or ankle strap and ensure that it makes good skin contact. Before removing a card from the chassis, connect the equipment end of the strap to the ESD plug at the bottom of the chassis below the power entry modules. Ensure that the chassis or rack or both have a grounding cable installed.
- Handle line cards by the faceplate and carrier edges only; avoid touching the card components or any connector pins.
- When removing a card, place the removed module component-side-up on an antistatic surface or in a static-shielding bag. If the module will be returned to the factory, immediately place it in a static-shielding bag.
- Avoid contact between the modules and clothing. The wrist-strap protects the card from ESD voltages on the body only; ESD voltages on clothing can still cause damage.
- When transporting a sensitive component, first place it an antistatic container or packaging.
- Handle all sensitive components in a static-safe area. If possible, use antistatic floor pads and workbench pads.

⚠

Caution For safety, periodically check the resistance value of the antistatic strap. The measurement should be between 1 and 10 megohms.

Site Requirements

This section provides information about environmental, power, cabling, and mounting requirements. Ensure that you have met all of these requirements before you install your product.

Environmental Requirements for the Cisco CMC

The table below lists the operating and non-operating environmental site requirements. The ranges listed are those within which the equipment continues to operate; however, a measurement that is approaching the minimum or maximum of a range indicates a potential problem. You can maintain normal operation by anticipating and correcting environmental anomalies before they approach a maximum operating range.

Table 14: Specifications for Operating and Non-operating Environments for the Cisco CMC

Specification	Minimum	Maximum
Operating Temperature (nominal)	-40°F (-40°C)	131°F (55°C)
Operating Temperature (short-term)	-40°F (-40°C)	131°F (55°C)

Specification	Minimum	Maximum
Operating Humidity (nominal, with relative humidity)	10%	90%
Operating Humidity (short-term)	10%	90%
Storage Temperature	-40°F (-40°C)	185°F (85°C)
Storage (relative humidity)	5%	93%
Operating Altitude Over Allowable Temperature Range	-197 ft (-60 m)	6,000 ft (2000 m)
Maximum Operational Altitude (40°C ambient temperature)	-197 ft (-60 m)	13,800 ft (4000 m)
Non-Operating Altitude Over Allowable Temperature Range	-197 ft (-60 m)	30,000 ft (9144 m)

Environmental Requirements for the Cisco uBR-MC3GX60V-RPHY Line Card

The table below lists the operating and non-operating environmental site requirements. The ranges listed are those within which the equipment continues to operate; however, a measurement that is approaching the minimum or maximum of a range indicates a potential problem. You can maintain normal operation by anticipating and correcting environmental anomalies before they approach a maximum operating range.

Table 15: Specifications for Operating and Non-operating Environments for the Cisco uBR-MC3GX60V-RPHY

Specification	Minimum
Power Consumption	211W
Thermal Heat Dissipation	211W
Mean Time Between Failure (MTBF)	360,870 hours
Temperature Range	Operating: 41 to 104°F (5 to 40°C)
	Non-operating: -4 to 149°F (-20 to 65°C)
Relative Humidity	Operating: 10 to 90% non-condensing
	Non-operating: 10 to 90%
Operating Altitude	-196 to 13,123 ft. (-60 to 4000 m)

Power Guidelines

Important If this equipment is a Class I equipment, it must be grounded.

- If this equipment plugs into an outlet, the outlet must be near this equipment, and must be easily accessible.
- Connect this equipment only to the power sources that are identified on the equipment-rating label, which is normally located close to the power inlet connector.
- This equipment may have two power sources. Be sure to disconnect all power sources before working on this equipment.
- If this equipment does not have a main power switch, the power cord connector serves as the disconnect device.
- Always disconnect the plug or the connector to disconnect a cable. Do not pull the cable itself.

Laser Safety Guidelines for the Cisco CMC

- Do not stare into an unmated fiber or at any mirror-like surface that could reflect light emitted from an unterminated fiber.
- Do not view an activated fiber with optical instruments such as eye loupes, magnifiers, or microscopes.
- Use safety-approved optical fibers to maintain compliance with applicable laser safety requirements.

Warning **This equipment is a Class 1 laser product.** Statement 1008

Warning **Invisible laser radiation present. Avoid direct exposure to the laser light source.** Statement 1016

Warning **Invisible laser radiation may be emitted from disconnected fibers or connectors. Do not stare into beams or view directly with optical instruments.** Statement 1051

Mounting Considerations for the Cisco CMC

Warning **This equipment must be grounded. Never defeat the ground conductor or operate the equipment in the absence of a suitably installed ground conductor. Contact the appropriate electrical inspection authority or an electrician if you are uncertain that suitable grounding is available.** Statement 1024.

Warning **Avoid personal injury and damage to this equipment. An unstable mounting surface may cause this equipment to fall.**

The Cisco CMC supports two types of mounting. Consider the following guidelines for mounting the Cisco CMC:

Wall-Mounting Guidelines for the Cisco CMC

The Cisco CMC can be mounted on a concrete, brick, wood, or metal wall, or in a cabinet. Before you wall-mount the Cisco CMC, consider the following guidelines:

- Be aware of the size and weight of the equipment. A fully loaded Cisco CMC weighs over 26 lbs (11.8 kg). Ensure that the mounting location has a stable, flat surface, and can safely support the maximum weight of the equipment.
- Ensure that the installation site meets the ventilation requirements given in the data sheet to avoid the possibility of equipment overheating.
- Ensure that the installation site and operating environment is compatible with the International Protection (IP) rating specified in the data sheet.
- Ensure that proper handling and lifting techniques are employed when working in confined spaces with heavy equipment.

Strand-Mounting Guidelines for the Cisco CMC

Before you strand-mount the Cisco CMC, consider the following guidelines:

- Be aware of the size and weight of the equipment while strand-mounting. A fully loaded Cisco CMC weighs over 26 lbs (11.8 kg). Ensure that the strand can safely support the maximum weight of the equipment.
- Ensure that proper handling and lifting techniques are employed when working in confined spaces with heavy equipment.
- Ensure the ground area below the installation site is clear of personnel before hoisting the equipment. If possible, block the walkway below the hoisting area to prevent pedestrian traffic during hoisting.

Tools for Installation

Tools for the Cisco CMC Installation

You need the following tools to install and cable the Cisco CMC:

- Torque wrench capable of 5 to 12 ft-lbs (6.8 to 16.3 Nm)
- 4-inch to 6-inch extension for torque wrench
- 1/8-inch slot screwdriver for the F-connectors
- 1/2-inch socket for the strand clamp bolts

- #2 Phillips-head screwdriver for the grounding screw
- Heavy-duty wire cutters or snips for cutting the cable
- Deburring tool for filing the rough edges

Tools for the Cisco uBR-MC3GX60V-RPHY Line Card Installation

You need the following tools to install and cable the Cisco uBR-MC3GX60V-RPHY line card:

- T-10 Torx driver tool
- 1/4-inch flathead screwdriver
- Blank Cisco uBR10012 slot cover (if required)
- ESD-preventive wrist strap
- Antistatic surface, such as a mat or antistatic bag

Torque Specifications for the Cisco CMC

The table below provides the torque specifications for the fasteners used with the Cisco CMC.

Fastener	Torque Specification	Illustration
Strand clamp mounting bracket bolts	5 ft-lb to 8 ft-lb (6.8 Nm to 10.8 Nm)	
Housing closure bolts	5 ft-lb to 12 ft-lb (6.8 Nm to 16.3 Nm)	
5/8" port plugs	6.7 ft-lb (9 Nm)	
PG11-to-5/8" adapter	4.63 ft-lb (6.25 Nm)	
RJ-45 port PG16 plug	5.55 ft-lb (7.5 Nm)	

Fastener	Torque Specification	Illustration
Power port PG11 gland	Plastic: 3 ft-lb (4 Nm) Metal: 4.63 ft-lb (6.25 Nm)	
RJ-45 port PG16 gland	Plastic: 4.44 ft-lb (6 Nm) Metal: 5.5 ft-lb (7.5 Nm)	
PG11 F-connector	4.63 ft-lb (6.25 Nm)	
5/8" F-connector	6.7 ft-lb (9 Nm)	

Unpacking the Equipment

Before You Begin

Read the safety guidelines and review the electrical safety and ESD-preventive guidelines.

Caution Ensure that you are properly grounded with an ESD-preventive wrist strap.

Step 1 Open the shipping box.

Step 2 Remove the equipment from the box.

Step 3 Place the equipment on an antistatic surface.

Installing the Cisco CMC

This section provides information on how to install the Cisco CMC.

Mounting the Cisco CMC

Wall-Mounting the Cisco CMC

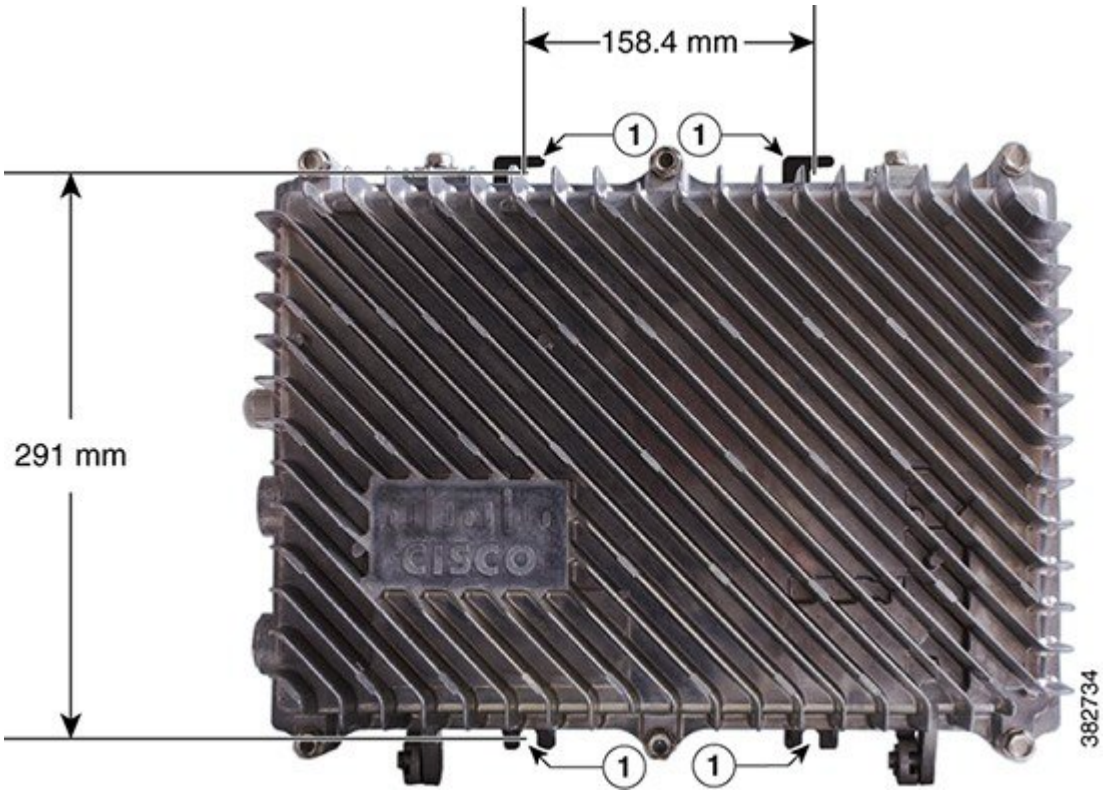
Before You Begin

- To prevent injury and damage to the equipment, review the safety guidelines in Wall-Mounting Guidelines for the Cisco CMC, on page 36 before installing the Cisco CMC on the wall.
- Close the Cisco CMC lid. See Closing the Cisco CMC, on page 74.

Step 1 Drill four holes at a distance of 291 mm x 158.4 mm on the wall as shown in the figure below.

Note Ensure proper ventilation around the equipment. Inadequate ventilation can cause the equipment to overheat.

Figure 15: Wall-Mounting the Cisco CMC



1	Mounting holes		—

Step 2 Align the mounting holes on the Cisco CMC with the holes on the wall.

Step 3 Insert a 5/16" or M8 expansion bolt through each mounting hole on the Cisco CMC and then into the hole on the wall.

Strand-Mounting the Cisco CMC

Strand-mounting is the aerial installation of the Cisco CMC.

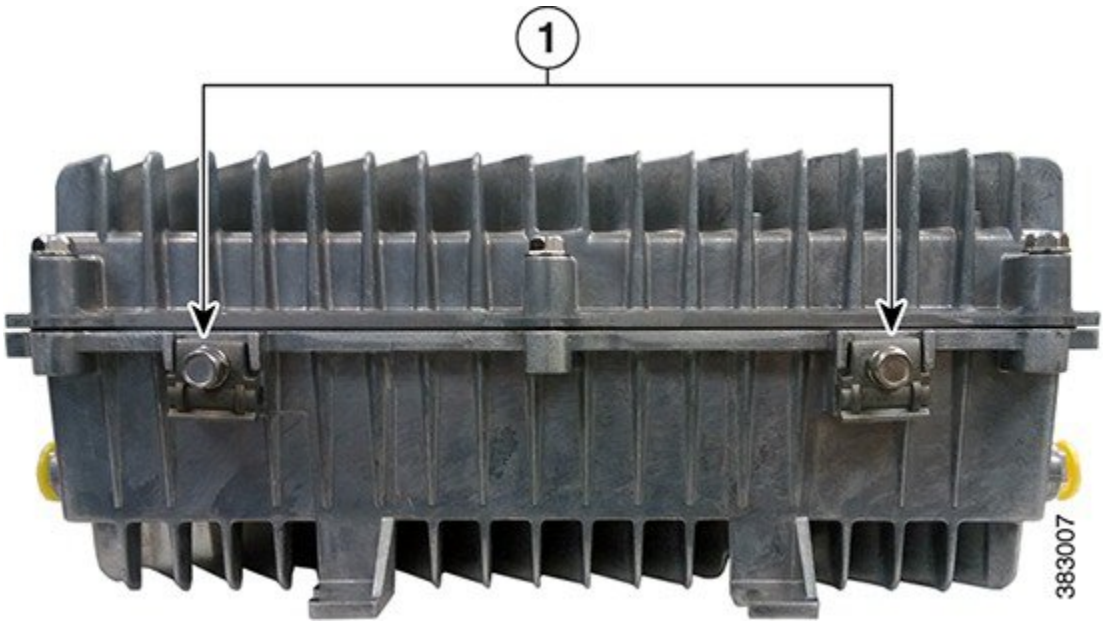
Before You Begin

- To prevent injury and damage to the equipment, review the safety guidelines in Strand-Mounting Guidelines for the Cisco CMC, on page 36 before installing the Cisco CMC on the strand.
- Close the Cisco CMC lid. See Closing the Cisco CMC, on page 74.
- Have the following tools ready before performing this task:
  - Torque wrench
  - 1/2-inch socket

Step 1 Check the strand size. The minimum strand diameter must be 5/16".

Step 2 Loosen the strand clamp bolts on the Cisco CMC to separate the clamps enough to insert the strand, but do not remove them.

Figure 16: Location of the Strand Clamp Bolts on the Cisco CMC



1	Strand clamp bolts		—

Step 3 Place the Cisco CMC into proper position on the strand.

Step 4 Insert the clamps over the strand and tighten the strand clamp bolts with your fingers. This allows additional side-to-side movement of the Cisco CMC as needed.

Figure 17: Strand-Mounting the Cisco CMC

1	Strand	2	Strand clamps

Step 5 Move and position the Cisco CMC on the strand as required for installing the cables.

Step 6 Tighten the strand clamp bolts from 5 ft-lb to 8 ft-lbs (6.8 to 10.8 Nm) using a torque wrench and 1/2-inch socket .

Note Due to the strand tension, a slight tilt of the face of the Cisco CMC is normal.

Opening the Cisco CMC

Installation or maintenance of the Cisco CMC requires opening the housing to access the internal components.

Before You Begin

Have the following tools ready before performing this task:

- Torque wrench

Step 1 Loosen the 1/2-inch closure bolts on the Cisco CMC lid using a torque wrench.

Figure 18: Location of the Closure Bolts on the Cisco CMC

1	Closure bolts		—

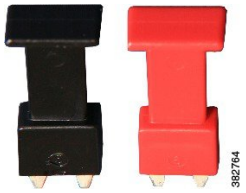
Step 2 Open the Cisco CMC lid.

Note The closure bolts remain attached to the Cisco CMC lid after opening the housing.

Removing and Installing the Accessories on the Cisco CMC

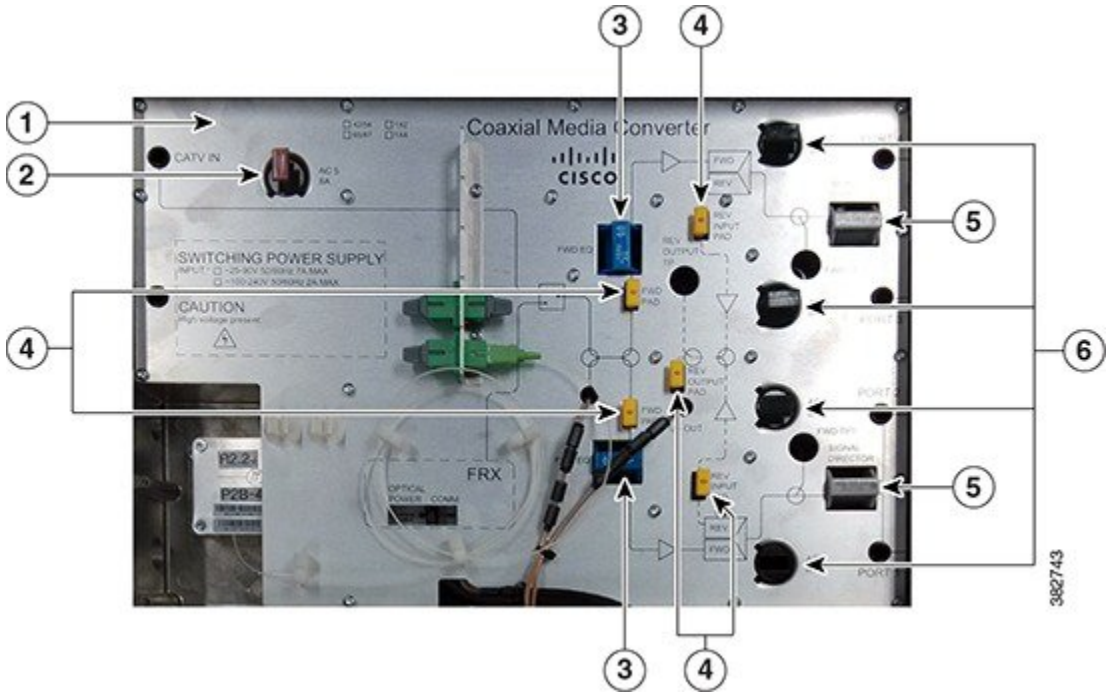
This section provides information on how to remove and install the following accessories located inside the Cisco CMC.

Accessory	Description	Illustration
Attenuator pads	An attenuator pad produces flat (even) loss across the forward and reverse frequency spectrums. It is used during the station balancing to adjust signal levels. The loss (in dB) produced by an attenuator pad is equal to the value printed on the top of the attenuator pad. An attenuator pad with *75* Ω printed on the top works as a 75 ohm terminator. **Important** Do not change the attenuator pads, unless specified by the system design.	
Equalizers	An equalizer produces linear tilt. It must be used on the Cisco CMC if the output tilt does not have the desired output tilt. The EQ value specified on the equalizer is the amount of tilt from lowest to highest frequency (52 to 1002 MHz).	

Accessory	Description	Illustration
Signal director—Splitter	A splitter splits the RF input signal to feed two RF output ports. It is used for configuring the 4-way RF configuration on the Cisco CMC.	
Signal director—Jumper	A jumper routes the RF input signal to the RF output port. It is used for configuring the 2-way RF configuration on the Cisco CMC.	
AC shunts	An AC shunt is used for configuring the power direction in the Cisco CMC with the 60VAC power supply unit. Use the red AC shunt for the RF input port and black AC shunts for the RF output ports. **Warning** Remove all the AC shunts if they are installed in the Cisco CMC before connecting the coaxial cables to the F-connectors. **Note** Do not use AC shunts in the Cisco CMC with the 220VAC power supply unit.	

These accessories can be removed and installed in the Cisco CMC through the cutouts in the base cover.

Figure 19: Location of the Accessories Inside the Cisco CMC



1	Base cover	4	Attenuator pads
2	AC shunt for the CATV IN port	5	Signal directors
3	Equalizers	6	AC shunts for the RF output ports

Before You Begin

Open the Cisco CMC lid. See Opening the Cisco CMC, on page 42.

Step 1 Remove the existing accessory from the slot if it is already installed.

Step 2 Align all the pins on the accessory with the pin holes in the appropriate accessory slot.

Step 3 Insert the accessory into the slot.

What to Do Next

Close the Cisco CMC lid. See Closing the Cisco CMC, on page 74.

Installing the Coaxial Cables on the Cisco CMC

Coaxial cables carry the forward-path RF signal input and outputs, and reverse-path RF signal inputs on the Cisco CMC. The coaxial cables can also supply 25 to 90VAC power input to the Cisco CMC. You can install up to:

- Five coaxial cables on the Cisco CMC with the 220VAC Power Supply Unit (PSU)
- Six coaxial cables on the Cisco CMC with the 60VAC PSU

Trimming the Center Conductor on the F-Connector

F-connectors are used for the RF connections on the Cisco CMC. The Cisco CMC supports PG11 and 5/8" F-connectors. The Cisco CMC has a strip on the external housing that shows the center conductor pin trim length for the F-connector. You must trim the center conductor pin if it extends beyond the strip line on the Cisco CMC before inserting it into the RF ports.

Before You Begin

Have the following tools ready before performing this task:

- Heavy-duty wire cutter
- Deburring tool

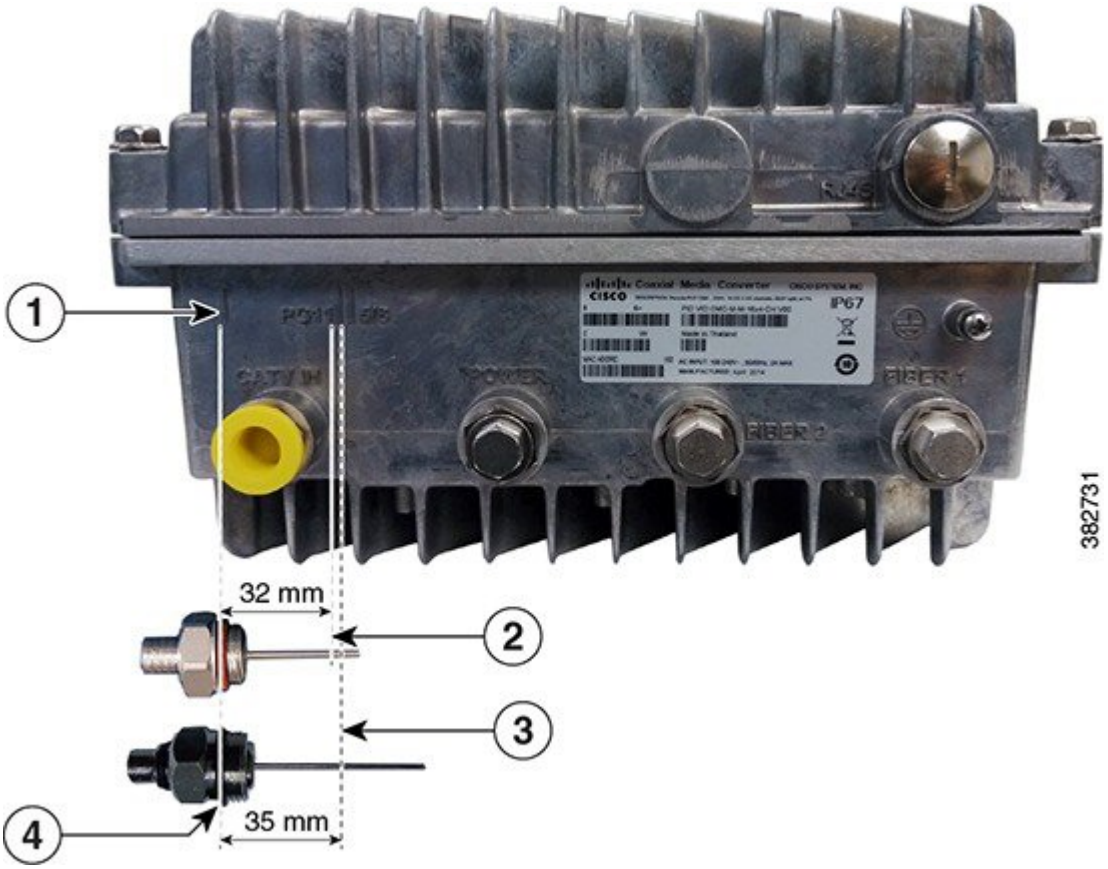
Step 1 Place the F-connector above the CATV IN port on the Cisco CMC so that the seal shoulder aligns with the strip.

Step 2 Perform one of the following:

- For the 5/8" F-connector, if the center conductor pin extends beyond the 5/8”-strip line, trim the pin to the 5/8”-strip line (35 mm) using a heavy-duty wire cutter.
- For the PG11 F-connector, if the center conductor pin extends beyond the PG11-strip line, trim the pin to the PG11-strip line (32 mm) using a heavy-duty wire cutter.

The figure below shows a visual guide of the center conductor trim length.

Figure 20: Trimming the Center Conductor Pin



1	Strip	3	5/8"-strip
2	PG11-strip	4	Seal shoulder

Step 3 Remove any burrs or sharp edges on the trimmed end of the center conductor pin using a deburring tool.

Connecting the Coaxial Cable to the Cisco CMC

Use the 75 ohm coaxial cables with the Cisco CMC.

Before You Begin

- Open the Cisco CMC lid. See Opening the Cisco CMC, on page 42.
- Remove the plastic cover or 5/8" port plug from the RF ports on the Cisco CMC using a torque wrench.

- Have the following tools ready before performing this task:
  - Heavy-duty wire cutter
  - Torque wrench
  - Slot screwdriver

Step 1 Trim the center conductor pin with a heavy-duty wire cutter if it extends beyond the strip line on the Cisco CMC. See Trimming the Center Conductor on the F-Connector, on page 46.

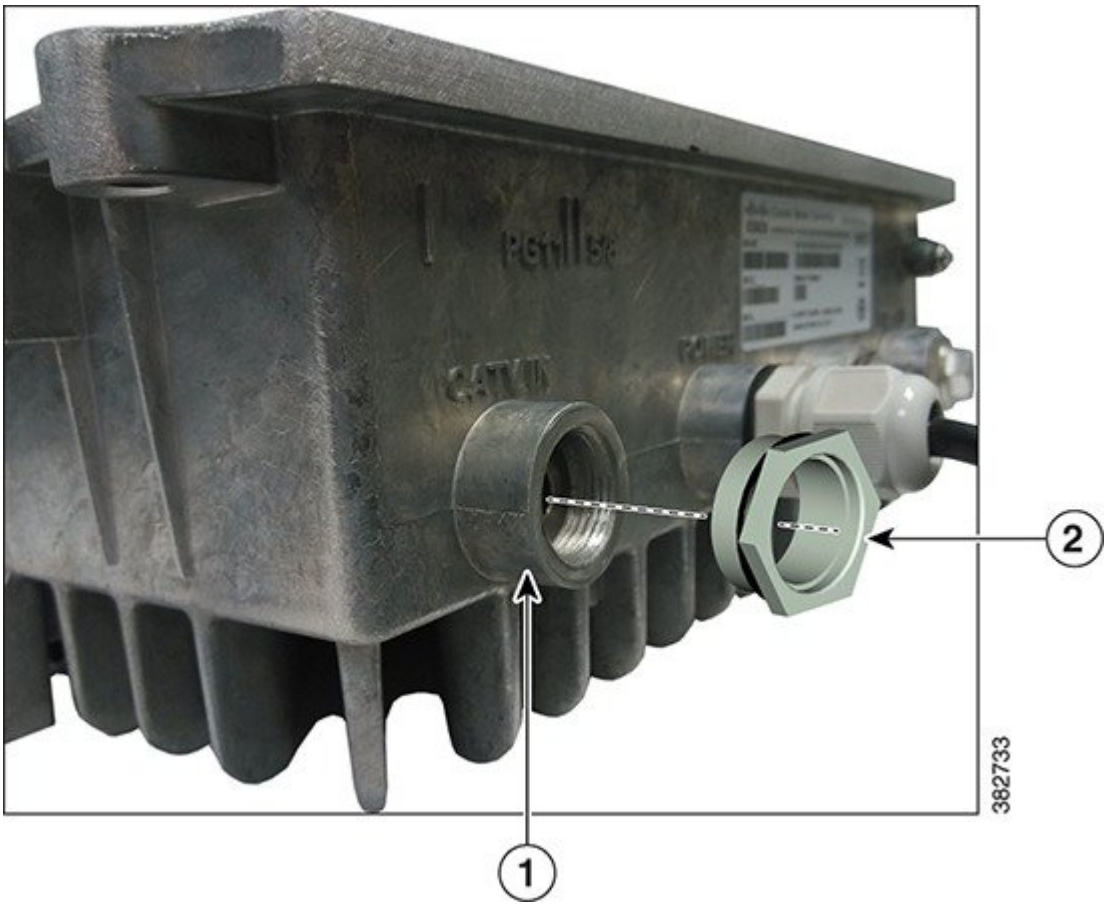
Step 2 Lightly loosen the seizure screw, do not remove it. The figure below shows the location of the seizure screw inside the Cisco CMC.

Figure 21: Location of Seizure Screw

1	Seizure screw		—

Step 3 To use the PG11 F-connector, remove the PG11-to-5/8" adapter plug from the RF port using a torque wrench. The figure below shows the PG11-to-5/8" adapter plug.

Figure 22: Removing the PG11-to-5/8" Adapter Plug



1	RF port	2	PG11-to-5/8" adapter plug

Step 4 Insert the F-connector into the RF port. Tighten the connector nut with a torque wrench.

Step 5 Tighten the seizure screw from 2 ft-lb to 5 ft-lb (2.7 Nm to 6.8 Nm) using a slot screwdriver.

Step 6 Remove the AC shunt for the RF port to prevent damage to the equipment that is connected to the other end of the coaxial cable.

Step 7 Connect the coaxial cable to the F-connector.

Step 8 Reinstall the AC shunt for the RF port.

Step 9 Repeat Step 1, on page 48 through Step 7, on page 49 for each RF port used.

Step 10 Check if RF signal is present at the unused RF ports and perform one of the following:

- If RF signal is present, insert a 75 ohm terminator into the RF port and tighten according to the manufacturer specifications.

- If RF signal is not present, insert a 5/8" port plug into the RF port and tighten from 5 ft-lb to 8 ft-lb (6.8 Nm to 10.8 Nm) using a torque wrench.

What to Do Next

Close the Cisco CMC lid. See Closing the Cisco CMC, on page 74.

Installing a Fiber Adapter on the Cisco CMC

The Cisco CMC supports two types of fiber adapters:

- SC/APC-LC/APC fiber adapter
- SC/APC-SC/APC fiber adapter

The Cisco CMC contains two pre-installed SC/APC-SC/APC fiber adapters. Perform this procedure to install additional fiber adapters.

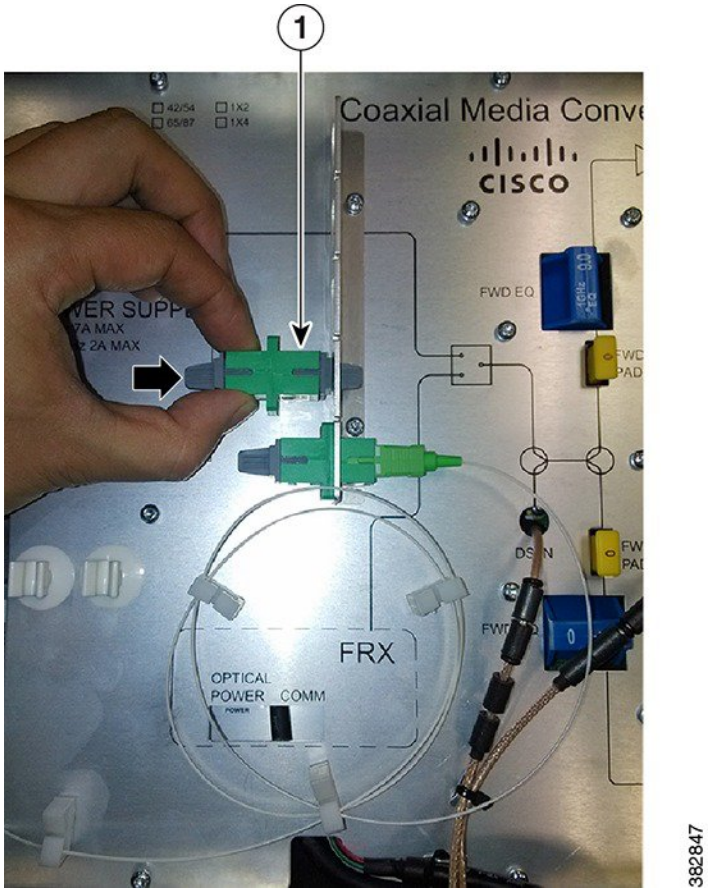
Before You Begin

Open the Cisco CMC lid. See Opening the Cisco CMC, on page 42.

Step 1 Align the fiber adapter with the slot.

Step 2 Insert the fiber adapter through the slot as shown in the figure below until you feel the fiber adapter lock into the slot.

Figure 23: Installing the Fiber Adapter on the Cisco CMC



1	SC/APC-SC/APC fiber adapter		—

Step 3 Remove the dust plug from the fiber adapter and connect the optical fibers. See Connecting the Optical Fibers to the SFP Module, on page 53 and Connecting the Optical Fibers to the FRx, on page 58.

What to Do Next

Close the Cisco CMC lid. See Closing the Cisco CMC, on page 74.

Installing an SFP Module on the Cisco CMC

The Cisco CMC supports Gigabit Ethernet SFP and Ethernet Passive Optical Network (EPON) SFP.

Before You Begin

Open the Cisco CMC lid. See Opening the Cisco CMC, on page 42.

Step 1 Remove the SFP module from its protective packaging.

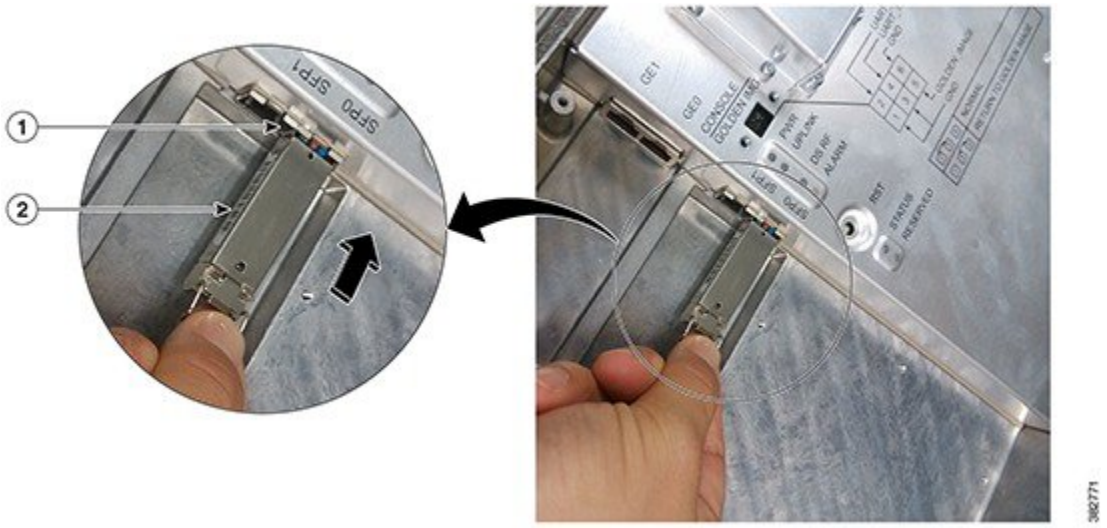
Step 2 Locate the transmit (Tx) and receive (Rx) markings on the top side of the SFP module.

Note On some SFP modules, the Tx and Rx markings may be replaced by arrowheads pointing from the SFP connector (transmit direction or Tx) and towards the connector (receive direction or Rx).

Step 3 Align the SFP module with the socket opening.

Step 4 Insert the SFP module into the socket until you feel the SFP module connector lock into the socket connector and then close the SFP latch.

Figure 24: Installing the SFP module on the Cisco CMC



1	SFP port	2	SFP module

Step 5 Remove the dust plug from the SFP module and save it for future use.

Note For optical SFP module, before you remove the dust plugs and make any optical connections, observe these guidelines:

- Do not remove the protective dust plugs on the SFP module until you are ready to make a connection.
- Inspect and clean the connector end-faces just before you make any connections.
- Grasp the connector housing to plug or unplug a optical.

Step 6 Perform one of the following:

- For the optical SFP module, connect the optical fibers to the SFP module. See Connecting the Optical Fibers to the SFP Module, on page 53.
- For the Gigabit Ethernet SFP module, connect the RJ-45 cable to the Gigabit Ethernet SFP module. See Connecting the RJ-45 Cables to the Cisco CMC, on page 55.

What to Do Next

Close the Cisco CMC lid. See Closing the Cisco CMC, on page 74.

Connecting the Optical Fibers to the SFP Module

Before You Begin

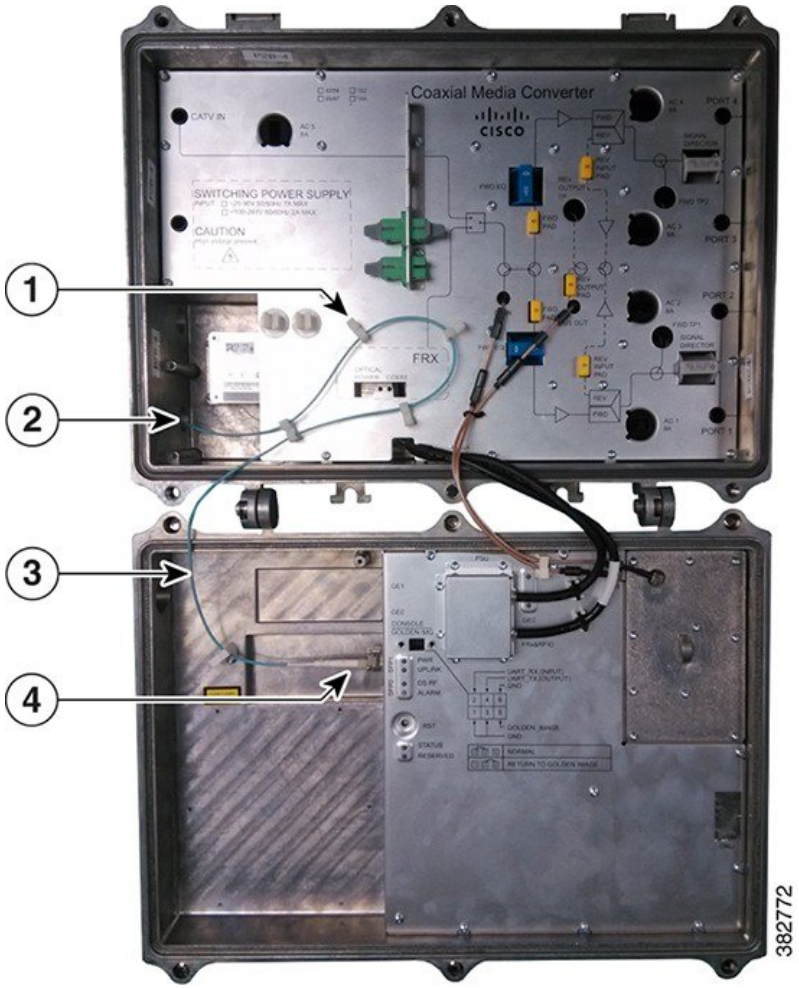
- Open the Cisco CMC lid. See Opening the Cisco CMC, on page 42.
- Install the SFP module on the Cisco CMC. See Installing an SFP Module on the Cisco CMC, on page 52.

- Remove the 5/8" port plug from the fiber port on the Cisco CMC using a torque wrench

Step 1 Insert the optical fiber into the fiber port.

Step 2 Secure the optical fibers using the cable clips and insert the optical fiber connector into the SFP port until it clicks and locks into place and as shown in the figure below:

Figure 25: Connecting Optical Fiber to the SFP Port



1	Cable clips	3	Optical fiber
2	Fiber port	4	Optical fiber connector

Step 3 Seal the fiber port with an appropriate gland to waterproof the port.

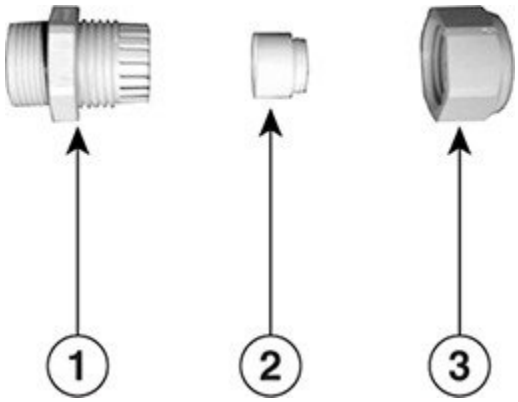
What to Do Next

Close the Cisco CMC lid. See Closing the Cisco CMC, on page 74.

Connecting the RJ-45 Cables to the Cisco CMC

Use the PG16 gland to connect the RJ-45 cable to the Cisco CMC.

Figure 26: PG16 Gland



1	Body	3	Sealing nut
2	Seal		—

The Cisco CMC supports two types of PG16 glands for the RJ-45 port:

- PG16 gland with one hole for single Ethernet connection
- PG16 gland with two holes for dual Ethernet connection

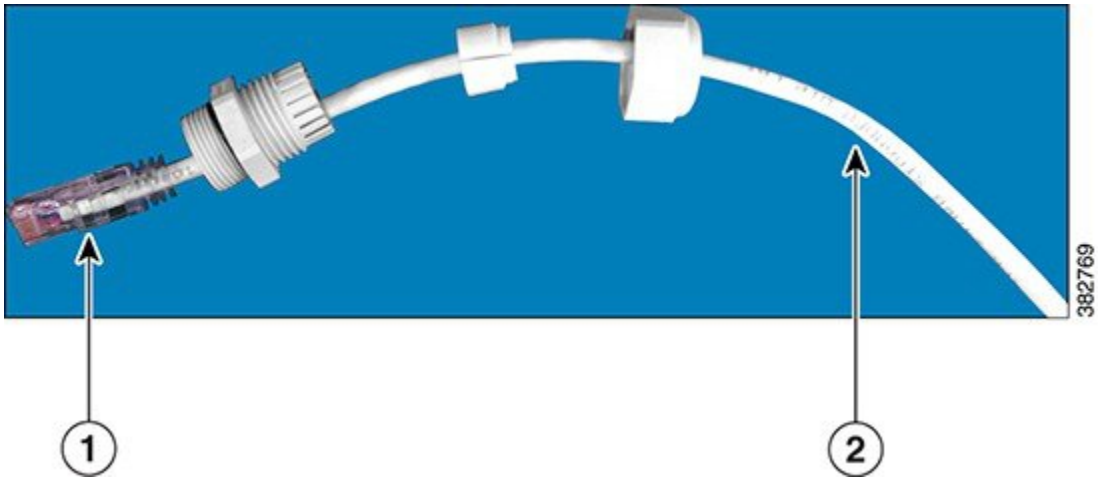
Before You Begin

- Open the Cisco CMC lid. See Opening the Cisco CMC, on page 42.
- Have the following tools ready before performing this task:
  - Torque wrench

Step 1 Remove the PG16 port plug or the PG16 gland from the RJ-45 port on the Cisco CMC if it is already installed.

Step 2 Insert the RJ-45 cable through the PG16 gland as shown in the figure below.

Figure 27: Inserting the RJ-45 Cable through the PG16 Port Plug

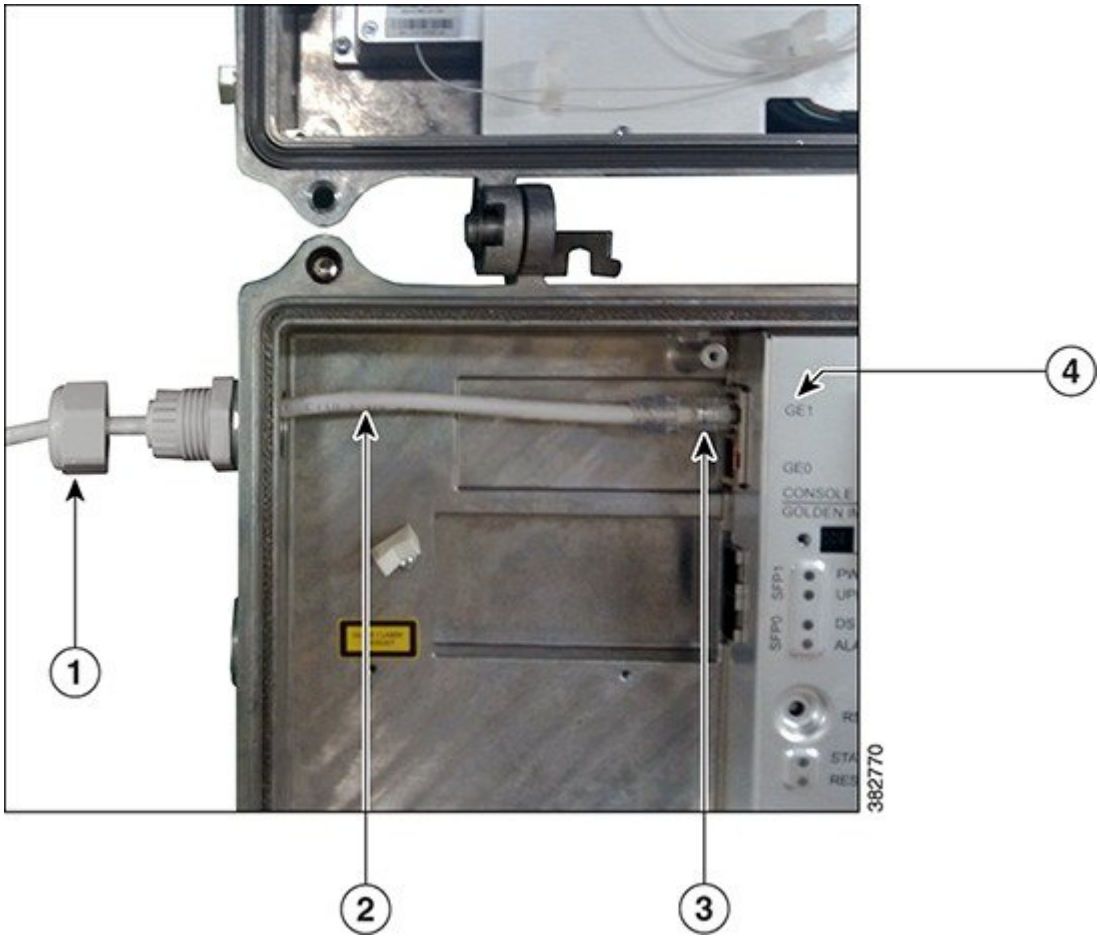


1	RJ-45 connector	2	RJ-45 cable

Step 3 Insert the RJ-45 connector through the RJ-45 port on the Cisco CMC.

Step 4 Insert the RJ-45 connector into the Gigabit Ethernet port until it clicks and locks into place.

Figure 28: Connecting the RJ-45 Connector to the Cisco CMC



1	PG16 gland	3	RJ-45 connector
2	RJ-45 cable	4	RJ-45 Gigabit Ethernet port

Step 5 Tighten the PG16 gland into the RJ-45 port using a torque wrench (4.44 ft-lb) and then tighten the dome cap using a torque wrench (2.44 ft-lb).

What to Do Next

Close the Cisco CMC lid. See Closing the Cisco CMC, on page 74.

Connecting the Optical Fibers to the FRx

Before You Begin

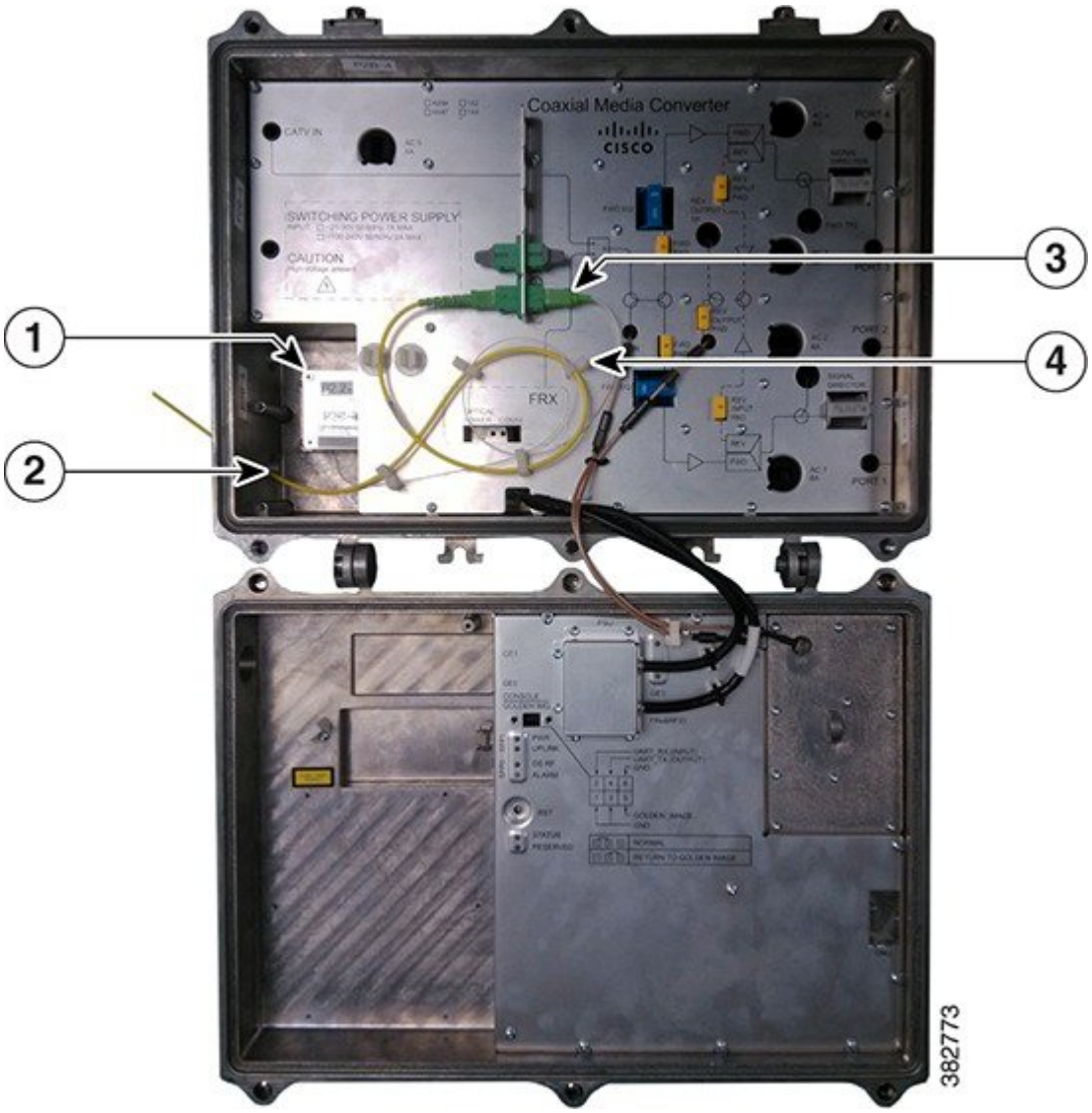
- Open the Cisco CMC lid. See Opening the Cisco CMC, on page 42.
- Ensure that the Forward Optical Receiver Module (FRx) module is installed on the Cisco CMC. To install the FRx on the Cisco CMC, contact the Cisco Technical Assistance Center (TAC) for further assistance.

- Remove the 5/8" port plug from the fiber port on the Cisco CMC using a torque wrench.

Step 1 Insert the optical fiber into the fiber port.

Step 2 Secure the optical fiber using the cable clips and insert the optical fiber connector to the fiber adapter as shown in the figure below:

Figure 29: Connecting Optical Fiber to the Fiber Adapter



1	FRx	3	Fiber adapter
2	Optical fiber	4	Cable clip

Step 3 Seal the fiber port with an appropriate gland to waterproof the port.

What to Do Next

Close the Cisco CMC lid. See Closing the Cisco CMC, on page 74.

Connecting I/O to the Cisco CMC

The Cisco CMC supports two types of I/O configurations:

- Forward-path I/O configurations
- Reverse-path I/O configurations

Forward-Path I/O Configurations

Forward-path refers to the signals received at the Cisco CMC from the headend. These signals are amplified in the Cisco CMC and routed to the subscribers through the cable modems. The Cisco CMC supports the following forward-path RF configurations:

- 4-way forward output RF configuration (default RF configuration)
- 2-way forward output RF configuration

Reverse-Path I/O Configurations

Reverse-path refers to the signals received at the Cisco CMC from the cable modem. These signals are amplified in Cisco CMC and returned to the headend optically through the fiber portion of the network. The reverse-path RF configuration is not used in all networks. The Cisco CMC supports the following reverse-path RF configurations:

- 4-way reverse input RF configuration (default RF configuration)
- 2-way reverse input RF configuration

The following sections provide information on how to enable the different RF configurations on the Cisco CMC:

Enabling the 4-Way Forward Output RF Configuration on the Cisco CMC

Before You Begin

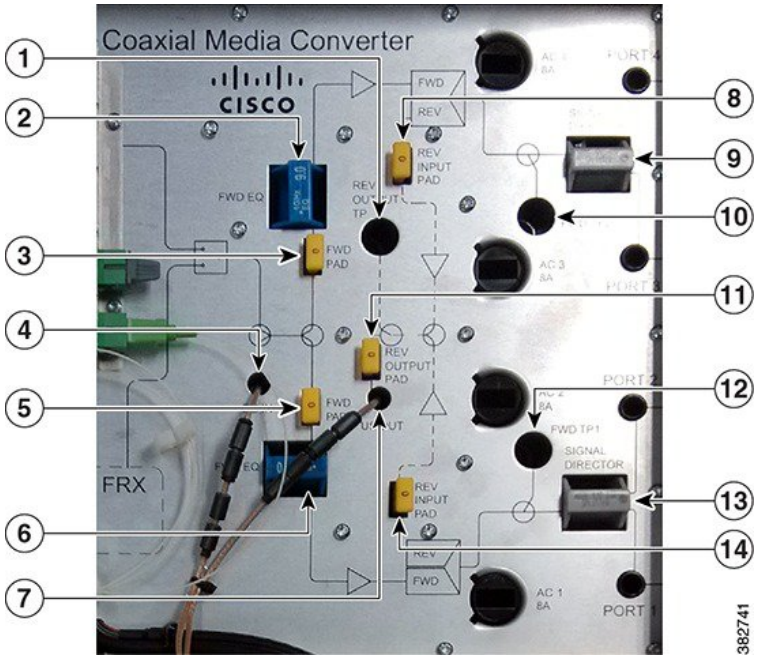
Open the Cisco CMC lid. See Opening the Cisco CMC, on page 42.

Step 1 Remove all the AC shunts installed on the Cisco CMC. Removing the AC shunts prevents damage to the equipment that is connected on the other end of the coaxial cable. Power surge to the components and F-connectors is reduced when the AC shunts are removed.

Caution The RF connectors and housing seizure assemblies can get damaged if the AC shunts are not removed from the Cisco CMC before installing or removing the components from the housing.

Step 2 Insert the signal director—splitter to provide the RF output to the four RF output ports.

Figure 30: 4-Way Forward Output RF Configuration



1	Reverse output test point	8	Reverse input pad 2
2	Forward equalizer 2	9	Splitter 2
3	Forward pad 2	10	Forward test point 2
4	Downstream input port	11	Reverse output pad
5	Forward pad 1	12	Forward test point 1
6	Forward equalizer 1	13	Splitter 1
7	Upstream input port	14	Reverse input pad 1

Step 3 Perform one of the following:

- If FRx is installed on the Cisco CMC, connect the optical input signal to the FRx. See Connecting the Optical Fibers to the FRx, on page 58.

- If FRx is not installed on the Cisco CMC, insert the F-connector into the CATV IN port. Connect the coaxial cable from the node or amplifier in the HFC network to the F-connector. See Installing the Coaxial Cables on the Cisco CMC, on page 46.

Step 4 Insert the F-connector into each RF output port (Port 1 through Port 4). Connect the coaxial cable from each F-connector to the cable modem. See Installing the Coaxial Cables on the Cisco CMC, on page 46.

Step 5 Reinstall the AC shunts on the Cisco CMC.

What to Do Next

Close the Cisco CMC lid. See Closing the Cisco CMC, on page 74.

Enabling the 2-Way Forward Output RF Configuration on the Cisco CMC

Before You Begin

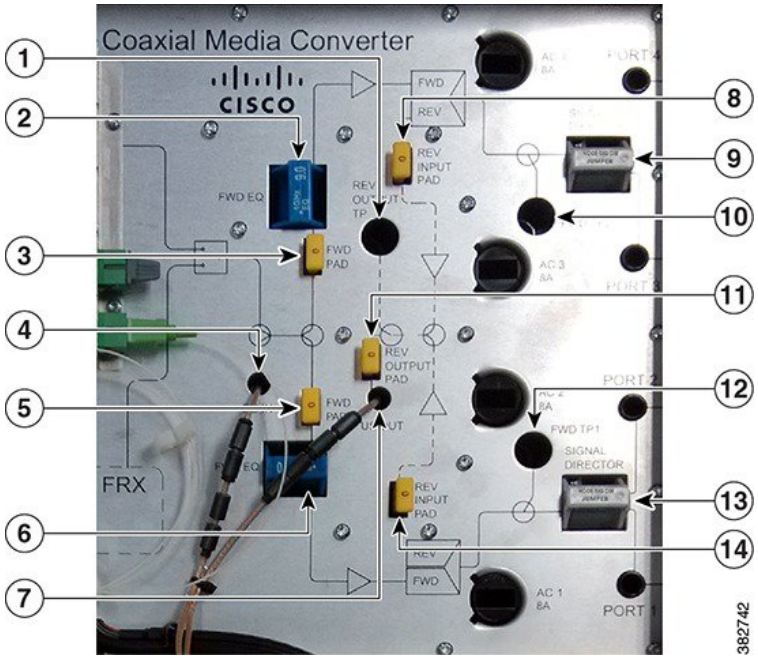
Open the Cisco CMC lid. See Opening the Cisco CMC, on page 42.

Step 1 Remove all the AC shunts installed on the Cisco CMC. Removing the AC shunts prevents damage to the equipment that is connected on the other end of the coaxial cable. Power surge to the components and F-connectors is reduced when the AC shunts are removed.

Caution The RF connectors and housing seizure assemblies can get damaged if the AC shunts are not removed from the Cisco CMC before installing or removing the components from the housing.

Step 2 Insert the signal director—jumper to provide the RF output to two RF output ports.

Figure 31: 2-Way Forward Output RF Configuration



1	Reverse output test point	8	Reverse input pad 2
2	Forward equalizer 2	9	Jumper 2
3	Forward pad 2	10	Forward test point 2
4	Downstream input port	11	Reverse output pad
5	Forward pad 1	12	Forward test point 1
6	Forward equalizer 1	13	Jumper 1
7	Upstream input port	14	Reverse input pad 1

Step 3 Perform one of the following:

- If FRx is installed on the Cisco CMC, connect the optical input signal to the FRx. See Connecting the Optical Fibers to the FRx, on page 58.
- If FRx is not installed on the Cisco CMC, insert the F-connector into the CATV IN port. Connect the coaxial cable from the node or amplifier in the HFC network to the F-connector. See Installing the Coaxial Cables on the Cisco CMC, on page 46.

Step 4 Insert the F-connector into two RF output ports. Connect the coaxial cable from each F-connector to the cable modem. See Installing the Coaxial Cables on the Cisco CMC, on page 46.

Note We recommend that you provide the RF output through the Port 1 and Port 4 for the 2-way forward output RF configuration.

Step 5 Reinstall the AC shunts on the Cisco CMC.

What to Do Next

Close the Cisco CMC lid. See Closing the Cisco CMC, on page 74.

Enabling the 4-Way Reverse Input RF Configuration on the Cisco CMC

Before You Begin

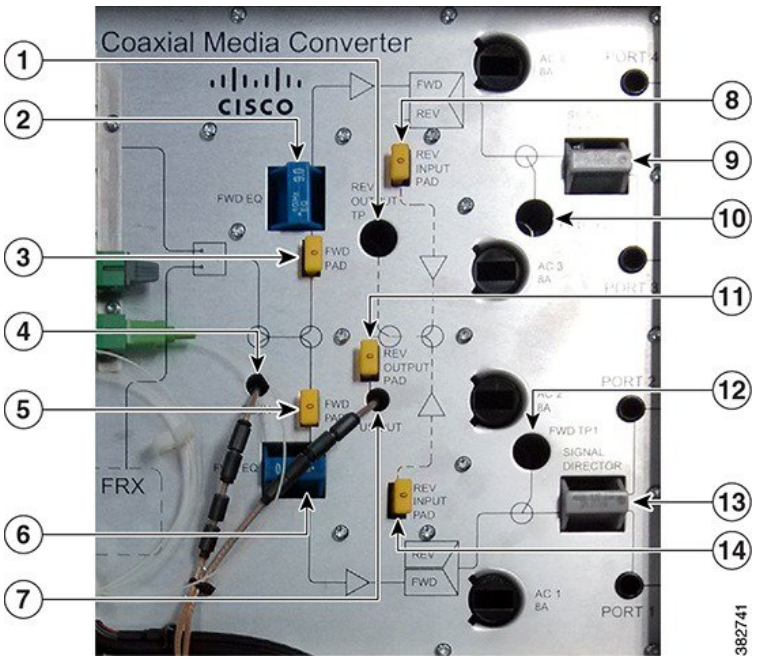
Open the Cisco CMC lid. See Opening the Cisco CMC, on page 42.

Step 1 Remove all the AC shunts installed on the Cisco CMC. Removing the AC shunts prevents damage to the equipment that is connected on the other end of the coaxial cable. Power surge to the components and F-connectors is reduced when the AC shunts are removed.

Caution The RF connectors and housing seizure assemblies can get damaged if the AC shunts are not removed from the Cisco CMC before installing or removing the components from the housing.

Step 2 Insert the signal director—splitter to provide the RF input from the four RF output ports.

Figure 32: 4-Way Reverse Input RF Configuration



1	Reverse output test point	8	Reverse input pad 2

2	Forward equalizer 2	9	Splitter 2
3	Forward pad 2	10	Forward test point 2
4	Downstream input port	11	Reverse output pad
5	Forward pad 1	12	Forward test point 1
6	Forward equalizer 1	13	Splitter 1
7	Upstream input port	14	Reverse input pad 1

Step 3 Insert the F-connector into each RF output port (Port 1 through Port 4). Connect the coaxial cables from the cable modems to each F-connectors. See Installing the Coaxial Cables on the Cisco CMC, on page 46.

Step 4 Reinstall the AC shunts on the Cisco CMC.

Step 5 Perform one of the following:

- If the optical SFP module is installed on the Cisco CMC, connect the optical fiber from the SFP module to the digital fiber network. See Connecting the Optical Fibers to the SFP Module, on page 53.
- If the optical SFP module is not installed on the Cisco CMC, connect the RJ-45 cable from the Gigabit Ethernet port to the PON module in the digital fiber network. See Connecting the RJ-45 Cables to the Cisco CMC, on page 55.

What to Do Next

Close the Cisco CMC lid. See Closing the Cisco CMC, on page 74.

Enabling the 2-Way Reverse Input RF Configuration on the Cisco CMC

Before You Begin

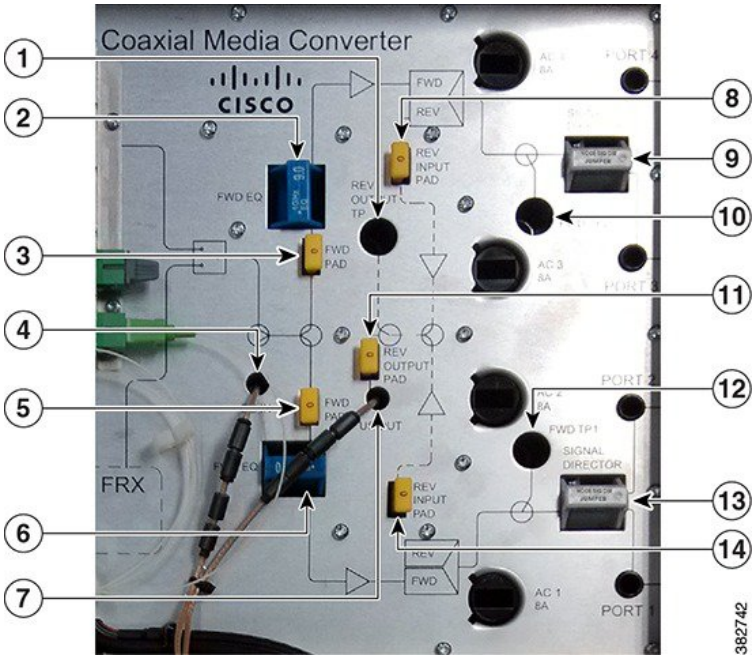
Open the Cisco CMC lid. See Opening the Cisco CMC, on page 42.

Step 1 Remove all the AC shunts installed on the Cisco CMC. Removing the AC shunts prevents damage to the equipment that is connected on the other end of the coaxial cable. Power surge to the components and F-connectors is reduced when the AC shunts are removed.

Caution The RF connectors and housing seizure assemblies can get damaged if the AC shunts are not removed from the Cisco CMC before installing or removing the components from the housing.

Step 2 Insert the signal director—jumper to provide the RF input from the two RF output ports.

Figure 33: 2-Way Reverse Input RF Configuration



1	Reverse output test point	8	Reverse input pad 2
2	Forward equalizer 2	9	Jumper 2
3	Forward pad 2	10	Forward test point 2
4	Downstream input port	11	Reverse output pad
5	Forward pad 1	12	Forward test point 1
6	Forward equalizer 1	13	Jumper 1
7	Upstream input port	14	Reverse input pad 1

Step 3 Insert the F-connector into two RF output ports. Connect the coaxial cable from the cable modems to each F-connector. See Installing the Coaxial Cables on the Cisco CMC, on page 46.

Note We recommend that you provide the RF input through the Port 1 and Port 4 for the 2-way reverse input RF configuration.

Step 4 Reinstall the AC shunts on the Cisco CMC.

Step 5 Perform one of the following:

- If the optical SFP module is installed on the Cisco CMC, connect the optical fiber from the SFP module to the digital fiber network. See Connecting the Optical Fibers to the SFP Module, on page 53.

- If the optical SFP module is not installed on the Cisco CMC, connect the RJ-45 cable from the Gigabit Ethernet port to the PON module in the digital fiber network. See Connecting the RJ-45 Cables to the Cisco CMC, on page 55.

What to Do Next

Close the Cisco CMC lid. See Closing the Cisco CMC, on page 74.

Powering Up the Cisco CMC

Warning **Before working on equipment that is connected to power lines, remove jewelry (including rings, necklaces, and watches). Metal objects will heat up when connected to power and ground and can cause serious burns or weld the metal object to the terminals.** Statement 43.

Warning **This equipment must be grounded. Never defeat the ground conductor or operate the equipment in the absence of a suitably installed ground conductor. Contact the appropriate electrical inspection authority or an electrician if you are uncertain that suitable grounding is available.** Statement 1024

Warning **This unit might have more than one power supply connection. All connections need to be removed to de-energize the unit.** Statement 1028

Before powering up the Cisco CMC, you must provide an adequate ground connection for the equipment.

The Cisco CMC available in the following variants of the power supply unit (PSU):

- Cisco CMC with the 220VAC PSU
- Cisco CMC with the 60VAC PSU

The following sections provide information on how to ground and power up the Cisco CMC:

Grounding the Cisco CMC

Grounding the equipment is mandatory for the Cisco CMC with the 60VAC PSU and optional for the Cisco CMC with the 220VAC PSU.

Warning **Use copper conductors only.** Statement 1025.

Warning **This equipment must be grounded. Never defeat the ground conductor or operate the equipment in the absence of a suitably installed ground conductor. Contact the appropriate electrical inspection authority or an electrician if you are uncertain that suitable grounding is available.** Statement 1024.

Warning **When installing or replacing the unit, the ground connection must always be made first and disconnected last.** Statement 1046.

Before You Begin

Have the following tools ready before performing this task:

- M4 (metric) panhead Philips screwdriver

Step 1 Power down the Cisco CMC.

Step 2 Connect one end of an 18-gauge or larger wire to the grounding screw on the Cisco CMC using the M4 panhead Phillips screwdriver.

Figure 34: Location of the Grounding Screw on the Cisco CMC

1	Grounding screw		—

Step 3 Connect the other end of the grounding wire to an appropriate ground source.

Powering Up the Cisco CMC with the 220VAC PSU

Before You Begin

Open the Cisco CMC lid. See Opening the Cisco CMC, on page 42.

Step 1 Ensure that the 220VAC power source is switched off.

Step 2 Connect the power cord on the Cisco CMC to the 220VAC power source.

Figure 35: Connecting 220VAC Power to the Cisco CMC

1	Power cord		—

Step 3 Switch on the power source to power up the Cisco CMC.

What to Do Next

Verify if the PWR LED illuminates (green) to ensure that the Cisco CMC is powered up. Close the Cisco CMC lid. See Closing the Cisco CMC, on page 74.

Powering Up the Cisco CMC with the 60VAC PSU

This section describes how to power up the Cisco CMC with the 60VAC PSU:

Connecting 60VAC Power to the Cisco CMC Through the Power Port

Before You Begin

- Ensure that the grounding wire is installed before powering up the Cisco CMC. See Grounding the Cisco CMC, on page 67.
- The F-connector used for connecting the 60VAC power must meet the following requirements:
  - Impedance of 75 ohms
  - IP rating of IP67
  - Pass through current not greater than 8A
- Open the Cisco CMC lid. See Opening the Cisco CMC, on page 42.

Restrictions

Warning You must supply 60VAC power to the Cisco CMC with 60VAC PSU using only one coaxial cable. Connecting more than one coaxial cable with the 60VAC power damages the Cisco CMC. If you are connecting a modem to the port that has a black AC shunt, ensure to use combiners in the network to isolate pass-through power to prevent accidental injury.

Restrictions

Warning F-connector is not capable of handling pass through current greater than 8A. For 15A pass through current applications, ensure that the chosen connector - rather than F-connector - is capable of safely passing the desired current

Step 1 Ensure that the power source is switched off.

Step 2 Install the F-connector in the power port. See Connecting the Coaxial Cable to the Cisco CMC, on page 47.

Figure 36: Connecting 60VAC Power to the Cisco CMC Through the Power Port

1	Power port		—

Step 3 Connect the coaxial cable to the F-connector.

Step 4 Connect the other end of the coaxial cable to a 60VAC power source.

Step 5 Switch on the power source to power up the Cisco CMC.

What to Do Next

Verify if the PWR LED illuminates (green) to ensure that the Cisco CMC is powered up. Close the Cisco CMC lid. See Closing the Cisco CMC, on page 74.

Connecting 60VAC Power to the Cisco CMC Through the RF Port

For the Cisco CMC with the 60VAC PSU, the power direction is configured by installing the AC shunts for the RF ports through which the AC power is passed. Use the red AC shunt for the RF input port and black AC shunts for the RF output ports.

Figure 37: Location of AC Shunts on the Cisco CMC

1	AC shunt for the CATV IN port	4	AC shunt for the RF output port (Port 2)
2	AC shunt for the RF output port (Port 4)	5	AC shunt for the RF output port (Port 1)
3	AC shunt for the RF output port (Port 3)		—

Before You Begin

- Ensure that the grounding wire is installed before powering up the Cisco CMC. See Grounding the Cisco CMC, on page 67.
- The F-connector used for connecting the 60VAC power must meet the following requirements:
  - Impedance of 75 ohms
  - IP rating of IP67
  - Pass through current not greater than 8A
- Open the Cisco CMC lid. See Opening the Cisco CMC, on page 42.

Restrictions

Warning You must supply 60VAC power to the Cisco CMC with 60VAC PSU using only one coaxial cable. Connecting more than one coaxial cable with the 60VAC power damages the Cisco CMC. If you are connecting a modem to the port that has a black AC shunt, ensure to use combiners in the network to isolate pass-through power to prevent accidental injury.

Restrictions

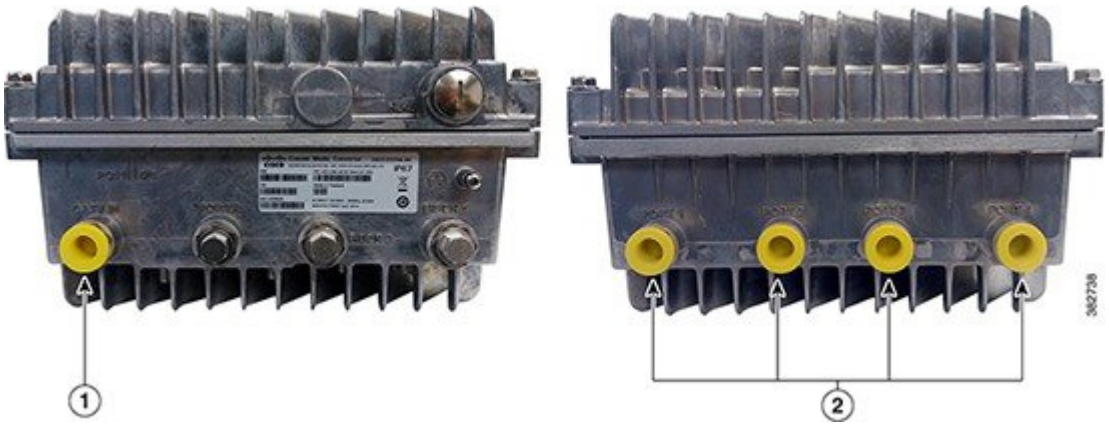
Warning F-connector is not capable of handling pass through current greater than 8A. For 15A pass through current applications, ensure that the chosen connector - rather than F-connector - is capable of safely passing the desired current

Step 1 Ensure that the power source is switched off.

Step 2 Install the F-connector in the CATV IN and four RF output ports (Port 1 through Port 4). See Connecting the Coaxial Cable to the Cisco CMC, on page 47.

Note Each RF port can support up to 8 A. Ensure that the total current from all the four RF output ports and Cisco CMC does not exceed 8 A.

Figure 38: Connecting 60VAC Power to the Cisco CMC Through the RF Port



1	CATV IN port	2	RF output ports

Step 3 Remove all the AC shunts installed on the Cisco CMC.

Step 4 Connect the coaxial cables to the F-connectors.

Step 5 Insert the black AC shunts for the RF ports that need to be supplied with 60VAC power **from** the Cisco CMC.

Step 6 Insert the red AC shunt for the RF port that supplies 60VAC power **to** the Cisco CMC. Connect the other end of the coaxial cable to a 60VAC power source.

Step 7 Switch on the power source to power up the Cisco CMC.

What to Do Next

Verify if the PWR LED illuminates (green) to ensure that the Cisco CMC is powered up. Close the Cisco CMC lid. See Closing the Cisco CMC, on page 74.

Closing the Cisco CMC

Proper housing closure is important to maintain the Cisco CMC in good working condition. Proper closure ensures a good seal against the environment and protects the internal modules.

Caution Avoid moisture damage and RF leakage. Follow the procedure exactly as shown below to ensure a proper seal.

The Cisco CMC has waterproof rubber and EMI gasket to seal the equipment.

Figure 39: Location of the Waterproof Rubber and EMI Gasket on the Cisco CMC

1	Waterproof rubber	2	EMI gasket

Before You Begin

- Ensure that the waterproof rubber and EMI gasket on the Cisco CMC are not worn out. Wipe off any excess dirt and debris. If the waterproof rubber or EMI gasket is worn out, contact the Cisco Technical Assistance Center (TAC) for further assistance.
- Have the following tools ready before performing this task:
  - Torque wrench
  - Hex driver or ratchet

Step 1 Close the lid.

Caution Ensure that all the cables are out of the way when closing the lid.

Step 2 Lightly secure the six 1/2-inch closure bolts using a hex driver or ratchet.

Step 3 Tighten the six housing closure bolts from 5 ft-lb to 12 ft-lb (6.8 Nm to 16.3 Nm) using a torque wrench in the correct sequence as shown in the figure below.

Figure 40: Torque Sequence

Step 4 Using the same sequence, tighten the closure bolts again with the same torque specification to ensure proper closure.

Installing the Cisco uBR-MC3GX60V-RPHY Line Card

This section provides information on how to install the Cisco uBR-MC3GX60V-RPHY line card.

Removing an SFP Module from the Existing Line Card

Before You Begin

Have the following tools and supplies ready before performing this task:

- Antistatic bag
- Dust plug, if required
- ESD-preventive wrist strap

Caution Removing and inserting an SFP module frequently can damage the SFP module. Do not remove and insert the SFP modules unless absolutely necessary.

Step 1 Disconnect all the network cables from the SFP module connector. For optical SFP module, immediately reinstall the dust plugs in the SFP optical bores.

Note We recommend that you do not remove the SFP module with the fiber-optic cables attached to it as it can damage the cable, cable connector, and optical interfaces in the SFP module.

Step 2 Unlock and remove the SFP module from the socket connector using one of the following:

- If the SFP module has a Mylar tab latch, pull the tab gently in a slightly downward direction until the SFP module disengages from the socket connector, and then pull the SFP module straight out of the socket. Do not twist or pull the Mylar tab as it can detach from the SFP module.
- If the SFP module has an Actuator button latch, gently press the Actuator button on the front of the SFP module until it clicks and the latch mechanism releases the SFP module from the socket connector. Grasp the Actuator button between your thumb and index finger, and carefully pull the SFP module straight from the socket.
- If the SFP module has a Bale-clasp latch, pull the bale to eject the SFP module from the socket. If the Bale-clasp latch is obstructed and you cannot use your index finger to open it, use a small, flat-blade screwdriver or a long narrow instrument to open the bale-clasp latch. Grasp the SFP module between your thumb and index finger, and carefully remove it from the socket.

Step 3 Place the removed SFP module in an antistatic bag.

Step 4 Insert a dust plug into each unused Gigabit Ethernet port.

What to Do Next

- To remove the existing line card, see Removing the Existing Line Card from the Card Slot, on page 78.

- To install an SFP module on the Cisco uBR-MC3GX60V-RPHY line card, see Installing an SFP Module on the Cisco uBR-MC3GX60V-RPHY Line Card, on page 82

Removing the Existing Line Card from the Card Slot

Before You Begin

- Remove the SFP module from the line card. See Removing an SFP Module from the Existing Line Card, on page 77.
- Delete the existing configurations on the PRE using the **no card** command.

Have the following tools and supplies ready before performing this task:

- T-10 Torx driver tool or 1/4-inch flathead screwdriver
- Antistatic bag
- Blank card slot cover, if required
- ESD-preventive wrist strap

Step 1 Attach an ESD-preventive wrist strap to your wrist.

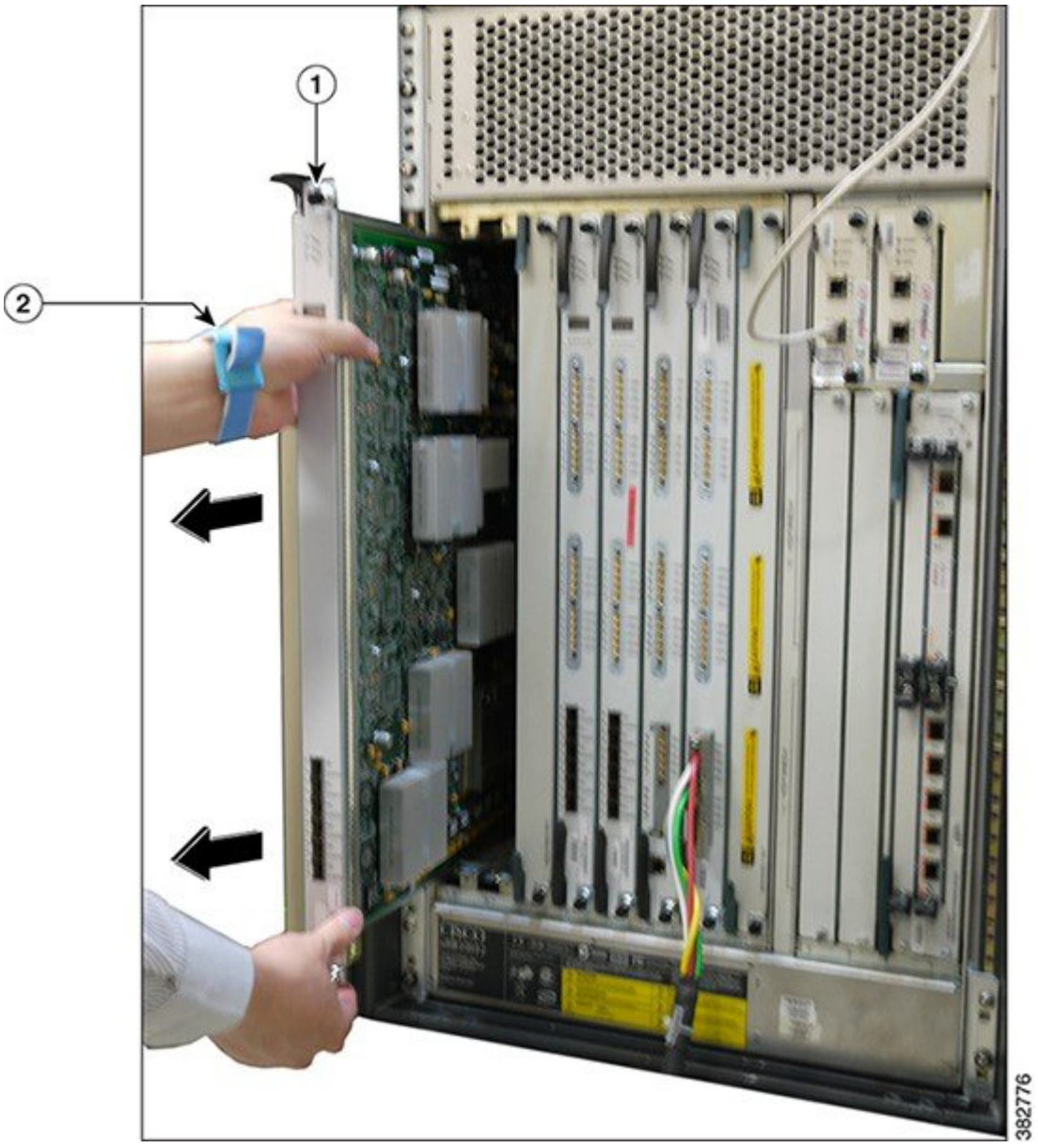
Step 2 Unscrew the top and bottom captive screws on the line card using a T-10 Torx driver tool or flathead screwdriver.

Step 3 Simultaneously pivot both ejector levers away from the line card to disengage the line card from the chassis.

Step 4 Slide the line card out of the slot in the chassis. Place it on an antistatic surface or in a static shielding bag with the component side up.

Caution Do not drop the line card. Dropping the line card can damage the carrier rails and card guides and prevent the reinstallation.

Figure 41: Removing the Existing Line Card from the Chassis



1	Captive screw	2	ESD-preventive strap

What to Do Next

Perform one of the following:

- Install a new or replacement Cisco uBR-MC3GX60V-RPHY line card, see Installing the Cisco uBR-MC3GX60V-RPHY Line Card in the Card Slot.
- Install a Blank card slot cover over the slot and tighten the captive screws, if you are not installing any line card in the slot. This ensures to keep dust out of the chassis and maintain proper airflow through the line card compartment.

Installing the Cisco uBR-MC3GX60V-RPHY Line Card in the Card Slot

Before You Begin

- Ensure that the existing line card or the Blank card slot cover is removed. See Removing the Existing Line Card from the Card Slot, on page 78.
- Ensure that you attach an ESD-preventive wrist strap to your wrist.
- For Class B emission compliance requirements, the two ferrites available in the CMTS accessory kit must be installed on the input DC power harness of the chassis. These ferrite beads are clamp-on type and should be placed as close to the input DC power connector (DC input terminal connector) as possible.

Have the following tools and supplies ready before performing this task:

- Cisco uBR-MC3GX60V-RPHY line card
- T-10 Torx driver tool or 1/4-inch flathead screwdriver
- ESD-preventive wrist strap

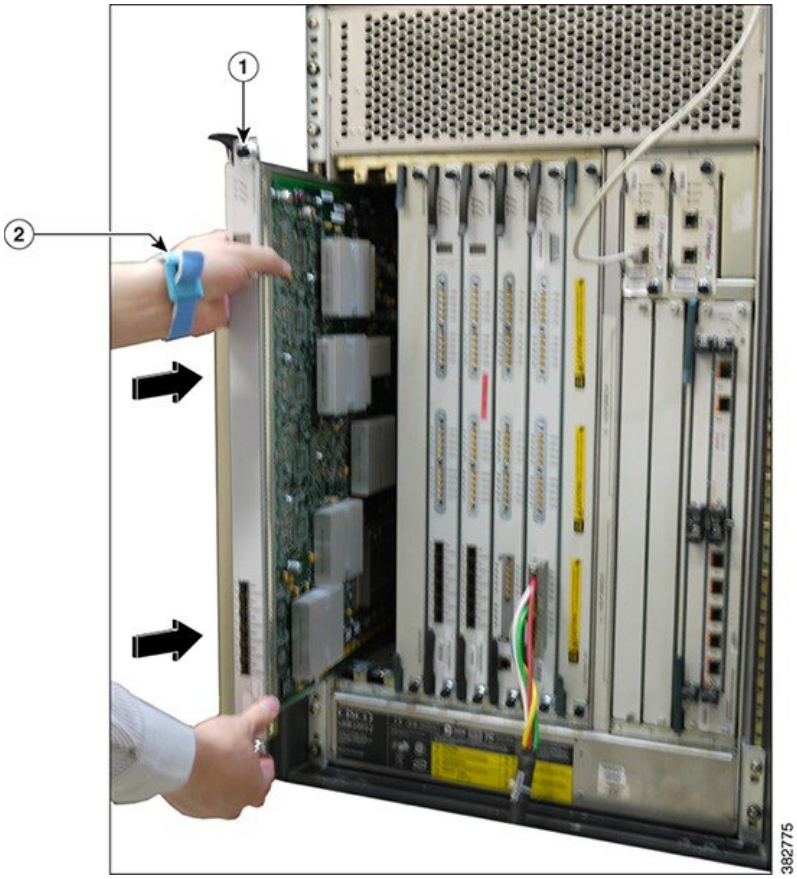
Step 1 Attach an ESD-preventive wrist strap to your wrist.

Step 2 Choose an available slot (5/0 to 8/0) for the line card and carefully align the upper and lower edges of the Cisco uBR-MC3GX60V-RPHY line card with the upper and lower guides in the chassis.

Caution The Cisco uBR-MC3GX60V-RPHY line card weighs 13 lbs. Use both hands when handling the Cisco uBR-MC3GX60V-RPHY line card. Do not drop the line card to avoid damaging the carrier rails. Bent or damaged rails can damage the line card guides and prevent line card installation. When installing line cards for the first time, or when all the captive screws of the line card are loose, insert cards first in slot 5/1 and work towards slot 8/0 to prevent uneven gasket pressure.

Step 3 Slide the Cisco uBR-MC3GX60V-RPHY line card into the slot until it is firmly seated in the chassis.

Figure 42: Installing the Cisco uBR-MC3GX60V-RPHY Line Card in the Cisco CMTS Chassis



1	Captive screw	2	ESD-preventive strap

Step 4 Close the ejector levers to secure the Cisco uBR-MC3GX60V-RPHY line card.

Step 5 Engage and tighten the captive screws with your fingers. Then, use either a T-10 Torx driver tool or a common flathead screwdriver to tighten the captive screws from 5 to 7 in-lbs.

What to Do Next

To install the SFP module, see Installing an SFP Module on the Cisco uBR-MC3GX60V-RPHY Line Card, on page 82.

Installing an SFP Module on the Cisco uBR-MC3GX60V-RPHY Line Card

Before You Begin

Ensure that the Cisco uBR-MC3GX60V-RPHY line card is installed in the Cisco CMTS chassis. See Installing the Cisco uBR-MC3GX60V-RPHY Line Card in the Card Slot, on page 80.

Have the following tools and supplies ready before performing this task:

- Appropriate SFP module
- ESD-preventive wrist strap

For more information on SFP modules that are supported on the Cisco uBR-MC3GX60V-RPHY line card, see SFP Modules for the Cisco uBR-MC3GX60V-RPHY Line Card, on page 17.

Step 1 Attach an ESD-preventive wrist strap to your wrist.

Step 2 Remove the SFP module from its protective packaging.

Step 3 Locate the transmit (Tx) and receive (Rx) markings on the top side of the SFP module.

Note On some SFP modules, the Tx and Rx markings might be replaced by arrowheads pointing from the SFP connector (transmit direction or Tx) and towards the connector (receive direction or Rx).

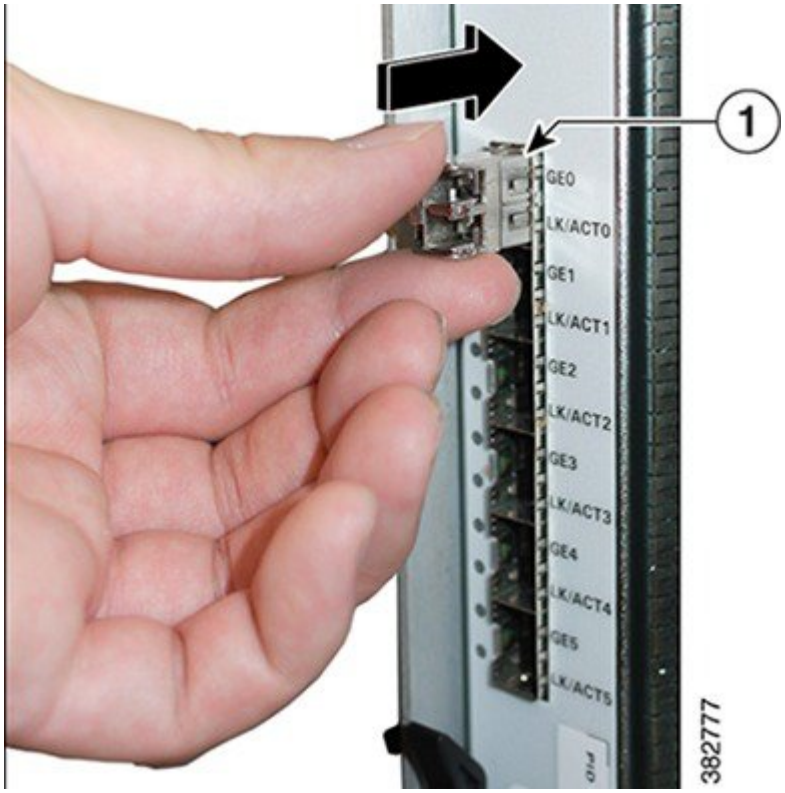
Step 4 Align the SFP module in front of the socket opening.

Step 5 Insert the SFP module into the socket until you feel the SFP module connector snap into the socket connector and then close the SFP latch.

Note For optical SFP modules, following are the guidelines to remove the dust plugs and make any optical connections:

- Do not remove the protective dust plugs on the unplugged fiber-optic cable connectors and the transceiver optical bores until you are ready to make a connection.
- inspect and clean the LC connector end-faces just before you make any connections.
- Grasp the LC connector housing to plug or unplug a fiber-optic cable.

Figure 43: Inserting an SFP Module into a Gigabit Ethernet Port



1	SFP Module		—

Step 6 Remove the dust plug from the SFP module and keep it safe for future use.

Note Leave the dust plug in the SFP module port if a cable is not being installed.

What to Do Next

To connect the network cable to an SFP module, see Connecting a Network Cable to an SFP Module, on page 84.

Connecting a Network Cable to an SFP Module

The following types of cables are used with Cisco uBR-MC3GX60V-RPHY line cards to connect to a switch or an OLT:

- RJ-45 10/100/1000BASE-T copper cable
- Single-mode or multimode fiber-optic cable

Before You Begin

- Ensure that the optical connectors are clean before making the connections. Contaminated connectors can damage the fiber and cause data errors.
- Ensure that the network cable has an appropriate connector to connect to an appropriate SFP module port.

Have the following tools and supplies ready before performing this task:

- Network cable with appropriate connector
- ESD-preventive wrist strap

For more information on the type of connectors supported, see SFP Modules for the Cisco uBR-MC3GX60V-RPHY Line Card, on page 17.

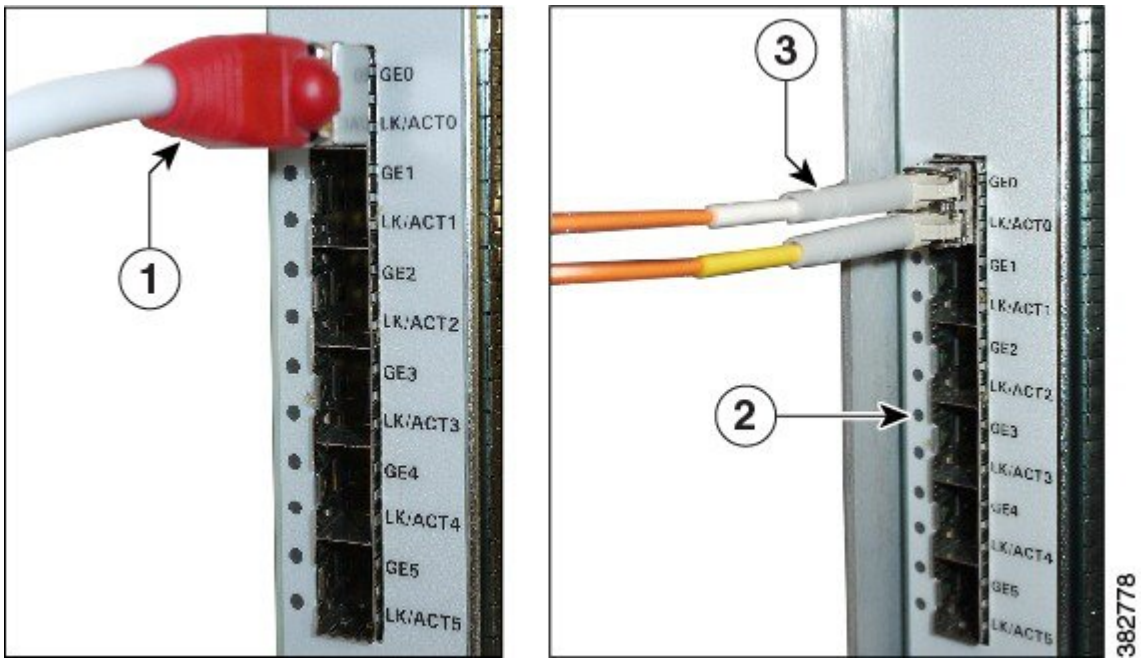
Step 1 Attach an ESD-preventive wrist strap to your wrist.

Step 2 Remove the dust plug from the SFP module, if already installed.

Step 3 Insert the appropriate network cable connector into the SFP module port until it clicks and locks into place to ensure proper seating.

Note Ensure to insert the network connector completely into the socket
.

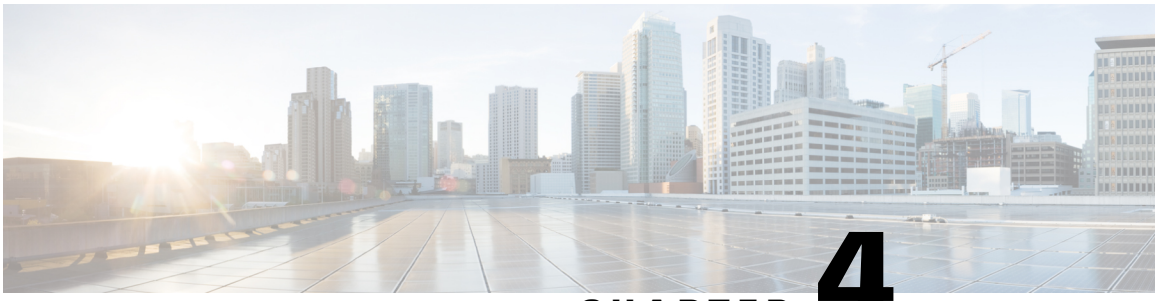
Figure 44: Gigabit Ethernet Port Cabling



1	RJ-45 connector	2	Gigabit Ethernet SFP module
3	LC fiber-optic connector		—

Step 4 Insert the other end of the network cable into the receptacle of a switch or an OLT.

Step 5 Repeat Step 3, on page 84 to Step 4, on page 85 until all cabling is complete.



CHAPTER 4

Configuring the Cisco Remote-PHY Solution

This section provides information on how to configure the Cisco Remote-PHY solution.

- Prerequisites for Configuring the Cisco Remote-PHY Solution, page 87
- Restrictions for Configuring the Cisco Remote-PHY Solution, page 87
- How to Configure the Cisco Remote-PHY Solution, page 87
- Configuration Example for the Cisco Remote-PHY Solution, page 106

Prerequisites for Configuring the Cisco Remote-PHY Solution

- The Cisco CMTS must have at least one DOCSIS Timing, Communication, and Control (DTCC) card configured in the DOCSIS Timing Interface (DTI) mode for the Cisco uBR-MC3GX60V-RPHY line card to work with the CMC device.

Restrictions for Configuring the Cisco Remote-PHY Solution

- Adding or removing the upstream or downstream channels in the channel group may trigger the Cisco CMC to reset.
- The Cisco uBR-MC3GX60V-RPHY line card supports only static DEPI configuration.
- The Cisco uBR-MC3GX60V-RPHY line card does not support Spectrum Management, Inter Line Card RF Spanning, and High Availability.

How to Configure the Cisco Remote-PHY Solution

This section provides information on how to configure the Cisco Remote-PHY solution. These procedures provide only the initial and basic configurations for the Cisco Remote-PHY solution.

Note The Cisco CMTS must be operational before beginning the following procedures to configure the Cisco Remote-PHY solution.

Configuring the Gigabit Ethernet Interface on the Cisco uBR-MC3GX60V-RPHY Line Card

The Cisco uBR-MC3GX60V-RPHY line card supports six (3 + 3) Gigabit Ethernet links and the links are arranged in three sets of redundant pairs. The links in the pair are modeled as an active-passive Gigabit Ethernet pair and traffic can be quickly switched from the working Gigabit Ethernet link to the standby Gigabit Ethernet link in the pair. The three active Gigabit Ethernet links are numbered as *slotnumber*/*subslotnumber*/0, 2, 4 and are mapped to the modular controllers *slotnumber*/*subslotnumber*/0, 1, 2 respectively.

The Cisco CMTS creates the following interfaces and controllers during the initialization of the Cisco uBR-MC3GX60V-RPHY line card:

- Three Gigabit Ethernet interfaces
- Three modular cable controllers
- 24x3 modular cable interfaces

Each Gigabit Ethernet pair is assigned as follows:

Gigabit Ethernet pair	Assignment
Gigabit Ethernet {0, 1} - Gigabit Ethernet interface 0	Modular cable controller {0}; 0 to 23 channels; 0 to 31 bonding groups
Gigabit Ethernet {2, 3} - Gigabit Ethernet interface 2	Modular cable controller {1}; 24 to 47 channels; 32 to 63 bonding groups
Gigabit Ethernet {4, 5} - Gigabit Ethernet interface 4	Modular cable controller {2}; 48 to 71 channels; 64 to 95 bonding groups

Before You Begin

Restriction Due to slow link loss detection, we do not recommend using the SFP-GE-T modules for primary interfaces.

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable**	Enables privileged EXEC mode.

	Command or Action	Purpose
	Example: `Router> enable`	• Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**interface gigabitEthernet** *slot /subslot /port* **Example:** `Router(config)# interface gigabitEthernet 8/1/0`	Enters Gigabit Ethernet interface configuration mode. • *slot*—Slot where the Cisco uBR-MC3GX60V-RPHY line card resides. The valid range is from 5 to 8. • *subslot*—Secondary slot number of the Cisco uBR-MC3GX60V-RPHY line card. The valid ranges are 0 or 1. • *port*—Port number. The valid range is from 3 to 6.
Step 4	**ip address** *ip-address IP-subnet-mask* **Example:** `Router(config-if)# ip address 192.71.0.1 255.255.255.0`	Sets the IP address of the Gigabit Ethernet interface. • *ip-address*—IP address of the Gigabit Ethernet interface. • *IP-subnet -mask*—Subnet mask for the network.
Step 5	**cable helper-address** *ip-address* **Example:** `Router(config-if)# cable helper-address 20.1.0.3`	Sets the destination IP address for UDP broadcast DHCP packets. • *ip-address*—IP address of a DHCP server to which the UDP broadcast packets are sent.
Step 6	**ip pim sparse-dense-mode** **Example:** `Router(config-if)# ip pim sparse-dense-mode`	Enables Protocol Independent Multicast (PIM) on the Gigabit Ethernet interface and treats the interface in either sparse mode or dense mode of operation, depending on which mode the multicast group operates in.
Step 7	**negotiation auto** **Example:** `Router(config-if)# negotiation auto`	Selects the auto-negotiation mode.
Step 8	**output-rate** *rate* **Example:** `Router(config-if))# output-rate 100`	Specifies the output link rate for DEPI packets on the Gigabit Ethernet interface. • *rate*—The valid range is from 1 to 1000000 kbps. **Note** The recommended value is 1000 kbps.

	Command or Action	Purpose
Step 9	**end** **Example:** `Router(config-if)# end`	Exits Gigabit Ethernet interface configuration mode. Returns to privileged EXEC mode.

What to Do Next

- To verify the Gigabit Ethernet interface configuration, run the **show interfaces gigabitEthernet** *slot* /*subslot* /*port* command.
- To verify the link status of the primary and secondary ports, run the **show controller** command.

Configuring the Modular Cable Controller on the Cisco uBR-MC3GX60V-RPHY Line Card

The downstream modular cable controller configuration defines the Layer 1 and Layer 2 parameters for the downstream RF channels, and the configuration parameters for the Gigabit Ethernet port. The modular cable controllers can be configured only using static DEPI.

Before You Begin

Restriction When you are configuring the parameters for the downstream RF channel in a channel group, the value of a parameter (except the frequency) must be the same for all RF channels in the channel group. If you change the value of any parameter in a downstream RF channels, the value of that parameter changes in all other channels.

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**controller modular-cable** *slot* /*subslot* /*controller*	Enters controller configuration mode to configure the Cisco uBR-MC3GX60V-RPHY line card modular cable controller.

	Command or Action	Purpose
	Example: `Router(config)# controller Modular-Cable 7/1/0`	• *slot*—Slot where the Cisco uBR-MC3GX60V-RPHY line card resides. The valid range is from 5 to 8. • *subslot*—Secondary slot number of the Cisco uBR-MC3GX60V-RPHY line card. The valid values are 0 or 1. • *controller*—Controller index for the modular cable. The valid range is from 0 to 2.
Step 4	**rf-channel** *rf-channel number* **cable downstream channel-id** *channel-id* **Example:** `Router(config-controller)# rf-channel 0 cable downstream channel-id 73`	**Note** We recommend that you retain the system-generated default channel IDs instead of configuring them. (Optional) Assigns a downstream channel ID to an RF channel. • *rf-channel number* —RF channel number on the physical port of the Cisco uBR-MC3GX60V-RPHY line card. The valid range is from 0 to 23. • *channel-id*—Unique channel ID. The valid range is from 1 to 255.
Step 5	**rf-channel** *rf-channel number* **frequency** [*freq*][**annex** {**A** | **B**} **modulation** {**64**|**256**} [**interleave-depth** {**8**|**12**|**16**|**32**|**64**|**128**}]] **Example:** `Router(config-controller)# rf-channel 0 frequency 451000000 annex A modulation 256 interleave-depth 12`	Configures the frequency of an RF channel. • *rf-channel number*—RF channel number on the physical port of the Cisco uBR-MC3GX60V-RPHY line card. The valid range is from 0 to 3. • *freq*—Center frequency of the RF channel. The valid range for each RF channel is different based on the Annex type. • **annex** {**A** | **B**}— Indicates the MPEG framing format for each RF channel. ◦ **A**—Indicates that the downstream is compatible with the European MPEG framing format specified in ITU-TJ.83 Annex A. ◦ **B**—Indicates that the downstream is compatible with the North American MPEG framing format specified in ITU-TJ.83 Annex B. • **modulation** {**64** | **256**}—Indicates the modulation rate (64 or 256 QAM) for each RF channel. • **interleave-depth**—Indicates the downstream interleave depth. For annex A, the value is 12. For annex B, the valid values are 8, 16, 32, 64, and 128. **Important** For the four downstream RF channel in a channel group, all the parameters except the frequency must have the same value. If the value of any parameter is changed in a downstream RF channels, it impacts all other channels.

	Command or Action	Purpose
Step 6	Perform one of the following: • To configure the DEPI in unicast mode, use the following command: **rf-channel** *rf-channel number* **ip-address** *ip-address* **mac-address** *mac-address* **depi-remote-id** *session-id* • To configure the DEPI in multicast mode, use the following command: **rf-channel** *rf-channel number* **group-address** *ip-address* **Example:** `Router(config-controller)# rf-channel 0 ip-address 192.3.2.1 mac-address 0090.f001.930c depi-remote-id 3001`	Configures the DEPI CMTS. **Note** For unicast, choose the **ip-address** option and for multicast choose the **group-address** option. • *rf-channel number*—RF channel number on the physical port of the Cisco uBR-MC3GX60V-RPHY line card. The valid range is from 0 to 3. • **ip-address** *ip-address*—IP address of the Cisco CMC. Use this option for the unicast. **Note** If the number of destination IP addresses, each corresponding to a DEPI tunnel, exceeds the limit of 24, the command with the 25th IP address is rejected. • *mac-address*—MAC address of the Cisco CMC. • *session-id*—DEPI remote session ID used for encapsulation of frames in D-MPT (DOCSIS MPEG Transport) mode. • **group-address** *ip-address*—DEPI multicast group address.
Step 7	**no rf-channel** *rf-channel number* **rf-shutdown** **Example:** `Router(config-controller)# no rf-channel 0 rf-shutdown`	Enables RF channel on the Cisco CMTS.
Step 8	**end** **Example:** `Router(config-controller)# end`	Exits controller configuration mode and returns to privileged EXEC mode.

What to Do Next

- To verify the modular cable controller configuration, run the **show controllers modular-cable** *slot* /*subslot* /*controller* command.

Troubleshooting Tips

Use the following troubleshooting tips if you did not get the expected results after performing the task.

When you run the **no rf-channel** *rf-channel number* **rf-shutdown** command, the following error message is displayed:

```
%ERROR: Cannot unshut channel 0, please upgrade linecard license and retry
```

This error message is displayed to indicate that there are insufficient licenses for the Cisco uBR-MC3GX60V-RPHY line card to unshut additional channels.

Upgrade the license or shut down the active channel. To upgrade the license, see Software License Activation on Cisco CMTS Routers.

Configuring the Modular Cable Interface on the Cisco uBR-MC3GX60V-RPHY Line Card

A modular cable interface forwards non-bonded traffic in the downstream direction. By default, this interface is allocated the bandwidth from the RF channel where it is configured.

The modular cable interface for the Cisco uBR-MC3GX60V-RPHY line card is restricted to slots 5 through 8.

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**interface modular-cable** *slot*/*subslot*/*port* :*rf-channel* **Example:** `Router(config)# interface modular-Cable 7/1/0:0`	Enters the configuration mode to configure the cable interface. • *slot*—Slot where the Cisco uBR-MC3GX60V-RPHY line card resides. The valid range is from 5 to 8. • *subslot*—Secondary slot number of the Cisco uBR-MC3GX60V-RPHY line card. The valid values are 0 or 1. • *port*—Port number. The valid range is from 0 to 2. • *rf-channel*—RF channel number. The valid range is from 0 to 23.
Step 4	**cable rf-bandwidth-percent** *percent-value* [**remaining ratio** *excess-value*] **Example:** `Router(config-if)# cable rf-bandwidth-percent 50`	Configures the bandwidth of the RF channel that is allocated to a wideband channel or bonding group. • *percent-value*—Static bandwidth allocation of a downstream RF channel in percent. The valid range is from 1 to 96. • **remaining ratio**—(Optional) Indicates the ratio of the remaining or excess bandwidth that can be allocated to the modular cable channel. **Note** If dynamic bandwidth sharing is disabled to use static bandwidth sharing, the remaining ratio option is not available. • *excess-value*—Value of the excess bandwidth that can be allocated to the modular cable channel. The valid range is from 1 to 100. The default value is 1.

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

What to Do Next

To verify the modular cable configuration, run the **show interfaces modular-cable** *slot* /*subslot* /*controller* :*rf-channel* command.

Configuring the Wideband Cable Interface on the Cisco uBR-MC3GX60V-RPHY Line Card

A wideband (WB) cable interface forwards bonded traffic in the downstream direction. A set of RF channels is configured under the wideband cable interface. The Cisco uBR-MC3GX60V-RPHY line card has 3 downstream controllers and 32 bonded channels per controller with a maximum of 24 RF channels in a bonding group. The 24 RF channels must be on the same controller.

Before You Begin

Restriction Wideband channels can be configured only for downstream RF channels that belongs to a single controller.

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**interface wideband-cable** *slot* /*subslot* /*controller* :*bonded-channel* **Example:** `Router(config)# interface Wideband-Cable7/1/0:0`	Enters the wideband cable interface configuration mode. • *slot*—Slot where the Cisco uBR-MC3GX60V-RPHY line card resides. The valid range is from 5 to 8. • *subslot*—Secondary slot number of the Cisco uBR-MC3GX60V-RPHY line card. The valid values are 0 or 1.

	Command or Action	Purpose
		• *controller*—Controller index for the modular cable. The valid range is from 0 to 2. • *bonded-channel*—Bonding Group Channel index for the modular cable. The valid range is from 0 to 31. **Note** An RF channel from a specific controller in a modular and multiple wideband group cannot exceed 96 percent.
Step 4	**cable bundle** *bundle-id* **Example:** `Router(config-if)# cable bundle 1`	Configures the wideband cable interface to belong to an interface bundle. • *bundle-id*—Bundle identifier. The valid range is from 1 to 255.
Step 5	**cable rf-channel** *rf-channel number***bandwidth-percent** *bw-percent* **Example:** `Router(config-if)# cable rf-channel 0 bandwidth-percent 25`	Configures the bandwidth of the RF channel that is allocated to a specified wideband channel or bonding group. • *rf-channel number*—RF channel number of the physical port on the field-programmable gate array (FPGA). • **bandwidth-percent** *bw-percent* —(Optional) Indicates the percentage of bandwidth from the RF channel that is used for the wideband interface. The valid range is from 0 to 100. The default bandwidth value is 100.
Step 6	**cable bonding-group-secondary** **Example:** `Router(config-if)# cable bonding-group-secondary`	Configures the bonding group for VDOC multicast.
Step 7	**end** **Example:** `Router(config-if)# end`	Exits interface configuration mode and returns to privileged EXEC mode.

What to Do Next

- To verify the wideband channel configuration, run the **show controllers modular-cable** [**association** | **config** | **mapping**] command.
- To view the entire configuration of the bandwidth allocation between WB channels and RF channels, run the **show interfaces wideband-cable** *slot* /*subslot*/*controller*:*bonded-channel* command.

Configuring the Cable Interface on the Cisco uBR-MC3GX60V-RPHY Line Card

The cable interface is the MAC domain interface that hosts modular cable interfaces and associates upstream channels with the modular cable interfaces.

The Cisco uBR-MC3GX60V-RPHY line card supports 15 cable MAC domains (cable interfaces). The 15 cable MAC domains are divided into following three sets. The downstream channels can be associated with any of these 15 MAC domains.

- Set 1: 0-4
- Set 2: 5-9
- Set 3: 10-14

Following is the association of the upstream channels with the MAC domain:

- Upstream channels 0-19 are associated with the Set 1 (0-4 MAC domain).
- Upstream channels 20-39 are associated with the Set 2 (5-9 MAC domain).
- Upstream channels 40-59 are associated with the Set 3 (10-14 MAC domain).

Before You Begin

Restriction Wideband channels can be configured only for downstream RF channels that belongs to a single controller.

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**interface cable** *slot /subslot /cable-interface-index* **Example:** `Router(config)# interface cable 7/0/0`	Enters the cable interface mode. • *slot*—Slot where the Cisco uBR-MC3GX60V-RPHY line card resides. The valid range is from 5 to 8. • *subslot*—Secondary slot number of the Cisco uBR-MC3GX60V-RPHY line card. The valid values are 0 or 1. • *cable-interface-index*—Downstream port number or MAC domain index of the Cisco uBR-MC3GX60V-RPHY line card.
Step 4	**cable bundle** *bundle-number* **Example:** `Router(config-if)# cable bundle 2`	Configures the cable interface to belong to an interface bundle. • *bundle-number*—Bundle identifier. The valid range is from 1 to 255.

	Command or Action	Purpose
Step 5	**downstream modular-cable** *slot* /*subslot* /*port* **rf-channel** *grouplist* **upstream** *grouplist* **Example:** `Router(config-if)# downstream modular-Cable 7/1/0 rf-channel 0-7 upstream 0-3`	Configures the RF channels from the Cisco uBR-MC3GX60V-RPHY line card as primary channels in the MAC domain. • *slot*—Slot where the Cisco uBR-MC3GX60V-RPHY line card resides. • *subslot*—Secondary slot number of the Cisco uBR-MC3GX60V-RPHY line card. • *port*—Port number. The valid range is from 0 to 2. • *grouplist*—List of ranges for downstream RF channels. The valid range is from 0 to 23. • **upstream**—Indicates the logical identifier of upstreams that serve these downstream RF channels. **Note** This keyword not indicate an upstream logical channel that requires both, the upstream port number and the logical channel index (0 or 1). This keyword specifies only the upstream port. • *grouplist*—Number of upstream with the modular cable downstream channel. The valid range is from 0 to 7.
Step 6	**cable upstream** *n* **frequency** *up-freq-hz* **Example:** `Router(config-if)# cable upstream 2 frequency 25000000`	Configures a fixed frequency of the upstream RF carrier for an upstream port. • *n*—Specifies the upstream port number on the Cisco uBR-MC3GX60V-RPHY line card. The valid range starts with 0 for the first upstream port on the line card. • *up-freq-hz*—Upstream center frequency in Hz. The valid range is from 5 MHz (5000000 Hz) to 85 MHz (85000000 Hz).
Step 7	**cable upstream max-ports** *n* **Example:** `Router(config-if)# cable upstream max-ports 4`	Configures the maximum number of upstreams on a cable interface (MAC domain) on the Cisco uBR-MC3GX60V-RPHY line card. • *n*—Number of upstream ports. The valid range is from 0 to 8.
Step 8	**cable upstream** *port* **connector** *physical-port* **Example:** `Router(config-if)# cable upstream 2 connector 0`	Maps an upstream port to a physical port on the Cisco uBR-MC3GX60V-RPHY line card for use with a downstream. • *port*—Upstream port number. The valid range is from 0 to 3. • *physical-port*—Upstream port number for the actual physical port to be assigned. The valid range is from 0 to 2.
Step 9	**cable upstream** *n* **docsis-mode** {**atdma** | **tdma** } **Example:** `Router(config-if)# cable upstream 2 docsis-mode tdma`	Configures an upstream channel to use either DOCSIS 1.x or DOCSIS 2.0 modulation profiles. • *n*—Upstream port number. The valid values start with 0 for the first upstream port on the Cisco uBR-MC3GX60V-RPHY line card. • **atdma** —Configures the upstream only for the DOCSIS 2.0 Advanced Time Division Multiple Access (A-TDMA) modulation profiles.

	Command or Action	Purpose
		• **tdma—**Configures the upstream only for the DOCSIS 1.0 and DOCSIS 1.1 Time Division Multiple Access (TDMA) modulation profiles (default).
Step 10	**cable upstream** *n* **channel-width** *first-choice-width* [*last-choice-width*] **Example:** `Router(config-if)# cable upstream 2 channel-width 1600000 1600000`	Specifies an upstream channel width for an upstream port. • *n***—**Upstream port number. The valid values start with 0 for the first upstream port on the Cisco uBR-MC3GX60V-RPHY line card. • *first-choice-width***—**Upstream channel width, in Hz. The valid values for all cards are: ◦ 200,000 (160,000 symbols/sec)**—**Not valid when using Unsolicited Grant Service (UGS) or UGS with Activity Detection (UGS-AD) service flows (such as PacketCable voice calls). ◦ 400,000 (320,000 symbols/sec) ◦ 800,000 (640,000 symbols/sec) ◦ 1,600,000 (1,280,000 symbols/sec) ◦ 3,200,000 (2,560,000 symbols/sec) • *last-choice-width***—**Upstream channel width, in Hz. The valid values are the same as those for the first-choice-width parameter, but for proper operation, the *last-choice-width* should be equal to or less than the *first-choice-width* value. Use this parameter with supported cards to enable symbol rate management algorithms. The symbol rate automatically steps up from the *first-choice-width* value to the highest value until a stable channel is established.
Step 11	**cable upstream** *n* **minislot-size** *size* **Example:** `Router(config-if)# cable upstream 2 minislot-size 4`	Specifies the mini slot size (in ticks) for a specific upstream interface. • *n***—**Upstream port number. The valid values start with 0 for the first upstream port on the Cisco uBR-MC3GX60V-RPHY line card. • *size***—**Mini slot size in time ticks. The valid values are 2, 4, 8, 16, 32, 64, and 128.
Step 12	**cable upstream** *n* **range-backoff** {**automatic** | *start* *end* } **Example:** `Router(config-if)# cable upstream 0 range-backoff 3 6`	Specifies automatic or configured initial ranging backoff calculation. • *n***—**Upstream port number. The valid values start with 0 for the first upstream port on the Cisco uBR-MC3GX60V-RPHY line card. • **automatic—**Configures the fixed data backoff start and end values. • *start* **—**Binary exponential algorithm. Sets the start value for the initial ranging backoff. The valid range is from 0 to 15. • *end* **—**Binary exponential algorithm. Sets the end value for the initial ranging backoff. The valid range is from *start* to 15.

	Command or Action	Purpose
Step 13	**cable upstream** *n* **modulation-profile** *primary-profile-number* [*secondary-profile-number*] [*tertiary-profile-number*] **Example:** `Router(config-if)# cable upstream 0 modulation-profile 21`	Assigns one or two modulation profiles to an upstream port. • *n*—Upstream port number. The valid values start with 0 for the first upstream port on the Cisco uBR-MC3GX60V-RPHY line card. • *primary-profile-number*—Primary modulation profile number for the upstream port. The valid range is from 21 to 30. • *secondary-profile-number*—Secondary modulation profile number for the upstream port, which is used when noise on the upstream increases to the point that the primary modulation profile can no longer be used. The valid range is same as the range for the *primary-profile-number*. *tertiary-profile-number*—Tertiary modulation profile number for the upstream port.
Step 14	**no cable upstream** *n* **shutdown** **Example:** `Router(config-if)# no cable upstream 0 shutdown`	Enables a single upstream port. • *n*—Upstream port number. The valid values start with 0 for the first upstream port on the Cisco uBR-MC3GX60V-RPHY line card.
Step 15	**end** **Example:** `Router(config-if)# end`	Exits interface configuration mode and returns to privileged EXEC mode.

What to Do Next

To verify the cable interface configuration, run the **show interface cable** *slot* / *subslot* / *port* or **show run interface cable** *slot* /*subslot* / *port* command.

Configuring a Channel Group on the Cisco uBR-MC3GX60V-RPHY Line Card

A channel group consists of up to four upstream channels, 16 downstream channels, and four Cisco CMCs, which are mapped to the same Gigabit Ethernet controller. Maximum of five channel groups can be defined for a modular controller with four upstream channels in the channel group (60 Cisco CMCs per Cisco uBR-MC3GX60V-RPHY line card) and maximum of 20 channel groups can be defined for a modular controller with one upstream in the channel group (maximum of 240 Cisco CMCs per Cisco uBR-MC3GX60V-RPHY line card).

A channel group assigns an upstream channel to a MAC domain on the Cisco CMC . In a channel group, each upstream channel can be present in only one MAC domain. Multiple MAC domains can be configured for a channel group.

The Cisco CMC is assigned to a channel group through the Cisco CMC MAC address and maximum of four Cisco CMC can share the downstream capacity of the channel group.

Before You Begin

Restriction

- A channel group must have at least one Cisco CMC and a maximum of four Cisco CMCs.
- A channel group must contain at least one upstream channel and can have a maximum of four upstream channels. All the upstream channels in a channel group must be associated with the same Gigabit Ethernet controller.
- A channel group can have a maximum of 16 downstream channels and all the downstream channels in a channel group must be associated with the same controller.
- The Cisco CMCs, upstream and downstream channels must be mapped to the same Gigabit Ethernet Controller.
- The upstream and downstream channels should be configured as a same fiber node.
- The Cisco CMC must be configured in a channel group before it comes online.

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**cable channel-group** *group-id* **Example:** `Router(config)# cable channel-group 100`	Enters channel group configuration mode. • *group-id* —Channel group ID. The valid range is from 1 to 1000.
Step 4	**upstream cable** *slot* /*subslot* /*port* **channel** *grouplist* **Example:** `Router(config-ch-group)# upstream Cable7/1/0 channel 0-1`	Configures the upstream RF channels for the channel group. • *slot*—Slot where the Cisco uBR-MC3GX60V-RPHY line card resides. • *subslot*—Secondary slot number of the Cisco uBR-MC3GX60V-RPHY line card. • *port*—Port number on the Cisco uBR-MC3GX60V-RPHY line card. The valid range is from 0 to 14. • *grouplist*—Range of upstream channel numbers. The valid range is from 0 to 7.
Step 5	**downstream modular-cable** *slot* / *subslot* /*port* **rf-channel** *grouplist*	Specifies the downstream channel ports for a fiber node.

	Command or Action	Purpose
	Example: `Router(config-ch-group)# downstream modular-Cable 7/1/0 rf-channel 0-3`	• *slot* —Slot where the Cisco uBR-MC3GX60V-RPHY line card resides. • *subslot* —Secondary slot number of the Cisco uBR-MC3GX60V-RPHY line card. • *port* —Port number on the Cisco uBR-MC3GX60V-RPHY line card. The valid range is from 0 to 2. • *grouplist* —Range of downstream RF channel numbers. The valid range is from 0 to 23.
Step 6	**cmc** *mac-address* **Example:** `Router(config-ch-group)# cmc 0004.9f01.8120`	Configures the Cisco CMC in the channel group. • *mac-address* —MAC address of the Cisco CMC.
Step 7	**end** **Example:** `Router(config-ch-group)# end`	Exits channel group configuration mode and returns to privileged EXEC mode.

What to Do Next

To verify the channel group configuration, run the **show cable channel-group** *group-id* command.

Configuring the Fiber Node on the Cisco uBR-MC3GX60V-RPHY Line Card

You must configure the service group units called fiber nodes to enable the DOCSIS 3.0 operations.

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**cable fiber-node** *fiber-node-id*	Enters the fiber node configuration mode.

	Command or Action	Purpose
	Example: `Router(config)# cable fiber-node 1`	• *fiber-node-id* —Unique numerical ID for the fiber node. The valid range is from 1 to 256.
Step 4	**downstream modular-Cable downstream** *slot* / *subslot* /*port* **rf-channel** *grouplist* **Example:** `Router(config-fiber-node)# downstream modular-Cable 7/1/0 rf-channel 0-3`	Specifies the downstream channel ports for a fiber node. • *slot* —Slot where the Cisco uBR-MC3GX60V-RPHY line card resides. The valid range is from 5 to 8. • *subslot* —Secondary slot number of the Cisco uBR-MC3GX60V-RPHY line card. The valid ranges are 0 or 1. • *port* —upstream port number or MAC domain index of the Cisco uBR-MC3GX60V-RPHY line card. The valid ranges is from 0 to 2. • *rf-channel number* —Specifies the rf-channel group number. • *grouplist* —Group of RF channel number, and number ranges. The valid range is from 0 to 23.
Step 5	**upstream cable** *slot* /*subslot* /*port* **channel** *grouplist* **Example:** `Router(config-fiber-node)# upstream Cable 7/1/0 channel 0-1`	Specifies the upstream channel ports for a fiber node. • *slot* —Slot where the Cisco uBR-MC3GX60V-RPHY line card resides. The valid range is from 5 to 8. • *subslot* —Secondary slot number of the Cisco uBR-MC3GX60V-RPHY line card. The valid ranges are 0 or 1. • *port* —upstream port number or MAC domain index of the Cisco uBR-MC3GX60V-RPHY line card. • *channel number* —List or range of upstream channel numbers. The valid range is from 0 to 3.
Step 6	**end** **Example:** `Router(config-fiber-node)# end`	Exits fiber node configuration mode and returns to privileged EXEC mode.

What to Do Next

To verify the fiber node configuration details, run the **show cable fiber-node** *fiber-node-id* command.

Configuring the Layer 3 CIN Network support

In Layer 3 CIN network, the connection between CMTS and CMC goes through the routers.

Note Only for the first router that established connection to CMC, the DHCP relay must be set to CMTS using **ip helper-address** command.

Currently we only support static routing to connect traffic between CMTS and CMC.

To establish Layer 3 CIN connection, only the internal DHCP server on the CMTS is supported.

Follow the steps below to configure the DHCP server and static routing using the illustration above as an example:

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**ip dhcp pool** *pool name* **Example:** `Router(config)# ip dhcp pool cmc-50`	Specify the DHCP pool.
Step 4	**network** *IP-address subnet-mask* **Example:** `Router(dhcp-config)# network 50.2.0.0 255.255.255.0`	Specify the IP address and subnet mask used by the DHCP pool.
Step 5	**boofile** *path* **Example:** `Router(dhcp-config)# bootfile tftp://20.1.0.3/cmc-16x4-os-20141127.bin`	Specify the CMC upgrade image path.
Step 6	**default-router** *IP-address* **Example:** `Router(dhcp-config)# default-router 50.2.0.1`	Specify the IP address of the default router.
Step 7	**lease** *days hours minutes* **Example:** `Router(dhcp-config)# lease 7 0 10`	Specify the lease time of the IP address given to the DHCP pool.

	Command or Action	Purpose
Step 8	**ip route** *IP-address subnet-maskinterface-IP* **Example:** `Router(config)# ip route 50.2.0.0 255.255.255.0 50.1.0.2`	Add static routing to the adjacent router which connects to CMTS. After the example step in the left column is performed, all the traffic targets to 50.2.0.0 (the subnet which is used for CMC) will be forwarded to this adjacent router. **Note** Roll back to **config** mode to perform this step.
Step 9	**end** **Example:** `Router(config)# end`	Exits fiber node configuration mode and returns to privileged EXEC mode.

Configuring the Downstream RF Power on the Cisco CMC

This configuration is optional. This procedure configures the resource sharing between the Cisco CMCs in a channel group based on the MAC address.

The valid downstream RF power value is based on the number of active downstream RF channels on the Cisco CMC. If the configured downstream RF power value for a specific number of downstream RF channels is out of the valid range, the downstream RF power is adjusted according to the number of active downstream RF channels on the Cisco CMC and a warning message is displayed.

We recommend that you use the following downstream RF power values based on the number of active downstream RF channels:

Table 16: Recommended Downstream RF Power Values

Number of Downstream RF Channels	Recommended RF Power Values
1	50 dBmV to 6 2dBmV
2	46 dBmV to 58 dBmV
3	44 dBmV to 56 dBmV
4	42 dBmV to 54 dBmV
5	41 dBmV to 53 dBmV
6	40 dBmV to 52 dBmV
7	39 dBmV to 51 dBmV
8	39 dBmV to 51 dBmV

Number of Downstream RF Channels	Recommended RF Power Values
9	38 dBmV to 50 dBmV
10	38 dBmV to 50 dBmV
11	37 dBmV to 49 dBmV
12	37 dBmV to 49 dBmV
13	36 dBmV to 48 dBmV
14	36 dBmV to 48 dBmV
15	35 dBmV to 47 dBmV
16	35 dBmV to 47 dBmV

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**cable cmc** *mac-address* **ds-rf-power** *power* [**tilt** *tilt-value*] **Example:** `Router(config)# cable cmc 0200.0000.0001 ds-rf-power 35.0 tilt 0dB`	Configures the downstream RF power for the downstream channel on the Cisco CMC. • *mac-address*—MAC address of the Cisco CMC. • *power*—RF power, in dBmV. The range is from 35 to 62. RF power is specified in the format *xy.z*, where *z* is 0. • **tilt** *tilt-value*—(Optional) Specifies the tile equalization value, in dB. The valid values are **-15dB**, **-12dB**, **-9dB**, **-6dB**, **-3dB**, and **0dB**. The default value is 9 dB.
Step 4	**end** **Example:** `Router(config)# end`	Exits global configuration mode and returns to privileged EXEC mode.

Configuring the FRx on the Cisco CMC

This configuration is optional. This procedure configures the attenuation and equalization values for the Forward Optical Receiver Module (FRx) on the Cisco CMC.

Before You Begin

Ensure that FRx is installed on the Cisco CMC.

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**cable cmc** *mac-address* **frx** {**att** *att-value* | **eq** *eq-value*} **Example:** `Router(config)# cable cmc 0200.0000.0001 frx att 1`	Configures the FRx on the Cisco CMC. • *mac-address*—MAC address of the Cisco CMC. • **att** *att-value*—Sets the attenuation value, in dB. The valid range is from 0 to 10. • **eq** *eq-value*—Sets the equalization value, in dB. The valid range is from 3 to 15.
Step 4	**end** **Example:** `Router(config)# end`	Exits global configuration mode and returns to privileged EXEC mode.

Configuration Example for the Cisco Remote-PHY Solution

Example: Configuring the Cisco Remote-PHY Solution

The following example shows how to configure the Cisco uBR-MC3GX60V-RPHY line card.

```
version 12.2
no service pad
service timestamps debug datetime msec localtime show-timezone
service timestamps log datetime msec localtime show-timezone
no service password-encryption
service internal
service debug-tracking ip-address 192.2.1.2
```

```
!
hostname App-10k-10
!
logging buffered 5000000
no logging rate-limit
no logging console
!
no aaa new-model
clock timezone CST 8
facility-alarm outlet-temperature major 58
facility-alarm outlet-temperature minor 48
facility-alarm outlet-temperature critical 85
facility-alarm intake-temperature major 51
facility-alarm intake-temperature minor 41
facility-alarm intake-temperature critical 73
!
card 1 4jacket-1
card 1/0 SPA-1XTENGE-XFP-V2
card 1/1 SPA-1XTENGE-XFP-V2
card 1/1 2cable-dtcc
card 7/1 ubr10k-clc-3g60-rphy license 72X60
!
!
cable logging badipsource
cable logging layer2events
cable logging overlapip
cable logging ironbus
cable logging downstream-index
cable clock dti
!
ip subnet-zero
no ip domain lookup
ip host rfsw-1 192.4.0.36
ip host rfsw-2 192.4.0.36
ip name-server 192.1.0.2
ip multicast-routing
!
ip dhcp pool cmc
network 192.71.0.0 255.255.255.0
next-server 192.71.0.1
default-router 192.71.0.1
lease 7 0 10
!

controller Modular-Cable 7/1/0
rf-channel 0 cable downstream channel-id 73
rf-channel 0 frequency 451000000 annex A modulation 256qam interleave 12
rf-channel 0 group-address 192.1.2.1
no rf-channel 0 rf-shutdown
rf-channel 1 cable downstream channel-id 74
rf-channel 2 cable downstream channel-id 75
rf-channel 3 cable downstream channel-id 76
rf-channel 4 cable downstream channel-id 77
rf-channel 5 cable downstream channel-id 78
rf-channel 6 cable downstream channel-id 79
rf-channel 7 cable downstream channel-id 80
rf-channel 8 cable downstream channel-id 81
rf-channel 9 cable downstream channel-id 82
rf-channel 10 cable downstream channel-id 83
rf-channel 11 cable downstream channel-id 84
rf-channel 12 cable downstream channel-id 85
rf-channel 13 cable downstream channel-id 86
rf-channel 14 cable downstream channel-id 87
rf-channel 15 cable downstream channel-id 88
rf-channel 16 cable downstream channel-id 89
rf-channel 17 cable downstream channel-id 90
rf-channel 18 cable downstream channel-id 91
rf-channel 19 cable downstream channel-id 92
rf-channel 20 cable downstream channel-id 93
rf-channel 21 cable downstream channel-id 94
rf-channel 22 cable downstream channel-id 95
rf-channel 23 cable downstream channel-id 96
!
```

```
controller Modular-Cable 7/1/1
rf-channel 0 cable downstream channel-id 97
rf-channel 1 cable downstream channel-id 98
rf-channel 2 cable downstream channel-id 99
rf-channel 3 cable downstream channel-id 100
rf-channel 4 cable downstream channel-id 101
rf-channel 5 cable downstream channel-id 102
rf-channel 6 cable downstream channel-id 103
rf-channel 7 cable downstream channel-id 104
rf-channel 8 cable downstream channel-id 105
rf-channel 9 cable downstream channel-id 106
rf-channel 10 cable downstream channel-id 107
rf-channel 11 cable downstream channel-id 108
rf-channel 12 cable downstream channel-id 109
rf-channel 13 cable downstream channel-id 110
rf-channel 14 cable downstream channel-id 111
rf-channel 15 cable downstream channel-id 112
rf-channel 16 cable downstream channel-id 113
rf-channel 17 cable downstream channel-id 114
rf-channel 18 cable downstream channel-id 115
rf-channel 19 cable downstream channel-id 116
rf-channel 20 cable downstream channel-id 117
rf-channel 21 cable downstream channel-id 118
rf-channel 22 cable downstream channel-id 119
rf-channel 23 cable downstream channel-id 120
!
controller Modular-Cable 7/1/2
rf-channel 0 cable downstream channel-id 121
rf-channel 1 cable downstream channel-id 122
rf-channel 2 cable downstream channel-id 123
rf-channel 3 cable downstream channel-id 124
rf-channel 4 cable downstream channel-id 125
rf-channel 5 cable downstream channel-id 126
rf-channel 6 cable downstream channel-id 127
rf-channel 7 cable downstream channel-id 128
rf-channel 8 cable downstream channel-id 129
rf-channel 9 cable downstream channel-id 130
rf-channel 10 cable downstream channel-id 131
rf-channel 11 cable downstream channel-id 132
rf-channel 12 cable downstream channel-id 133
rf-channel 13 cable downstream channel-id 134
rf-channel 14 cable downstream channel-id 135
rf-channel 15 cable downstream channel-id 136
rf-channel 16 cable downstream channel-id 137
rf-channel 17 cable downstream channel-id 138
rf-channel 18 cable downstream channel-id 139
rf-channel 19 cable downstream channel-id 140
rf-channel 20 cable downstream channel-id 141
rf-channel 21 cable downstream channel-id 142
rf-channel 22 cable downstream channel-id 143
rf-channel 23 cable downstream channel-id 144
!
!
interface Loopback1
no ip address
no ip route-cache cef
no ip route-cache
ip rsvp bandwidth 10000
ip rsvp listener outbound reply
!
interface FastEthernet0/0/0
ip address 192.4.0.37 255.255.255.0
no ip route-cache cef
no ip route-cache
media-type rj45
speed auto
duplex auto
ipv6 address 2001:DB:4:1::37/64
ipv6 enable
!
interface TenGigabitEthernet1/0/0
no ip address
!
```

```
interface TenGigabitEthernet1/1/0
no ip address
!
!
interface Cable7/1/0
downstream Modular-Cable 7/1/0 rf-channel 0
no cable mtc-mode
no cable packet-cache
cable bundle 1
cable upstream max-ports 4
cable upstream 0 connector 0
cable upstream 0 frequency 20000000
cable upstream 0 channel-width 6400000
cable upstream 0 docsis-mode atdma
cable upstream 0 minislot-size 4
cable upstream 0 range-backoff 3 6
cable upstream 0 modulation-profile 221
no cable upstream 0 shutdown
cable upstream 1 connector 0
cable upstream 1 channel-width 1600000
cable upstream 1 docsis-mode atdma
cable upstream 1 minislot-size 4
cable upstream 1 range-backoff 3 6
cable upstream 1 modulation-profile 221
cable upstream 1 shutdown
cable upstream 2 connector 0
cable upstream 2 channel-width 1600000
cable upstream 2 docsis-mode atdma
cable upstream 2 minislot-size 4
cable upstream 2 range-backoff 3 6
cable upstream 2 modulation-profile 221
cable upstream 2 shutdown
cable upstream 3 connector 0
cable upstream 3 channel-width 1600000
cable upstream 3 docsis-mode atdma
cable upstream 3 minislot-size 4
cable upstream 3 range-backoff 3 6
cable upstream 3 modulation-profile 221
cable upstream 3 shutdown
!
interface Cable7/1/1
no cable packet-cache
cable upstream max-ports 4
cable upstream 0 connector 0
cable upstream 0 channel-width 1600000
cable upstream 0 docsis-mode atdma
cable upstream 0 minislot-size 4
cable upstream 0 range-backoff 3 6
cable upstream 0 modulation-profile 221
cable upstream 0 shutdown
cable upstream 1 connector 0
cable upstream 1 channel-width 1600000
cable upstream 1 docsis-mode atdma
cable upstream 1 minislot-size 4
cable upstream 1 range-backoff 3 6
cable upstream 1 modulation-profile 221
cable upstream 1 shutdown
cable upstream 2 connector 0
cable upstream 2 channel-width 1600000
cable upstream 2 docsis-mode atdma
cable upstream 2 minislot-size 4
cable upstream 2 range-backoff 3 6
cable upstream 2 modulation-profile 221
cable upstream 2 shutdown
cable upstream 3 connector 0
cable upstream 3 channel-width 1600000
cable upstream 3 docsis-mode atdma
cable upstream 3 minislot-size 4
cable upstream 3 range-backoff 3 6
cable upstream 3 modulation-profile 221
cable upstream 3 shutdown
!
```

```
interface GigabitEthernet7/1/0
ip address 192.71.0.1 255.255.255.0
ip pim sparse-dense-mode
negotiation auto
!
interface GigabitEthernet7/1/2
no ip address
negotiation auto
!

interface Bundle1
ip address 192.2.1.1 255.255.255.0
ip pim sparse-mode
ip igmp version 3
cable multicast-qos group 20
cable arp filter request-send 3 2
cable arp filter reply-accept 3 2
cable dhcp-giaddr policy
cable helper-address 192.1.0.3
ip rsvp bandwidth 10000
ip rsvp listener outbound reply
!
ip default-gateway 192.4.0.1
ip classless
!
no ip http server
no ip http secure-server
!
!
logging cmts ipc-cable log-level errors
logging cmts sea syslog-level errors
cpd cr-id 1
nls resp-timeout 1
cdp run
!
tftp-server disk0:basic.cm alias golden.cm
!
control-plane
!
alias exec ccmad clear cable modem all delete
alias exec scm show cable modem
alias exec ccm clear cable modem
alias exec scc show cable cmc
!
line con 0
exec-timeout 0 0
privilege level 15
stopbits 1
line aux 0
stopbits 1
line vty 0 4
exec-timeout 0 0
privilege level 15
no login
line vty 5 15
privilege level 15
no login
line vty 16 50
no login
!
scheduler isr-watchdog
!
cable channel-group 71
upstream Cable7/1/0 channel 0-3
downstream Modular-Cable 7/1/0 rf-channel 0-7
cmc 0200.0000.0001
!
ntp clock-period 17179828
ntp update-calendar
ntp server 20.1.0.2
end
```

Example: Configuring CMTS and Router in Layer 3 CIN Network

The following example shows how to configure CMTS in Layer 3 CIN network shown in the illustration of Configuring the Layer 3 CIN Network support, on page 102.

```
issu-ubr10k-5#show run
Building configuration...

Current configuration : 143626 bytes
!
! Last configuration change at 16:28:30 CST Tue Mar 24 2015
!
version 12.2
no service pad
service timestamps debug datetime msec localtime show-timezone
service timestamps log datetime msec localtime show-timezone
no service password-encryption
service internal
service udp-small-servers max-servers 25
service debug-tracking ip-address 50.1.0.1
service debug-tracking context-copy
!
hostname issu-ubr10k-5
!
boot-start-marker
boot system disk0:ubr10k4-k9p6u2-mz.cd102.dbg
boot-end-marker
!
logging buffered 20000000
logging rate-limit console 10
no logging console
enable password lab
!
no aaa new-model
clock timezone CST 8
facility-alarm outlet-temperature major 58
facility-alarm outlet-temperature minor 48
facility-alarm outlet-temperature critical 85
no facility-alarm intake-temperature major
no facility-alarm intake-temperature minor
facility-alarm intake-temperature critical 72
!
!
!
!
card 1 4jacket-1
card 3 4jacket-1
card 5/0 ubr10k-clc-3g60-rphy license 72X60
card 6/0 ubr10k-clc-3g60 license 16X60
card 7/1 ubr10k-clc-3g60-rphy license 72X60!
cable admission-control preempt priority-voice
!
cable source-verify group ngspa-perf
!
!
!
cable modem v6-max-cpe-prefix 16
cable service class 1 name mcast1
cable service class 1 downstream
cable service class 11 name ugs_test
cable service class 11 upstream
cable service class 11 sched-type 6
cable service class 11 req-trans-policy 3FF
cable service class 11 grant-size 232
cable service class 11 grant-interval 20000
cable service class 11 grant-jitter 10000
cable service class 11 grants-per-interval 1
cable service class 11 max-buff-size 200000000
no cable qos permission create
no cable qos permission update
```

```
cable qos permission modems
!
cable logging badipsource
cable logging layer2events
cable logging overlapip
cable logging ironbus
cable logging downstream-index
cable time-server
cable clock dti
cable cmc 9078.5634.1200 ds-rf-power 52.0 tilt -12dB
cable privacy hotlist cm 7cb2.1b10.32d2
cable privacy hotlist cm 7cb2.1b10.2248
cable load-balance docsis-enable
!
cable load-balance docsis-group 1
!
cable load-balance docsis-group 2
!
cable load-balance group 1 method utilization
cable load-balance group 1 threshold load minimum 1
cable load-balance group 79
cable load-balance group 80
!
ip subnet-zero
no ip domain lookup
ip host rfsw-1 20.5.0.50
ip host rfsw-2 20.5.0.50
ip multicast-routing
ip dhcp smart-relay
no ip dhcp use vrf connected
ip dhcp excluded-address 50.2.0.1
!
ip dhcp pool CMC-50
   network 50.2.0.0 255.255.255.0
   bootfile tftp://50.1.0.1/cmc-16x4-os-20141127.bin
   default-router 50.2.0.1
   lease 7 0 10
!
!
!
!
ipv6 multicast rpf use-bgp
l2tp-class l2tp-class_6_0
 hello 5
 hostname lchc6_0
 retransmit retries 5
 retransmit timeout max 1
!
packetcable multimedia
depi-class depi-class_6_0
 mode mpt
!
depi-tunnel 3g60_6_0_0
 dest-ip 192.60.0.2
 l2tp-class l2tp-class_6_0
 depi-class depi-class_6_0
 protect-tunnel 3g60_6_1_0_p
!
depi-tunnel 3g60_6_1_0_p
 dest-ip 192.61.0.2
!
!
diagnostic bootup level minimal
!
redundancy
  mode sso
!
controller Modular-Cable 5/0/0
 rf-channel 0 cable downstream channel-id 1
 rf-channel 0 frequency 453000000 annex B modulation 256qam interleave 32
 rf-channel 0 group-address 225.1.1.2
 no rf-channel 0 rf-shutdown
 rf-channel 1 cable downstream channel-id 2
```

```
 rf-channel 1 frequency 459000000 annex B modulation 256qam interleave 32
 rf-channel 1 group-address 225.1.1.2
 no rf-channel 1 rf-shutdown
 rf-channel 2 cable downstream channel-id 3
 rf-channel 2 frequency 465000000 annex B modulation 256qam interleave 32
 rf-channel 2 group-address 225.1.1.2
 no rf-channel 2 rf-shutdown
 rf-channel 3 cable downstream channel-id 4
 rf-channel 3 frequency 471000000 annex B modulation 256qam interleave 32
 rf-channel 3 group-address 225.1.1.2
 no rf-channel 3 rf-shutdown
 rf-channel 4 cable downstream channel-id 5
 rf-channel 4 frequency 477000000 annex B modulation 256qam interleave 32
 rf-channel 4 group-address 225.1.1.2
 no rf-channel 4 rf-shutdown
 rf-channel 5 cable downstream channel-id 6
 rf-channel 5 frequency 483000000 annex B modulation 256qam interleave 32
 rf-channel 5 group-address 225.1.1.2
 no rf-channel 5 rf-shutdown
 rf-channel 6 cable downstream channel-id 7
 rf-channel 6 frequency 489000000 annex B modulation 256qam interleave 32
 rf-channel 6 group-address 225.1.1.2
 no rf-channel 6 rf-shutdown
 rf-channel 7 cable downstream channel-id 8
 rf-channel 7 frequency 495000000 annex B modulation 256qam interleave 32
 rf-channel 7 group-address 225.1.1.2
 no rf-channel 7 rf-shutdown
 rf-channel 8 cable downstream channel-id 9
 rf-channel 9 cable downstream channel-id 10
 rf-channel 10 cable downstream channel-id 11
 rf-channel 11 cable downstream channel-id 12
 rf-channel 12 cable downstream channel-id 13
 rf-channel 13 cable downstream channel-id 14
 rf-channel 14 cable downstream channel-id 15
 rf-channel 15 cable downstream channel-id 16
 rf-channel 16 cable downstream channel-id 17
 rf-channel 17 cable downstream channel-id 18
 rf-channel 18 cable downstream channel-id 19
 rf-channel 19 cable downstream channel-id 20
 rf-channel 20 cable downstream channel-id 21
 rf-channel 21 cable downstream channel-id 22
 rf-channel 22 cable downstream channel-id 23
 rf-channel 23 cable downstream channel-id 24
!
controller Modular-Cable 5/0/1
 rf-channel 0 cable downstream channel-id 25
 rf-channel 1 cable downstream channel-id 26
 rf-channel 2 cable downstream channel-id 27
 rf-channel 3 cable downstream channel-id 28
 rf-channel 4 cable downstream channel-id 29
 rf-channel 5 cable downstream channel-id 30
 rf-channel 6 cable downstream channel-id 31
 rf-channel 7 cable downstream channel-id 32
 rf-channel 8 cable downstream channel-id 33
 rf-channel 9 cable downstream channel-id 34
 rf-channel 10 cable downstream channel-id 35
 rf-channel 11 cable downstream channel-id 36
 rf-channel 12 cable downstream channel-id 37
 rf-channel 13 cable downstream channel-id 38
 rf-channel 14 cable downstream channel-id 39
 rf-channel 15 cable downstream channel-id 40
 rf-channel 16 cable downstream channel-id 41
 rf-channel 17 cable downstream channel-id 42
 rf-channel 18 cable downstream channel-id 43
 rf-channel 19 cable downstream channel-id 44
 rf-channel 20 cable downstream channel-id 45
 rf-channel 21 cable downstream channel-id 46
 rf-channel 22 cable downstream channel-id 47
 rf-channel 23 cable downstream channel-id 48
!
controller Modular-Cable 5/0/2
 rf-channel 0 cable downstream channel-id 1
 rf-channel 0 frequency 453000000 annex B modulation 256qam interleave 32
```

```
 rf-channel 0 group-address 225.1.1.2
 no rf-channel 0 rf-shutdown
 rf-channel 1 cable downstream channel-id 2
 rf-channel 1 frequency 459000000 annex B modulation 256qam interleave 32
 rf-channel 1 group-address 225.1.1.2
 no rf-channel 1 rf-shutdown
 rf-channel 2 cable downstream channel-id 3
 rf-channel 2 frequency 465000000 annex B modulation 256qam interleave 32
 rf-channel 2 group-address 225.1.1.2
 no rf-channel 2 rf-shutdown
 rf-channel 3 cable downstream channel-id 4
 rf-channel 3 frequency 471000000 annex B modulation 256qam interleave 32
 rf-channel 3 group-address 225.1.1.2
 no rf-channel 3 rf-shutdown
 rf-channel 4 cable downstream channel-id 5
 rf-channel 4 frequency 477000000 annex B modulation 256qam interleave 32
 rf-channel 4 group-address 225.1.1.2
 no rf-channel 4 rf-shutdown
 rf-channel 5 cable downstream channel-id 6
 rf-channel 5 frequency 483000000 annex B modulation 256qam interleave 32
 rf-channel 5 group-address 225.1.1.2
 no rf-channel 5 rf-shutdown
 rf-channel 6 cable downstream channel-id 7
 rf-channel 6 frequency 489000000 annex B modulation 256qam interleave 32
 rf-channel 6 group-address 225.1.1.2
 no rf-channel 6 rf-shutdown
 rf-channel 7 cable downstream channel-id 8
 rf-channel 7 frequency 495000000 annex B modulation 256qam interleave 32
 rf-channel 7 group-address 225.1.1.2
 no rf-channel 7 rf-shutdown
 rf-channel 8 cable downstream channel-id 57
 rf-channel 9 cable downstream channel-id 58
 rf-channel 10 cable downstream channel-id 59
 rf-channel 11 cable downstream channel-id 60
 rf-channel 12 cable downstream channel-id 61
 rf-channel 13 cable downstream channel-id 62
 rf-channel 14 cable downstream channel-id 63
 rf-channel 15 cable downstream channel-id 64
 rf-channel 16 cable downstream channel-id 65
 rf-channel 17 cable downstream channel-id 66
 rf-channel 18 cable downstream channel-id 67
 rf-channel 19 cable downstream channel-id 68
 rf-channel 20 cable downstream channel-id 69
 rf-channel 21 cable downstream channel-id 70
 rf-channel 22 cable downstream channel-id 71
 rf-channel 23 cable downstream channel-id 72
!
controller Modular-Cable 6/0/0
 rf-channel 0 cable downstream channel-id 1
 rf-channel 0 frequency 483000000 annex B modulation 256qam interleave 128
 rf-channel 0 depi-tunnel 3g60_6_0_0 tsid 5091
 no rf-channel 0 rf-shutdown
 rf-channel 1 cable downstream channel-id 2
 rf-channel 1 frequency 489000000 annex B modulation 256qam interleave 128
 rf-channel 1 depi-tunnel 3g60_6_0_0 tsid 5092
 no rf-channel 1 rf-shutdown
 rf-channel 2 cable downstream channel-id 3
 rf-channel 2 frequency 495000000 annex B modulation 256qam interleave 128
 rf-channel 2 depi-tunnel 3g60_6_0_0 tsid 5093
 no rf-channel 2 rf-shutdown
 rf-channel 3 cable downstream channel-id 4
 rf-channel 3 frequency 501000000 annex B modulation 256qam interleave 128
 rf-channel 3 depi-tunnel 3g60_6_0_0 tsid 5094
 rf-channel 3 rf-shutdown
 rf-channel 4 cable downstream channel-id 5
 rf-channel 4 frequency 507000000 annex B modulation 256qam interleave 128
 rf-channel 4 depi-tunnel 3g60_6_0_0 tsid 5095
 no rf-channel 4 rf-shutdown
 rf-channel 5 cable downstream channel-id 6
 rf-channel 5 frequency 146000000 annex B modulation 256qam interleave 128
 rf-channel 5 depi-tunnel 3g60_6_0_0 tsid 5096
 no rf-channel 5 rf-shutdown
 rf-channel 6 cable downstream channel-id 7
```

```
 rf-channel 6 frequency 152000000 annex B modulation 256qam interleave 128
 rf-channel 6 depi-tunnel 3g60_6_0_0 tsid 5097
 no rf-channel 6 rf-shutdown
 rf-channel 7 cable downstream channel-id 8
 rf-channel 8 cable downstream channel-id 9
 rf-channel 9 cable downstream channel-id 10
 rf-channel 10 cable downstream channel-id 11
 rf-channel 11 cable downstream channel-id 11
 rf-channel 12 cable downstream channel-id 13
 rf-channel 13 cable downstream channel-id 14
 rf-channel 14 cable downstream channel-id 15
 rf-channel 15 cable downstream channel-id 16
 rf-channel 16 cable downstream channel-id 17
 rf-channel 17 cable downstream channel-id 18
 rf-channel 18 cable downstream channel-id 19
 rf-channel 19 cable downstream channel-id 20
 rf-channel 20 cable downstream channel-id 21
 rf-channel 21 cable downstream channel-id 22
 rf-channel 22 cable downstream channel-id 23
 rf-channel 23 cable downstream channel-id 24
!
controller Modular-Cable 6/0/1
 ip-address 192.60.0.1
 rf-channel 0 cable downstream channel-id 25
 rf-channel 1 cable downstream channel-id 26
 rf-channel 2 cable downstream channel-id 27
 rf-channel 3 cable downstream channel-id 28
 rf-channel 4 cable downstream channel-id 29
 rf-channel 5 cable downstream channel-id 30
 rf-channel 6 cable downstream channel-id 31
 rf-channel 7 cable downstream channel-id 32
 rf-channel 8 cable downstream channel-id 33
 rf-channel 9 cable downstream channel-id 34
 rf-channel 10 cable downstream channel-id 35
 rf-channel 11 cable downstream channel-id 36
 rf-channel 12 cable downstream channel-id 37
 rf-channel 13 cable downstream channel-id 38
 rf-channel 14 cable downstream channel-id 39
 rf-channel 15 cable downstream channel-id 40
 rf-channel 16 cable downstream channel-id 41
 rf-channel 17 cable downstream channel-id 42
 rf-channel 18 cable downstream channel-id 43
 rf-channel 19 cable downstream channel-id 44
 rf-channel 20 cable downstream channel-id 45
 rf-channel 21 cable downstream channel-id 46
 rf-channel 22 cable downstream channel-id 47
 rf-channel 23 cable downstream channel-id 48
!
controller Modular-Cable 6/0/2
 ip-address 192.60.0.1
 rf-channel 0 cable downstream channel-id 49
 rf-channel 1 cable downstream channel-id 50
 rf-channel 2 cable downstream channel-id 51
 rf-channel 3 cable downstream channel-id 52
 rf-channel 4 cable downstream channel-id 53
 rf-channel 5 cable downstream channel-id 54
 rf-channel 6 cable downstream channel-id 55
 rf-channel 7 cable downstream channel-id 56
 rf-channel 8 cable downstream channel-id 57
 rf-channel 9 cable downstream channel-id 58
 rf-channel 10 cable downstream channel-id 59
 rf-channel 11 cable downstream channel-id 60
 rf-channel 12 cable downstream channel-id 61
 rf-channel 13 cable downstream channel-id 62
 rf-channel 14 cable downstream channel-id 63
 rf-channel 15 cable downstream channel-id 64
 rf-channel 16 cable downstream channel-id 65
 rf-channel 17 cable downstream channel-id 66
 rf-channel 18 cable downstream channel-id 67
 rf-channel 19 cable downstream channel-id 68
 rf-channel 20 cable downstream channel-id 69
 rf-channel 21 cable downstream channel-id 70
 rf-channel 22 cable downstream channel-id 71
```

```
 rf-channel 23 cable downstream channel-id 72
!
!
!
!
!
!
interface FastEthernet0/0/0
 ip address 80.1.1.51 255.255.255.0
 no ip proxy-arp
 no ip route-cache cef
 no ip route-cache
 media-type rj45
 speed 100
 duplex auto
!
interface Cable5/0/0
 downstream Modular-Cable 5/0/0 rf-channel 0-7 upstream 0-3
 cable mtc-mode
 no cable packet-cache
 cable default-phy-burst 0
 cable bundle 4
 cable upstream max-ports 4
 cable upstream bonding-group 1
  upstream 0
  upstream 1
  upstream 2
  upstream 3
  attributes 80000000
 cable upstream 0 connector 0
 cable upstream 0 frequency 20000000
 cable upstream 0 channel-width 6400000
 cable upstream 0 docsis-mode atdma
 cable upstream 0 minislot-size 4
 cable upstream 0 range-backoff 3 6
 cable upstream 0 modulation-profile 221
 no cable upstream 0 rate-limit
 cable upstream 0 rate-adapt
 no cable upstream 0 shutdown
 cable upstream 1 connector 0
 cable upstream 1 frequency 28000000
 cable upstream 1 channel-width 6400000
 cable upstream 1 docsis-mode atdma
 cable upstream 1 minislot-size 4
 cable upstream 1 range-backoff 3 6
 cable upstream 1 modulation-profile 221
 no cable upstream 1 rate-limit
 cable upstream 1 rate-adapt
 no cable upstream 1 shutdown
 cable upstream 2 connector 0
 cable upstream 2 frequency 36000000
 cable upstream 2 channel-width 6400000
 cable upstream 2 docsis-mode atdma
 cable upstream 2 minislot-size 4
 cable upstream 2 range-backoff 3 6
 cable upstream 2 modulation-profile 221
 no cable upstream 2 rate-limit
 cable upstream 2 rate-adapt
 no cable upstream 2 shutdown
 cable upstream 3 connector 0
 cable upstream 3 frequency 44000000
 cable upstream 3 channel-width 6400000
 cable upstream 3 docsis-mode atdma
 cable upstream 3 minislot-size 4
 cable upstream 3 range-backoff 3 6
 cable upstream 3 modulation-profile 221
 no cable upstream 3 rate-limit
 cable upstream 3 rate-adapt
 no cable upstream 3 shutdown
!
interface Cable5/0/1
 no cable packet-cache
 cable upstream max-ports 4
```

```
 cable upstream 0 connector 0
 cable upstream 0 channel-width 1600000
 cable upstream 0 docsis-mode atdma
 cable upstream 0 minislot-size 4
 cable upstream 0 range-backoff 3 6
 cable upstream 0 modulation-profile 221
 cable upstream 0 shutdown
 cable upstream 1 connector 0
 cable upstream 1 channel-width 1600000
 cable upstream 1 docsis-mode atdma
 cable upstream 1 minislot-size 4
 cable upstream 1 range-backoff 3 6
 cable upstream 1 modulation-profile 221
 cable upstream 1 shutdown
 cable upstream 2 connector 1
 cable upstream 2 channel-width 1600000
 cable upstream 2 docsis-mode atdma
 cable upstream 2 minislot-size 4
 cable upstream 2 range-backoff 3 6
 cable upstream 2 modulation-profile 221
 cable upstream 2 shutdown
 cable upstream 3 connector 0
 cable upstream 3 channel-width 1600000
 cable upstream 3 docsis-mode atdma
 cable upstream 3 minislot-size 4
 cable upstream 3 range-backoff 3 6
 cable upstream 3 modulation-profile 221
 cable upstream 3 shutdown
!
interface Cable5/0/2
 no cable packet-cache
 cable upstream max-ports 4
 cable upstream 0 connector 0
 cable upstream 0 channel-width 1600000
 cable upstream 0 docsis-mode atdma
 cable upstream 0 minislot-size 4
 cable upstream 0 range-backoff 3 6
 cable upstream 0 modulation-profile 221
 cable upstream 0 shutdown
 cable upstream 1 connector 0
 cable upstream 1 channel-width 1600000
 cable upstream 1 docsis-mode atdma
 cable upstream 1 minislot-size 4
 cable upstream 1 range-backoff 3 6
 cable upstream 1 modulation-profile 221
 cable upstream 1 shutdown
 cable upstream 2 connector 0
 cable upstream 2 channel-width 1600000
 cable upstream 2 docsis-mode atdma
 cable upstream 2 minislot-size 4
 cable upstream 2 range-backoff 3 6
 cable upstream 2 modulation-profile 221
 cable upstream 2 shutdown
 cable upstream 3 connector 0
 cable upstream 3 channel-width 1600000
 cable upstream 3 docsis-mode atdma
 cable upstream 3 minislot-size 4
 cable upstream 3 range-backoff 3 6
 cable upstream 3 modulation-profile 221
 cable upstream 3 shutdown
!
interface Cable5/0/3
 no cable packet-cache
 cable upstream max-ports 4
 cable upstream 0 connector 0
 cable upstream 0 channel-width 1600000
 cable upstream 0 docsis-mode atdma
 cable upstream 0 minislot-size 4
 cable upstream 0 range-backoff 3 6
 cable upstream 0 modulation-profile 221
 cable upstream 0 shutdown
 cable upstream 1 connector 0
 cable upstream 1 channel-width 1600000
```

```
 cable upstream 1 docsis-mode atdma
 cable upstream 1 minislot-size 4
 cable upstream 1 range-backoff 3 6
 cable upstream 1 modulation-profile 221
 cable upstream 1 shutdown
 cable upstream 2 connector 0
 cable upstream 2 channel-width 1600000
 cable upstream 2 docsis-mode atdma
 cable upstream 2 minislot-size 4
 cable upstream 2 range-backoff 3 6
 cable upstream 2 modulation-profile 221
 cable upstream 2 shutdown
 cable upstream 3 connector 0
 cable upstream 3 channel-width 1600000
 cable upstream 3 docsis-mode atdma
 cable upstream 3 minislot-size 4
 cable upstream 3 range-backoff 3 6
 cable upstream 3 modulation-profile 221
 cable upstream 3 shutdown
!
interface Cable5/0/4
 no cable packet-cache
 cable upstream max-ports 4
 cable upstream 0 connector 0
 cable upstream 0 channel-width 1600000
 cable upstream 0 docsis-mode atdma
 cable upstream 0 minislot-size 4
 cable upstream 0 range-backoff 3 6
 cable upstream 0 modulation-profile 221
 cable upstream 0 shutdown
 cable upstream 1 connector 0
 cable upstream 1 channel-width 1600000
 cable upstream 1 docsis-mode atdma
 cable upstream 1 minislot-size 4
 cable upstream 1 range-backoff 3 6
 cable upstream 1 modulation-profile 221
 cable upstream 1 shutdown
 cable upstream 2 connector 0
 cable upstream 2 channel-width 1600000
 cable upstream 2 docsis-mode atdma
 cable upstream 2 minislot-size 4
 cable upstream 2 range-backoff 3 6
 cable upstream 2 modulation-profile 221
 cable upstream 2 shutdown
 cable upstream 3 connector 0
 cable upstream 3 channel-width 1600000
 cable upstream 3 docsis-mode atdma
 cable upstream 3 minislot-size 4
 cable upstream 3 range-backoff 3 6
 cable upstream 3 modulation-profile 221
 cable upstream 3 shutdown
!
interface Cable5/0/5
 no cable packet-cache
 cable upstream max-ports 4
 no cable upstream 0 connector
 cable upstream 0 channel-width 1600000
 cable upstream 0 docsis-mode atdma
 cable upstream 0 minislot-size 4
 cable upstream 0 range-backoff 3 6
 cable upstream 0 modulation-profile 221
 cable upstream 0 shutdown
 no cable upstream 1 connector
 cable upstream 1 channel-width 1600000
 cable upstream 1 docsis-mode atdma
 cable upstream 1 minislot-size 4
 cable upstream 1 range-backoff 3 6
 cable upstream 1 modulation-profile 221
 cable upstream 1 shutdown
 cable upstream 2 connector 1
 cable upstream 2 channel-width 1600000
 cable upstream 2 docsis-mode atdma
 cable upstream 2 minislot-size 4
```

```
 cable upstream 2 range-backoff 3 6
 cable upstream 2 modulation-profile 221
 cable upstream 2 shutdown
 cable upstream 3 connector 1
 cable upstream 3 channel-width 1600000
 cable upstream 3 docsis-mode atdma
 cable upstream 3 minislot-size 4
 cable upstream 3 range-backoff 3 6
 cable upstream 3 modulation-profile 221
 cable upstream 3 shutdown
!
interface Cable5/0/6
 no cable packet-cache
 cable upstream max-ports 4
 cable upstream 0 connector 1
 cable upstream 0 channel-width 1600000
 cable upstream 0 docsis-mode atdma
 cable upstream 0 minislot-size 4
 cable upstream 0 range-backoff 3 6
 cable upstream 0 modulation-profile 221
 cable upstream 0 shutdown
 cable upstream 1 connector 1
 cable upstream 1 channel-width 1600000
 cable upstream 1 docsis-mode atdma
 cable upstream 1 minislot-size 4
 cable upstream 1 range-backoff 3 6
 cable upstream 1 modulation-profile 221
 cable upstream 1 shutdown
 cable upstream 2 connector 1
 cable upstream 2 channel-width 1600000
 cable upstream 2 docsis-mode atdma
 cable upstream 2 minislot-size 4
 cable upstream 2 range-backoff 3 6
 cable upstream 2 modulation-profile 221
 cable upstream 2 shutdown
 cable upstream 3 connector 1
 cable upstream 3 channel-width 1600000
 cable upstream 3 docsis-mode atdma
 cable upstream 3 minislot-size 4
 cable upstream 3 range-backoff 3 6
 cable upstream 3 modulation-profile 221
 cable upstream 3 shutdown
!
interface Cable5/0/7
 no cable packet-cache
 cable upstream max-ports 4
 cable upstream 0 connector 1
 cable upstream 0 channel-width 1600000
 cable upstream 0 docsis-mode atdma
 cable upstream 0 minislot-size 4
 cable upstream 0 range-backoff 3 6
 cable upstream 0 modulation-profile 221
 cable upstream 0 shutdown
 cable upstream 1 connector 1
 cable upstream 1 channel-width 1600000
 cable upstream 1 docsis-mode atdma
 cable upstream 1 minislot-size 4
 cable upstream 1 range-backoff 3 6
 cable upstream 1 modulation-profile 221
 cable upstream 1 shutdown
 cable upstream 2 connector 1
 cable upstream 2 channel-width 1600000
 cable upstream 2 docsis-mode atdma
 cable upstream 2 minislot-size 4
 cable upstream 2 range-backoff 3 6
 cable upstream 2 modulation-profile 221
 cable upstream 2 shutdown
 cable upstream 3 connector 1
 cable upstream 3 channel-width 1600000
 cable upstream 3 docsis-mode atdma
 cable upstream 3 minislot-size 4
 cable upstream 3 range-backoff 3 6
 cable upstream 3 modulation-profile 221
```

```
 cable upstream 3 shutdown
!
interface Cable5/0/8
 no cable packet-cache
 cable upstream max-ports 4
 cable upstream 0 connector 1
 cable upstream 0 channel-width 1600000
 cable upstream 0 docsis-mode atdma
 cable upstream 0 minislot-size 4
 cable upstream 0 range-backoff 3 6
 cable upstream 0 modulation-profile 221
 cable upstream 0 shutdown
 cable upstream 1 connector 1
 cable upstream 1 channel-width 1600000
 cable upstream 1 docsis-mode atdma
 cable upstream 1 minislot-size 4
 cable upstream 1 range-backoff 3 6
 cable upstream 1 modulation-profile 221
 cable upstream 1 shutdown
 cable upstream 2 connector 1
 cable upstream 2 channel-width 1600000
 cable upstream 2 docsis-mode atdma
 cable upstream 2 minislot-size 4
 cable upstream 2 range-backoff 3 6
 cable upstream 2 modulation-profile 221
 cable upstream 2 shutdown
 cable upstream 3 connector 1
 cable upstream 3 channel-width 1600000
 cable upstream 3 docsis-mode atdma
 cable upstream 3 minislot-size 4
 cable upstream 3 range-backoff 3 6
 cable upstream 3 modulation-profile 221
 cable upstream 3 shutdown
!
interface Cable5/0/9
 no cable packet-cache
 cable upstream max-ports 4
 cable upstream 0 connector 1
 cable upstream 0 channel-width 1600000
 cable upstream 0 docsis-mode atdma
 cable upstream 0 minislot-size 4
 cable upstream 0 range-backoff 3 6
 cable upstream 0 modulation-profile 221
 cable upstream 0 shutdown
 cable upstream 1 connector 1
 cable upstream 1 channel-width 1600000
 cable upstream 1 docsis-mode atdma
 cable upstream 1 minislot-size 4
 cable upstream 1 range-backoff 3 6
 cable upstream 1 modulation-profile 221
 cable upstream 1 shutdown
 cable upstream 2 connector 1
 cable upstream 2 channel-width 1600000
 cable upstream 2 docsis-mode atdma
 cable upstream 2 minislot-size 4
 cable upstream 2 range-backoff 3 6
 cable upstream 2 modulation-profile 221
 cable upstream 2 shutdown
 cable upstream 3 connector 1
 cable upstream 3 channel-width 1600000
 cable upstream 3 docsis-mode atdma
 cable upstream 3 minislot-size 4
 cable upstream 3 range-backoff 3 6
 cable upstream 3 modulation-profile 221
 cable upstream 3 shutdown
!
interface Cable5/0/10
 no cable packet-cache
 cable upstream max-ports 4
 cable upstream 0 connector 2
 cable upstream 0 channel-width 1600000
 cable upstream 0 docsis-mode atdma
 cable upstream 0 minislot-size 4
```

```
 cable upstream 0 range-backoff 3 6
 cable upstream 0 modulation-profile 221
 cable upstream 0 shutdown
 cable upstream 1 connector 2
 cable upstream 1 channel-width 1600000
 cable upstream 1 docsis-mode atdma
 cable upstream 1 minislot-size 4
 cable upstream 1 range-backoff 3 6
 cable upstream 1 modulation-profile 221
 cable upstream 1 shutdown
 cable upstream 2 connector 2
 cable upstream 2 channel-width 1600000
 cable upstream 2 docsis-mode atdma
 cable upstream 2 minislot-size 4
 cable upstream 2 range-backoff 3 6
 cable upstream 2 modulation-profile 221
 cable upstream 2 shutdown
 cable upstream 3 connector 2
 cable upstream 3 channel-width 1600000
 cable upstream 3 docsis-mode atdma
 cable upstream 3 minislot-size 4
 cable upstream 3 range-backoff 3 6
 cable upstream 3 modulation-profile 221
 cable upstream 3 shutdown
!
interface Cable5/0/11
 no cable packet-cache
 cable upstream max-ports 4
 cable upstream 0 connector 2
 cable upstream 0 channel-width 1600000
 cable upstream 0 docsis-mode atdma
 cable upstream 0 minislot-size 4
 cable upstream 0 range-backoff 3 6
 cable upstream 0 modulation-profile 221
 cable upstream 0 shutdown
 cable upstream 1 connector 2
 cable upstream 1 channel-width 1600000
 cable upstream 1 docsis-mode atdma
 cable upstream 1 minislot-size 4
 cable upstream 1 range-backoff 3 6
 cable upstream 1 modulation-profile 221
 cable upstream 1 shutdown
 cable upstream 2 connector 2
 cable upstream 2 channel-width 1600000
 cable upstream 2 docsis-mode atdma
 cable upstream 2 minislot-size 4
 cable upstream 2 range-backoff 3 6
 cable upstream 2 modulation-profile 221
 cable upstream 2 shutdown
 cable upstream 3 connector 2
 cable upstream 3 channel-width 1600000
 cable upstream 3 docsis-mode atdma
 cable upstream 3 minislot-size 4
 cable upstream 3 range-backoff 3 6
 cable upstream 3 modulation-profile 221
 cable upstream 3 shutdown
!
interface Cable5/0/12
 no cable packet-cache
 cable upstream max-ports 4
 cable upstream 0 connector 2
 cable upstream 0 channel-width 1600000
 cable upstream 0 docsis-mode atdma
 cable upstream 0 minislot-size 4
 cable upstream 0 range-backoff 3 6
 cable upstream 0 modulation-profile 221
 cable upstream 0 shutdown
 cable upstream 1 connector 2
 cable upstream 1 channel-width 1600000
 cable upstream 1 docsis-mode atdma
 cable upstream 1 minislot-size 4
 cable upstream 1 range-backoff 3 6
 cable upstream 1 modulation-profile 221
```

```
 cable upstream 1 shutdown
 cable upstream 2 connector 2
 cable upstream 2 channel-width 1600000
 cable upstream 2 docsis-mode atdma
 cable upstream 2 minislot-size 4
 cable upstream 2 range-backoff 3 6
 cable upstream 2 modulation-profile 221
 cable upstream 2 shutdown
 cable upstream 3 connector 2
 cable upstream 3 channel-width 1600000
 cable upstream 3 docsis-mode atdma
 cable upstream 3 minislot-size 4
 cable upstream 3 range-backoff 3 6
 cable upstream 3 modulation-profile 221
 cable upstream 3 shutdown
!
interface Cable5/0/13
 no cable packet-cache
 cable upstream max-ports 4
 cable upstream 0 connector 2
 cable upstream 0 channel-width 1600000
 cable upstream 0 docsis-mode atdma
 cable upstream 0 minislot-size 4
 cable upstream 0 range-backoff 3 6
 cable upstream 0 modulation-profile 221
 cable upstream 0 shutdown
 cable upstream 1 connector 2
 cable upstream 1 channel-width 1600000
 cable upstream 1 docsis-mode atdma
 cable upstream 1 minislot-size 4
 cable upstream 1 range-backoff 3 6
 cable upstream 1 modulation-profile 221
 cable upstream 1 shutdown
 cable upstream 2 connector 2
 cable upstream 2 channel-width 1600000
 cable upstream 2 docsis-mode atdma
 cable upstream 2 minislot-size 4
 cable upstream 2 range-backoff 3 6
 cable upstream 2 modulation-profile 221
 cable upstream 2 shutdown
 cable upstream 3 connector 2
 cable upstream 3 channel-width 1600000
 cable upstream 3 docsis-mode atdma
 cable upstream 3 minislot-size 4
 cable upstream 3 range-backoff 3 6
 cable upstream 3 modulation-profile 221
 cable upstream 3 shutdown
!
interface Cable5/0/14
 no cable packet-cache
 cable upstream max-ports 4
 cable upstream 0 connector 2
 cable upstream 0 channel-width 1600000
 cable upstream 0 docsis-mode atdma
 cable upstream 0 minislot-size 4
 cable upstream 0 range-backoff 3 6
 cable upstream 0 modulation-profile 221
 cable upstream 0 shutdown
 cable upstream 1 connector 2
 cable upstream 1 channel-width 1600000
 cable upstream 1 docsis-mode atdma
 cable upstream 1 minislot-size 4
 cable upstream 1 range-backoff 3 6
 cable upstream 1 modulation-profile 221
 cable upstream 1 shutdown
 cable upstream 2 connector 2
 cable upstream 2 channel-width 1600000
 cable upstream 2 docsis-mode atdma
 cable upstream 2 minislot-size 4
 cable upstream 2 range-backoff 3 6
 cable upstream 2 modulation-profile 221
 cable upstream 2 shutdown
 cable upstream 3 connector 2
```

```
 cable upstream 3 channel-width 1600000
 cable upstream 3 docsis-mode atdma
 cable upstream 3 minislot-size 4
 cable upstream 3 range-backoff 3 6
 cable upstream 3 modulation-profile 221
 cable upstream 3 shutdown
!
interface GigabitEthernet5/0/0
 mac-address 7081.052d.2438
 ip address 50.1.0.1 255.255.255.0
 ip access-group cmc-l3connect out
 ip helper-address 20.1.0.33
 ip pim sparse-dense-mode
 ip igmp version 3
 load-interval 30
 negotiation auto
!
interface GigabitEthernet5/0/2
 no ip address
 negotiation auto
!
interface GigabitEthernet5/0/4
 no ip address
 negotiation auto
!
interface Modular-Cable5/0/0:0
 cable bundle 4
 cable rf-bandwidth-percent 50
!
interface Modular-Cable5/0/0:1
 cable bundle 4
 cable rf-bandwidth-percent 50
!
interface Modular-Cable5/0/0:2
 cable bundle 4
 cable rf-bandwidth-percent 50
!
interface Modular-Cable5/0/0:3
 cable bundle 4
 cable rf-bandwidth-percent 50
!
interface Modular-Cable5/0/0:4
 cable bundle 4
 cable rf-bandwidth-percent 50
!
interface Modular-Cable5/0/0:5
 cable bundle 4
 cable rf-bandwidth-percent 50
!
interface Modular-Cable5/0/0:6
 cable bundle 4
 cable rf-bandwidth-percent 50
!
interface Modular-Cable5/0/0:7
 cable bundle 4
 cable rf-bandwidth-percent 50
!
interface Wideband-Cable5/0/0:0
 cable bundle 4
 cable rf-channel 0 bandwidth-percent 20
 cable rf-channel 1 bandwidth-percent 20
 cable rf-channel 2 bandwidth-percent 20
 cable rf-channel 3 bandwidth-percent 20
 cable rf-channel 4 bandwidth-percent 20
 cable rf-channel 5 bandwidth-percent 20
 cable rf-channel 6 bandwidth-percent 20
 cable rf-channel 7 bandwidth-percent 20
!
interface Cable6/0/0
 downstream Modular-Cable 6/0/0 rf-channel 0-6 upstream 0-3
 cable mtc-mode
 no cable packet-cache
 cable bundle 1
```

```
 cable upstream max-ports 4
 cable upstream bonding-group 1
  upstream 0
  upstream 1
  upstream 2
  upstream 3
  attributes A0000000
 cable upstream 0 connector 0
 cable upstream 0 frequency 20000000
 cable upstream 0 channel-width 1600000 1600000
 cable upstream 0 docsis-mode atdma
 cable upstream 0 minislot-size 4
 cable upstream 0 range-backoff 3 6
 cable upstream 0 modulation-profile 221
 cable upstream 0 attribute-mask 20000000
 no cable upstream 0 shutdown
 cable upstream 1 connector 1
 cable upstream 1 frequency 28000000
 cable upstream 1 channel-width 1600000 1600000
 cable upstream 1 docsis-mode atdma
 cable upstream 1 minislot-size 4
 cable upstream 1 range-backoff 3 6
 cable upstream 1 modulation-profile 221
 cable upstream 1 attribute-mask 20000000
 no cable upstream 1 shutdown
 cable upstream 2 connector 2
 cable upstream 2 frequency 36000000
 cable upstream 2 channel-width 1600000 1600000
 cable upstream 2 docsis-mode atdma
 cable upstream 2 minislot-size 4
 cable upstream 2 range-backoff 3 6
 cable upstream 2 modulation-profile 221
 cable upstream 2 attribute-mask 20000000
 no cable upstream 2 shutdown
 cable upstream 3 connector 3
 cable upstream 3 frequency 44000000
 cable upstream 3 channel-width 1600000 1600000
 cable upstream 3 docsis-mode atdma
 cable upstream 3 minislot-size 4
 cable upstream 3 range-backoff 3 6
 cable upstream 3 modulation-profile 221
 cable upstream 3 attribute-mask 20000000
 no cable upstream 3 shutdown
!
interface Cable6/0/1
 no cable packet-cache
 cable upstream max-ports 4
 no cable upstream 0 connector
 cable upstream 0 channel-width 1600000 1600000
 cable upstream 0 docsis-mode atdma
 cable upstream 0 minislot-size 4
 cable upstream 0 range-backoff 3 6
 cable upstream 0 modulation-profile 221
 cable upstream 0 attribute-mask 20000000
 cable upstream 0 shutdown
 no cable upstream 1 connector
 cable upstream 1 channel-width 1600000 1600000
 cable upstream 1 docsis-mode atdma
 cable upstream 1 minislot-size 4
 cable upstream 1 range-backoff 3 6
 cable upstream 1 modulation-profile 221
 cable upstream 1 attribute-mask 20000000
 cable upstream 1 shutdown
 no cable upstream 2 connector
 cable upstream 2 channel-width 1600000 1600000
 cable upstream 2 docsis-mode atdma
 cable upstream 2 minislot-size 4
 cable upstream 2 range-backoff 3 6
 cable upstream 2 modulation-profile 221
 cable upstream 2 attribute-mask 20000000
 cable upstream 2 shutdown
 no cable upstream 3 connector
 cable upstream 3 channel-width 1600000 1600000
```

```
 cable upstream 3 docsis-mode atdma
 cable upstream 3 minislot-size 4
 cable upstream 3 range-backoff 3 6
 cable upstream 3 modulation-profile 221
 cable upstream 3 attribute-mask 20000000
 cable upstream 3 shutdown
!
interface Cable6/0/2
 no cable packet-cache
 cable upstream max-ports 4
 no cable upstream 0 connector
 cable upstream 0 channel-width 1600000 1600000
 cable upstream 0 docsis-mode atdma
 cable upstream 0 minislot-size 4
 cable upstream 0 range-backoff 3 6
 cable upstream 0 modulation-profile 221
 cable upstream 0 attribute-mask 20000000
 cable upstream 0 shutdown
 no cable upstream 1 connector
 cable upstream 1 channel-width 1600000 1600000
 cable upstream 1 docsis-mode atdma
 cable upstream 1 minislot-size 4
 cable upstream 1 range-backoff 3 6
 cable upstream 1 modulation-profile 221
 cable upstream 1 attribute-mask 20000000
 cable upstream 1 shutdown
 no cable upstream 2 connector
 cable upstream 2 channel-width 1600000 1600000
 cable upstream 2 docsis-mode atdma
 cable upstream 2 minislot-size 4
 cable upstream 2 range-backoff 3 6
 cable upstream 2 modulation-profile 221
 cable upstream 2 attribute-mask 20000000
 cable upstream 2 shutdown
 no cable upstream 3 connector
 cable upstream 3 channel-width 1600000 1600000
 cable upstream 3 docsis-mode atdma
 cable upstream 3 minislot-size 4
 cable upstream 3 range-backoff 3 6
 cable upstream 3 modulation-profile 221
 cable upstream 3 attribute-mask 20000000
 cable upstream 3 shutdown
!
interface Cable6/0/3
 no cable packet-cache
 cable upstream max-ports 4
 no cable upstream 0 connector
 cable upstream 0 channel-width 1600000 1600000
 cable upstream 0 docsis-mode atdma
 cable upstream 0 minislot-size 4
 cable upstream 0 range-backoff 3 6
 cable upstream 0 modulation-profile 221
 cable upstream 0 attribute-mask 20000000
 cable upstream 0 shutdown
 no cable upstream 1 connector
 cable upstream 1 channel-width 1600000 1600000
 cable upstream 1 docsis-mode atdma
 cable upstream 1 minislot-size 4
 cable upstream 1 range-backoff 3 6
 cable upstream 1 modulation-profile 221
 cable upstream 1 attribute-mask 20000000
 cable upstream 1 shutdown
 no cable upstream 2 connector
 cable upstream 2 channel-width 1600000 1600000
 cable upstream 2 docsis-mode atdma
 cable upstream 2 minislot-size 4
 cable upstream 2 range-backoff 3 6
 cable upstream 2 modulation-profile 221
 cable upstream 2 attribute-mask 20000000
 cable upstream 2 shutdown
 no cable upstream 3 connector
 cable upstream 3 channel-width 1600000 1600000
 cable upstream 3 docsis-mode atdma
```

```
 cable upstream 3 minislot-size 4
 cable upstream 3 range-backoff 3 6
 cable upstream 3 modulation-profile 221
 cable upstream 3 attribute-mask 20000000
 cable upstream 3 shutdown
!
interface Cable6/0/4
 no cable packet-cache
 cable upstream max-ports 4
 no cable upstream 0 connector
 cable upstream 0 channel-width 1600000 1600000
 cable upstream 0 docsis-mode atdma
 cable upstream 0 minislot-size 4
 cable upstream 0 range-backoff 3 6
 cable upstream 0 modulation-profile 221
 cable upstream 0 attribute-mask 20000000
 cable upstream 0 shutdown
 no cable upstream 1 connector
 cable upstream 1 channel-width 1600000 1600000
 cable upstream 1 docsis-mode atdma
 cable upstream 1 minislot-size 4
 cable upstream 1 range-backoff 3 6
 cable upstream 1 modulation-profile 221
 cable upstream 1 attribute-mask 20000000
 cable upstream 1 shutdown
 no cable upstream 2 connector
 cable upstream 2 channel-width 1600000 1600000
 cable upstream 2 docsis-mode atdma
 cable upstream 2 minislot-size 4
 cable upstream 2 range-backoff 3 6
 cable upstream 2 modulation-profile 221
 cable upstream 2 attribute-mask 20000000
 cable upstream 2 shutdown
 no cable upstream 3 connector
 cable upstream 3 channel-width 1600000 1600000
 cable upstream 3 docsis-mode atdma
 cable upstream 3 minislot-size 4
 cable upstream 3 range-backoff 3 6
 cable upstream 3 modulation-profile 221
 cable upstream 3 attribute-mask 20000000
 cable upstream 3 shutdown
!
interface Cable6/0/5
 no cable packet-cache
 cable upstream max-ports 4
 no cable upstream 0 connector
 cable upstream 0 channel-width 1600000 1600000
 cable upstream 0 docsis-mode atdma
 cable upstream 0 minislot-size 4
 cable upstream 0 range-backoff 3 6
 cable upstream 0 modulation-profile 221
 cable upstream 0 attribute-mask 20000000
 cable upstream 0 shutdown
 no cable upstream 1 connector
 cable upstream 1 channel-width 1600000 1600000
 cable upstream 1 docsis-mode atdma
 cable upstream 1 minislot-size 4
 cable upstream 1 range-backoff 3 6
 cable upstream 1 modulation-profile 221
 cable upstream 1 attribute-mask 20000000
 cable upstream 1 shutdown
 no cable upstream 2 connector
 cable upstream 2 channel-width 1600000 1600000
 cable upstream 2 docsis-mode atdma
 cable upstream 2 minislot-size 4
 cable upstream 2 range-backoff 3 6
 cable upstream 2 modulation-profile 221
 cable upstream 2 attribute-mask 20000000
 cable upstream 2 shutdown
 no cable upstream 3 connector
 cable upstream 3 channel-width 1600000 1600000
 cable upstream 3 docsis-mode atdma
 cable upstream 3 minislot-size 4
```

```
 cable upstream 3 range-backoff 3 6
 cable upstream 3 modulation-profile 221
 cable upstream 3 attribute-mask 20000000
 cable upstream 3 shutdown
!
interface Cable6/0/6
 no cable packet-cache
 cable upstream max-ports 4
 no cable upstream 0 connector
 cable upstream 0 channel-width 1600000 1600000
 cable upstream 0 docsis-mode atdma
 cable upstream 0 minislot-size 4
 cable upstream 0 range-backoff 3 6
 cable upstream 0 modulation-profile 221
 cable upstream 0 attribute-mask 20000000
 cable upstream 0 shutdown
 no cable upstream 1 connector
 cable upstream 1 channel-width 1600000 1600000
 cable upstream 1 docsis-mode atdma
 cable upstream 1 minislot-size 4
 cable upstream 1 range-backoff 3 6
 cable upstream 1 modulation-profile 221
 cable upstream 1 attribute-mask 20000000
 cable upstream 1 shutdown
 no cable upstream 2 connector
 cable upstream 2 channel-width 1600000 1600000
 cable upstream 2 docsis-mode atdma
 cable upstream 2 minislot-size 4
 cable upstream 2 range-backoff 3 6
 cable upstream 2 modulation-profile 221
 cable upstream 2 attribute-mask 20000000
 cable upstream 2 shutdown
 no cable upstream 3 connector
 cable upstream 3 channel-width 1600000 1600000
 cable upstream 3 docsis-mode atdma
 cable upstream 3 minislot-size 4
 cable upstream 3 range-backoff 3 6
 cable upstream 3 modulation-profile 221
 cable upstream 3 attribute-mask 20000000
 cable upstream 3 shutdown
!
interface Cable6/0/7
 no cable packet-cache
 cable upstream max-ports 4
 no cable upstream 0 connector
 cable upstream 0 channel-width 1600000 1600000
 cable upstream 0 docsis-mode atdma
 cable upstream 0 minislot-size 4
 cable upstream 0 range-backoff 3 6
 cable upstream 0 modulation-profile 221
 cable upstream 0 attribute-mask 20000000
 cable upstream 0 shutdown
 no cable upstream 1 connector
 cable upstream 1 channel-width 1600000 1600000
 cable upstream 1 docsis-mode atdma
 cable upstream 1 minislot-size 4
 cable upstream 1 range-backoff 3 6
 cable upstream 1 modulation-profile 221
 cable upstream 1 attribute-mask 20000000
 cable upstream 1 shutdown
 no cable upstream 2 connector
 cable upstream 2 channel-width 1600000 1600000
 cable upstream 2 docsis-mode atdma
 cable upstream 2 minislot-size 4
 cable upstream 2 range-backoff 3 6
 cable upstream 2 modulation-profile 221
 cable upstream 2 attribute-mask 20000000
 cable upstream 2 shutdown
 no cable upstream 3 connector
 cable upstream 3 channel-width 1600000 1600000
 cable upstream 3 docsis-mode atdma
 cable upstream 3 minislot-size 4
 cable upstream 3 range-backoff 3 6
```

```
 cable upstream 3 modulation-profile 221
 cable upstream 3 attribute-mask 20000000
 cable upstream 3 shutdown
!
interface Cable6/0/8
 no cable packet-cache
 cable upstream max-ports 4
 no cable upstream 0 connector
 cable upstream 0 channel-width 1600000 1600000
 cable upstream 0 docsis-mode atdma
 cable upstream 0 minislot-size 4
 cable upstream 0 range-backoff 3 6
 cable upstream 0 modulation-profile 221
 cable upstream 0 attribute-mask 20000000
 cable upstream 0 shutdown
 no cable upstream 1 connector
 cable upstream 1 channel-width 1600000 1600000
 cable upstream 1 docsis-mode atdma
 cable upstream 1 minislot-size 4
 cable upstream 1 range-backoff 3 6
 cable upstream 1 modulation-profile 221
 cable upstream 1 attribute-mask 20000000
 cable upstream 1 shutdown
 no cable upstream 2 connector
 cable upstream 2 channel-width 1600000 1600000
 cable upstream 2 docsis-mode atdma
 cable upstream 2 minislot-size 4
 cable upstream 2 range-backoff 3 6
 cable upstream 2 modulation-profile 221
 cable upstream 2 attribute-mask 20000000
 cable upstream 2 shutdown
 no cable upstream 3 connector
 cable upstream 3 channel-width 1600000 1600000
 cable upstream 3 docsis-mode atdma
 cable upstream 3 minislot-size 4
 cable upstream 3 range-backoff 3 6
 cable upstream 3 modulation-profile 221
 cable upstream 3 attribute-mask 20000000
 cable upstream 3 shutdown
!
interface Cable6/0/9
 no cable packet-cache
 cable upstream max-ports 4
 no cable upstream 0 connector
 cable upstream 0 channel-width 1600000 1600000
 cable upstream 0 docsis-mode atdma
 cable upstream 0 minislot-size 4
 cable upstream 0 range-backoff 3 6
 cable upstream 0 modulation-profile 221
 cable upstream 0 attribute-mask 20000000
 cable upstream 0 shutdown
 no cable upstream 1 connector
 cable upstream 1 channel-width 1600000 1600000
 cable upstream 1 docsis-mode atdma
 cable upstream 1 minislot-size 4
 cable upstream 1 range-backoff 3 6
 cable upstream 1 modulation-profile 221
 cable upstream 1 attribute-mask 20000000
 cable upstream 1 shutdown
 no cable upstream 2 connector
 cable upstream 2 channel-width 1600000 1600000
 cable upstream 2 docsis-mode atdma
 cable upstream 2 minislot-size 4
 cable upstream 2 range-backoff 3 6
 cable upstream 2 modulation-profile 221
 cable upstream 2 attribute-mask 20000000
 cable upstream 2 shutdown
 no cable upstream 3 connector
 cable upstream 3 channel-width 1600000 1600000
 cable upstream 3 docsis-mode atdma
 cable upstream 3 minislot-size 4
 cable upstream 3 range-backoff 3 6
 cable upstream 3 modulation-profile 221
```

```
 cable upstream 3 attribute-mask 20000000
 cable upstream 3 shutdown
!
interface Cable6/0/10
 no cable packet-cache
 cable upstream max-ports 4
 no cable upstream 0 connector
 cable upstream 0 channel-width 1600000 1600000
 cable upstream 0 docsis-mode atdma
 cable upstream 0 minislot-size 4
 cable upstream 0 range-backoff 3 6
 cable upstream 0 modulation-profile 221
 cable upstream 0 attribute-mask 20000000
 cable upstream 0 shutdown
 no cable upstream 1 connector
 cable upstream 1 channel-width 1600000 1600000
 cable upstream 1 docsis-mode atdma
 cable upstream 1 minislot-size 4
 cable upstream 1 range-backoff 3 6
 cable upstream 1 modulation-profile 221
 cable upstream 1 attribute-mask 20000000
 cable upstream 1 shutdown
 no cable upstream 2 connector
 cable upstream 2 channel-width 1600000 1600000
 cable upstream 2 docsis-mode atdma
 cable upstream 2 minislot-size 4
 cable upstream 2 range-backoff 3 6
 cable upstream 2 modulation-profile 221
 cable upstream 2 attribute-mask 20000000
 cable upstream 2 shutdown
 no cable upstream 3 connector
 cable upstream 3 channel-width 1600000 1600000
 cable upstream 3 docsis-mode atdma
 cable upstream 3 minislot-size 4
 cable upstream 3 range-backoff 3 6
 cable upstream 3 modulation-profile 221
 cable upstream 3 attribute-mask 20000000
 cable upstream 3 shutdown
!
interface Cable6/0/11
 no cable packet-cache
 cable upstream max-ports 4
 no cable upstream 0 connector
 cable upstream 0 channel-width 1600000 1600000
 cable upstream 0 docsis-mode atdma
 cable upstream 0 minislot-size 4
 cable upstream 0 range-backoff 3 6
 cable upstream 0 modulation-profile 221
 cable upstream 0 attribute-mask 20000000
 cable upstream 0 shutdown
 no cable upstream 1 connector
 cable upstream 1 channel-width 1600000 1600000
 cable upstream 1 docsis-mode atdma
 cable upstream 1 minislot-size 4
 cable upstream 1 range-backoff 3 6
 cable upstream 1 modulation-profile 221
 cable upstream 1 attribute-mask 20000000
 cable upstream 1 shutdown
 no cable upstream 2 connector
 cable upstream 2 channel-width 1600000 1600000
 cable upstream 2 docsis-mode atdma
 cable upstream 2 minislot-size 4
 cable upstream 2 range-backoff 3 6
 cable upstream 2 modulation-profile 221
 cable upstream 2 attribute-mask 20000000
 cable upstream 2 shutdown
 no cable upstream 3 connector
 cable upstream 3 channel-width 1600000 1600000
 cable upstream 3 docsis-mode atdma
 cable upstream 3 minislot-size 4
 cable upstream 3 range-backoff 3 6
 cable upstream 3 modulation-profile 221
 cable upstream 3 attribute-mask 20000000
```

```
 cable upstream 3 shutdown
!
interface Cable6/0/12
 no cable packet-cache
 cable upstream max-ports 4
 no cable upstream 0 connector
 cable upstream 0 channel-width 1600000 1600000
 cable upstream 0 docsis-mode atdma
 cable upstream 0 minislot-size 4
 cable upstream 0 range-backoff 3 6
 cable upstream 0 modulation-profile 221
 cable upstream 0 attribute-mask 20000000
 cable upstream 0 shutdown
 no cable upstream 1 connector
 cable upstream 1 channel-width 1600000 1600000
 cable upstream 1 docsis-mode atdma
 cable upstream 1 minislot-size 4
 cable upstream 1 range-backoff 3 6
 cable upstream 1 modulation-profile 221
 cable upstream 1 attribute-mask 20000000
 cable upstream 1 shutdown
 no cable upstream 2 connector
 cable upstream 2 channel-width 1600000 1600000
 cable upstream 2 docsis-mode atdma
 cable upstream 2 minislot-size 4
 cable upstream 2 range-backoff 3 6
 cable upstream 2 modulation-profile 221
 cable upstream 2 attribute-mask 20000000
 cable upstream 2 shutdown
 no cable upstream 3 connector
 cable upstream 3 channel-width 1600000 1600000
 cable upstream 3 docsis-mode atdma
 cable upstream 3 minislot-size 4
 cable upstream 3 range-backoff 3 6
 cable upstream 3 modulation-profile 221
 cable upstream 3 attribute-mask 20000000
 cable upstream 3 shutdown
!
interface Cable6/0/13
 no cable packet-cache
 cable upstream max-ports 4
 no cable upstream 0 connector
 cable upstream 0 channel-width 1600000 1600000
 cable upstream 0 docsis-mode atdma
 cable upstream 0 minislot-size 4
 cable upstream 0 range-backoff 3 6
 cable upstream 0 modulation-profile 221
 cable upstream 0 attribute-mask 20000000
 cable upstream 0 shutdown
 no cable upstream 1 connector
 cable upstream 1 channel-width 1600000 1600000
 cable upstream 1 docsis-mode atdma
 cable upstream 1 minislot-size 4
 cable upstream 1 range-backoff 3 6
 cable upstream 1 modulation-profile 221
 cable upstream 1 attribute-mask 20000000
 cable upstream 1 shutdown
 no cable upstream 2 connector
 cable upstream 2 channel-width 1600000 1600000
 cable upstream 2 docsis-mode atdma
 cable upstream 2 minislot-size 4
 cable upstream 2 range-backoff 3 6
 cable upstream 2 modulation-profile 221
 cable upstream 2 attribute-mask 20000000
 cable upstream 2 shutdown
 no cable upstream 3 connector
 cable upstream 3 channel-width 1600000 1600000
 cable upstream 3 docsis-mode atdma
 cable upstream 3 minislot-size 4
 cable upstream 3 range-backoff 3 6
 cable upstream 3 modulation-profile 221
 cable upstream 3 attribute-mask 20000000
 cable upstream 3 shutdown
```

```
!
interface Cable6/0/14
 no cable packet-cache
 cable upstream max-ports 4
 no cable upstream 0 connector
 cable upstream 0 channel-width 1600000 1600000
 cable upstream 0 docsis-mode atdma
 cable upstream 0 minislot-size 4
 cable upstream 0 range-backoff 3 6
 cable upstream 0 modulation-profile 221
 cable upstream 0 attribute-mask 20000000
 cable upstream 0 shutdown
 no cable upstream 1 connector
 cable upstream 1 channel-width 1600000 1600000
 cable upstream 1 docsis-mode atdma
 cable upstream 1 minislot-size 4
 cable upstream 1 range-backoff 3 6
 cable upstream 1 modulation-profile 221
 cable upstream 1 attribute-mask 20000000
 cable upstream 1 shutdown
 no cable upstream 2 connector
 cable upstream 2 channel-width 1600000 1600000
 cable upstream 2 docsis-mode atdma
 cable upstream 2 minislot-size 4
 cable upstream 2 range-backoff 3 6
 cable upstream 2 modulation-profile 221
 cable upstream 2 attribute-mask 20000000
 cable upstream 2 shutdown
 no cable upstream 3 connector
 cable upstream 3 channel-width 1600000 1600000
 cable upstream 3 docsis-mode atdma
 cable upstream 3 minislot-size 4
 cable upstream 3 range-backoff 3 6
 cable upstream 3 modulation-profile 221
 cable upstream 3 attribute-mask 20000000
 cable upstream 3 shutdown
!
interface GigabitEthernet6/0/0
 ip address 192.60.0.1 255.255.255.0
 negotiation auto
!
interface GigabitEthernet6/0/2
 no ip address
 negotiation auto
!
interface GigabitEthernet6/0/4
 no ip address
 negotiation auto
!
interface Modular-Cable6/0/0:0
 cable bundle 1
 cable rf-bandwidth-percent 20
!
interface Modular-Cable6/0/0:1
 cable bundle 1
 cable rf-bandwidth-percent 10
!
interface Modular-Cable6/0/0:2
 cable bundle 1
 cable rf-bandwidth-percent 10
!
interface Modular-Cable6/0/0:3
 cable bundle 1
 cable rf-bandwidth-percent 50
!
interface Modular-Cable6/0/0:4
 cable bundle 1
 cable rf-bandwidth-percent 50
!
interface Modular-Cable6/0/0:5
 cable bundle 1
 cable rf-bandwidth-percent 50
!
```

```
interface Modular-Cable6/0/0:6
 cable bundle 1
 cable rf-bandwidth-percent 50
!
interface Wideband-Cable6/0/0:0
 cable bundle 1
 cable rf-channel 0 bandwidth-percent 10
 cable rf-channel 1 bandwidth-percent 10
 cable rf-channel 2 bandwidth-percent 10
 cable rf-channel 3 bandwidth-percent 10
 cable rf-channel 4 bandwidth-percent 10
 cable rf-channel 5 bandwidth-percent 10
 cable rf-channel 6 bandwidth-percent 10
!
interface Bundle1
 ip address 70.2.0.1 255.255.0.0
 cable arp filter request-send 3 2
 cable arp filter reply-accept 3 2
 cable dhcp-giaddr policy
!
interface Bundle4
 ip address 80.2.0.1 255.255.255.0 secondary
 ip address 80.1.0.1 255.255.255.0
 cable arp filter request-send 3 2
 cable arp filter reply-accept 3 2
 cable dhcp-giaddr policy
!
ip default-gateway 80.1.1.1
ip classless
ip route 0.0.0.0 0.0.0.0 80.1.1.1
ip route 50.2.0.0 255.255.255.0 50.1.0.2
!
!
no ip http server
no ip http secure-server
!
!
logging cmts ipc-cable log-level errors
logging cmts sea syslog-level errors
cpd cr-id 1
nls resp-timeout 1
cdp run
!
tftp-server disk0:hayu2_cdoc.cm alias golden.cm
tftp-server disk0:basic_cm.cm alias config.cm
tftp-server disk0:cmc-16x4-os-20140731_QDR.bin alias cmc-16x4-os-20140731_QDR.bin
tftp-server disk0:cmc-16x4-os-20141127.bin alias cmc-16x4-os-20141127.bin
snmp-server engineID local A00A00A00AA00A00A00A
snmp-server view hccp_chansw_snmp_view enterprises.6804.2.1.1.3 included
snmp-server view hccp_chansw_snmp_view enterprises.6804.2.1.1.4 included
snmp-server view hccp_chansw_snmp_view enterprises.6804.2.1.1.6 included
snmp-server view hccp_chansw_snmp_view enterprises.6804.2.1.1.7 included
snmp-server view hccp_chansw_snmp_view enterprises.2750.3.1.4.2.2 included
snmp-server view hccp_chansw_snmp_view enterprises.2750.3.2.3.1.0 included
snmp-server view hccp_chansw_snmp_view enterprises.2750.3.2.4.2.1.5 included
snmp-server view hccp_chansw_snmp_view enterprises.2750.3.2.4.2.1.20 included
snmp-server view hccp_chansw_snmp_view enterprises.6804.2.1.1.1.1.4 included
snmp-server view hccp_chansw_snmp_view enterprises.6804.2.1.1.2.1.4 included
snmp-server view hccp_chansw_snmp_view enterprises.2750.3.1.4.2.1.1.1.2 included
snmp-server view hccp_chansw_snmp_view enterprises.2750.3.1.4.2.1.1.1.14 included
snmp-server view hccp_chansw_snmp_trap_view ciscoCableAvailabilityMIBNotifications included
snmp-server community private RW
snmp-server community public RW
snmp-server enable traps cable cmc-onoff
snmp-server host 20.1.0.2 version 2c public udp-port 9988
snmp-server manager
!
!
control-plane
!
alias exec scm show cable modem
alias exec ccm clear cable modem
alias exec spgs show packetcable gate sum
```

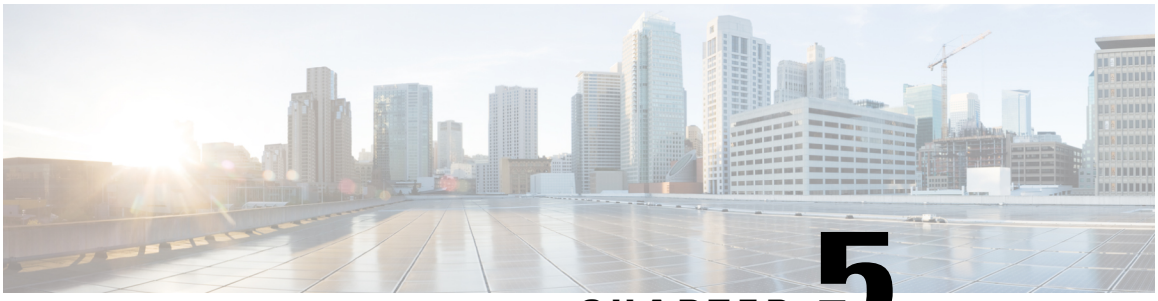
```
alias exec scc show cable cmc
!
line con 0
 exec-timeout 0 0
 privilege level 15
 transport output all
 stopbits 1
line aux 0
 transport output all
 stopbits 1
line vty 0 4
 password cisco
 login
 transport input all
 transport output all
!
exception-slave core-file /guyin/ubr10kg4clc-lc-mz.test
exception-slave dump 20.1.0.2
exception crashinfo dump command show chassis eeprom
exception crashinfo dump command show chassis fpga
exception crashinfo dump command show htdp
exception crashinfo dump command show pxf dma register rp
exception crashinfo dump command show pxf dma config rp
exception crashinfo dump command show pxf backplane-bus glob register
exception crashinfo dump command show pxf backplane-bus fbb register
exception crashinfo dump command show pxf backplane-bus tbb register
exception crashinfo dump command show pxf backplane-bus fts register
exception crashinfo dump command show pxf backplane-bus stt register
exception crashinfo dump command show pxf backplane-bus ib register
exception crashinfo dump command show pxf backplane-bus all error
scheduler isr-watchdog
!
cable channel-group 1
 upstream Cable5/0/0 channel 0-3
 downstream Modular-Cable 5/0/0 rf-channel 0-7
 cmc badb.ad02.1cb2
 cmc badb.ad02.3cc2
 cmc badb.ad02.1cd6
 cmc 0004.9f01.8121
!
!
cable fiber-node 2
 downstream Modular-Cable 5/0/0 rf-channel 0-7
 upstream Cable5/0/0 channel 0-3
!
cable fiber-node 60
 downstream Modular-Cable 6/0/0 rf-channel 0-6
 upstream Cable 6/0 connector 0-3
!
ntp clock-period 17179669
ntp update-calendar
ntp server 172.16.0.1
ntp server 20.1.0.2
ntp peer 20.1.0.7
event manager environment _load Line protocol on Interface GigabitEthernet.*changed state
to up
event manager directory user policy "disk0:/"
event manager directory user library "disk0:/"
event manager policy test.tcl type user
!
end

issu-ubr10k-5#scc
MAC Address    IP Address      State      Group Offset CMCID Conn ID    IF
badb.ad02.1cb2 50.2.0.2        online     1     0      2     0          Gi5/0/0

Total 1 CMC.
```

The following example shows how to configure the router next to the CMC in Layer 3 CIN network shown in the illustration of Configuring the Layer 3 CIN Network support, on page 102.

```
NS7-PGN-DOWN#show run
Building configuration...
```

```
Current configuration : 1593 bytes
!
version 12.4
service timestamps debug datetime msec localtime show-timezone
service timestamps log datetime msec localtime show-timezone
no service password-encryption
!
hostname NS7-PGN-DOWN
!
boot-start-marker
boot-end-marker
!
no logging console
!
aaa new-model
!
!
aaa authentication login default none
aaa authentication enable default none
!
!
aaa session-id common
!
monitor session 1 source interface Fa0/1/0
clock timezone CST 8
!
!
ip cef
!
!
ip multicast-routing
!
multilink bundle-name authenticated
!
!
voice-card 0
 no dspfarm
!
!
!
!
!
!
!
!
interface FastEthernet0/0
 description CONNECT TO CMC
 ip address 50.2.0.1 255.255.255.0
 ip helper-address 50.1.0.1
 ip pim sparse-dense-mode
 load-interval 30
 duplex auto
 speed auto
!
interface FastEthernet0/1
 description CONNECT TO CMTS Gige5/0/0
 ip address 50.1.0.2 255.255.255.0
 ip pim sparse-dense-mode
 load-interval 30
 duplex auto
 speed auto
!
interface FastEthernet0/1/0
!
interface FastEthernet0/1/1
!
interface FastEthernet0/1/2
!
interface FastEthernet0/1/3
!
interface FastEthernet0/1/4
!
```

```
interface FastEthernet0/1/5
!
interface FastEthernet0/1/6
!
interface FastEthernet0/1/7
!
interface FastEthernet0/1/8
!
interface Vlan1
 no ip address
!
!
!
no ip http server
no ip http secure-server
!
!
!
!
!
!
!
control-plane
!
!
!
!
!
!
line con 0
 exec-timeout 0 0
line aux 0
line vty 0 4
!
scheduler allocate 20000 1000
!
!
end
```



CHAPTER 5

Upgrading the Cisco Remote-PHY Solution

- Upgrading the Cisco CMC Image through the Cisco CMTS, page 137
- Upgrading the Cisco CMC Image through the Cisco CMC Console, page 139

Upgrading the Cisco CMC Image through the Cisco CMTS

The Cisco CMC consists of the following three images:

- Golden image
- Bank 1 image
- Bank 2 image

Golden Image

The image on the Cisco CMC that is downloaded as part of the factory settings is called the golden image. This image is read-only and cannot be deleted or replaced using the CLI. This image supports only the Cisco CMC image upgrade and does not support the other features.

Bank 1 and Bank 2 Images

The non-golden images on the Cisco CMC that support all the features are called the bank 1 and bank 2 images. These images can be copied to or deleted from the Cisco CMC. When the Cisco CMC image is upgraded, the bank 1 and bank 2 images are upgraded alternately. That is, if the last upgraded image is the bank 1 image, then the bank 2 image is upgraded with the current upgrade, and vice versa. When the image (non-golden) upgrade fails, the Cisco CMC tries to boot with the image from the other bank. If the images from both the banks fail, the Cisco CMC boots with the golden image.

Before You Begin

Before upgrading the Cisco CMC image through the Cisco CMTS, you must specify the TFTP or FTP server address and full file path in the DHCP server.

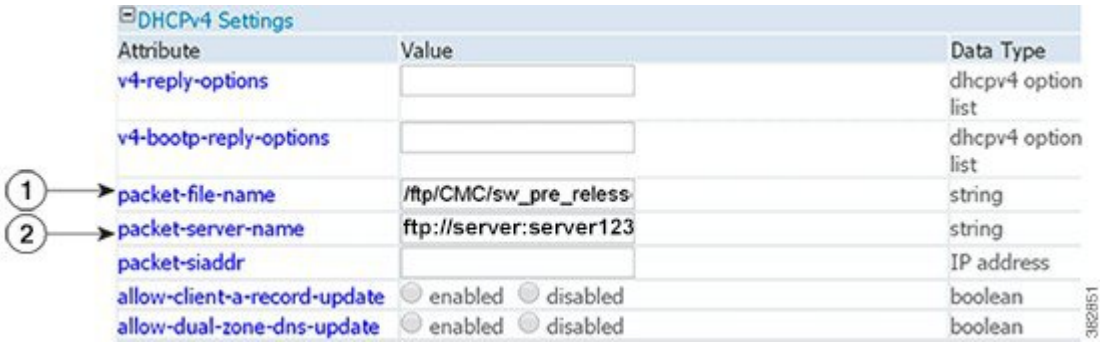
If you are using a Cisco Network Registrar as the DHCP server, you must specify the values for the following fields:

- *packet-file-name*
- *packet-server-name*

For more information on the Cisco Network Registrar, see Cisco Network Registrar.

The figure below shows an example of how to specify the values in the Cisco Network Registrar:

Figure 45: Specifying the Values on Cisco Network Registrar



1	Specify the new image file name and its full path
2	Specify the TFTP or FTP server address where the new image is located

Restriction

While upgrading the software images on Cisco CMTS and Cisco CMC, upgrade the Cisco CMC first, and then upgrade the Cisco CMTS.

Important If the Cisco CMTS is upgraded before the Cisco CMC, the Cisco CMC may not come online.

Step 1 Enable the privileged EXEC mode using the **enable** command. Enter your password, if prompted.

Example:

```
Router> enable
```

Step 2 Upgrade the Cisco CMC image using the **cable cmc** *mac-address* **image_upgrade** command.
mac-address—MAC address of the Cisco CMC.

Example:

```
Router# cable cmc 0001.0002.0003 image_upgrade
```

What to Do Next

If you are unable to upgrade the Cisco CMC image through Cisco CMTS, upgrade it through the Cisco CMC console. For more information, see Upgrading the Cisco CMC Image through the Cisco CMC Console, on page 139.

Upgrading the Cisco CMC Image through the Cisco CMC Console

Important Perform this procedure only if you are unable to upgrade the Cisco CMC image through the Cisco CMTS.

Restriction

While upgrading the software images on Cisco CMTS and Cisco CMC, upgrade the Cisco CMC first, and then upgrade the Cisco CMTS.

Important If the Cisco CMTS is upgraded before the Cisco CMC, the Cisco CMC may not come online.

Step 1 Open the Cisco CMC lid. See Opening the Cisco CMC, on page 42.

Step 2 Connect the console cable to the Cisco CMC console port and connect the other end of the console cable to a computer. See Using the Console Port on the Cisco CMC, on page 147.

Step 3 Log in to the Cisco CMC console using telnet.

Note Use a baud rate of 115200.

Step 4 Enable the privilege mode on the Cisco CMC using the **enable** command. Enter your password, if prompted.

Example:

```
CMC> enable
```

Step 5 Upgrade the Cisco CMC image using the **upgrade system** *url* command.
url—Firmware path, where the image is available.

Tip The firmware path is case-sensitive.

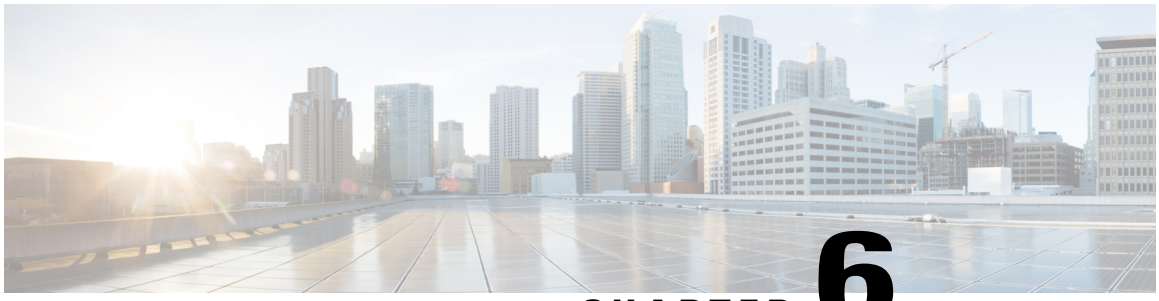
Note If the image version available on the specified firmware path is the same as the image running on the Cisco CMC currently, the Cisco CMC does not upgrade the image.

Example:

```
CMC# upgrade system tftp://192.168.1.1/image-1.1.bin
```

Step 6 After the image upgrade is completed, disconnect the console cable from the Cisco CMC console port.

Step 7 Close the Cisco CMC lid. See Closing the Cisco CMC, on page 74.



CHAPTER 6

Maintaining and Monitoring the Cisco Remote-PHY Solution

This section provides information on how to maintain and monitor the Cisco Remote-PHY solution.

- Monitoring the Cisco Remote-PHY Solution, page 141
- Maintaining the Cisco Remote-PHY Solution, page 147

Monitoring the Cisco Remote-PHY Solution

Verifying the Cisco CMC Using the LEDs

Verify the following LEDs located inside the Cisco CMC to check if it is operational.

LED	Status	Description
PWR	Off	The Cisco CMC is not powered up.
	Green	The Cisco CMC is powered up.
UPLINK	Off	Passive Optical Network (PON) or Metro Ethernet is not connected.
	Green	PON or Metro Ethernet is connected.
	Green (blinking)	PON or Metro Ethernet is connected and transmitting data.
DS RF	Off	Downstream RF is not connected.
	Green	Downstream RF is connected.

LED	Status	Description
ALARM	Off	The Cisco CMC is working.
	Yellow (major alarm)	Indicates one of the following: • The power received on the Optical Network Unit (ONU) is less than -25 dBm, unstable or unable to build link between Optical Line Terminal (OLT) and ONU. • Voltage or current has exceeded the major threshold value. • Temperature has exceeded the major threshold value.
	Red (critical alarm)	Indicates one of the following: • Voltage or current has exceeded the critical threshold value and the Cisco CMC must be shut down. • Temperature has exceeded the critical threshold value and the Cisco CMC must be shut down. • The switch chipset is not working and unable to read the register.
STATUS	Off	The Cisco CMC has not booted or run the power-on self-test (POST).
	Green	The Cisco CMC is connected to the Cisco CMTS and has received an IP address.
	Green (blinking)	The Cisco CMC is in bootup mode and running the power-on self-test.
RESERVED	Off	Reserved for future use.
GE0 and GE1	Off	The RJ-45 Gigabit Ethernet port is not connected on the Cisco CMC.
	Green	The RJ-45 Gigabit Ethernet port is connected on the Cisco CMC.
	Green (blinking)	The RJ-45 Gigabit Ethernet port is connected on the Cisco CMC and transmitting data.

Verify the following LEDs located inside the Cisco CMC to check if the FRx is operational.

LED	Status	Description
COMM	Off	There is no power.
	Green	There is no communication.
	Green (blinking)	Communication is working.
OPTICAL POWER	Off	Optical input level is normal (optical input level ≥ -6 dBm)
	Red (blinking)	Low optical input level (-10 dBm ≤ optical input level < -6 dBm)
	Red	No optical input (optical input level < -10 dBm)

Verifying the Cisco CMC Using the CLI

Using the Cisco CMTS Commands

Use the following commands on the Cisco CMTS to verify the Cisco CMC configuration.

Table 17: Commands for Monitoring the Cisco CMC using the Cisco CMTS

Command	Purpose
show cable cmc	Displays the Cisco CMC information.
show cable channel-group	Displays information on the associated Cisco CMCs in the channel group.

Using the Cisco CMC Commands

Use the following commands on the Cisco CMC console to verify the Cisco CMC configuration.

Table 18: Commands for Monitoring the Cisco CMC using the Cisco CMC Console

Command	Purpose
show frx	Displays the FRx information on the Cisco CMC.
show frx alarm	Displays the FRx alarm information on the Cisco CMC.
show gcp config command stats info	Displays the statistics information for the Generic Control Protocol (GCP) Exchange Data Structure (EDS) messages at *command* level.

Command	Purpose
show gcp config op stats info	Displays the statistics information for the GCP EDS messages at *operation code* level.
show gcp config subtype stats info	Displays the statistics information for the GCP EDS messages at *TLV* level.
show gcp stats	Displays the GCP statistics information.
show hardware	Displays the basic hardware information of the Cisco CMC.
show hardware alarm active	Displays the current information of the hardware sensor monitors on the Cisco CMC.
show hardware alarm history	Displays information on the history of the hardware sensor monitors on the Cisco CMC.
show hardware alarm threshold	Displays the alarm threshold information for the hardware sensor monitors on the Cisco CMC.
show igmp status	Displays the current Internet Group Management Protocol (IGMP) status on the Cisco CMC.
show log file	Display the Cisco CMC error log files.
show onu	Displays the Optical Network Unit (ONU) information.
show psu	Displays the Power Supply Unit (PSU) information.
show system	Displays the basic system information of the Cisco CMC.

For more information on the Cisco CMC commands, see Cisco Coaxial Media Converter Command Reference.

Verifying the Cisco uBR-MC3GX60V-RPHY Line Card Installation Using LEDs

Verify the following LEDs on the Cisco uBR-MC3GX60V-RPHY line card to check if it is operational.

Table 19: LEDs on the Cisco uBR-MC3GX60V-RPHY Line Card

LED	Status	Description
POWER	Off	The Cisco uBR-MC3GX60V-RPHY line card is not powered on.
	Green	The Cisco uBR-MC3GX60V-RPHY line card is not powered on.
STATUS	Off	The Cisco uBR-MC3GX60V-RPHY line card is powered on.
	Green	The processor on the Cisco uBR-MC3GX60V-RPHY line card has booted and passed the diagnostics, or is in the standby mode.
	Yellow	The Cisco uBR-MC3GX60V-RPHY line card is in bootup mode.
MAINT	Off	No action is required.
	Yellow	It is safe to remove the Cisco uBR-MC3GX60V-RPHY line card.
GE0 and GE1	Off	The DEPI port is not enabled.
	Green	The DEPI port is configured and is able to send traffic.
LK/ACT0-LK/ACT5	Off	The Ethernet link is not working.
	Green (steady)	The Gigabit Ethernet port is enabled and the Ethernet link is working, and there is no US or DS traffic flow.
	Green (blinking)	The Gigabit Ethernet port is enabled and the Ethernet link is working, and there is US or DS traffic flow.

Verifying the Cisco uBR-MC3GX60V-RPHY Line Card Using the CLI

Verify the Cisco uBR-MC3GX60V-RPHY line card using the following commands:

Table 20: Commands Used to Verify the Cisco uBR-MC3GX60V-RPHY Line Card

Command	Purpose
• **show cable mac-domain cable cgd-associations** • **show cable mac-domain cable downstream-service-group** • **show cable mac-domain cable forwarding** • **show cable mac-domain cable rcc** • **show cablemac-domain cable upstream-service-group**	Displays the MAC domain information to verify the bonding operation on the Cisco uBR-MC3GX60V-RPHY line card.
• **show cable license** • **show license detail**	Displays the software license of the Cisco uBR-MC3GX60V-RPHY line card.
show controller modular-cable	Displays the Cisco uBR-MC3GX60V-RPHY line card Statistics. This command allows the user to view the following line card statistics: • Interface association • JIB hardware downstream configuration • Channel counters • Errors • Mapping of wideband and RF channels • JIB hardware downstream registers • JIB hardware downstream status
• **show controllers cable** *slot*/*subslot*/*port* • **show interface cable** *slot*/*subslot*/*cable-interface-index*	Displays the interface controllers information on the Cisco uBR-MC3GX60V-RPHY line card.
show cable modem	Displays the Cable modem information.
show cable clock	Displays the DOCSIS Timing and Control Card (DTCC) and its current status.

Command	Purpose
show controllers modular-cable sfp	Displays information about the SFP modules on the Cisco uBR-MC3GX60V-RPHY line card. If the SFP module is not present, the following output is displayed: `SFP in Port1 is NOT PRESENT`
show ip interfaces brief	Displays the bidirectional communication between the Cisco CMTS and the Cisco CMC. The Cisco uBR-MC3GX60V-RPHY line card has three Gigabit Ethernet interfaces. When an IP address is configured on the Gigabit Ethernet interface in a subnet that includes the Cisco CMC, the IP address of the Cisco CMC becomes pingable.
show diag	Displays the hardware and diagnostic information of the Cisco uBR-MC3GX60V-RPHY line card.

Maintaining the Cisco Remote-PHY Solution

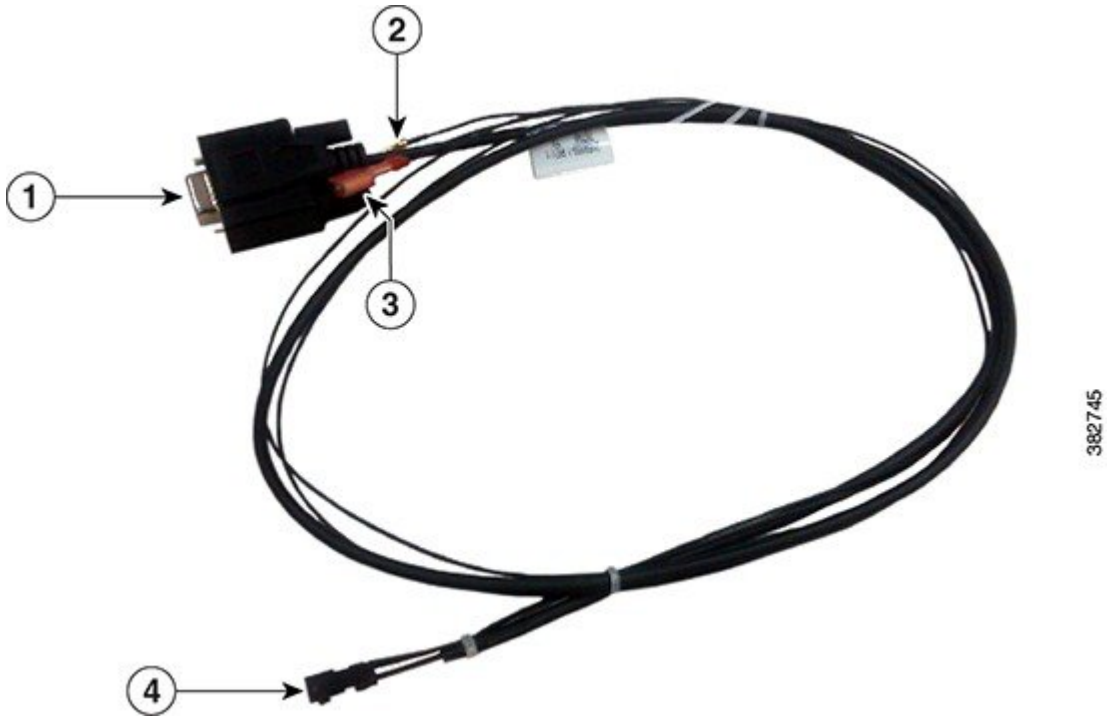
Using the Console Port on the Cisco CMC

The console port on the Cisco CMC is used for connecting the Cisco CMC to a PC using a console cable.

Warning The console cable connection is only for initial installation and maintenance of the Cisco CMC. The console cable must not be connected during electromagnetic compliance testing. The console cable must be disconnected from the Cisco CMC after the final installation.

The figure below shows the console cable used with the Cisco CMC.

Figure 46: Console Cable



1	DB9 connector	3	Pin 3 (P3)
2	Pin 2 (P2)	4	PCB connector

The table below provides the console cable connector pin definitions.

Table 21: Console Cable—Connector Pin Definitions

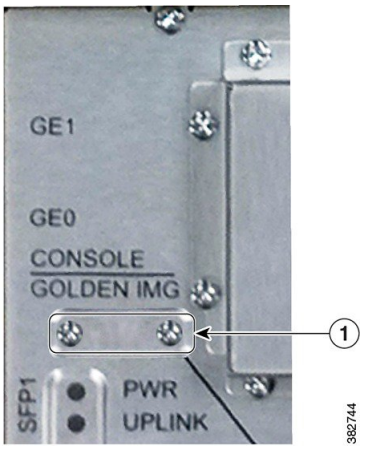
Pin Number	Definition
Pin 1	Ground (GND)
Pin 2	Input (UART_RX)
Pin 3	Ground (GND)
Pin 4	Output (UART_TX)
Pin 5	Golden image (Golden_Image)
Pin 6	Ground (GND)

Before You Begin

- Open the Cisco CMC lid. See Opening the Cisco CMC, on page 42.
- Have the following tools ready before performing this task:
  - Screwdriver

Step 1 Remove the screws on the console port cover using a screwdriver to access the console port. The figure below shows the console port with its cover.

Figure 47: Cisco CMC Console Port



1	Console port cover		—

Step 2 Align the PCB connector of the console cable with the pins on the Cisco CMC console port and insert the PCB connector into the console port.

Step 3 (Optional) To boot the Cisco CMC with the golden image, insert P2 into P3.

Tip If P2 is not connected to P3, the Cisco CMC boots normally.

Step 4 Connect the DB9 connector of the console cable with the appropriate serial port on the PC.

Step 5 Power up the PC.

Step 6 Configure the PC terminal emulation software with the following default settings for the Cisco CMC:

- 115200 baud rate
- 8 data bits
- No parity generation or checking
- 1 stop bit

What to Do Next

1. Disconnect the console cable from the console port.
2. Reinstall the console port cover and tighten the screws using a screwdriver.
3. Close the Cisco CMC lid. See Closing the Cisco CMC, on page 74.

Removing the Coaxial Cable from the Cisco CMC

Before You Begin

- Open the Cisco CMC lid. See Opening the Cisco CMC, on page 42.
- Have the following tools ready before performing this task:
  - Torque wrench

- Slot screwdriver

Step 1 Remove the coaxial cable from the F-connector installed in the RF port.

Step 2 Loosen the seizure screw, do not remove it. The figure below shows the location of the seizure screw inside the Cisco CMC.

Figure 48: Location of the Seizure Screw

1	Seizure screw		—

Step 3 Loosen the connector nut using a torque wrench and remove the F-connector from the RF port.

Step 4 Reinstall the PG11-to-5/8" adapter plug in the RF port and tighten using a torque wrench (4.63 ft-lb or 6.25 Nm), if you removed a PG11 F-connector from the RF port.

Step 5 Check if RF signal is present at the unused RF ports and perform one of the following:

- If RF signal is present, insert a 75 ohm terminator into the RF port and tighten according to the manufacturer specifications.

- If RF signal is not present, insert a 5/8" port plug into the RF port and tighten from 5 ft-lb to 8 ft-lb (6.8 Nm to 10.8 Nm) using a torque wrench.

What to Do Next

- To install the F-connector and connect the coaxial cable to the Cisco CMC, see Installing the Coaxial Cables on the Cisco CMC, on page 46.
- Close the Cisco CMC lid. See Closing the Cisco CMC, on page 74.

Removing the Fiber Adapter from the Cisco CMC

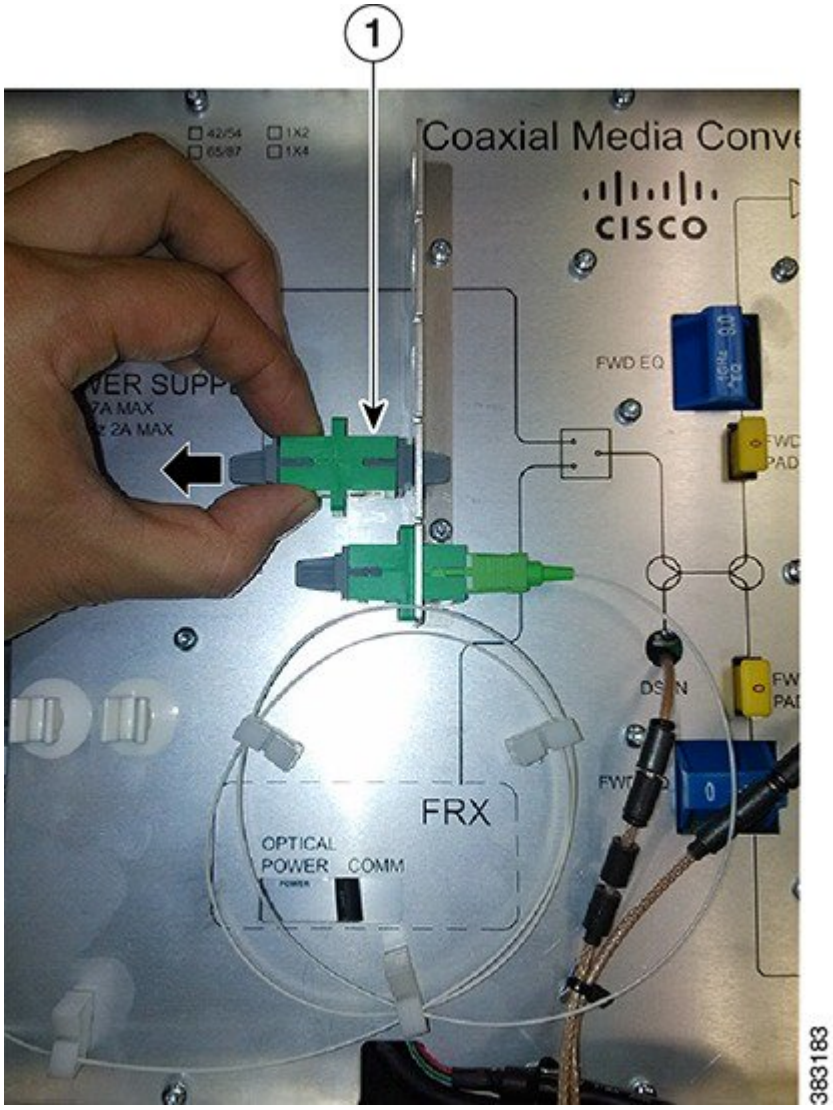
Before You Begin

Open the Cisco CMC lid. See Opening the Cisco CMC, on page 42.

Step 1 Disconnect the optical fibers connected to the fiber adapter. Immediately reinstall the dust plugs in the fiber adapters.

Step 2 Remove the fiber adapter from the slot as shown in the figure below:

Figure 49: Removing the Fiber Adapter from the Cisco CMC



1	SC/APC-SC/APC fiber adapter		—

Step 3 Place the fiber adapter in its protective packaging.

What to Do Next

- To install a fiber adapter, see Installing a Fiber Adapter on the Cisco CMC, on page 50.
- Close the Cisco CMC lid. See Closing the Cisco CMC, on page 74.

Removing the SFP Module from the Cisco CMC

Before You Begin

- Open the Cisco CMC lid. See Opening the Cisco CMC, on page 42.
- Have the following tools ready before performing this task:
  - Torque wrench

Step 1 Perform one of the following and immediately reinstall the dust plug in the SFP module:

- Disconnect the optical fiber connected to the SFP module. If the fiber port does not have any other optical fibers, remove the gland. Reinstall the 5/8" port plug in the fiber port and tighten to 6.7 ft-lb (9 Nm) using a torque wrench.
- Disconnect the RJ-45 cable connected to the SFP module. If the RJ-45 port does not have any other RJ-45 cables, remove the PG16 gland using a torque wrench. Reinstall the PG16 port plug in the RJ-45 port and tighten using a torque wrench.

Step 2 Unlock and remove the SFP module from the socket connector using one of the following:

- If the SFP module has a Mylar tab latch, pull the tab gently in a slightly downward direction until the SFP module disengages from the socket connector, and then pull the SFP module straight out of the socket. Do not twist or pull the Mylar tab as it can detach from the SFP module.
- If the SFP module has an Actuator button latch, gently press the Actuator button on the front of the SFP module until it clicks and the latch mechanism releases the SFP module from the socket connector. Grasp the Actuator button between your thumb and index finger, and carefully pull the SFP module straight from the socket.
- If the SFP module has a Bale-clasp latch, pull the bale to eject the SFP module from the socket. If the Bale-clasp latch is obstructed and you cannot use your index finger to open it, use a small, flat-blade screwdriver or a long narrow instrument to open the bale-clasp latch. Grasp the SFP module between your thumb and index finger, and carefully remove it from the socket.

Step 3 Place the removed SFP module in an antistatic bag.

What to Do Next

- To install the SFP module, see Installing an SFP Module on the Cisco CMC, on page 52.
- Close the Cisco CMC lid. See Closing the Cisco CMC, on page 74.

Online Insertion and Removal of the Cisco uBR-MC3GX60V-RPHY Line Card

You can replace a Cisco uBR-MC3GX60V-RPHY line card with only a Cisco uBR-MC3GX60V-RPHY line card.

Before You Begin

- Save the Cisco uBR-MC3GX60V-RPHY line card configurations before starting the OIR.
- Change the standby card (if available) to HOT state.
- Save the startup configuration file before any reload of the system (if there is a need to reload), after a successful OIR.
- Perform OIR when the Cisco CMTS is up and running.

Restriction

- The OIR cannot be used if you want to upgrade to Cisco uBR-MC3GX60V-RPHY line card directly from any of the old line card (Cisco uBR-MC3GX60V, Cisco uBR10-MC5X20H, Cisco UBR-MC20X20V)other than LC like 520 or 20x20 to 3G60.
- OIR cannot be performed when the standby PRE is being loaded.

Step 1 Enter the **cr10k card oir-compatibility** command for the existing Cisco uBR-MC3GX60V-RPHY line card.

Example:
```
Router(config)# cr10k card 8/0 oir-compatibility
```

This command preserves the configuration and performs internal synchronization to ensure that the OIR runs successfully.

Step 2 Save the configuration to ensure the transition.

Example:
```
Router# copy running-config startup-config
```

Step 3 Power down the existing Cisco uBR-MC3GX60V-RPHY line card using **cable power off** command.

Example:
```
Router# cable power off 8/0
Line Card 8/0 is POWERED OFF
```

This powers off the Cisco uBR-MC3GX60V-RPHY line card gracefully.

Step 4 Before removing the existing Cisco uBR-MC3GX60V-RPHY line card, verify that the proper grounding instructions have been followed.

Step 5 Remove the existing Cisco uBR-MC3GX60V-RPHY line card from the slot.
See Removing the Existing Line Card from the Card Slot, on page 78.

Step 6 Install the new Cisco uBR-MC3GX60V-RPHY line card in the slot.
See Installing the Cisco uBR-MC3GX60V-RPHY Line Card in the Card Slot, on page 80.

Step 7 Power up the new Cisco uBR-MC3GX60V-RPHY line card using the **cable power on** command.

Example:
```
Router# cable power on 8/0
```

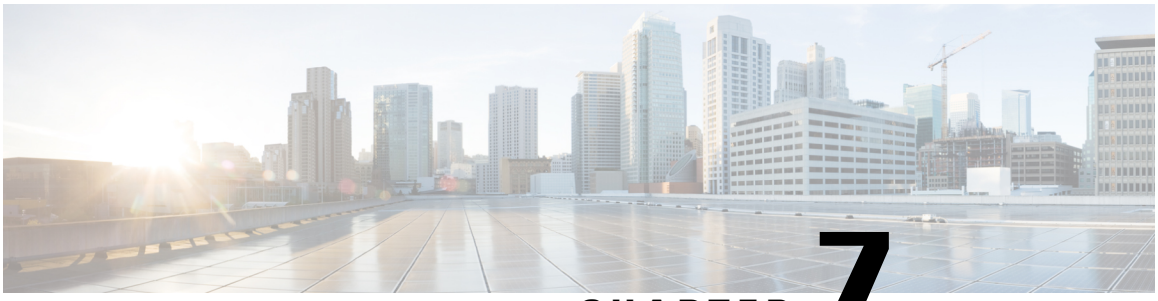
Step 8 Verify that the new Cisco uBR-MC3GX60V-RPHY line card and line protocol is up using the **show interface cable** command.

Example:
```
Router#  show interface cable 8/0/0
Cable8/0/0 is up, line protocol is up
Hardware is BCM3210 ASIC, address is 010a.13e8.1ca8 (bia 010a.13e8.1a60)
Internet address is 192.1.1.3/24
MTU 1500 bytes, BW 27000 Kbit, DLY 1000 usec, rely 255/255, load 1/255
Encapsulation, loopback not set, keepalive not set
ARP type: ARPA, ARP Timeout 04:00:00
Last input 4d07h, output 00:00:00, output hang never
Last clearing of "show interface" counters never
Queuing strategy: fifo
Output queue 0/40, 0 drops; input queue 0/75, 0 drops
5 minute input rate 1834000 bits/sec, 2385 packets/sec
5 minute output rate 1982000 bits/sec, 2431 packets/sec
24461542 packets input, 2348214388 bytes, 0 no buffer
Received 1979 broadcasts, 0 runts, 0 giants, 0 throttles
0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
24854257 packets output, 2536222931 bytes, 0 underruns
0 output errors, 0 collisions, 0 interface resets
0 output buffer failures, 0 output buffers swapped out
```

Step 9 Verify the hardware status using the **show controllers cable** command.

Example:
```
Router# show controllers cable 8/0/0
Cable8/0/0 JIB hardware status:
JIB Downstream port Enabled
JIB Upstream port 0 Enabled
JIB Upstream port 1 Enabled
JIB Upstream port 2 Enabled
JIB Upstream port 3 Enabled
Cable8/0/0 Upconverter is Enabled Output is Enabled
```

Step 10 Verify the configuration with the **show running-configuration** command.



CHAPTER 7

Troubleshooting the Cisco Remote-PHY Solution

This section provides the troubleshooting procedures for the Cisco Remote-PHY solution.

Note **show cable cmc** command can be used to identify the status of CMC in first hand.

```
issu-ubr10k-5#show cable cmc
MAC Address    IP Address      State      Group Offset CMCID Conn ID    IF
9078.5634.1200 0.0.0.0         init(d)    0     0      1     N/A        Gi7/0/0
```

The table below shows the description of each state.

Table 22: CMC State Description

State	Description
Offline	CMC is not operational
Reject(i)	IP assign failed
Init(d)	DHCP discovery
Init(g)	GCP connection establishing
Init(est)	GCP connection established
Init(c)	Get CMC Capability
Init(s)	Download configuration to CMC
Reject(c)	Get CMC Capability failed
Online	CMC is operational

- Troubleshooting the Cisco Remote-PHY Solution, page 158
- Troubleshooting: Cisco uBR-MC3GX60V-RPHY Line Card Link LED Does Not Illuminate, page 158

- Troubleshooting: Cisco CMC Resets After DHCP Timeout, page 159
- Troubleshooting: Cisco CMC is Not Working, page 159
- Troubleshooting: The Cisco uBR-MC3GX60V-RPHY Line Card is Not Working, page 159
- Troubleshooting: The DTI Timer is Not Working, page 160

Troubleshooting the Cisco Remote-PHY Solution

This section provides the troubleshooting procedures for the Cisco Remote-PHY solution.

Note **show cable cmc** command can be used to identify the status of CMC in first hand.

```
issu-ubr10k-5#show cable cmc
MAC Address    IP Address      State      Group Offset CMCID Conn ID    IF
9078.5634.1200 0.0.0.0         init(d)    0     0      1     N/A        Gi7/0/0
```

The table below shows the description of each state.

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Init(g)	GCP connection establishing
Init(est)	GCP connection established
Init(c)	Get CMC Capability
Init(s)	Download configuration to CMC
Reject(c)	Get CMC Capability failed
Online	CMC is operational

Troubleshooting: Cisco uBR-MC3GX60V-RPHY Line Card Link LED Does Not Illuminate

Problem After inserting the network cable into the SFP module of the Cisco uBR-MC3GX60V-RPHY line card, the LINK LED of the line card does not illuminate.

Possible Cause Dirt or skin oil is accumulated on the network cable plug faceplate generating significant attenuation and reducing the optical power levels below threshold levels. This could result in link failure.

Solution Clean the plug faceplate with a lint-free tissue soaked in 99 percent pure isopropyl alcohol and then with a dry lint-free tissue. Remove any residual dust from the faceplate with compressed air before installing the network cable.

Troubleshooting: Cisco CMC Resets After DHCP Timeout

Problem The Cisco CMC is reset after DHCP timeout.

Possible Cause The DHCP server address is not specified in the Gigabit Ethernet interface of the Cisco uBR-MC3GX60V-RPHY line card.

Solution Verify the Gigabit Ethernet Interface configuration on the Cisco uBR-MC3GX60V-RPHY line card. To specify the DCHP server address, use the **ip helper-address** command. For more information, see Configuring the Gigabit Ethernet Interface on the Cisco uBR-MC3GX60V-RPHY Line Card, on page 88.

Troubleshooting: Cisco CMC is Not Working

Problem The Cisco CMC is online but the cable modem fails to come online.

Possible Cause The Cisco uBR-MC3GX60V-RPHY line card is not properly configured.

Solution Verify the configuration on the Cisco uBR-MC3GX60V-RPHY line card. See Configuring the Cisco Remote-PHY Solution, on page 87.

Possible Cause The Cisco CMC is not properly connected to the line card.

Solution Verify the connection between Cisco uBR-MC3GX60V-RPHY line card and Cisco CMC.

Troubleshooting: The Cisco uBR-MC3GX60V-RPHY Line Card is Not Working

Problem The Cisco uBR-MC3GX60V-RPHY line card is not working.

Possible Cause The Cisco uBR-MC3GX60V-RPHY line card is not connected to the power supply.

Solution Verify if the power LED is illuminated and the power supply is connected to the Cisco uBR-MC3GX60V-RPHY line card. Connect to the power supply, if not connected.

Possible Cause The Cisco uBR-MC3GX60V-RPHY line card is not configured on the Cisco CMTS.

Solution Configure the Cisco uBR-MC3GX60V-RPHY line card. See Configuring the Cisco Remote-PHY Solution, on page 87.

Possible Cause The captive screws are not secured on the faceplate and the ejector levers are not properly closed.

Solution Close the ejector levers and tighten the captive screws with your fingers. Then, use either a T-10 Torx or a common flathead screwdriver to tighten the captive screws from 5 to 7 in-lbs.

Possible Cause The Cisco uBR-MC3GX60V-RPHY line card is not firmly seated in the chassis.

Solution Unscrew the top and bottom captive screws on the line card using a T-10 Torx driver tool or flathead screwdriver. Simultaneously pivot both ejector levers away from the line card to disengage the line card. Slide the line card partially out of the slot in the chassis and slide it back in until it is firmly seated in the chassis. Close the ejector levers and tighten the captive screws with your fingers. Then, use either a T-10 Torx or a common flathead screwdriver to tighten the captive screws from 5 to 7 in-lbs.

Possible Cause The network cable connectors are not properly seated in the ports on the Cisco uBR-MC3GX60V-RPHY line card and cables are broken.

Solution Verify if the cables are broken. Replace the cables, if broken and insert the network cable connector into the SFP module port until it clicks and locks into place to ensure proper seating..

Possible Cause Incorrect or inappropriate software license is configured on the Cisco uBR-MC3GX60V-RPHY line card.

Solution Reinstall or rehost the appropriate license on the Cisco uBR-MC3GX60V-RPHY line card.

Possible Cause Power on Self Test (POST) fails when the line card is installed in the chassis.

Solution Verify the power supply connection and if the problem persists, contact the Technical Assistance Center (TAC) for further assistance.

Troubleshooting: The DTI Timer is Not Working

Problem The DOCSIS Timing Interface (DTI) timer is not working correctly and the cable modems are not in init() state.

Possible Cause DTI-based timing is disabled on the active card.

Solution Use the **show cable clock** command to identify the active card and enable the DTI-based timing using the **cable clock dti** command.