Cisco uBR10012 Universal Broadband Router Overview

The Cisco uBR10012 universal broadband router provides a high-end, high-performance, high-capacity Cable Modem Termination System (CMTS) solution. The Cisco uBR10012 router is an aggregation platform that places a new level of intelligence and performance at the edge of the network, enabling cable service providers to maximize their revenues by delivering more feature-rich services to their customers. The system can provide high-speed data, broadband entertainment, and IP telephony services to residential and commercial subscribers using cable modems or digital set-top boxes (STBs).

The Cisco uBR10012 router is based on the Data-over-Cable Service Interface Specifications (DOCSIS), which were developed by a cable industry initiative to ensure the reliable and secure operation of cable data networks. The router can interoperate with cable modems or STBs that support the DOCSIS 1.0, DOCSIS 1.1, EuroDOCSIS 1.1, DOCSIS 2.0, DOCSIS 3.0 and EuroDOCSIS 2.0 versions of the DOCSIS specification.

DOCSIS supports the 6 MHz North American channel plans using the ITU J.83 Annex B RF standard. The downstream uses a 6 MHz channel width in the 85 to 860 MHz frequency range, and the upstream supports the 5 to 42 MHz frequency range. Each chassis can support multiple standards and multiple interfaces, allowing operators to choose the appropriate services and devices that optimize their capital investment with a single CMTS platform.

The Cisco uBR10012 router supports data and digitized voice connectivity over a bidirectional cable television and IP backbone network, using advanced quality of service (QoS) techniques to ensure that real-time traffic such as voice can be reliably delivered, while still transmitting other traffic on a best-effort basis. The Cisco uBR10012 router concentrates traffic from two-way DOCSIS-based cable modems and STBs that is transmitted over the coaxial cable television (CATV) network, and presents that traffic to local and remote Internet Protocol (IP) hosts over its high-speed network uplink interfaces.

The Cisco uBR10012 universal broadband router uses the same Parallel Express Forwarding (PXF) technology used by the Cisco ESR10000 edge services router. The combination of PXF technology with Cisco's CMTS solutions creates a cost-effective, scalable, and industry-proven CMTS that provides consistent, high-performance throughput that is optimized for high-volume traffic over a cable network.

Based on the Cisco IOS networking software, the router supports the most advanced networking and routing options. Also, with access to current and future software enhancements, the router ensures investment protection as standards and customer needs continue to evolve.

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

Cisco uBR10012 Router Features

The Cisco uBR10012 router has the following features:

- 19-inch rack mount, 22.75-inch depth. See "Cisco uBR10012 Router".

- 31.5-inch height, 18 Rack Units (RU)—2 chassis per 7-foot rack

- Twelve card slots:

    – 8 cable interface line cards

    – 4 network uplink line cards

- LCD module, see "LCD Module".

- 64,000 subscribers—Supports up to a maximum of 64,000[1] subscribers in a basic configuration.

- Performance routing engine (PRE1, PRE2 and PRE4) modules, see "Performance Routing Engine".

    – PRE1 modules support error checking and correction (ECC) for all onboard memory, replacing the simpler parity error algorithm of the original PRE module.

    – PRE2 modules are designed to address Internet-service-provider (ISP) requirements. The PRE2 provides 6.2 mpps of processing power and has a 500-MHz RM7000 mips processor with integrated 16-KB data and 16-KB instruction Level 1 caches integrated 256-KB Level 2 cache, and 4-MB Level 3 cache. Cisco IOS Release 12.3(9)BC.

    – The PRE4 is the fifth generation Parallel Express Forwarding (PXF) packet processing and scheduling engine for the Cisco uBR10012 router. The PRE4 provides 10 mpps of processing power and has a 800-MHz dual processor with a 512-MB packet buffer and a 128-MB control memory with error-correcting code. Cisco IOS Release 12.3(33)SB.

Note When replacing a PRE1 module with a PRE2 module, you must also install EMI gaskets and RF absorber material, for more information, go to the following URL:

http://www.cisco.com/en/US/docs/cable/cmts/ubr10012/installation/field_replaceable_units/pre2gkit.html

- AC and DC power supply options:

    – Dual –48/–60 VDC hot-swappable and redundant power entry modules (DC PEMs). See "DC Power Entry Modules".

    – Dual 200–240 VAC hot-swappable and redundant power entry modules (AC PEMs). See "Timing, Communication, and Control Plus Card".

    – External AC-input power shelf with redundant power supply support. See Supported External AC-Input Power Shelves.

- Alarm relays: minor, major, and critical.

- Two timing, communication, and control plus (TCC+) modules —each TCC+ card provides a connector for an external clock reference source, with a second connector for a backup clock source. See "Timing, Communication, and Control Plus Card".

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1. This is for reference only. The total number of subscribers for specific systems might vary depending on whether high availability is deployed, network or service loading, traffic, features deployed, and other parameters. A high availability N+1 enabled system with more than 50,000 subscribers is not recommended.

- Fan module—Forced-air convection cooling, see "Fan Assembly Module".
  - Variable speed levels. The operating speed of the fan is determined by the temperature of the facility.
  - Multiple fans in the fan assembly provide redundancy to support single failure.
  - Status LEDs on the fan assembly indicate single or multiple fan failure.
  - Replacing the fan assembly module does not interrupt service (within certain time limits).

Comparisons with Other Cisco CMTS Platforms

The Cisco uBR10012 router is a next-generation CMTS platform with the following significant differences from the other Cisco CMTS platforms (Cisco uBR7100 series and Cisco uBR7200 series universal broadband routers):

- The Cisco uBR10012 router supports a larger form factor for cable interface line cards. The existing cable interface line cards for the Cisco uBR7200 series routers cannot be used with the Cisco uBR10012 router.

- The Cisco uBR10012 router uses high-performance PRE modules as its processor cards. It does not use any of the network processor cards used on the Cisco uBR7200 series router.

- The Cisco uBR10012 router is a high-performance, high-throughput CMTS router that requires high-performance network uplink line cards for its WAN connectivity to the Internet and other connected networks. It does not use any of the port adapters that are available for the Cisco uBR7100 series and Cisco uBR7200 series router.

- The Cisco uBR10012 router does not use the Cisco cable clock card because the TCC+ cards include national clock support.

- To accommodate the new architecture of the Cisco uBR10012 chassis, slot numbering on the router has been expanded to include a card and subcard numbering system (1/0, 2/0, and so forth). See Figure 1-4 for a diagram of the slot numbering on the Cisco uBR10012 chassis.

Cisco uBR10012 Router Functional Overview

The Cisco uBR10012 router is a cable modem termination system (CMTS) that provides Internet, LAN, and WAN access for cable modems and set-top-boxes (STBs) over a coaxial cable connection. The router enables high-speed data services to be packaged like they are in basic cable television service or video programming.

The path from the CMTS to the cable modem or STB is the downstream, which carries the majority of traffic over the cable interface. The path from the cable modem or STB to the CMTS is the upstream, and it typically carries approximately 10 percent of the traffic that is sent over the downstream. A large number of users can be assigned to the same downstream, and for efficient use of bandwidth, those users can be split among several different upstreams.

The following sections provide a high-level overview of the data path over the upstream and the downstream.

Upstream Data Path

The following example describes the upstream data path.

1. A request for service is generated by a subscriber. The modem transmits the request as a series of packets to the CMTS on the upstream.

2. The cable line card receives the packets on its upstream interface and forwards them to its onboard processor.

3. The line card's processor verifies the header check sequence (HCS), frame check sequence (FCS), and system identification number (SID), processes all fields in the DOCSIS MAC header, and then removes the header.

   a. The line card examines and processes the extended headers (Request, Acknowledgement, Privacy, PHSs and Unsolicited Grand Synchronization header elements). If Baseline Privacy Interface (BPI) is used, the processor also decrypts the Privacy EH frames using the appropriate key.

   b. Bandwidth requests, acknowledgment (ACK) requests, and unsolicited grant syncs are reformatted and passed to the request ring of the Cisco cable line card.

   c. The DOCSIS MAC header is removed and another header is added, which includes the SID, the upstream port information, and status bits that indicate whether any errors were detected.

4. The packet is sent across the backplane to the forwarding processor (FP) or the routing processor (RP) on the PRE.

5. The PRE performs packet operations such as access list processing, classification, switching, and QoS. It is also where major routing and IOS management functions (filtering) are run.

6. The packet is moved to the correct output queue and transmitted over the backplane to the network uplink card (OC-48 DPT/POS, GigE) or another cable interface line card.

7. The output card forwards the packet to the next interface point.

Downstream Data Path

The following example describes the downstream data path.

1. Data packets from the Internet are received by the network uplink cards (OC-48 DPT/ POS, GigE).

2. The packets are forwarded to the file processor (FP) on the PRE module.

3. The FP performs MAC classification to determine the type of frame or packet to be processed.

4. The PRE performs access list filtering, policing, and marking.

5. A forwarding information base (FIB) lookup and rewrite happens.

   a. The rewrite consists of a downstream header and 802.3 MAC header.

   b. The downstream header contains destination primary SID, physical DS port number, PHS rule index, and some control bits and other fields.

   c. The packet is policed, shaped and prepared for queueing. Queueing is based on the priority of the queue and the state of the flow bits from the card. The destination card address (port) is prepended on the header of the packet being transmitted.

6. The packet is transmitted over the backplane to the appropriate cable interface line card.

7. The cable interface line card receives the packet and forwards it to all the ASICs on the line card.

    a. Each ASIC decodes the header to determine if the packet is destined for one of the downstream ports on that card. If so, the downstream header is removed and the 802.3 MAC header is saved.

    b. The MAC header is processed to determine how to build the DOCSIS MAC header and what operations to perform on the packet. These might include prepending the DOCSIS MAC header, computing the HCS and FCS, performing Packet Header Suppression, and BPI encryption.

8. Once the packet is ready, it is immediately transmitted on the downstream.

Cisco uBR10012 Router and Cisco IOS Software

The Cisco uBR10012 router runs the Cisco IOS software, which is stored on the Type II PCMCIA flash memory disks stored in the two PCMCIA slots in the primary PRE module. A PCMCIA flash memory disk in either slot can store a Cisco IOS image or configuration file.

In addition to the flash memory disks, each PRE module contains onboard flash memory that is used to store a boot loader. The loader executes following a system reset to reload and execute the Cisco IOS software on the flash memory disks.

The PRE module also stores the system configuration in the onboard flash memory. The configuration information read from the flash memory is buffered in operational memory following initialization, and is written to the flash memory device when the configuration is saved.

Each line card also contains onboard flash memory that is used to store a boot loader, similar in function to that used on the PRE module. However, the line card loader executes following a system reset, line card reset, or line card insertion to reload and execute any code that must run on the line card.

Software images may also be stored on an external TFTP server. If the Cisco uBR10012 router is so configured, it then downloads the proper image from the TFTP server and executes it.

DOCSIS and EuroDOCSIS Data Rates and Modulation Schemes

Cisco cable interface line cards can be configured in a number of different upstream combinations based on the card used, your cable network, and the anticipated subscription and service levels. Table 1-1 lists the data rates and modulation schemes for both DOCSIS1.1 and EuroDOCSIS 1.1 standards. Table 1-2 lists the data rates and modulation schemes for DOCSIS 2.0 and EuroDOCSIS 2.0 standards. Table 1-3 lists the downstream data rates.

Table 1-1   *DOCSIS and EuroDOCSIS 1.1 Upstream Data Rates*

Upstream Channel Width	Modulation Scheme, bit/symbol	Baud Rate, symbol/sec	Raw Bit Rate, Mb/sec	Throughput (Bit Rate - Overhead), Mb/sec
3.2 MHz	16-QAM (4) QPSK (2)	2.56 M	10.24 5.12	9.0 4.6
1.6 MHz	16-QAM (4) QPSK (2)	1.28 M	5.12 2.56	4.5 2.3
800 kHz	16-QAM (4) QPSK (2)	640 K	2.56 1.28	2.3 1.2
400 kHz	16-QAM (4) QPSK (2)	320 K	1.28 0.64	1.2 0.6
200 kHz	16-QAM (4) QPSK (2)	160 K	0.64 0.32	0.6 0.3

Table 1-2   DOCSIS and EuroDOCSIS 2.0 Upstream Data Rates

Upstream Channel Width	Modulation Scheme, bit/symbol	Baud Rate, symbol/sec	Raw Bit Rate, Mb/sec	Throughput (Bit Rate - Overhead), Mb/sec
6.4 MHz	64-QAM 32-QAM 16-QAM 8-QAM QPSK	5.12M	30.96 25.80 20.54 15.48 10.30	27.2 22.3 19.8 13.3 8.9
3.2 MHz	64-QAM 32-QAM 16-QAM 8-QAM QPSK	2.56 M	15.48 12.90 10.30 7.68 5.12	13.3 11 8.9 6.6 4.4
1.6 MHz	64-QAM 32-QAM 16-QAM 8-QAM QPSK	1.28 M	7.68 6.45 5.12 3.84 2.56	6.6 5.5 4.4 3.3 2.2
800 kHz	64-QAM 32-QAM 16-QAM 8-QAM QPSK	640 K	3.84 3.20 2.56 1.92 1.28	3.3 2.75 2.2 1.65 1.1
400 kHz	64-QAM 32-QAM 16-QAM 8-QAM QPSK	320 K	1.92 1.60 1.28 0.96 0.64	1.65 1.38 1.1 0.83 0.54
200 kHz	64-QAM 32-QAM 16-QAM 8-QAM QPSK	160 K	0.96 0.80 0.64 0.48 0.32	0.83 0.63 0.54 0.40 0.27

Table 1-3   DOCSIS and EuroDOCSIS Downstream Data Rates

Downstream Channel Width, MHz	Modulation Scheme, bit/symbol	Baud Rate, MSym/sec	Raw Bit Rate, Mb/sec	Throughput (Bit Rate - Overhead), Mb/sec
6	64 QAM (6) 256 QAM (8)	5.056 5.360	30.34 42.88	27 39
8	64 QAM (6) 256 QAM (8)	6.592 6.592	39.55 52.74	36 51

NEBS Level 3 Compliance

The Cisco uBR10012 router is Network Equipment Building System (NEBS) Level 3 compliant. This includes the following categories:

- Filtration and front to back airflow
- Transportation and storage
- Operating temperature and humidity
- Heat dissipation and fire spread
- Packaged equipment shock
- Earthquake, office, and transportation vibration
- Airborne contaminants and acoustic noise
- Lightning immunity
- Electrical safety
- EMI emissions and immunity

Cisco uBR10012 Universal Broadband Router Hardware

This section describes the Cisco uBR10012 router and router components.

Cisco uBR10012 Router

The Cisco uBR10012 router is installed in a standard 19-inch equipment or telco rack. A rack-mount kit ships from the Cisco factory with each router. The rack-mount kit includes the hardware needed to mount the router in a standard 19-inch equipment rack or telco-type rack. Mounting in 23-inch equipment racks is possible with optional third-party mounting hardware.

The Cisco uBR10012 chassis is designed for front and rear access. The two AC or DC power entry modules (PEM)s, two Performance Routing Engine (PRE) modules, the LCD panel, and the fan assembly module are accessed from the front of the chassis, see Figure 1-2. The eight slots for cable interface line cards, four full-slots for network uplink line cards, and two slots for the Timing, Communication, and Control Plus (TCC+) cards, and DOCSIS Timing, Communication, and Control Plus (DTCC) cards are accessed from the rear of the chassis, see Figure 1-3.

Note If the only available power supply source is 100-120 VAC, you can use the auxiliary AC-input power shelf. The AC-input power shelf converts AC to DC power for the Cisco uBR10012 router. See "Supported External AC-Input Power Shelves" for more information.

Figure 1-1 shows the front of the Cisco uBR10012 router with the front cover installed.

Figure 1-1 **Cisco uBR10012 Universal Broadband Router—Front View with Front Cover**
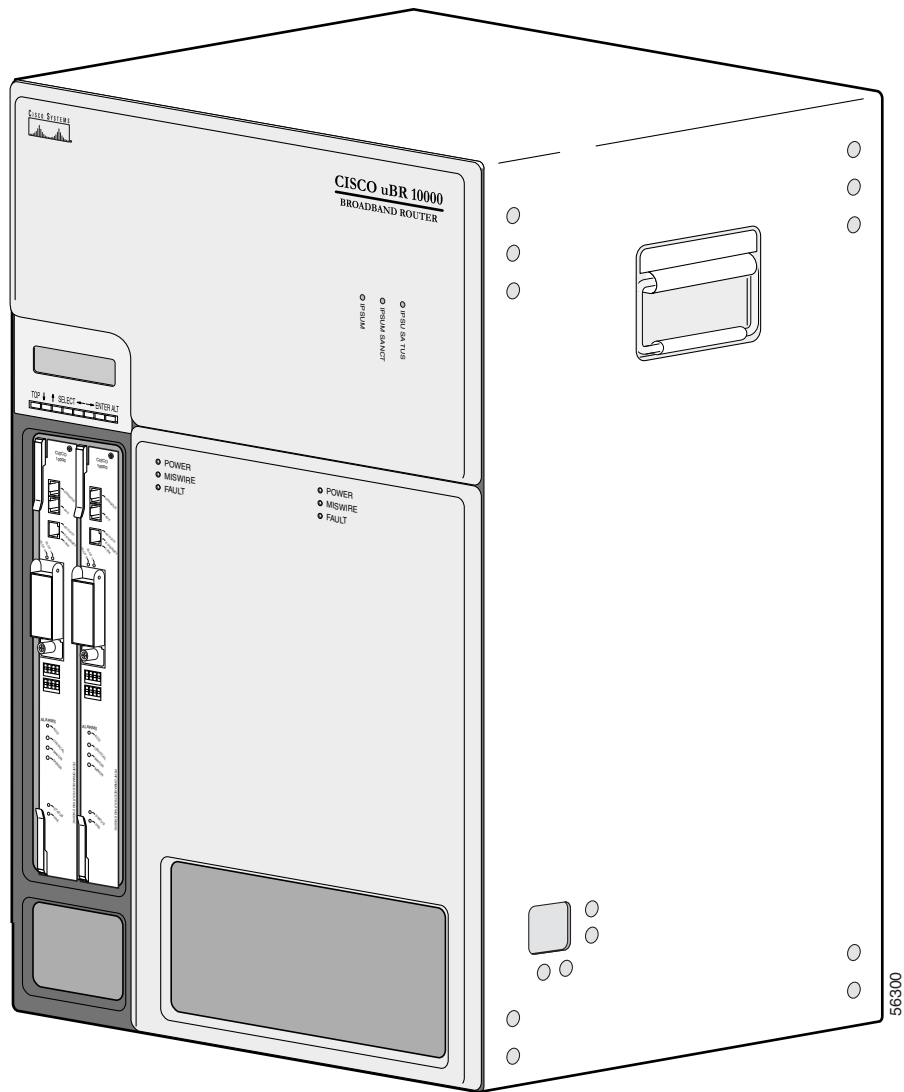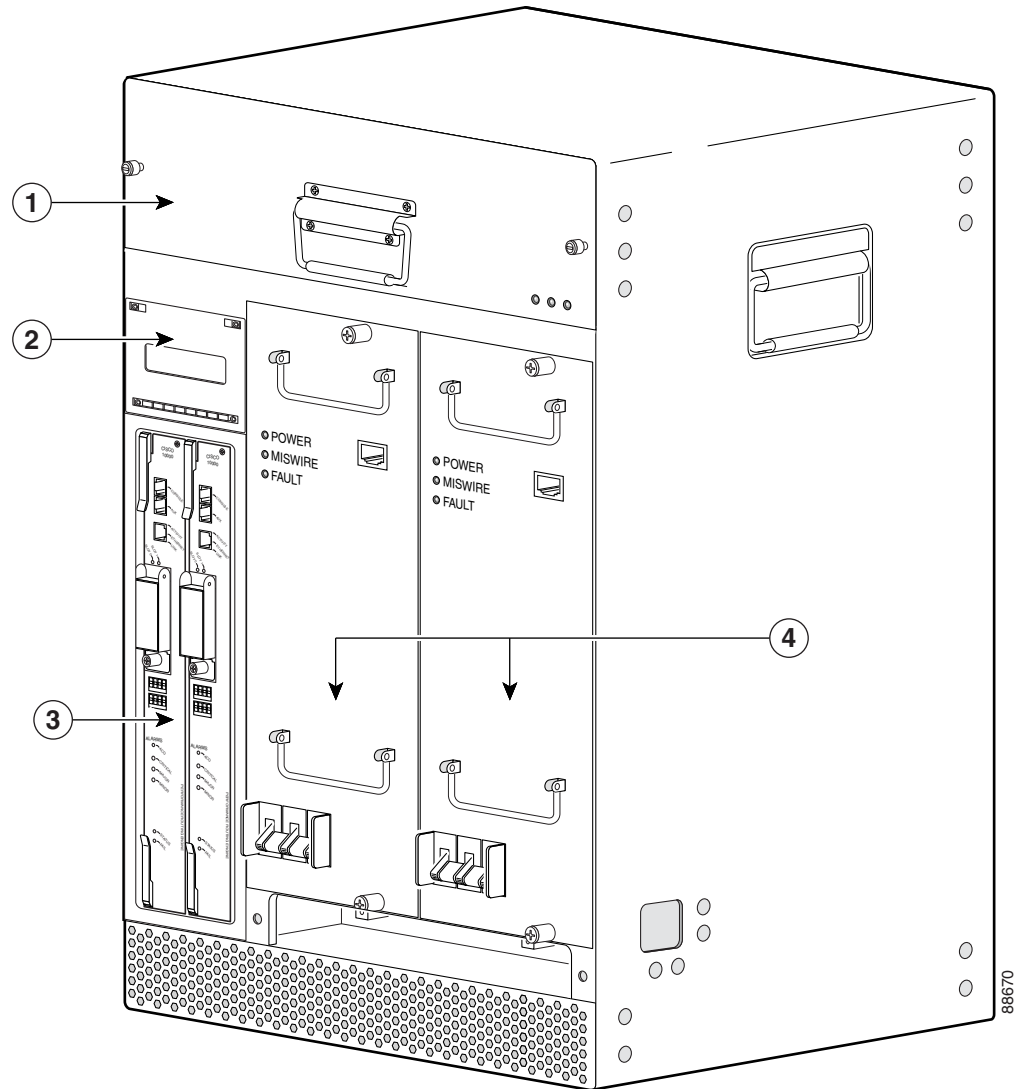
Figure 1-2 shows the front of a fully loaded chassis without the front cover.

Note   Figure 1-2 is a sample representation of the Cisco uBR10012 chassis with the DC PEM (UBR10-PWR-DC=) modules.
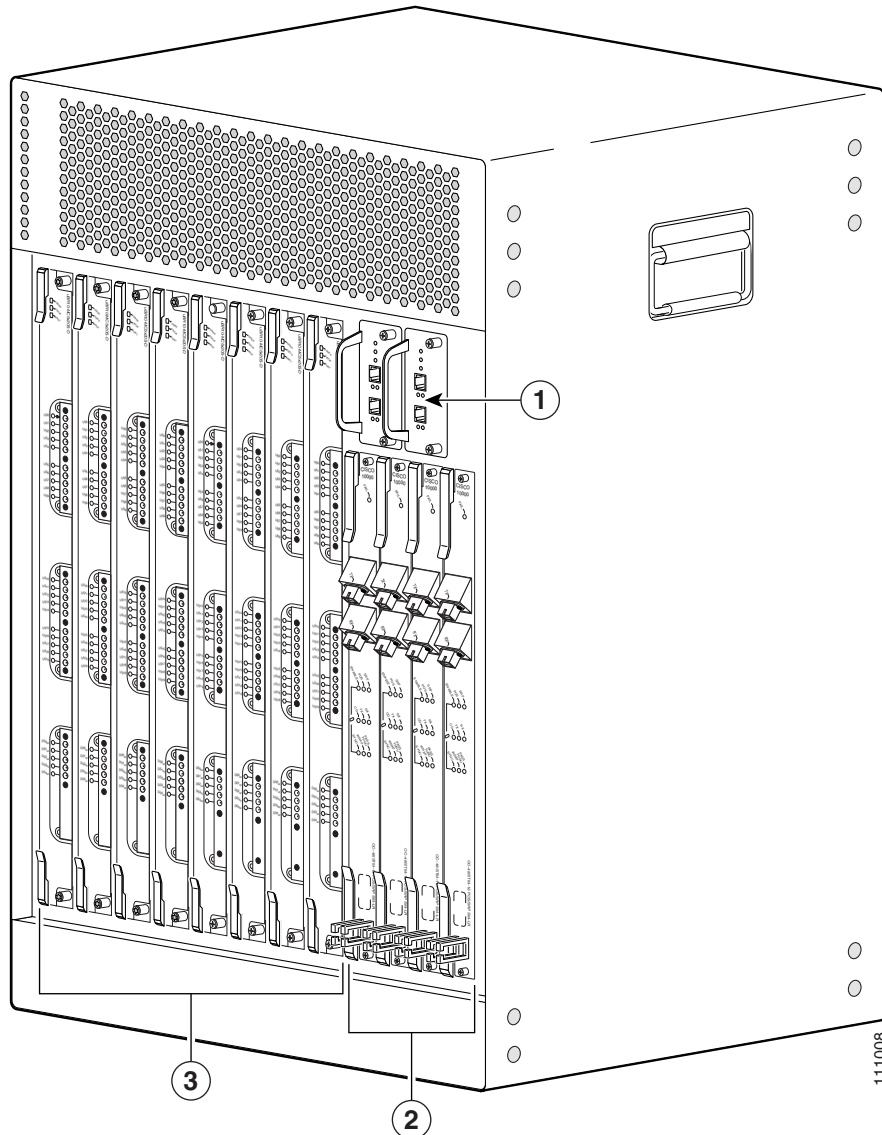
Figure 1-2   Cisco uBR10012 Router Chassis—Front View without the Front Cover

1	Fan assembly module	**3**	Two PRE modules
2	LCD module	**4**	Two DC PEM modules

Figure 1-3 shows the rear of a fully-loaded Cisco uBR10012 router.

Figure 1-3   Cisco uBR10012 Router Chassis—Rear View

| **1**	Two TCC+ cards	**3**	Eight cable interface line cards
2	Four high-speed, high-performance network uplink line cards (HHGE line cards not shown)		—

⚠
Caution   The handles shown on the left and right sides of the chassis should be used only when lifting a depopulated chassis that does not have any PEMs, fan assembly module, or line cards installed. See "Chassis-Lifting Guidelines" for more information.

Cisco uBR10012 Router Slot Numbering

Figure 1-4 shows the slot numbering for the line cards and TCC+ cards in the rear of the chassis. The Cisco uBR5X20S/U cable interface line cards are used in this Figure 1-4.

Figure 1-4   Cisco uBR10012 Chassis Slot Numbering—Rear View
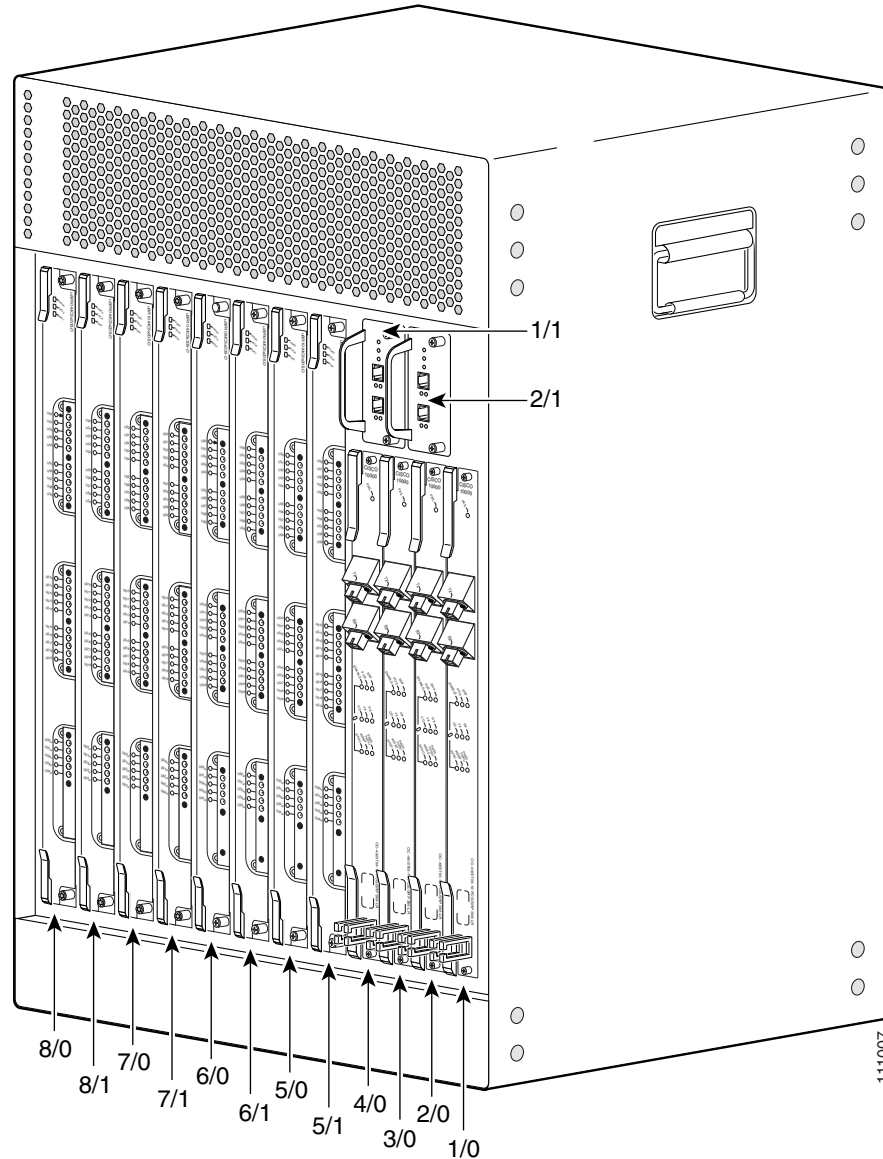
Note   Half-height Gigabit Ethernet (HHGE) line cards use slot 3 and slot 4 only. These cards are used with a slot splitter that subdivides the slots so that they become slots 3/0/0, 3/0/1, and slots 4/0/0, 4/0/1.
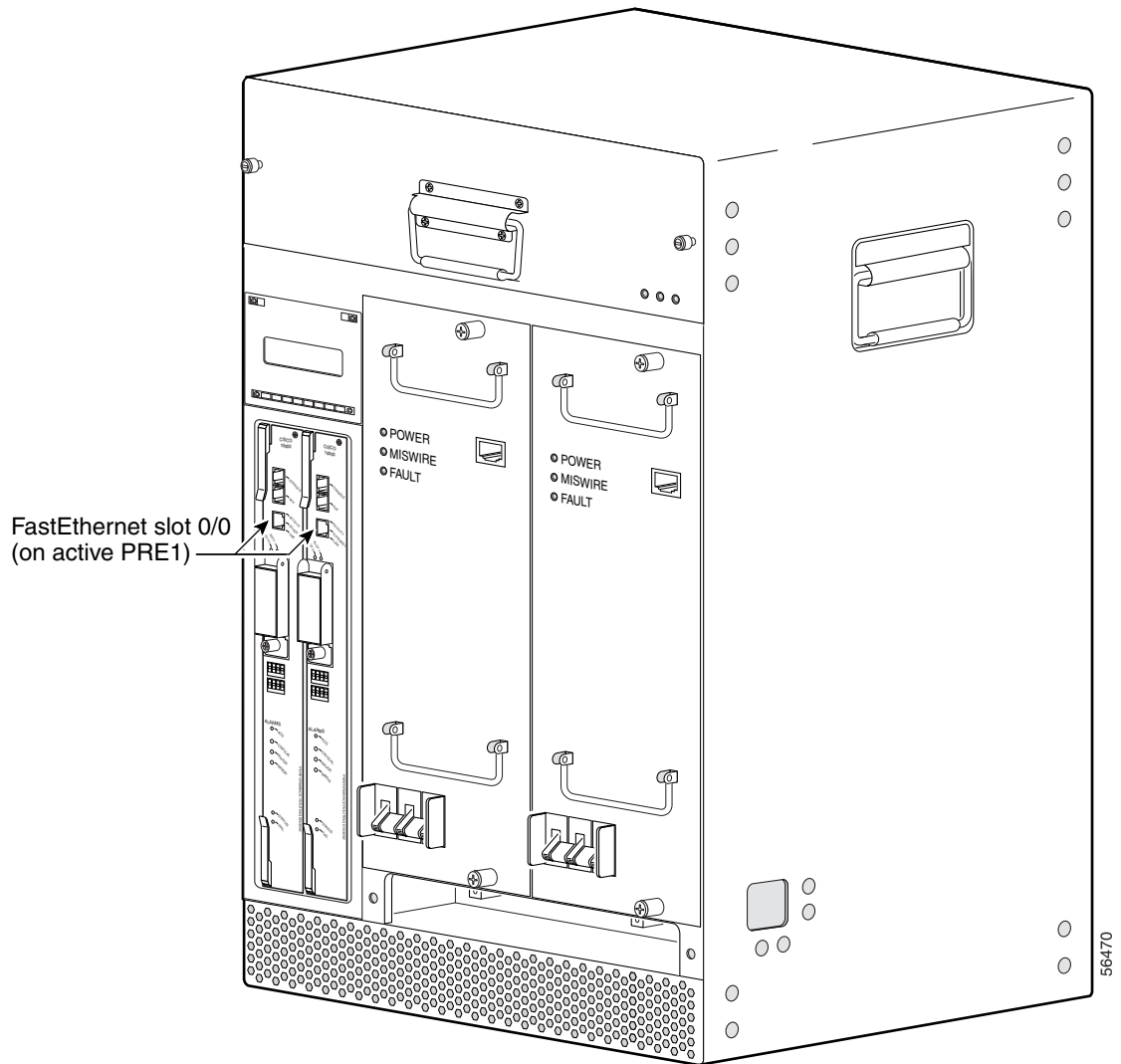
Caution   If you place a slot splitter and HHGE line card in slot 1/0 or slot 2/0, these slots shut down.

Figure 1-5 shows the slot numbering for the Fast Ethernet interface on the active PRE module.

Figure 1-5   Cisco uBR10012 Chassis Slot Numbering—Front View

FastEthernet slot 0/0
(on active PRE1)

🔍
Tip   The Fast Ethernet interface on the backup PRE is not used unless the primary PRE fails and the backup
PRE is activated. When the backup PRE becomes the active PRE module, its Fast Ethernet interface
automatically becomes the active Fast Ethernet interface at slot 0/0.

✎
Note   The Cisco uBR10012 router also has an internal Ethernet interface, Ethernet 0/0/0, which PRE
processors and line cards use to transfer packets between cards. This interface is not user-configurable,
although you can see the configuration and run-time information using the **show interface** command.

⚠
Warning   **Ultimate disposal of this product should be handled according to all national laws and regulations.**
Statement 1040

Cisco uBR10012 Universal Broadband Router Modules

The following section describes the modules used in the Cisco uBR10012 router. For a list of field replaceable units (FRUs) used in this chassis, see "Cisco uBR10012 Router FRU Resources".

Fan Assembly Module

The Cisco uBR10012 chassis uses a fan assembly module containing fans to supply cooling air to the chassis. The fan assembly connects to the chassis through a blind mate connector that plugs into the cable assembly and then into the chassis backplane. The fan assembly modules can be identified by the product part numbers. The fan assembly module supported on the Cisco uBR10012 chassis is:

- Fan Assembly Module (UBR10-FAN-ASSY=)
- Fan Assembly Module (UBR10012-FAN-PLUS=)

For information on installing, removing and replacing the fan assembly module, see *Cisco uBR10012 Universal Broadband Router Fan Assembly Module*.

AC Power Entry Modules

The Cisco uBR10012 router is shipped with two AC power entry modules (AC PEMs) that provide power supply to the system. One AC PEM module is sufficient to provide power for a fully configured chassis. However, if one AC PEM module fails, the other AC PEM module automatically begins providing power to the entire chassis, without impacting the system operation.

The AC PEM modules use a standard 200–240 VAC (50 or 60 Hz) input power obtained through power receptacles on the front panel of each PEM. The two AC PEMs convert the AC power to provide filtered, redundant, and load shared DC power to the Cisco uBR10012 chassis. The AC PEM modules can be identified by their product part numbers.

The AC PEM modules supported on the Cisco uBR10012 chassis are:

- AC PEM Module (UBR10-PWR-AC=)
- AC PEM Module (UBR10-PWR-AC-PLUS=)

For information on installing, removing and replacing the 2400 W AC PEM module, see *AC Power Entry Module for the Cisco uBR10012 Universal Broadband Router*.

For information on installing, removing, replacing the 3300 W AC PEM module, and migrating from the 2400 W AC PEM to the 3300 W AC PEM, see *3300 W AC Power Entry Module for the Cisco uBR10012 Universal Broadband Router*.

DC Power Entry Modules

The Cisco uBR10012 router is shipped with two DC power entry modules (DC PEMs) that provide power to the system. One DC PEM can provide sufficient power for a fully configured chassis. However, if one DC PEM fails, the other automatically begins providing power to the entire chassis, without impacting the system operation.

The two DC PEMs provide filtered, redundant, and load shared DC power to the Cisco uBR10012 chassis. The DC PEM modules can be identified by their product part numbers.

The DC PEM modules supported on the Cisco uBR10012 chassis are:

- DC PEM Module (UBR10-PWR-DC=)
- DC PEM Module (UBR10-PWR-DC-PLUS=)

Table 4 summarizes the specifications of the DC PEM modules.

Table 4   Specifications of the DC PEM modules

Component	UBR10-PWR-DC-PLUS=	UBR10-PWR-DC=	
Cisco DC PEM (Part Number)[1]	341-0388-01	34-1651-04 and 34-1651-05	34-1651-05
Power output	3300 W	2400 W	3000 W
DC-input Voltage	–48 to –60 VDC nominal	–48 to –60 VDC nominal	–55 to –60 VDC nominal
DC-output Voltage (nominal)	–57.5 V	See footnote[2]	
DC-input Current Connections	50 A + 50 A	50 A	56 A
Physical Differences			
LEDs	5	3	3
Weight	16 lbs (7.25 kg)	10 lbs (4.54 kg)	10 lbs (4.54 kg)
PRODUCT ID LED/switch	Yes	No	No

1. The 34- part number is listed on compliance label of the DC PEM.

2. For the 34-1651-04 and 34-1651-05 DC PEM modules, the DC-output voltage varies according to the DC-input voltage with a drop in voltage between 1 V and 1.85 V. The allowable DC-input range is -40.5 V to -72 V. The DC-output voltage is not constant for these DC PEM modules. For the 341-0388-01 DC PEM module, the DC-output voltage is regulated and is constant.

For information on installing, removing and replacing the 2400 W or the 3000 W DC PEM module, see *DC Power Entry Module for the Cisco uBR10012 Universal Broadband Router*.

For information on installing, removing, replacing the 3300 W DC PEM module, and migrating from the 2400 W or the 3000 W DC PEM to the 3300 W DC PEM, see *3300 W DC Power Entry Module for the Cisco uBR10012 Universal Broadband Router*.

Supported External AC-Input Power Shelves

If 100–120 VAC is the only available power source at the facility, then use the external AC-input power shelf with the Cisco uBR10012 router The AC-input power shelf converts AC power from an external AC power supply source into DC power that is suitable for powering on the Cisco uBR10012 router.

The external power shelves supported on the Cisco uBR10012 router are:

- 2400 W AC-Input Power Shelf
- Lineage AC-DC Power Shelf

Table 1-5 lists the specifications of the external power shelves on the Cisco uBR10012 chassis.

Table 1-5   Supported External Power Shelves for Cisco uBR10012 Router Specifications

	Lineage AC-DC Power Shelf	2400 W AC-Input Power Shelf
Part Number	J85480S1 L30[1]	UBR10-PWR-AC-EXT
Output Power supplied to the Cisco uBR10012 chassis	3300 W	2400 W
DC Output Voltage	-54 V	-54 V

1. For more information on ordering the Lineage kit, see Table D-6.

For information about the 2400 W AC-input power shelf, see the *2400 W AC-Input Power Shelf for the Cisco uBR10012 Universal Broadband Router* at the following URL:

We recommend you use the external Lineage AC-DC power shelf in conjunction with the Cisco uBR10012 router chassis. For an overview of the Lineage AC-DC power shelf, see the "Lineage AC-DC Power Shelf" section on page 1-15. For information on connecting the Lineage AC-DC power shelf with the Cisco uBR10012 router, see "Connecting the External AC-input Power Shelf to the Cisco uBR10012 Router" section on page 3-28.

Table 1-6 lists the number of Lineage power shelves that are required to supply power to the DC PEM modules.

Table 1-6   Cisco uBR10012 Router DC PEM Modules and Lineage Shelves

Component	UBR10-PWR-DC-PLUS=	UBR10-PWR-DC=	
Cisco DC PEM (Part Number)[1]	341-0388-01	34-1651-04 and 34-1651-05	34-1651-05
Power Output	3300 W	2400 W	3000 W
No. of Lineage Shelves	2	1	1

1. The 34- part number is listed on the compliance label of the DC PEM.

For information on installation, power shelf safety features, safety warnings, and troubleshooting the Lineage power shelf, see the product documentation available at http://www.lineagepower.com/.

Lineage AC-DC Power Shelf

This external AC-DC power shelf from Lineage (part number J85480S1 L30) with AC module (CP2000AC54PE) is 1-rack unit high (1.75 inch) and can be mounted on a standard 19-inch 4-post equipment rack or telco-type rack. We recommend installing the Lineage power shelf in the rack in a

way that the power connections reside facing inside the rack when viewed from the front. This allows the DC output terminals of the external AC-input power shelf to be on the same side as the DC-input terminals of the Cisco uBR10012 chassis.

The Lineage AC-DC power shelf has two DC power sources, four AC-input power supply sources, and J1 and J2 connectors. Each AC-input power supply module is automatically powered on when it is plugged into the wall socket. (See Figure 1-6).

Figure 1-6   *Lineage AC-DC Power Shelf - Front and Rear View*
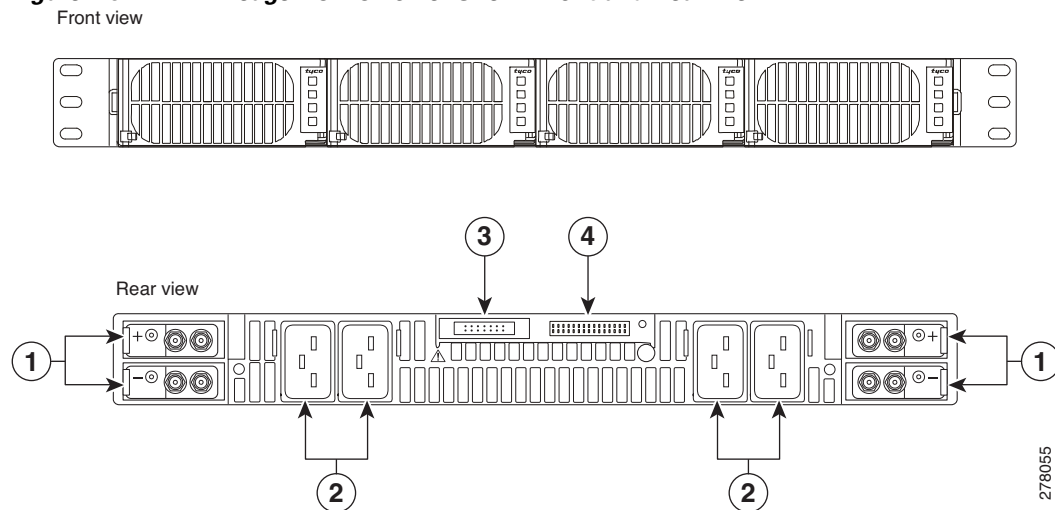
| 1 | DC power source terminal blocks | 3 | J2 connector |
| 2 | AC input power connectors | 4 | J1 connector / alarm cable interface |

All cable connections for AC-input power, DC-output power, and status signals are made from the rear of the power shelf. Each AC power supply module has an individual AC facility cord attachment. All four AC-input cords must be attached to the facility for all four AC power modules to function. Two DC-interconnect cables provide DC-output power to the DC PEM (UBR10-PWR-DC=) modules on the Cisco uBR10012 chassis. (See Figure 1-7).

Note   The AC-input power cables, DC-output power cables, and alarm monitor cable are supplied along with Lineage. We recommend that you use these cables for cabling the shelf to the Cisco uBR10012 router.

Figure 1-7   Rear View of the Lineage AC-DC Power Shelf with Cables
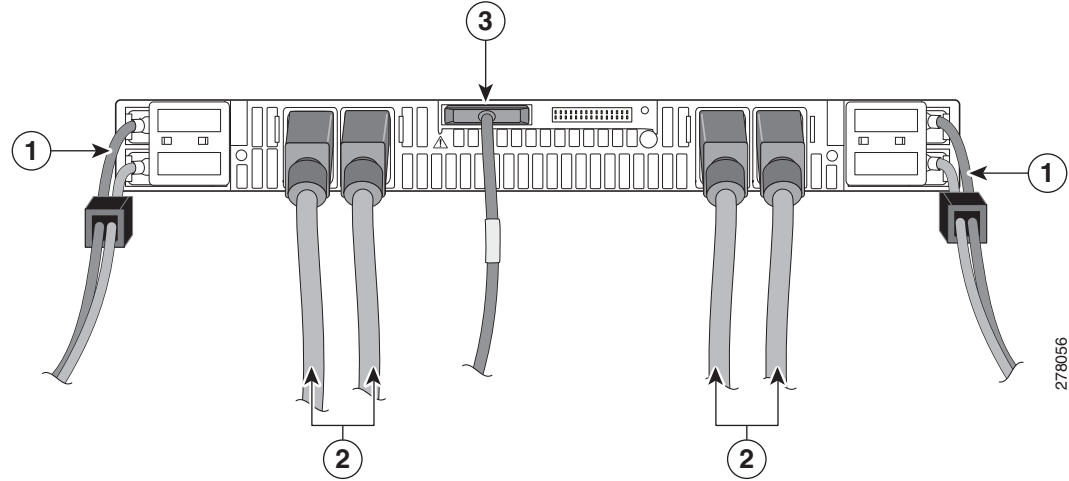
1	DC power supply cables	3	Alarm monitor cable
2	AC power supply cables		—

To meet compliance standards, use the DC power cables (3 m cable supplied along with Lineage power shelf), while cabling the Lineage AC-DC power shelf to the Cisco uBR10012 chassis. Ensure proper rating and fit in the chassis when connecting the cables into the input DC terminal block on the backplane of the Cisco uBR10012 chassis.

To meet the Class A emission compliance requirements, ferrite beads must be used with Lineage AC-DC power shelf when used to power on the Cisco uBR10012 router. For information on ferrite beads, see "Attaching Ferrite Beads on DC Power Cables" section on page 3-23.

For information on connecting the Lineage power shelf see, Connecting the External AC-input Power Shelf to the Cisco uBR10012 Router, page 3-28.

LCD Module

The LCD module provides real-time operating status and configuration information for the chassis and line cards. The buttons below the screen provide a menu system that allows you to display different parts of the system configuration without using a terminal. Figure 1-8 shows the Cisco LCD module without the chassis front cover.

Figure 1-8   *LCD Module Display Panel*

Keypads
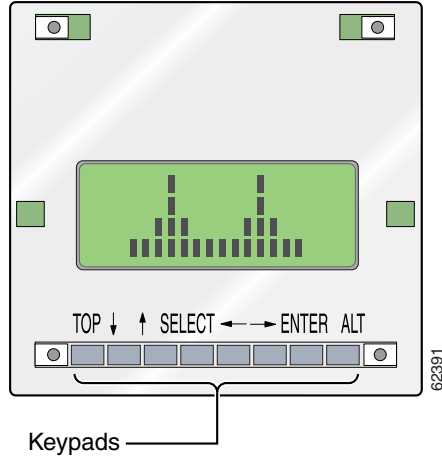
Note   The LCD module functions depend on the release of the Cisco IOS software running on your
Cisco uBR10012 router. Refer to the release notes for the Cisco IOS release you are using, and the
Cisco uBR10012 Software Configuration Guide, for details. See the "Obtaining Documentation and
Submitting a Service Request" section on page xvii.

LCD Cable

The LCD ribbon cable connects the LCD module to the backplane. The folded end is connected to the LCD module. See Figure 1-9.

Figure 1-9   LCD Cable

Performance Routing Engine

There are four models of PREs, the original PRE module that was initially shipped with the Cisco uBR10012 router, the PRE1 module that began shipping with Cisco IOS Release 12.2(4)XF, the PRE2 module that is shipping with Cisco IOS Release 12.3(9)BC, and the PRE4 module that is shipping with Cisco IOS Release 12.2(33)SB.

- PRE1 functionality was introduced in Cisco IOS Release 12.2(4)XF.
- PRE2 functionality was introduced in Cisco IOS Release 12.3(9a)BC.
- PRE4 functionality was introduced in Cisco IOS Release 12.2(33)SCB.

You can use the CLI **show version** command to determine whether a PRE, PRE1, PRE2, or PRE4 module is installed in your system.

Note   The PRE3 is not supported on the Cisco uBR10012 router

The PRE is a single-slot module used with the Cisco uBR10012 routers. The PRE performs all Layer 2 and Layer 3 packet routing and forwarding using an advanced parallel processing architecture called Parallel eXpress Forwarding (PXF). This process separates the control plane from the data plane. The PXF architecture supports high-performance throughput with IP services enabled on every port.

Note   When replacing a PRE1 module with a PRE2 module, you must also install EMI gaskets and RF absorber material. For more information, go to the following URL:

http://www.cisco.com/en/US/docs/cable/cmts/ubr10012/installation/field_replaceable_units/pre2gkit.html

PRE Modules and PRE1 Modules

PRE1 modules support error checking and correction (ECC) for all onboard memory, replacing the simpler parity error algorithm of the original PRE module. A general-purpose RISC processor (262–300 MHz MIPS RISCMark RM7000) support high performance Layer 3 forwarding of traffic. The

combination of a general purpose RISC processor with advanced programmable PXF network processors provides the capacity to support the aggregation of thousands of active connections in a single Cisco uBR10012 chassis when supporting IP applications such as access policy filtering, rate-based queuing, and QoS.

PRE2 Modules

PRE2 modules are designed to address Internet service provider (ISP) requirements. The PRE2 has four PFX network processors (containing 64 individual processors) with two independent 32-MB SDRAM control memories on each processor set. The PRE2 provides 6.2 Mpps of processing power and has a 500-MHz RM 7000 mips processor with integrated 16-KB data and 16-KB instruction Level 1 caches, an integrated 256-KB Level 2 cache, and a 4-MB Level 3 cache.

Cisco IOS Release 12.3(9a)BC automatically enables the following features:

- Route Processor Redundancy Plus (RPR+)
- 6.2 mpps processing power
- Software features available with PRE2 and Cisco IOS Release 12.3(9a)BC:
  - EtherChannel
  - TLS 802.1q
  - NetFlow

PRE4 Modules

The Performance Routing Engine 4 (PRE4) is the fifth-generation Parallel Express Forwarding (PXF) packet processing and scheduling engine for the Cisco uBR10012 router.

PRE4 enhances the performance capability of the Cisco uBR10012 router to 10 Mpps by providing increased density Gigabit Ethernet (GE) and higher throughput of the 10GE SPA interface.

The PRE4 runs Cisco IOS Release 12.2(33)SCB and later releases. Benefits of the PRE4 include:

- 800-MHz dual processor
- 64 PXF network processors arranged as 8 columns and 8 rows
- 512-MB packet buffer and 128-MB control memory with error-correcting code
- 4-GB ECC-protected Route Processor (RP) memory
- 10 million packets per second (Mpps) forwarding performance through the PXF complex
- 5.6-Gbps backplane bandwidth for each full-height backplane slot
- 11.2 Gbps backplane bandwidth to each SPA interface processor (SIP)
- Maximum transmission unit (MTU) support of 9216 bytes
- An external CompactFlash Disk slot (disk0)
- A 100/1000 Megabit Ethernet interface for communication between redundant PRE4s

Note   Unless otherwise indicated, all references in this document to the PRE refer to the PRE, the PRE1, the PRE2, or the PRE4 modules. The PRE is now end-of-life (EOL) and is replaced by the PRE1, PRE2, or PRE4.

Redundant PRE Modules

The PRE module supports redundant operation (two PRE modules in a Cisco uBR10012 chassis). If the primary PRE fails, the secondary PRE automatically takes over operation of the chassis. Because all Cisco uBR10012 line cards are physically connected to both the primary and secondary PRE modules, a switchover of PRE modules does not require human intervention to reset the line cards, as they automatically fail over to the redundant PRE. The PRE module is hot-swappable if there is a redundant PRE module in the chassis.

⚠️

Caution   You cannot use different models of the PRE in the same chassis. If you have PRE2 modules and you wish to upgrade, you must upgrade both of your PREs to the PRE4s. You cannot use a PRE1 or a PRE2 and a PRE4 in the same system.
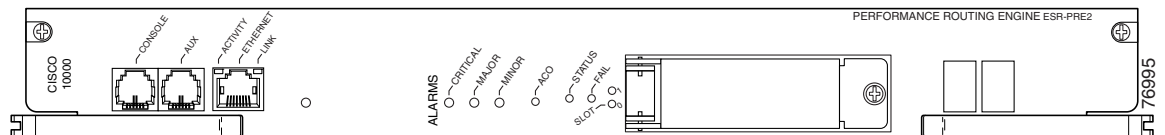
PRE Module Description

The PRE1 contains two PC media card two slots and 64 MB of onboard flash memory. Figure 1-10 shows the PRE 1 faceplate.
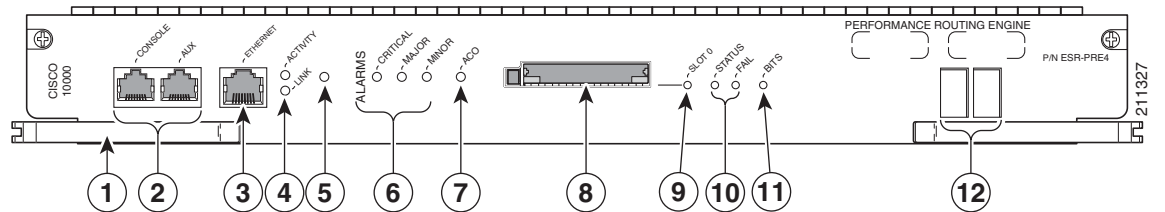
Figure 1-10   **PRE1 Faceplate**
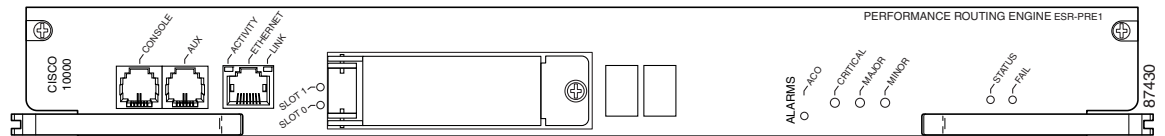
The PRE2 contains two PC media card slots and 128 MB of onboard flash memory. Figure 1-11 shows the PRE2 faceplate.

Figure 1-11   **PRE2 Faceplate**

The PRE4 contains a CompactFlash Disk slot (disk0) and 128 MB of onboard flash memory. Figure 1-12 shows the PRE4 faceplate.

Figure 1-12   **PRE4 Faceplate**

1	Ejector levers	7	ACO (Alarm Cut-off) button
2	Console and Auxiliary ports	8	CompactFlash Disk slot, disk0
3	Network Management Ethernet (NME) port	9	Slot 0 (disk0) LED
4	NME Activity and Link LEDs	10	Status, Fail LEDs
5	Reset button	11	Building Internal Timing Source (BITS) LED
6	Alarms: Critical, Major, Minor LEDs	12	Alphanumeric display

Connector Ports

The faceplate on the PRE contains three ports with RJ-45 connectors:

- Console port—This asynchronous EIA/TIA-232 serial port is used to connect a terminal to the PRE for local administrative access.

- Auxiliary port (AUX)—This asynchronous EIA/TIA-232 serial port is used to connect a modem to the PRE for remote administrative access.

- Fast Ethernet port—This Fast Ethernet port is used to connect the PRE to a 10/100Base-T network management LAN.

> **Note**   The Fast Ethernet interface on the PRE module is intended for network management access and should not be used for WAN connectivity purposes. For WAN connections, use the appropriate network uplink cards, which take full advantage of the system's high-performance PXF processing subsystem.

PC Media Card Slots

Two PC media card slots (one CompactFlash Disk slot for the PRE4) can store the Cisco IOS image or a system configuration file on a PC media card or CompactFlash Disk. The system can also boot from the software stored on the PC media card or CompactFlash Disk. The PC media card slots support Type I or Type II cards. See the "Removing and Installing a PC Media Card" section on page 16 for more information about inserting and removing PC media cards from the PRE.

LCD Screens

The two LCD screens below the PC media card slots display alphanumeric information about the status of the of the PRE module.

PRE LED Indicators and Buttons

LEDs on the faceplate of the PRE provide a visual indication of the status of PRE operation (see Figure 1-10). The LEDs are separated into three categories: alarms, status, and failure.

- ALARM—Alarm relay contacts on the Cisco uBR10012 router connect the router to a site alarm maintenance system. This allows critical, major, and minor alarms generated by the Cisco uBR10012 router to be displayed on the PRE faceplate and also translated to external visual or audible alarms connected to the system. See the "Connecting Alarm Indicators" section on page 3-41 for more information about alarm connections. Pressing the alarm cutoff (ACO) button

on the (primary) PRE during an alarm condition shuts off the external alarm, but does not deactivate the alarm LEDs on the PRE faceplate. Alarm LEDs on the faceplate are deactivated only after the condition that caused the alarm is corrected.

- STATUS—Indicates the status of the PRE.
- FAIL—Indicates that a major failure has disabled the PRE.

Table 1-7 describes the LEDs and switch on the PRE.

Table 1-7   Cisco PRE LEDs and Cutoff Switch

LEDs/Switch	Status	Description
ACTIVITY	Green	Packets are being transmitted and received.
	Off	No packet activity.
LINK	Green	Carrier detected; the port is able to pass traffic.
	Off	No carrier detected; the port is not passing traffic.
Reset button	–	Resets the PRE4.
Alarm cutoff (ACO) button	–	Pressing this button disables an audible alarm.
CRITICAL, MAJOR, and MINOR LEDs	Off	No alarm.
	Yellow	Alarm condition.
STATUS	Green	PRE is ready and active as the primary PRE.
	Off	No power to the PRE or the PRE is acting as the secondary PRE.
	Flashing Yellow	System is booting.
	Flashing Green	PRE4 is standby.
FAIL	Off	PRE is operating properly.
	Yellow	A major failure has disabled the PRE.
CompactFlash slot 0	Green	Disk0 is active.
PC media card slot 0	Green	Flash card in Slot 0 is active[1].
PC media card slot 1	Green	Flash card in Slot 1 is active.
BITS	Green	BITS input to the PRE is configured and functioning normally.
	Yellow	BITS input to the PRE is configured, but not functional. For example, the framer may have detected a Loss of Signal (LOS).
	Off	BITS input to the PRE4 is not configured.

1. The Cisco uBR10012 router supports PCMCIA flash memory cards of 64 MB or above.

PRE Module Disposal

The PRE module contains a small lithium battery. Some jurisdictions restrict the ways in which you can dispose of items containing lithium batteries. In particular, never dispose of lithium batteries or products containing lithium batteries in an unregulated fire. Other restrictions might apply in your area.

Warning   **Ultimate disposal of this product should be handled according to all national laws and regulations.** Statement 1040.

SIP and SPA Compatibility

The Cisco uBR10012 router currently supports the following SIPs:

- Cisco Wideband SIP for the Cisco Wideband SPA

> ✎
>
> **Note** Effective with Cisco IOS Release 12.2(33)SCH, the Cisco Wideband SIP is not supported on the Cisco uBR10012 router.

- Cisco 10000 Series SPA Interface Processor-600

The Cisco Wideband SIP can support up to two Cisco Wideband SPAs. The Cisco uBR10012 router can support up to eight SPAs. For more information about the introduction of support for different SIPs and SPAs, refer to the *Cisco uBR10012 Universal Broadband Router SIP and SPA Software Configuration Guide* at the following location:

http://www.cisco.com/en/US/docs/interfaces_modules/shared_port_adapters/configuration/ubr10012/12.3_23_bc/sipsp_d3.html

Timing, Communication, and Control Plus Card

On the Cisco uBR10012 router, the Timing, Communication, and Control Plus (TCC+) card acts as a secondary processor that performs the following functions:

- Generates and distributes 10.24 MHz clock references to each of the cable interface line cards.

- Generates and distributes 32-bit time-stamp references to each of the cable interface line cards.

- Allows software to power off independently any or all of the cable interface line cards.

- Drives the LCD module used to display system configuration and status information.

- Monitors the supply power used by the chassis.

- Provides two redundant RJ-45 ports for external timing clock reference inputs such as a Global Positioning System (GPS) or building integrated timing supplies (BITS) clock.

When two TCC+ cards are installed, they are configured as active and backup (redundant). If the TCC+ card in the first slot is working at system power-up, it automatically becomes the active card and the TCC+ card in the second slot becomes the backup card. The TCC+ cards monitor each other's priority information so that if the active card fails, the active card role is transferred to the redundant backup card without lose of data.
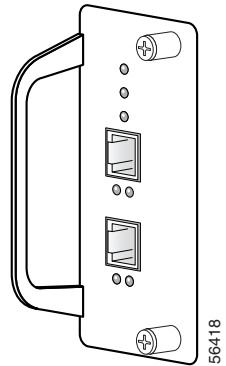
Figure 1-13 shows the faceplate of the TCC+ card. The handle provides for the insertion and removal of the card from the chassis.

> ⚠
>
> **Caution** Do not attempt to lift the chassis using one of these handles.

Figure 1-13   TCC+ Card Faceplate

The faceplate on the TCC+ card has seven LEDs labeled POWER, STATUS, MAINT, PRESENT, and ACTIVE. Separate PRESENT and ACTIVE LEDs are associated with the primary and secondary external clock reference inputs.

For more information, see *Cisco uBR10012 Universal Broadband Router TCC+ Card*.

DOCSIS Timing, Communication, and Control Card

On the Cisco uBR10012 universal broadband router, the DTCC card acts as a secondary processor that performs the following functions:

- In the default DTI mode, a 10.24 MHz clock and 32-bit DOCSIS timestamp are generated by the DTI Server, propagated to DTI client using DTI protocol, and distributed by DTI client to each cable interface line card.

- Allows software to independently power off any or all cable interface line cards.

- Drives the LCD panel used to display system configuration and status information.

- Monitors the supply power usage of the chassis.

- Two RJ-45 cables with the DTI server, which, in turn, can generate the clock using its own oscillator or external timing reference inputs such as GPS or network clock.

Two DTCC cards are installed and configured as active (primary) and backup (redundant). If the DTCC card in the first slot is working at system power-up, it automatically becomes the active card and the DTCC card in the second slot becomes the backup card. The DTCC cards monitor each other's priority information, so that if the active card fails, the active card role is transferred to the redundant backup card without loss of data.

Figure 1-13 shows the faceplate of the DTCC card.

Figure 1-14   Cisco DTCC Front Panel
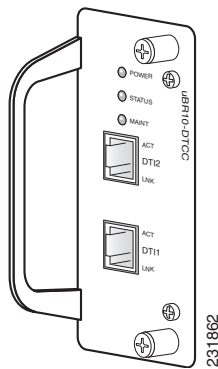
The front panel on the DTCC card has seven LEDs. They are labeled POWER, STATUS, MAINTENANCE, PRESENT, and ACTIVE. The second set of PRESENT and ACTIVE LEDs are associated with the primary and secondary external clock reference inputs.

For more information, see *Cisco uBR10012 Universal Broadband Router DTCC Card*.

Cable Interface Line Cards

The following section describes the cable interface line cards used in the Cisco uBR10012 universal broadband router.

Cisco uBR-MC5X20S/U/H Cable Interface Card

The Cisco uBR10-MC5X20S, U and H cable interface line cards are 20 by 16 inch cards designed specifically for the Cisco uBR10012 router. These cards transmit and receive RF signals between the subscriber and the headend over hybrid fiber-coaxial (HFC) system.

Upstream data, from the subscriber, comes through the upstream ports (US0-US19) on the Cisco uBR10-MC5X20S/U/H cable interface line card. The line card processes and configures the data and sends it across the backplane to the WAN/backhaul card and out to the Internet.

Downstream data, to the subscriber, comes from the Internet through the WAN/backhaul card, and across the backplane to the Cisco uBR10-MC5X20S/U/H cable interface line card. The Cisco uBR10-MC5X20S/U/H card processes and configures the data and sends it out through the appropriate downstream port (DS0-DS4) to be combined with the rest of the downstream signals in the headend.

The Cisco uBR10-MC5X20S/U line cards use burst receivers that report unequalized Modulation Error Ratio (MER). The Cisco uBR10-MC5X20H line cards use burst receivers that report equalized MER. Equalized MER will almost always be at least a few decibels (dB) higher than an unequalized MER measurement of the same signal under identical conditions.

Cisco uBR10-MC5X20S

The Cisco uBR10-MC5X20S cable interface line card supports downstream and upstream traffic over Data-over-Cable Service Interface Specification (DOCSIS)-based cable modem networks. The card supports downstream channels in the 70 to 860 MHz range, and upstream channels in the 5 to 42 MHz range. Each downstream port includes an onboard integrated upconverter. The Cisco uBR10-MC5X20S cable interface line card supports Annex B radio frequency (RF) data rates, channel widths, and modulation schemes and has DOCSIS MAC management and spectrum management capabilities. DOCSIS 2.0, Asynchronous Time Division Multiple Access (A-TDMA) rates are also supported.

Cisco uBR10-MC5X20U and H

The Cisco uBR10-MC5X20U/H cable interface line card supports both DOCSIS and EuroDOCSIS cable modem networks. The card supports downstream channels in the 70 to 860 MHz range, and upstream channels in the 5 to 65 MHz range. Each downstream port includes an onboard integrated upconverter. The Cisco uBR10-MC5X20U/H cable interface line card supports Annex B and Annex A radio frequency (RF) data rates, channel widths, and modulation schemes and has DOCSIS MAC management and spectrum management capabilities. DOCSIS 2.0, A-TDMA rates are also supported.

For more information, see *Cisco uBR10-MC5X20S/U/H Cable Interface Line Card Hardware Installation Guide*.

Cisco UBR-MC20X20V Cable Interface Card

The Cisco UBR-MC20X20V cable interface line card is a 20 by 16 inch card designed specifically for the Cisco uBR10012 universal broadband router. This card transmits and receives RF signals between the subscriber and the headend over hybrid fiber-coaxial (HFC) system. It has five downstream (DS) ports and twenty upstream (US) ports. The line card supports five cable MAC domains (cable interfaces), and the 20 DS and 20 US channels are dynamically associated with any of these five MAC domains. The card has twenty US spigots and five DS spigots. Each of the US spigots supports either two-frequency stacked US channels across ten ports or a single US channel across twenty ports. Each of the DS spigots supports four-frequency stacked channels across five ports.

Note   You must ensure that two DOCSIS Timing, Communication and Control (DTCC) cards are configured on the Cisco uBR10012 router before installing the Cisco UBR-MC20X20V cable interface line card.

For more information, refer to *Cisco UBR-MC20X20V Cable Interface Line Card Hardware Installation Guide*.

Cisco uBR-MC3GX60V Cable Interface Card

The Cisco uBR-MC3GX60V cable interface line card is a DOCSIS 3.0 compliant line card designed specifically for the Cisco uBR10012 universal broadband router. This line card conforms to the Modular CMTS (M- CMTS) architecture and has the capacity to support up to 72 downstream (DS) and 60 upstream (US) channels.

The Cisco uBR-MC3GX60V cable interface line card has 20 US spigots for RF connectivity, which are organized into 5 groups of 4 connectors each. Each connector group supports up to 12 frequency-stacked US channels, with a default configuration of 3 US channels per RF connector.

The Cisco uBR-MC3GX60V cable interface line card has six Gigabit Ethernet (GE) interface ports organized into three pairs for DS connectivity. Each pair supports 1+1 redundancy and supports 24 DS channels in Annex B mode by default. The GE interfaces connect to an external Edge Quadrature Amplitude Modulation (EQAM) device and provide M-CMTS compliant Downstream External PHY Interface (DEPI) data.

Another unique feature of the Cisco uBR-MC3GX60V cable interface line card is the use of a front panel display (FPD) to show the licensing status information of the US and DS channels.

For detailed information, refer to *Cisco uBR-MC3GX60V Cable Interface Line Card Hardware Installation Guide*.

Cisco uBR-MC3GX60V-RPHY Cable Interface Card

The Cisco uBR-MC3GX60V-RPHY line card is DOCSIS 3.0 compliant and is designed for the Cisco uBR10012 universal broadband router. This line card conforms to the Modular CMTS (M-CMTS) architecture and has the capacity to support up to 72 downstream (DS) and 60 upstream (US) channels.

The Cisco uBR-MC3GX60V-RPHY line card has six Gigabit Ethernet interface ports organized into three pairs, which connect to the Cisco Coaxial Media Converter device via EPON, GPON, or Metro Ethernet. Each pair supports 1+1 redundancy for the Metro Ethernet ports. The

Cisco uBR-MC3GX60V-RPHY line card supports 24 downstream RF channels and 20 upstream RF channels per Gigabit Ethernet port. It has a front panel display (FPD) to show the licensing status information of the US and DS channels. For detailed information, refer to *Cisco Remote-PHY Solution Workflow.*

Network Uplink Cards

The following sections describe the network uplink cards used in the Cisco uBR10012 universal broadband router:

- Cisco Single Port Gigabit Ethernet Line Card, page 1-30
- Cisco Half-Height Gigabit Ethernet Line Card, page 1-32
- Cisco OC-12 POS Line Card, page 1-32
- Cisco uBR10-SRP-OC12SML DPT WAN Line Card, page 1-34
- Cisco uBR10012 OC-48 DPT/POS Interface Module, page 1-34

Cisco Single Port Gigabit Ethernet Line Card

The single-port Gigabit Ethernet (GE) line card provides a trunk uplink to devices such as GSRs, as well as connections to content servers and Web caches. The GE line card provides the Cisco uBR10012 router with an IEEE 802.3z compliant Ethernet interface running at 1 Gbps in full duplex mode.

The port uses a Gigabit Interface Converter (GBIC) that supports Gigabit Ethernet rates on a variety of Gigabit Ethernet interface types (SX, LX/LH, ZX) which can be changed or upgraded at any time (see Table 1-9). The Cisco uBR10012 router supports multiple GE line cards to support connectivity to multiple destinations and to provide network layer redundancy.

⚠
Warning   **Class 1 laser product.** Statement 1008.

⚠
Warning   **Invisible laser radiation present.** Statement 1016.

⚠
Warning   **Because invisible radiation may be emitted from the aperture of the port when no fiber cable is connected, avoid exposure to radiation and do not stare into open apertures.** Statement 1056.

Warning Statement for Sweden

⚠
Warning   **Osynlig laserstrålning när denna del är öppen och förregleringen är urkopplad. Rikta inte blicken in mot strålen.** Statement 36.
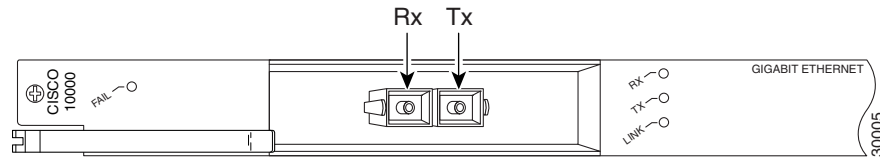
Warning Statement for Finland

⚠
Warning   **Alleviates ja suojalukitus ohitettaessa olet alttiina näkymättömälle lasersäteilylle. Äjä katso säteeseen.** Statement 35

Figure 1-15 shows the faceplate for the Gigabit Ethernet line card.

Figure 1-15   **Gigabit Ethernet Line Card Faceplate**

Cisco Gigabit Ethernet Line Card LEDs

Table 1-8 describes the LEDs on the Gigabit Ethernet line card.

Table 1-8   **Gigabit Ethernet Line Card LEDs and Their Functions**

LED	Color/Status	Description
FAIL	Yellow	A major failure has disabled the line card
	Off	The line card is operating properly
RX (receive)	Green	Receiving traffic
	Off	Not receiving traffic
TX (transmit)	Green	Transmitting traffic
	Off	Not transmitting traffic
LINK	Green	Carrier detected; the port is able to pass traffic
	Off	No carrier detected; the port is not able to pass traffic

GBIC Specifications

Table 1-9 lists the GE line card GBICs and their respective cable types and lengths.

Table 1-9   GBIC Port Cabling Specifications

GBIC	Wavelength (nm)	Fiber Type	Core Size, microns	Modal Bandwidth, MHz/km	Cable Distance, feet/meters
1000Base-SX ESR-GBIC-SX	850	MMF	62.5	160	722 ft (220 m)
			62.5	200	902 ft (275 m)
			50.0	400	1640 ft (500 m)
			50.0	500	1804 ft (550 m)
1000Base-LX/LH ESR-GBIC-LH	1300	MMF[1]	62.5	500	1804 ft (550 m)
			50.0	400	1804 ft (550 m)
			50.0	500	1804 ft (550 m)
		SMF	8 to 10	—	32,808 ft (10 km)
1000Base-ZX ESR-GBIC-ZX	1550	SMF	Not conditional	N/A	43.5 miles (70 km) to 62 miles (100 km)[2]

1. Mode-conditioning patch cord (CAB-GELX-625 or equivalent) is required. If you use an ordinary patch cord with MMF, 1000Base-LX/LH GBICs, and a short link distance (tens of meters), this can cause transceiver saturation, resulting in a elevated bit error rate (BER). In addition, when you use the LX/LH GBIC with 62.5-micron diameter MMF, you must install a mode-conditioning patch cord between the GBIC and the MMF cable on both the transmit and receive ends of the link. The mode-conditioning patch cord is required for link distances greater than 984 ft (300 m).

2. 100 km over premium single-mode fiber or dispersion shifted singe-mode fiber.

Cisco Half-Height Gigabit Ethernet Line Card

The Cisco HHGE line card contains a single Gigabit Ethernet port that provides a trunk uplink to switches and core routers. The Cisco HHGE line card provides an IEEE 802.3z compliant Ethernet interface that can run up to 1 Gbps in full duplex mode. The line card uses a Small Form-factor Pluggable (SFP) Gigabit interface converter (GBIC) module that supports a variety of Gigabit Ethernet interface types (SX LX/LH, and ZX), which you can change or upgrade at any time.

Note   Only SFP GBIC modules purchased from Cisco work with the Gigabit Ethernet line card software.

For more information, see *Cisco uBR10012 Universal Broadband Router Gigabit Ethernet Half-Height Line Card Installation*.

Cisco OC-12 POS Line Card

The OC-12 POS card provides a trunk uplink that supports up to 622 Mbps over a standard SONET/SDH interface using a single-mode fiber intermediate reach SC connector.

Warning   **Class 1 laser product.** Statement 1008.

Warning   **Invisible laser radiation present.** Statement 1016.

Warning   **Because invisible radiation may be emitted from the aperture of the port when no fiber cable is connected, avoid exposure to radiation and do not stare into open apertures.** Statement 1056.

Warning Statement for Sweden

Warning   **Osynlig laserstrålning när denna del är öppen och förregleringen är urkopplad. Rikta inte blicken in mot strålen.** Statement 36.

Warning Statement for Finland

Warning   **Alleviates ja suojalukitus ohitettaessa olet alttiina näkymättömälle lasersäteilylle. Äjä katso säteeseen.** Statement 35

Figure 1-16 shows the faceplate for the Cisco OC-12 POS line card.

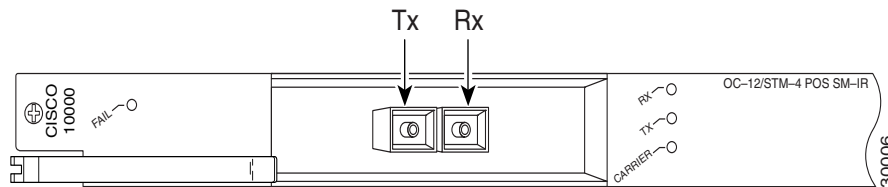*Figure 1-16*   *Cisco OC-12 POS Line Card Faceplate*

Table 1-10 lists the cable specifications for the Cisco OC12 POS card.

Table 1-10   *Cisco OC-12 POS Line Card Cable Specifications*

Fiber Type	Wavelength, nm	Core Size, microns	Cable Distance
Single Mode Fiber	1300	8 to 10	49,213 ft (15 km)

Cisco OC-12 POS Line Card LEDs

Table 1-11 describes the LEDs and their functions on the Cisco OC-12 POS line card.

Table 1-11   *Cisco OC-12 POS Line Card LEDs and Their Functions*

LED	Color/Status	Description
FAIL	Yellow	A major failure has disabled the line card
	Off	The line card is operating properly
RX (receive)	Green	Receiving traffic
	Off	Not receiving traffic

Table 1-11   Cisco OC-12 POS Line Card LEDs and Their Functions (continued)

LED	Color/Status	Description
TX (transmit)	Green	Transmitting traffic
	Off	Not transmitting traffic
CARRIER	Green	Carrier detected; the port is able to pass traffic
	Off	No carrier detected; the port is not able to pass traffic

Cisco uBR10-SRP-OC12SML DPT WAN Line Card

The Cisco uBR10 Spatial Reuse Protocol (SRP) OC12 single-mode fiber, long-reach (SML) dynamic packet transport (DPT) WAN line card provides shared IP over SONET capability for the Cisco uBR10012 router platform.

For more information, see *Cisco uBR10-SRP-OC12SML/SMI DPT Adapter Card for the Cisco uBR10012 Universal Broadband Router*.

Cisco uBR10012 OC-48 DPT/POS Interface Module

The Cisco uBR10012 OC-48 dynamic packet transport (DPT) and packet-over-SONET interface module is a full-height line card for the Cisco uBR10012 universal broadband router. This card provides trunk uplink capabilities that support up to 1.4 Gbps full duplex throughput over a standard SONET/ITU-T Synchronous Digital Hierarchy (SDH) interface, using a single mode fiber with SC connectors.

Two versions of the Cisco uBR10012 OC-48 DPT/POS interface module are available— short reach (SR) or long reach (LR). Both versions work with the performance routing engine (PRE).

The Cisco uBR10012 OC-48 DPT/POS interface module provides a point-to-point connection to a backbone router and encapsulates IP Packets with byte-wise HDLC framing, placing them directly into the OC-48 SONET (or SDH) payload.

The Cisco uBR10012 OC-48 DPT/POS interface module is a standard implementation of packet over SONET switching, and supports the following features:

- OC-48 bandwidth between the line card and the PRE.
- North American (SONET) and European (SDH) formats
- Automatic protection switching (APS)
- Alarm processing

Note   Two Cisco uBR10012 OC-48 DPT/POS interface modules are required when using the card when using the card in DPT mode in a Cisco uBR10012 universal broadband router.

For more information, see *Cisco uBR10012 OC-48 DPT/POS Interface Module*.

Optical Connectors and Cables

For single-mode optical fiber connections, use one duplex SC-type cable (see Figure 1-17), or two simplex SC-type cables (see Figure 1-18), one for transmit (Tx) and one for receive (Rx).

For optical connector and cable cleaning information, go to the following URL:
http://www.cisco.com/en/US/tech/tk482/tk876/technologies_white_paper09186a0080254eba.shtml

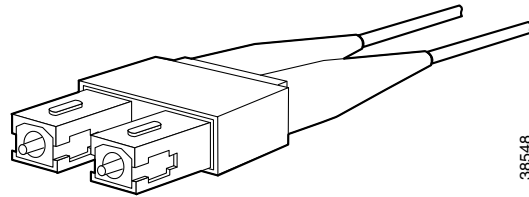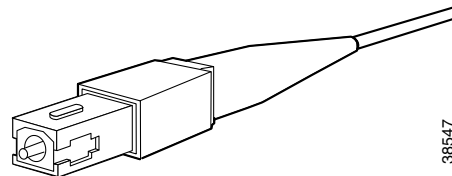*Figure 1-17   Duplex SC-Type Cable and Connector*

Figure 1-18   Simplex SC-Type Cable and Connector

These tables list the proper single-mode or multimode optical fiber cables to use to connect your router to a network:

- Table 1-9, for the Gigabit Ethernet line card
- Table 1-10, for the OC-12 POS line card

Cisco uBR10012 Router FRU Resources

The following section lists the field-replaceable units (FRUs), FRU product order numbers, and provides links to specific FRU documentation.

FRU Modules and Order Numbers

Table 1-12 lists the major FRUs used in the Cisco uBR10012 router.

Table 1-12   Cisco uBR10012 Field-Replaceable Units and Product Order Numbers

Field-Replaceable Unit	Product Order Number
Chassis Components	
Performance routing engine (PRE) with 512 MB DRAM	End of life (EOL), replace with ESR-PRE
PRE 512 MB DRAM (spare)	EOL, replace with ESR-PRE/R
PRE1 (primary and redundant)	ESR-PRE1

Table 1-12   *Cisco uBR10012 Field-Replaceable Units and Product Order Numbers (continued)*

Field-Replaceable Unit	Product Order Number
PRE1 (spare)	ESR-PRE1/R=
PRE2 (primary and redundant)	ESR-PRE2/R
PRE2 (spare)	ESR-PRE2=
PRE4 (primary and redundant)	ESR-PRE4
PRE4 (spare)	ESR-PRE4/R=
PRE PC media card—64 MB (default)	10000-PREMEMFD64=
PRE PCM media card—128 MB	ESR-PRE-MEM-FD128=
Blank PRE1 slot cover	ESR-PRE-Cover=
TCC+ card	UBR10-TCC+-T1=
Blank TCC+ card slot cover	UBR10-TCC+-COVER=
DC power entry module (2400 W or 3000 W)	UBR10-PWR-DC=
DC power entry module (3300 W)	UBR10-PWR-DC-PLUS=
AC power entry module (2400 W	UBR10-PWR-AC=
AC power entry module (3300 W)	UBR10-PWR-AC-PLUS=
Fan assembly module (spare)	UBR10-FAN-ASSY=
Fan assembly module (spare)	UBR10012-FAN-PLUS=
Fan assembly filter (spare)	UBR10-FAN-FILTER=
Front cover (spare)	UBR10-CHAS-COVER=
Power supply monitoring cable for the AC power shelf alarm	UB10-PWR-MON-CAB=
Cable Interface Line Cards	
Line Card Processor (spare)	UBR10-LCP2=
Cisco uBR10-MC5X20S cable interface line card	UBR10-MC5X20S=
Cisco uBR10-MC5X20U cable interface line card	UBR10-MC5X20U=
Cisco UBR-MC20X20V cable interface line card	UBR-MC20X20V-20D=, UBR-MC20X20V-5D=, UBR-MC20X20V-0D=
Cisco uBR-MC3GX60V cable interface line card	UBR-MC3GX60V=
Cisco uBR-MC3GX60V-RPHY cable interface line card	UBR-MC3GX60V-RPHY, UBR-MC3GX60V-RPHY=
Blank cable interface line card cover	UBR10-MC-COVER=
Network Line Cards	
Cisco Single Port Gigabit Ethernet line card (GigE)	UBR10-1GE, UBR10-1GE=
1000Base-SX—pluggable transceiver	ESR-GBIC-SX
1000Base-LX/LH—pluggable transceiver	ESR-GBIC-LH
1000Base-ZX— pluggable transceiver	ESR-GBIC-ZX

Table 1-12 *Cisco uBR10012 Field-Replaceable Units and Product Order Numbers (continued)*

Field-Replaceable Unit	Product Order Number
Cisco Half-Height Gigabit Ethernet line card	ESR-HH-1GE
Slot splitter card	ESR-HH-CARRIER
Half height slot blank cover	ESR-HH-COVER
Full height slot blank cover	ESR-COVER
1000Base-SX—pluggable transceiver	SFP-GE-S
1000Base-LX/LH—pluggable transceiver	SFP-GE-L
1000Base-TX—pluggable transceiver	SFP-GE-T
1000Base-ZX— pluggable transceiver	GLC-ZX-SM
Cisco OC12/STS12c/STM4 POS, single mode, intermediate reach line card	UBR10-OC12/P-SMI=
Cisco uBR10-SRP-OC12SML DPT WAN adapter card	UBR-SRP-OC12SML=
Cisco uBR10012 OC-48 DPT/POS Interface Module	
Single mode[1], short reach modules Single spare[2]	UBR10-SRP-OC48SMS ESR1OC48/P/SRPSMS=
Single mode[1], long reach modules Single spare[2]	UBR10-SRP-OC48SML= ESR1OC48/P/SRPSML=
Blank network line card cover	ESR-LC-COVER=

1. Use this number to order the dual interface modules.

2. Use this number to order a single interface module.

> **Note** The output of the **show inventory** command does not display the serial numbers for the fan assembly modules (UBR10-FAN-ASSY and UBR10012-FAN-PLUS), AC PEMs (UBR10-PWR-AC and UBR10-PWR-AC-PLUS), and DC PEMs (UBR10-PWR-DC and UBR10-PWR-DC-PLUS). Visually inspect the serial number labels printed on these FRUs to locate the serial number.

FRU Documentation

Table 1-13 lists the Cisco field replaceable unit (FRU) documentation for the modules and interface line cards that are used in the Cisco uBR10012 router and the corresponding URL where that documentation can be found. Refer to the FRU documentation for more detailed information and installation instructions for each module or card.

Table 1-13   Cisco FRU Document Title and URL

Document title	*2400W AC-Input Power Shelf for the Cisco uBR10012 Universal Broadband Router*
URL	http://www.cisco.com/en/US/docs/cable/cmts/ubr10012/installation/field_replaceable_units/ub10acsh.html
Document title	*AC Power Entry Module for the Cisco uBR10012 Universal Broadband Router*
URL	http://www.cisco.com/en/US/docs/cable/cmts/ubr10012/installation/field_replaceable_units/ub10acpm.html
Document title	*3300 W AC Power Entry Module for the Cisco uBR10012 Universal Broadband Router*
URL	http://www.cisco.com/en/US/docs/cable/cmts/ubr10012/installation/field_replaceable_units/ub10acpem_HornBill.html
Document title	*DC Power Entry Module for the Cisco uBR10012 Universal Broadband Router*
URL	http://www.cisco.com/en/US/docs/cable/cmts/ubr10012/installation/field_replaceable_units/ub10pem.html
Document title	*3300 W DC Power Entry Module for the Cisco uBR10012 Universal Broadband Router*
URL	http://www.cisco.com/en/US/partner/docs/cable/cmts/ubr10012/installation/field_replaceable_units/ub10dcpem_Hornbill.html
Document title	*Cisco uBR10012 Universal Broadband Router Fan Assembly Module*
URL	http://www.cisco.com/en/US/docs/cable/cmts/ubr10012/installation/field_replaceable_units/fan5093.html
Document title	*Cisco LCD Module for the Cisco uBR10012 Universal Broadband Router*
URL	http://www.cisco.com/en/US/docs/cable/cmts/ubr10012/installation/field_replaceable_units/lcd5090.html
Document title	Cisco uBR10012 Universal Broadband Router TCC+ Card
URL	http://www.cisco.com/en/US/docs/interfaces_modules/cable/installation/tcc5094.html
Document title	Cisco uBR10012 Universal Broadband Router DTCC Card
URL	http://www.cisco.com/en/US/partner/docs/interfaces_modules/cable/installation/dtcccard.html
Document title	*Cisco uBR10-SRP-OC12SML DPT WAN Line Card for the Cisco uBR10012 Router*
URL	http://www.cisco.com/en/US/docs/interfaces_modules/cable/line_cards/ubr_srp_oc12sml_dpt_wan/quick/start/ub10oc12.html
Document title	*Performance Routing Engine Module for the Cisco uBR10012 Universal Broadband Router*
URL	http://www.cisco.com/en/US/docs/interfaces_modules/cable/performance_routing_engine/installation/guide/pre5096.html

Table 1-13   Cisco FRU Document Title and URL (continued)

Document title URL	*Installing EMI Gaskets and RF Absorber Material on the Cisco uBR10012 Universal Broadband Router* http://www.cisco.com/en/US/docs/cable/cmts/ubr10012/installation/field_replaceable_units/pre2gkit.html
Document title URL	*Cisco uBR10-MC5X20S/U Cable Interface Line Card* http://www.cisco.com/en/US/docs/interfaces_modules/cable/broadband_processing_engines/ubr10_mc5x20s_u_h/installation/guide/ubrmc520.html
Document title URL	*Cisco UBR-MC20X20V Cable Interface Line Card Hardware Installation Guide* http://www.cisco.com/en/US/docs/interfaces_modules/cable/broadband_processing_engines/ubr_mc20x20v/installation/guide/mc20x20v_hig.html
Document title URL	*Cisco UBR-MC3GX60V Cable Interface Line Card Hardware Installation Guide* http://www.cisco.com/en/US/docs/interfaces_modules/cable/broadband_processing_engines/ubr_mc3gx60v/installation/guides/b_3g60_lchig.html
Document title URL	*Cisco Remote-PHY Solution Workflow* http://www.cisco.com/web/techdoc/cable/cisco-remote-phy/index.html
Document title URL	*Cisco Half-Height Gigabit Ethernet Line Card* http://www.cisco.com/en/US/docs/interfaces_modules/cable/line_cards/ubr_hh_ge/quick/start/ubr_hhge.html
Document title URL	*Inspection and Cleaning Procedures for Fiber-Optic Connections* http://www.cisco.com/en/US/tech/tk482/tk876/technologies_white_paper09186a0080254eba.shtml