Cisco uBR7200 Series Overview

This chapter describes the Cisco uBR7200 series universal broadband routers. The chapter contains the following sections:

Cisco uBR7200 Series Chassis Descriptions

The Cisco uBR7200 series universal broadband routers comprise Cisco's Cable Modem Termination System (CMTS) solution. Three different chassis are available: the Cisco uBR7223, the Cisco uBR7246, and the Cisco uBR7246 VXR. The routers allow high-speed data services to be packaged similar to basic cable television service or video fare.

The routers are based on Data Over Cable Service Interface Specifications (DOCSIS) and support data and digitized voice connectivity over a bidirectional cable television and IP backbone network. The Cisco uBR7200 series routers typically concentrate traffic from DOCSIS-based cable modems and set-top boxes (STBs) with integrated EuroDOCSIS cable modems on the cable television network and present that traffic to local and remote Internet Protocol (IP) hosts. For NCTA cable plants not fully upgraded to support two-way cable transmission, the routers work in conjunction with dial-up access products to support upstream traffic from DOCSIS-based cable modems connected to the Public Switched Telephone Network (PSTN). The routers support both 6-MHz North American channel plans and 8-MHz Phase Alternating Line (PAL) and Systeme Electronique Couleur Avec Memoire (SECAM) channel plans.

Cisco uBR7200 series universal broadband routers contain:

- Cable modem cards that interface to the cable television network. The Cisco uBR7200 series card set includes varying upstream-to-downstream interface ratios with differing bandwidth and modulation schemes supported, as well as the capability to dynamically perform complex spectrum management and operate in an 8-MHz channel width environment.

Note For detailed information regarding Cisco cable modem cards and procedures for their removal and installation, refer to the *Cisco uBR7200 Series Universal Broadband Router Cable Modem Card Hardware Installation* (Cisco document number 78-10494-01) field-replaceable unit (FRU) document.

- Port adapters that connect to the IP backbone and external networks.

Note For a complete list of port adapters supported in the various Cisco uBR7200 series routers, refer to the *Cisco uBR7200 Series Universal Broadband Router Software Configuration Guide*.

- A Cisco Cable Clock Card that allows you to lock on to and propagate a T1 clock signal throughout the router midplane.

Note The Cisco Cable Clock Card is only available in the Cisco uBR7246 VXR.

- One network processing engine (NPE) that performs system management functions for the chassis. The NPEs supported include:
  - NPE-150 with an R4700 microprocessor that operates at an internal clock speed of 150 MHz.
  - NPE-200 with an R5000 microprocessor that operates at an internal clock speed of 200 MHz.
  - NPE-300 with an RM7000 microprocessor that operates at an internal clock speed of 262 MHz.

  Table 1-1 shows the NPEs supported in each universal broadband router chassis.

Table 1-1   NPEs Supported in Universal Broadband Router Chassis

Chassis	Supported NPEs
Cisco uBR7223 and Cisco uBR7246	NPE-150, NPE-200
Cisco uBR7246 VXR	NPE-300

- An input/output (I/O) controller that contains a console port to connect data terminal equipment (DTE), auxiliary port to connect data communications equipment (DCE), two Personal Computer Memory Card International Association (PMCIA) slots that hold Flash memory cards to remotely load and store multiple system and boot helper images, as well as an optional Fast Ethernet port to provide a 100 Mbps connection to the network.
- Power supply that provides power to the router:
  - The Cisco uBR7223 comes equipped with one 550W, AC-input or DC-input power supply.
  - The Cisco uBR7246 VXR and Cisco uBR7246 support an optional, second power supply for load sharing and power redundancy.
- Midplane (Triple PCI Bus) that distributes power from the power supply to the I/O controller, bridges the peripheral component interconnect (PCI) buses from the port adapter(s) to the packet static random-access memory (SRAM) on the NPE-150 and NPE-200 or synchronous dynamic random-access memory (SDRAM) on the NPE-300, arbitrates traffic across the PCI buses, and generates clock signals for the port adapter on the PCI bus.

- Fan tray, enclosing internal fans that draw cooling air into the chassis to maintain an acceptable operating temperature:

    - The fan tray for the Cisco uBR7223 contains four fans.

    - The fan trays for the Cisco uBR7246 VXR and Cisco uBR7246 each contain seven fans.

The cable modem cards, port adapters, clock card, NPE, I/O controller, and power supplies slide into their respective chassis slots and connect directly to the router's midplane. There are no internal cables to connect. The midplane distributes power from the power supplies to the I/O controller, cable modem cards, port adapters, clock card, fan tray, and NPE.

Caution   To ensure the proper flow of cooling air across internal components, make sure blank cable modem card, blank port adapters, and a blank clock card are installed in unoccupied chassis slots. Also make sure power supply filler plates (with their attached air dams) are installed in unoccupied power supply bays.

Cisco uBR7200 series universal broadband routers can be installed on a tabletop or rack mounted. 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.

The Cisco uBR7200 series universal broadband routers support:

- Environmental monitoring and reporting functions to resolve adverse environmental conditions before loss of operation.

- Online insertion and removal (OIR), allowing key system components to be added or removed without powering off the chassis.

Caution   You can remove and replace a cable modem card or port adapter with the same type of component without interrupting the system. To replace a cable modem card or port adapter with a different type of card or port adapter (for example, hot swapping from an MC16B to an MC16C or replacing a HSSI adapter with an ATM adapter), you will need to copy your startup configuration to your running configuration on the Cisco uBR7200 series in order to enable the interfaces on the new cable modem card or port adapter.

The I/O controller, NPE, and clock card components do not support OIR. You must power down the chassis before removing the I/O controller or NPE.

Note   For applicable instructions to install, remove, or replace system components, refer to the configuration notes that ship with the FRUs.

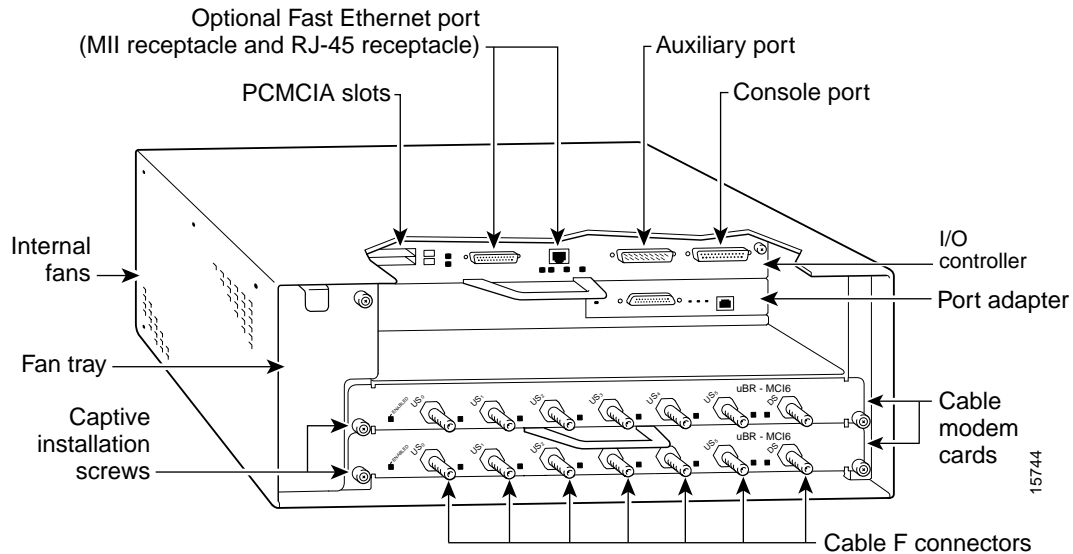## Cisco uBR7223 Chassis

The Cisco uBR7223 contains:

- Two slots for cable modem cards

- One slot for a single-width port adapter

- One slot for an I/O controller

- One slot for a network processing engine

The front of the chassis provides access to the I/O controller, the single-width port adapter, and two cable modem cards, if fully equipped. (See Figure 1-1.)
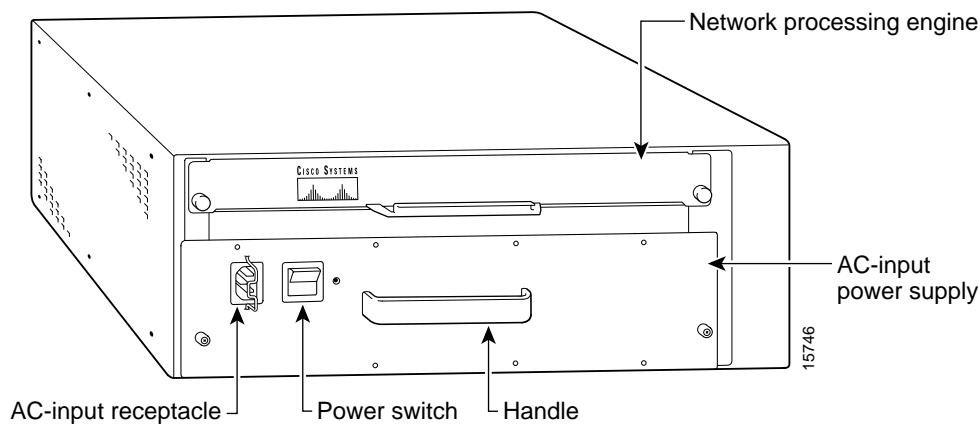
Note The Cisco uBR7223 chassis contains one AC-input or DC-input power supply only.

Figure 1-1   Cisco uBR7223 Universal Broadband Router—Front View

The rear of the Cisco uBR7223 provides access to the network processing engine and the power supply. (See Figure 1-2.)

Figure 1-2   Cisco uBR7223 Universal Broadband Router—Rear View

A fully configured Cisco uBR7223, with an installed power supply and all slots filled, weighs approximately 75 pounds (34.0 kg). For clearance requirements and rack-mount installation considerations, refer to the "Site Environment" section on page 2-6.

Cisco uBR7246 Chassis
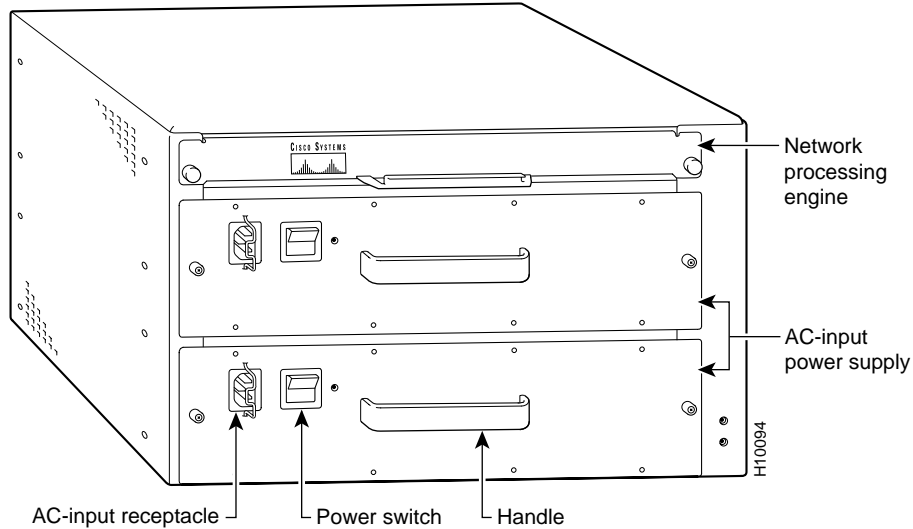
The Cisco uBR7246 contains:

- Four slots for cable modem cards
- Two slots for port adapters (one slot for a dual-width port adapter)
- One slot for an I/O controller
- One slot for a network processing engine

The front of the chassis provides access to the I/O controller, two port adapters, and four cable modem cards, if fully equipped. (See Figure 1-3.)

Figure 1-3   Cisco uBR7246 Universal Broadband Router—Front View
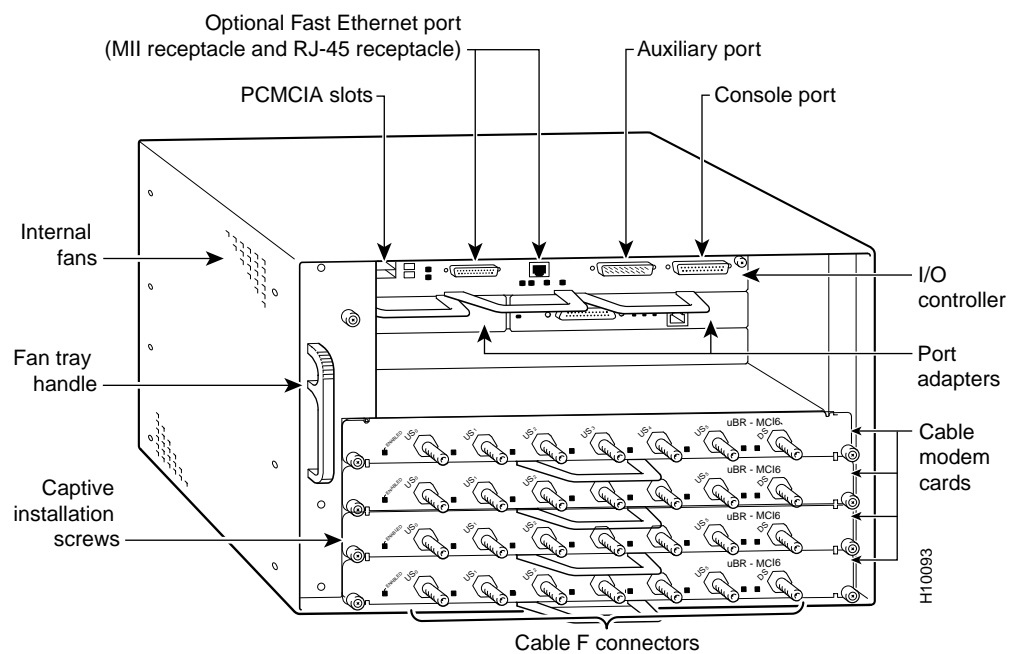
The rear of the Cisco uBR7246 provides access to the network processing engine and up to two power supplies. (See Figure 1-4.)

Figure 1-4   Cisco uBR7246 Universal Broadband Router—Rear View

A fully configured Cisco uBR7246 operates with only one installed power supply. A second power supply can be installed in the chassis to provide hot-swappable, load-sharing, redundant power.

Note   The Cisco uBR7246 supports dual hot-swappable, load-sharing power supplies. If one power supply fails or is removed, the other power supply maintains system power without interruption. The second power supply immediately takes over the router's power requirements to maintain normal operation. In addition, ensure that you have plugged the two power supplies into separate branch circuits.

The Cisco uBR7246 does not support a mix of AC-input and DC-input power supplies in the same chassis. If an AC-input power supply is installed and you want to add a second, redundant power supply, you must add another AC-input power supply. If you want a redundant DC-input power supply configuration, you must remove any installed AC-input power supplies and replace them with two DC-input power supplies.

A fully configured Cisco uBR7246, with two installed power supplies and all chassis slots filled, weighs approximately 100 pounds (45.4 kg). For clearance requirements and rack-mount installation considerations, refer to the "Site Environment" section on page 2-6.
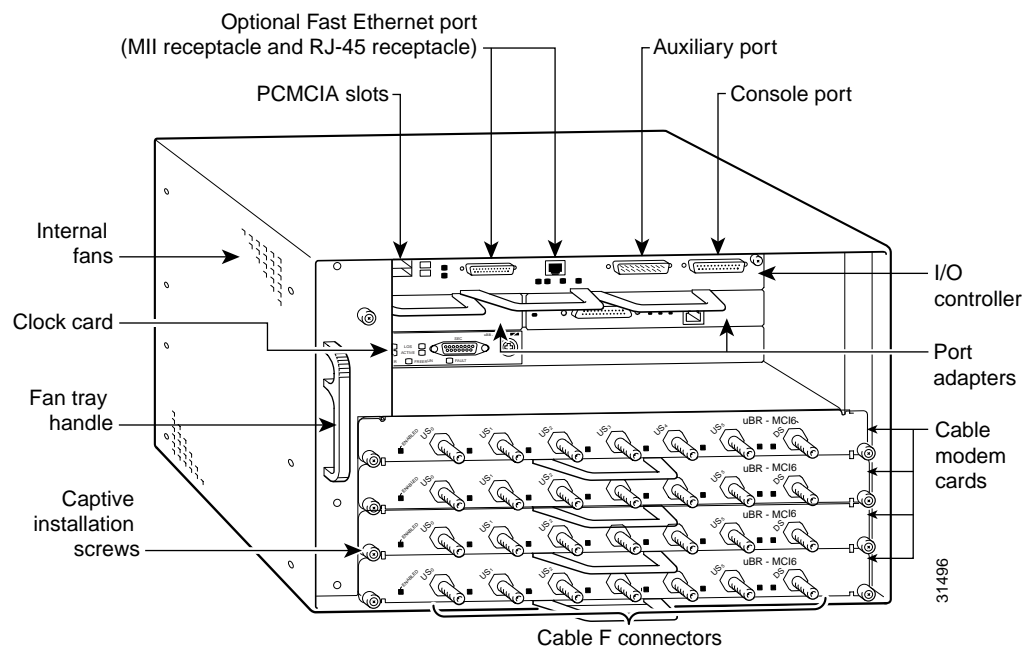
Cisco uBR7246 VXR Chassis
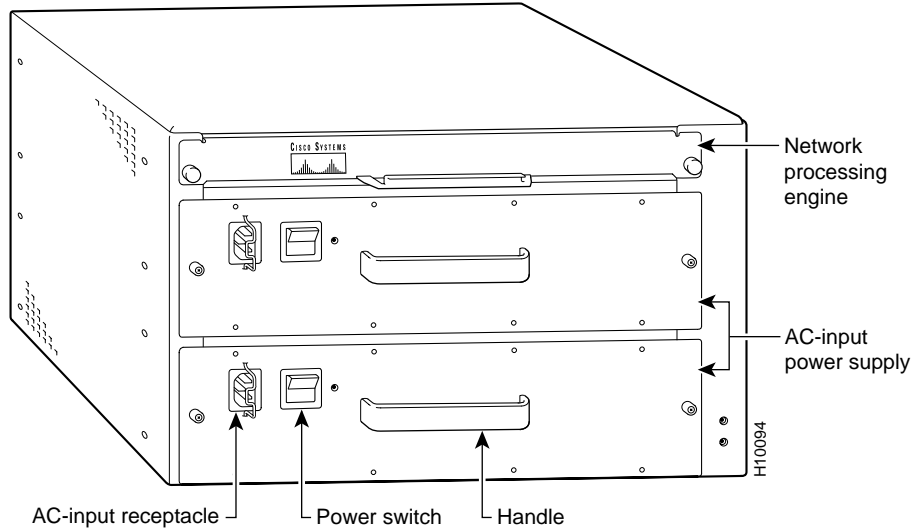
The Cisco uBR7246 VXR contains:

- Four slots for cable modem cards
- Two slots for port adapters (one slot for a dual-width port adapter)
- One slot for an I/O controller
- One slot for a network processing engine
- One slot for the Cisco Cable Clock Card

The front of the chassis provides access to the I/O controller, two port adapters, four cable modem cards, and the clock card if fully equipped. (See Figure 1-5.)

Figure 1-5   Cisco uBR7246 VXR Universal Broadband Router—Front View

The rear of the Cisco uBR7246 VXR provides access to the network processing engine and up to two power supplies. (See Figure 1-6.)

Figure 1-6   Cisco uBR7246 VXR Universal Broadband Router—Rear View

A fully configured Cisco uBR7246 VXR operates with only one installed power supply. A second power supply can be installed in the chassis to provide hot-swappable, load-sharing, redundant power.

Note The Cisco uBR7246 VXR supports dual hot-swappable, load-sharing power supplies. If one power supply fails or is removed, the other power supply maintains system power without interruption. The second power supply immediately takes over the router's power requirements to maintain normal operation. In addition, ensure that you have plugged the two power supplies into separate branch circuits.

The Cisco uBR7246 VXR does not support a mix of AC-input and DC-input power supplies in the same chassis. If an AC-input power supply is installed and you want to add a second, redundant power supply, you must add another AC-input power supply. If you want a redundant DC-input power supply configuration, you must remove any installed AC-input power supplies and replace them with two DC-input power supplies.

A fully configured Cisco uBR7246 VXR, with two installed power supplies and all chassis slots filled, weighs approximately 100 pounds (45.4 kg). For clearance requirements and rack-mount installation considerations, refer to the "Site Environment" section on page 2-6.

Cisco uBR7200 Series Interface Overview

This section provides a functional overview of the network interfaces available on the Cisco uBR7200 series universal broadband router. The following sections describe port adapter and cable modem card slot and logical interface numbering, as well as MAC address assignments for port adapter and cable modem card interfaces.

Port Adapter and Cable Modem Card Slot and Logical Interface Numbering

In all of the Cisco uBR7200 series universal broadband routers, the *slot number* is the chassis slot in which a port adapter or a cable modem card is installed, and the *logical interface number* is the physical location of the interface port on a port adapter.

The Media Access Control (MAC)-layer or hardware address is a standardized data link layer address that is required for certain network interface types. These addresses are not used by other devices in the network; they are specific and unique to each port. The Cisco uBR7200 series uses a specific method to assign and control the MAC-layer addresses of its port adapters. For a description of the MAC-layer address, refer to the "MAC-Layer Address" section on page 1-11.

Port adapter and cable modem card slots maintain the same slot number regardless of whether other port adapters or cable modem cards are installed or removed. However, when you move a port adapter or cable modem card to a different slot, the logical interface number changes to reflect the new slot number.

For complete descriptions and instructions for the commands used to configure your Cisco uBR7200 series, refer to the *Configuration Fundamentals Configuration Guide* and *Configuration Fundamentals Command Reference* publications, which are available on the Documentation CD-ROM, CCO, or in print.

Cisco uBR7223

The single port adapter and the two cable modem cards in the Cisco uBR7223 provide the connection between the router's three peripheral component interconnect (PCI) buses, called mb0, mb1, and mb2; and external networks. Bus mb0 is for the optional Fast Ethernet port on the I/O controller, bus mb1 is for port adapter slot 1, and cable modem card slot 2; and bus mb2 is for cable modem card slot 3.

In the Cisco uBR7223, the port adapter slot is numbered 1; port adapter slot 0 is the Fast Ethernet port on the I/O controller. Cable modem card slots are numbered 2 and 3. (See Figure 1-7 for the numbering scheme of the port adapter and cable modem card slots.) The number of logical interfaces depends on the type of port adapter or cable modem card.

Figure 1-7   Cisco uBR7223 Port Adapter and Cable Modem Card Slot Numbering
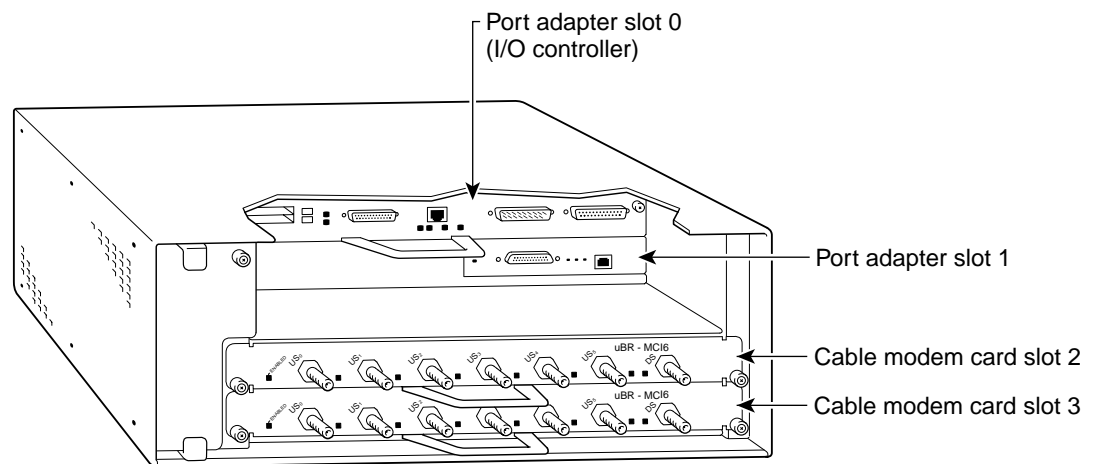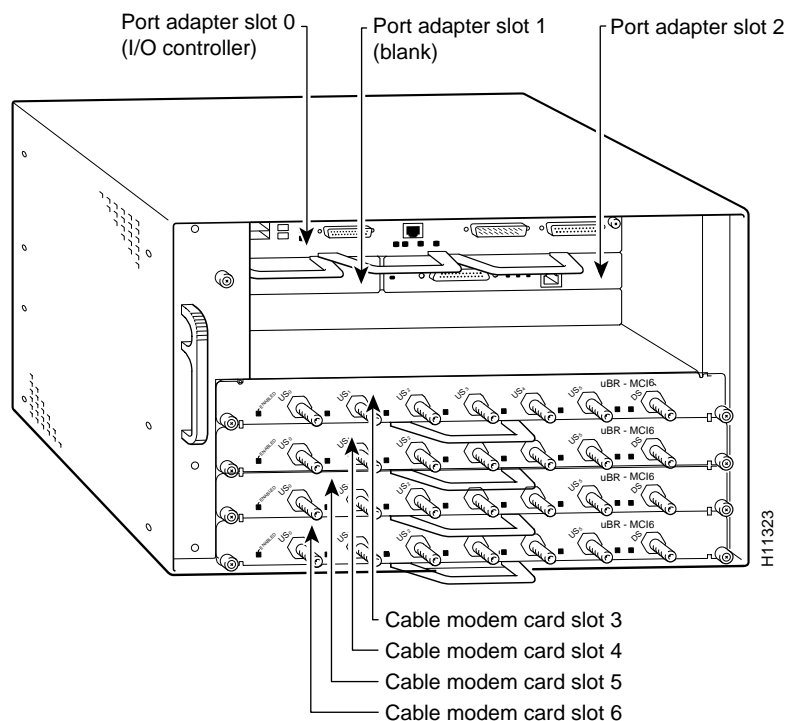
Cisco uBR7246

The two port adapters and the four cable modem cards in the Cisco uBR7246 provide the connection between the router's three peripheral component interconnect (PCI) buses, called mb0, mb1, and mb2; and external networks. Bus mb0 is for the optional Fast Ethernet port on the I/O controller, bus mb1 is for port adapter slot 1, and cable modem card slot 3 and slot 5; and bus mb2 is for port adapter slot 2 and cable modem card slot 4 and slot 6.

In the Cisco uBR7246, port adapter slots are numbered 1 and 2; port adapter slot 0 is the Fast Ethernet port on the I/O controller. Cable modem card slots are numbered from 3 to 6. (See Figure 1-8 for the numbering scheme of the port adapter and cable modem card slots.) The number of logical interfaces depends on the type of port adapter or cable modem card.

Figure 1-8   Cisco uBR7246 Port Adapter and Cable Modem Card Slot Numbering

Cisco uBR7246 VXR

The two port adapters and the four cable modem cards in the Cisco uBR7246 VXR provide the connection between the router's three peripheral component interconnect (PCI) buses, called mb0, mb1, and mb2; and external networks. Bus mb0 is for the optional Fast Ethernet port on the I/O controller, bus mb1 is for port adapter slot 1, and cable modem card slot 3 and slot 5; and bus mb2 is for port adapter slot 2 and cable modem card slot 4 and slot 6.

In the Cisco uBR7246 VXR, port adapter slots are numbered 1 and 2; port adapter slot 0 is the Fast Ethernet port on the I/O controller. Cable modem card slots are numbered from 3 to 6. (See Figure 1-9 for the numbering scheme of the port adapter and cable modem card slots.) The number of logical interfaces depends on the type of port adapter or cable modem card.

Figure 1-9   Cisco uBR7246 VXR Port Adapter and Cable Modem Card Slot Numbering

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Note   Some port adapters available for the Cisco uBR7246 VXR only work if a minimum hardware revision requirement has been satisfied. Refer to the *Cisco uBR7200 Series Universal Broadband Router Software Configuration Guide* for specific information.

MAC-Layer Address

All LAN interfaces (ports) require unique MAC-layer addresses, also known as *hardware* addresses. Typically, the MAC address of an interface is stored on a memory component that resides directly on the interface circuitry; however, the OIR feature requires a different method. For a description of OIR, refer to the "RF and Digital Data Overview" section on page 4-3.

The OIR feature allows you to remove a port adapter or cable modem card and replace it with another identically configured one. If the new port adapter or cable modem card matches the port adapter or cable modem card you removed, the system immediately brings it online. In order to allow OIR, an address allocator with a unique MAC address is stored in an EEPROM on the universal broadband router midplane. Each address is reserved for a specific port and slot in the router regardless of whether a port adapter or a cable modem card resides in that slot.

The MAC addresses are assigned to the slots in sequence. The first addresses are assigned to port adapter slot 0 and slot 1, and the next addresses are assigned to port adapter slot 2 through cable modem card slot 6. This address scheme allows you to remove port adapters or cable modem cards and insert them into other universal broadband routers without causing the MAC addresses to move around the network or be assigned to multiple devices.

> **Note** Storing the MAC addresses for every slot in one central location means the addresses stay with the memory device on which they are stored.

Supported System Configurations

Cisco uBR7200 series universal broadband routers are installed at a cable television headend or a distribution hub. Related networking and RF equipment, servers, and other host computers are installed, along with the Cisco uBR7200 series routers, to support digital data transmission.

To deliver data and VoIP services over the cable television system, TV channels are allocated to carry digital data. Data is modulated downstream on:

- 6-MHz channels in the 54 to 860 MHz range using North American channel plans via cable modem cards installed in the chassis. For bidirectional cable plants, a portion of the channel in the 5 to 42 MHz range is used for upstream data transmission. For one-way cable plants or cable segments yet to be upgraded, DOCSIS-based cable modems configured for telco return are also supported.

- 8-MHz channels in the 85 to 860 MHz range using PAL/SECAM channel plans via MC16E cable modem cards installed in the chassis. For bidirectional cable plants, a portion of the channel in the 5 to 65 MHz range is used for upstream data transmission.

The following sections illustrate the supported configurations including:

- Basic Internet access services
- Virtual private network (VPN) services
- IP telephony services
- Telco return

Basic Internet Access Services

Architecture and Operating Mode Description

Figure 1-10 shows the architecture of a typical two-way hybrid fiber coaxial (HFC) network, equipped to support two-way data communication.

Figure 1-10   Two-Way HFC Cable Network Example
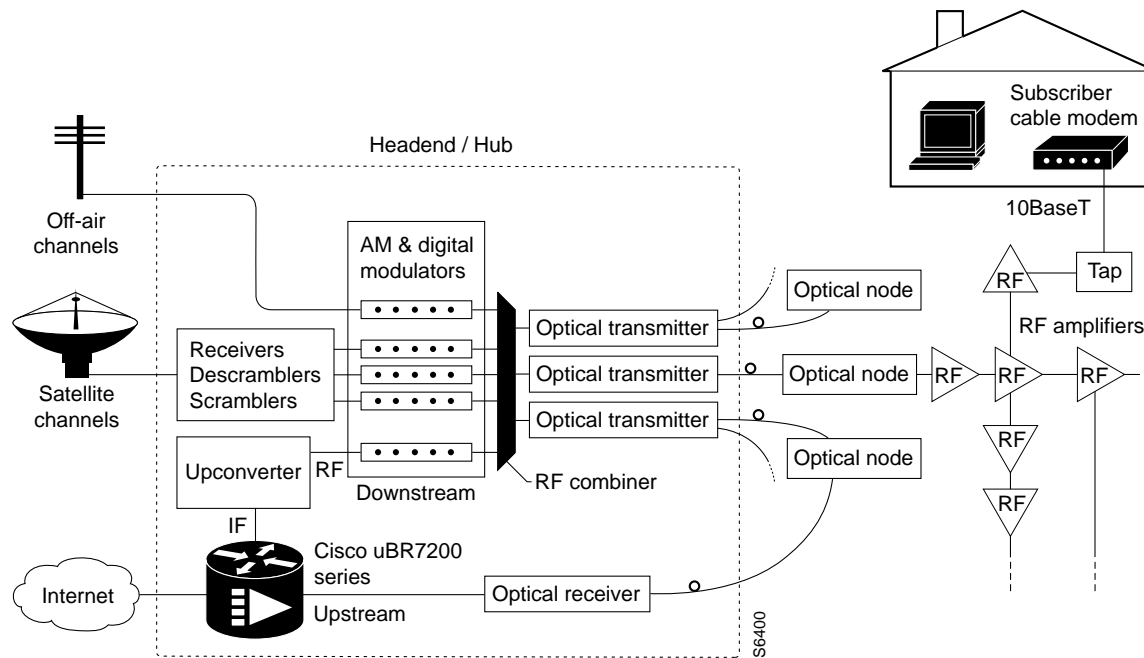
A Cisco uBR7200 series universal broadband router and an IF-to-RF upconverter are installed at the headend or distribution hub. The Cisco uBR7200 series downstream ports transmit IF signals to the upconverter, which translates the downstream signals to RF for broadcast. The Cisco uBR7200 series enables you to transmit downstream data in both the 6-MHz North American and the 8-MHz European channel environments.

Receivers, scramblers, and descramblers process the television signals to encode or decode signals as needed for broadcast. Modulators format the analog television and digital signals.

The analog and digital signals then pass through the RF combiner—cables, amplifiers, and taps at the headend. The signals are broadcast from the headend through optical transmitters typically to fiber nodes in the network. Amplifiers, coaxial cable, and taps carry the signals to the subscriber premises. Signals are processed as follows:

- Set top boxes (STBs), televisions, and/or VCRs receive analog and digital data signals.

- DOCSIS-based cable modems and STBs connected to customer premises equipment (CPE) receive digital data signals:

    – Two-way cable modems transmit RF signals back through amplifiers to optical fiber receivers at the headend. These receivers pass the upstream signal to the upstream ports on the Cisco uBR7200 series for processing.

    – Telco return cable modems transmit over the PSTN. Dial-up servers and other equipment handle the upstream traffic and pass appropriate data to the Cisco uBR7200 series routers for downstream transmission via the cable plant. For telco return specifics, refer to the "Telco Return" section on page 1-15.

Cisco provides a configuration tool with every Cisco uBR7200 series universal broadband router—Cisco Network Registrar (CNR)—to automate dynamic IP address allocation to cable modems, PCs, and other devices on the broadband network.

In addition, Cisco provides an integrated suite of configuration tools, including CNR, for relatively large cable networks called Cisco Subscriber Registration Center (CSRC). CSRC allows large-scale configuration and management of broadband modems. Leveraging the extensibility of CNR, CSRC enables and administers subscriber self-registration. The directory-enabled architecture of CSRC allows it to integrate with LDAP version 3 directory servers.

For more information on CSRC and CNR involvement in the cable network, refer to the CSRC and CNR documentation and the *Cisco uBR7200 Series Universal Broadband Router Software Configuration Guide*.

VPN Services

The Cisco uBR7200 series supports VPN services. Figure 1-11 shows a typical VPN architecture. VPNs can be initiated at a cable modem residing at a subscriber site or can be initiated by the CMTS at the headend or distribution hub depending upon your particular Cisco IOS software image.

Figure 1-11   Two-Way VPN Network Example
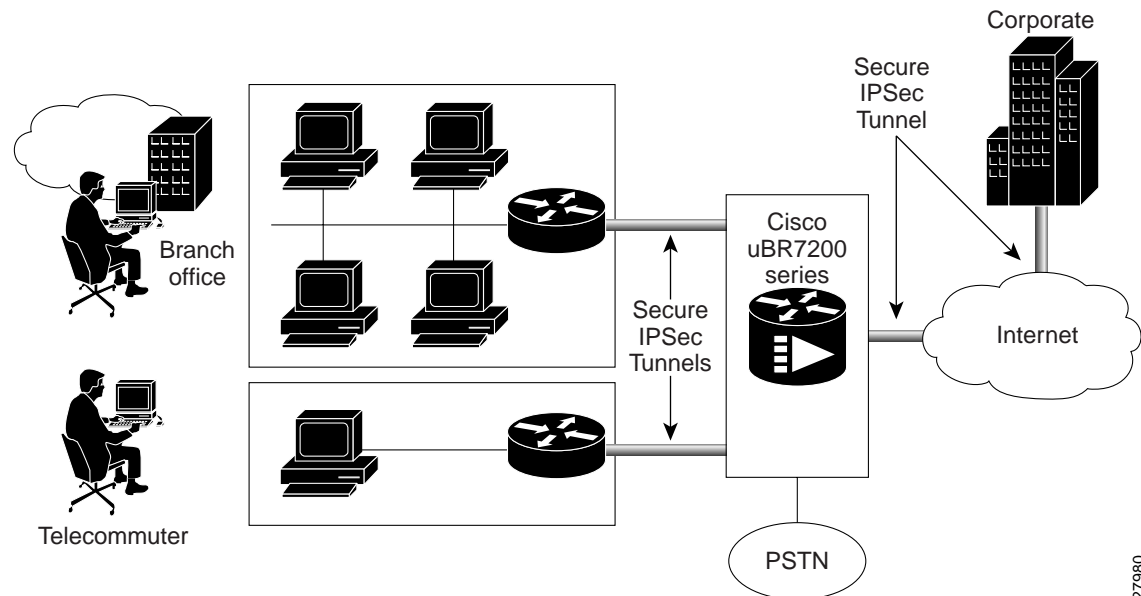
Note   VPN typically involves use of encryption/decryption. Encryption/decryption is subject to export licensing controls. For more information, refer to Appendix A, "Specifications and Export Restrictions."

IP Telephony Services

Figure 1-12 shows a typical two-way configuration involving voice over IP (VoIP) telephony services. The Cisco uBR7200 series supports the transmission of digitized voice and facsimile traffic over the cable and IP backbone network.

Figure 1-12   Two-Way IP Telephony Network Example
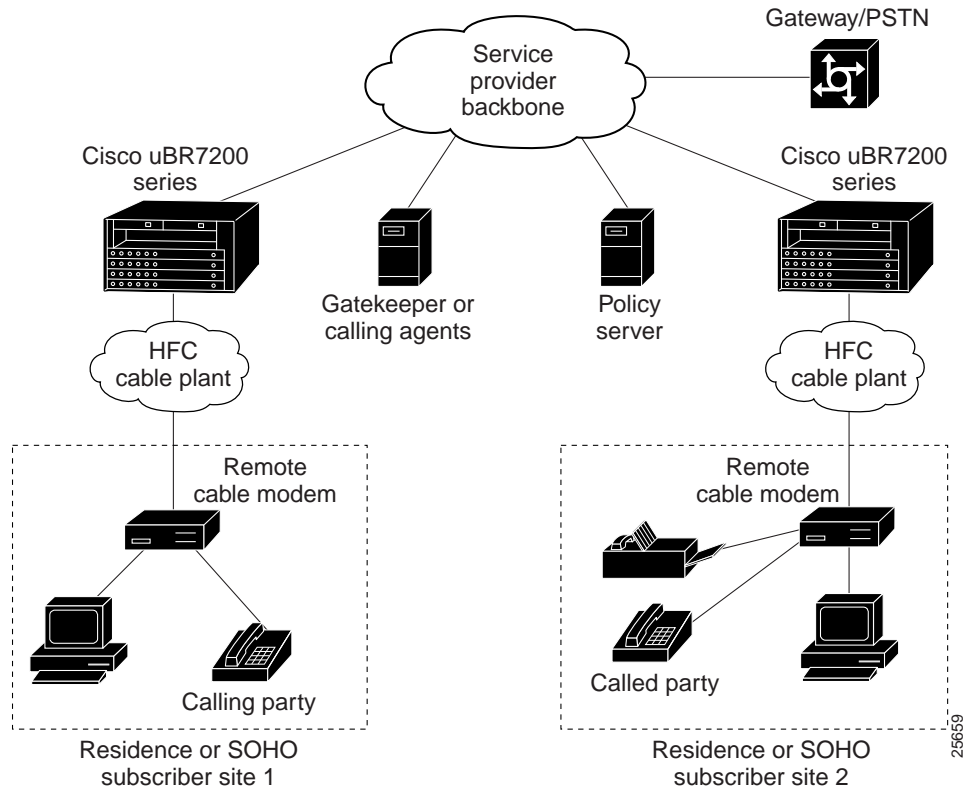
Telco Return

In telco return configurations, the Cisco uBR7200 series universal broadband router provides downstream data flow from cable modem cards connected to the cable system and accepts upstream traffic via a combination of the local PSTN and IP network path that terminates at the Cisco uBR7200 series router. Upstream data transmission takes place over a telephone modem (external or internal to a cable modem, as well as a cable modem card in a PC, based on the third-party cable modem vendor) connected to an analog telephone line. Figure 1-13 illustrates a telco return configuration.

Figure 1-13   Telco Return Network Example
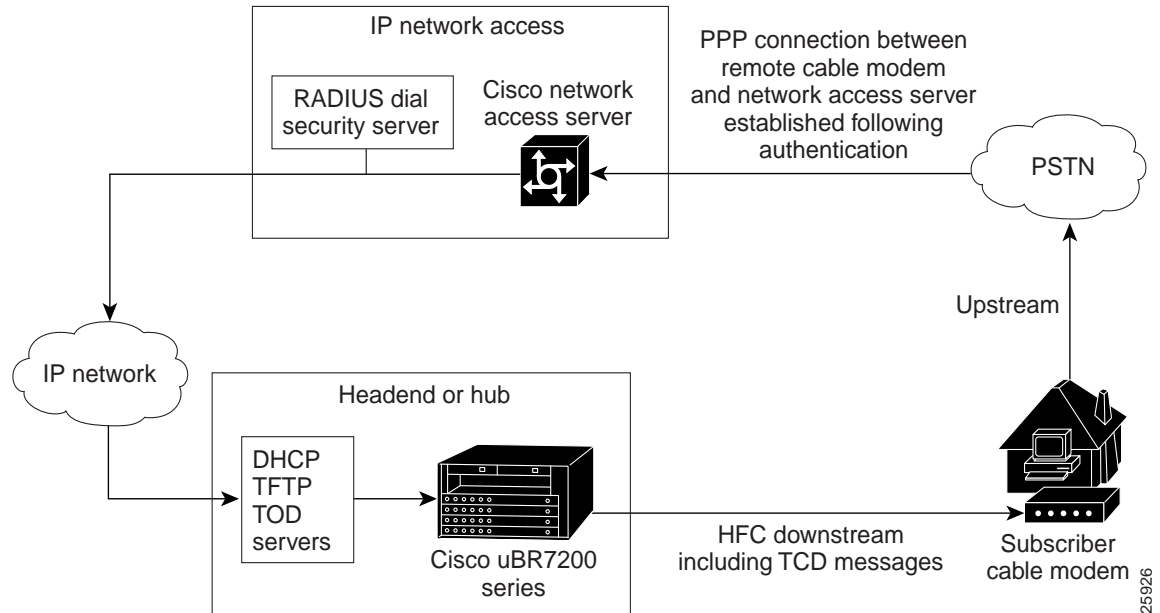
Hardware Component Descriptions

Most Cisco uBR7200 series universal broadband router components are FRUs. These units consist of:

- Network Processing Engine
- Input/Output Controller
- Cable Modem Cards
- Port Adapters
- Cisco Cable Clock Card (Cisco uBR7246 VXR only)
- Power Supplies
- Fan Trays
- Chassis
- Subchassis and Midplane
- Flash Memory Cards

Instructions to install, remove, replace or configure these units are contained in separate documents called FRU documents.

Network Processing Engine

The network processing engine performs the following system management functions:

- Sending and receiving routing protocol updates

- Managing tables, caches, and buffers

- Monitoring interface and environmental status

- Providing Simple Network Management Protocol (SNMP) management and console/Telnet interface

- Accounting and switching of data traffic

- Booting and reloading images

- Managing port adapters (recognition and initialization during OIR)

The network processing engines used in the routers include the NPE-150, NPE-200, and NPE-300. Figure 1-14 shows the NPE-150. Figure 1-15 shows the NPE-200. Figure 1-16 shows the NPE-300.

Figure 1-14   Network Processing Engine—NPE-150
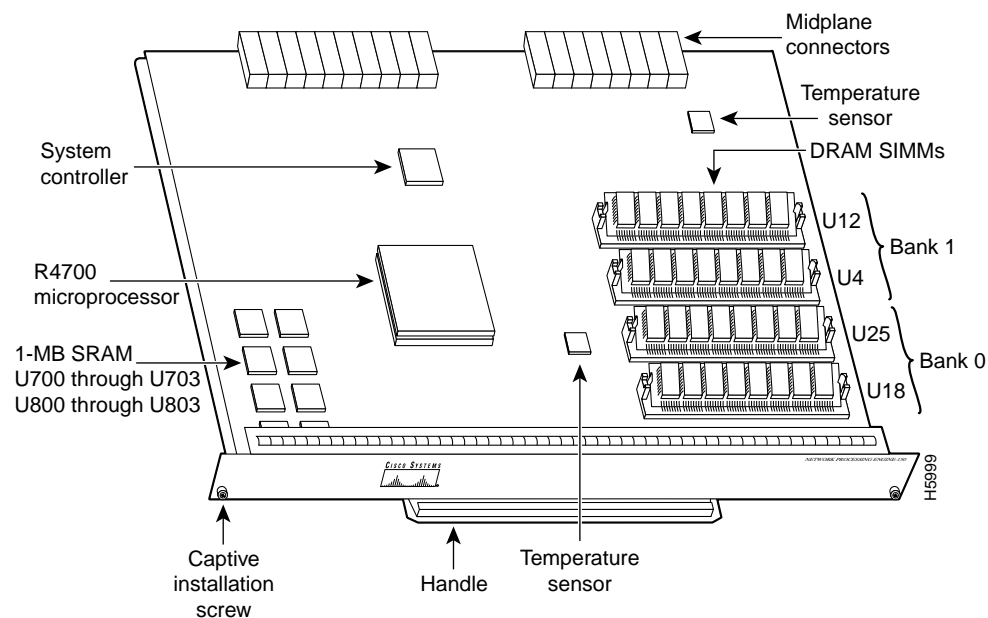
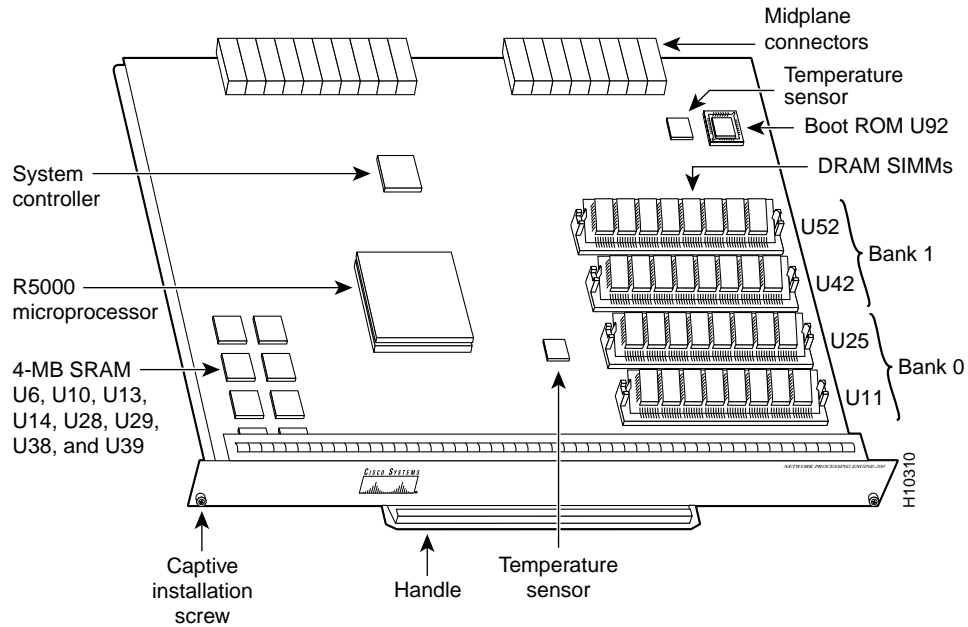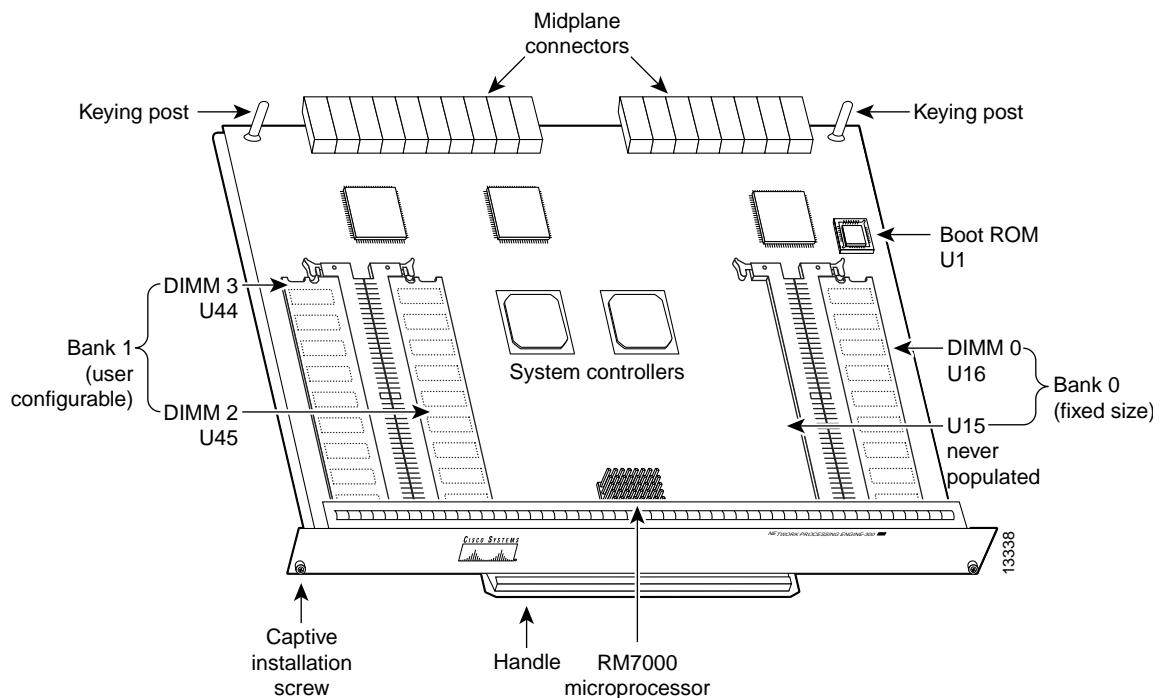*Figure 1-15   Network Processing Engine—NPE-200*

Figure 1-16   Network Processing Engine—NPE-300

The network processing engines consist of the following components:

- Reduced instruction set computing (RISC) microprocessor:
  - NPE-150 has an R4700 microprocessor that operates at an internal clock speed of 150 MHz.
  - NPE-200 has an R5000 microprocessor that operates at an internal clock speed of 200 MHz.
  - NPE-300 uses an RM7000 microprocessor that operates at an internal clock speed of 262 MHz.
- System controller:
  - NPE-150 and NPE-200 have a system controller that uses direct memory access (DMA) to transfer data between DRAM and packet SRAM on the network processing engine.
  - NPE-300 has two system controllers that provide processor access to the two midplane and single I/O controller PCI buses. The system controllers also allow port adapters on either of the two midplane PCI buses access to SDRAM.
- Upgradable memory modules:
  - NPE-150 and NPE-200 use DRAM for storing routing tables, network accounting applications, packets of information in preparation for process switching, and packet buffering for SRAM overflow (except in the NPE-100, which contains no packet SRAM). The standard configuration is 32 MB, with up to 128 MB available through single in-line memory module (SIMM) upgrades.
  - NPE-300 uses SDRAM for storing all packets received or sent from network interfaces. The SDRAM also stores routing tables and network accounting applications. Two independent SDRAM memory arrays in the system allow concurrent access by port adapters and the processor.
- Packet SRAM for storing packets of information in preparation for fast switching:
  - NPE-150 has 1 MB of SRAM.
  - NPE-200 has 4 MB of SRAM.
  - NPE-300 does not have packet SRAM.
- Cache memory:
  - NPE-150 and NPE-200 have unified cache SRAM that functions as the secondary cache for the microprocessor. (The primary cache is within the microprocessor.)
  - NPE-300 has three levels of cache: a primary and a secondary cache that are internal to the microprocessor, and a tertiary, 2-MB external cache that provides additional high-speed storage for data and instructions.
- Two environmental sensors for monitoring the cooling air as it leaves the chassis
- Boot ROM for storing sufficient code for booting the Cisco IOS software; NPE-200, and NPE-300 have boot ROM

Note Refer to the *Network Processing Engine Replacement Instructions* (Cisco document number 78-3225-12) for instructions to remove and replace this component. This document accompanies each engine shipped from the Cisco factory as a FRU. The document is also available on the Documentation CD-ROM and on Cisco Connection Online (CCO).

Table 1-2 lists the network processing engine memory components.

Table 1-2   NPE-150 and NPE-200 Memory Specifications

Memory Type	Size	Quantity	Description	Location
DRAM	32 to 128 MB	2 to 4	16- or 32-MB SIMMs (based on maximum DRAM required)	Bank 0: U18 and U25 or U11 and U25[1] Bank 1: U4 and U12 or U42 and U52[2]
SRAM NPE-150 NPE-200	 1 MB 4 MB	 8 8	 8 chips, each being 128K x 9 bits wide 8 chips, each being 512K x 8 bits wide	 U700 through U703 U800 through U803 U6, U10, U13, U14, U28, U29, U38, and U39
Boot ROM[3] NPE-200	 256 KB	 1	 EPROM for the ROM monitor program	 Socket U92

Unified cache	512 KB	4	Secondary cache for the R4700
			
			 Secondary cache for the R5000
				NPE-150
				    U2, U10, U14, and U26
				 NPE-200
				    U16, U9, U109, and U107

1. The sockets for bank 0 on the NPE-150 are numbered U18 and U25. The same sockets on the NPE-200 are numbered U11 and U25.

2. The sockets for bank 1 on the NPE-150 are numbered U4 and U12. The same sockets on the NPE-200 are numbered U42 and U52.

3. ROM = read-only memory. NPE-150 uses the boot ROM present on the I/O controller.

Note   To prevent DRAM errors in the NPE-150 or NPE-200, and to ensure that your system initializes correctly at startup, DRAM bank 0 (socket U18 and U25, or U11 and U25) *must* contain no fewer than two SIMMs of the same type. You may also install two SIMMs of the same type in bank 1 (socket U4 and U12, or U42 and U52); however, bank 0 must always contain the two largest SIMMs.

Table 1-3 lists the NPE-300 memory specifications.

Table 1-3   NPE-300 Memory Specifications

Memory Type	Size	Quantity	Description	Location
SDRAM	32 to 128 MB	1 configurable[1] bank with 2 SDRAM slots	32-, 64-, or 128-MB DIMMs (based on maximum SDRAM required)	Bank 1: U45 and U44[2]
Boot ROM	512 KB	1	OTP[3] ROM for the ROM monitor program	Socket U1
Primary cache	16 KB (instruction), 16 KB (data)		RM7000 processor primary internal cache	Socket U49

Table 1-3   NPE-300 Memory Specifications (continued)

Memory Type	Size	Quantity	Description	Location
Unified cache	256 KB		Secondary RM7000 processor internal, unified instruction and data cache	Socket U49
Integrated cache	2 MB (fixed)		Tertiary external cache for the RM7000 processor	

1. Bank 0 is used exclusively for packet memory and is not user configurable.

2. Bank 1 contains the Cisco IOS software, processor memory, and packet memory.

3. OTP = one time programmable.

Table 1-4 lists the NPE-150 and NPE-200 factory-installed DRAM configurations and their product numbers.

Table 1-4   NPE-150 and NPE-200 DRAM SIMM Configurations

Total DRAM[1]	DRAM Bank 0	Quantity	DRAM Bank 1	Quantity	Product Number
32 MB	U18 and U25 or U11 and U25	2 16-MB SIMMs	U4 and U12 or U42 and U52	–	MEM-NPE-32MB[2]
64 MB	U18 and U25 or U11 and U25	2 32-MB SIMMS	U4 and U12 or U42 and U52	–	MEM-NPE-64MB[2]
128 MB	U18 and U25 or U11 and U25	2 32-MB SIMMs	U4 and U12 or U42 and U52	2 32-MB SIMMs	MEM-NPE-128MB[2]

1. Refer to the Cisco AS5800 universal access server documentation for Cisco AS5800 universal access server DRAM options.

2. These products are also available as DRAM upgrades. For example, to upgrade a network processing engine from 32 MB to 64 MB of DRAM, order Product Number MEM-NPE-32MB=.

Input/Output Controller

The Input/Output controller shares the environmental monitoring and system memory functions for the router with the network processing engine.

The I/O controller consists of the following components:

- Dual EIA/TIA-232 channels for local and auxiliary console ports. The console port has full DCE functionality and a DB-25 receptacle. The auxiliary port has full DTE functionality and a DB-25 plug.

- Optional Fast Ethernet port that is configurable for use at 100-Mbps full-duplex or half-duplex (half-duplex is the default). The Fast Ethernet port is equipped with an MII receptacle and an RJ-45 receptacle (see Figure 1-17). The I/O controller without the Fast Ethernet port is shown in Figure 1-18.

Note When using the I/O controller that is equipped with an MII receptacle and an RJ-45 receptacle, only one receptacle can be configured for use at a time.

Many of the initial shipments of Cisco uBR7246 chassis that were equipped with a Fast Ethernet I/O controller, have an I/O controller with a single MII receptacle installed. These I/O controllers are fully compatible with the router, and they are still supported; however, they are no longer available as spares.

- Nonvolatile random-access memory (NVRAM) for storing the system configuration and environmental monitoring logs. NVRAM uses lithium batteries to maintain its contents when disconnected from power.

- Two PCMCIA slots for Type II Flash memory cards.

- Flash memory SIMM and Flash memory cards for storing the boot helper image and the default Cisco IOS software image.

- Erasable programmable read-only memory (EPROM) for storing sufficient code for booting the Cisco IOS software.

- Two environmental sensors for monitoring the cooling air as it enters and leaves the Cisco uBR7200 series chassis.

Note There are currently two distinct I/O controller designs featuring a Fast Ethernet port. Your particular I/O controller will look like either of those displayed in Figure 1-17. There is no functional difference between these two I/O controllers with the Fast Ethernet port.

Figure 1-17   I/O Controller with Fast Ethernet Port (MII and RJ-45 Receptacles)
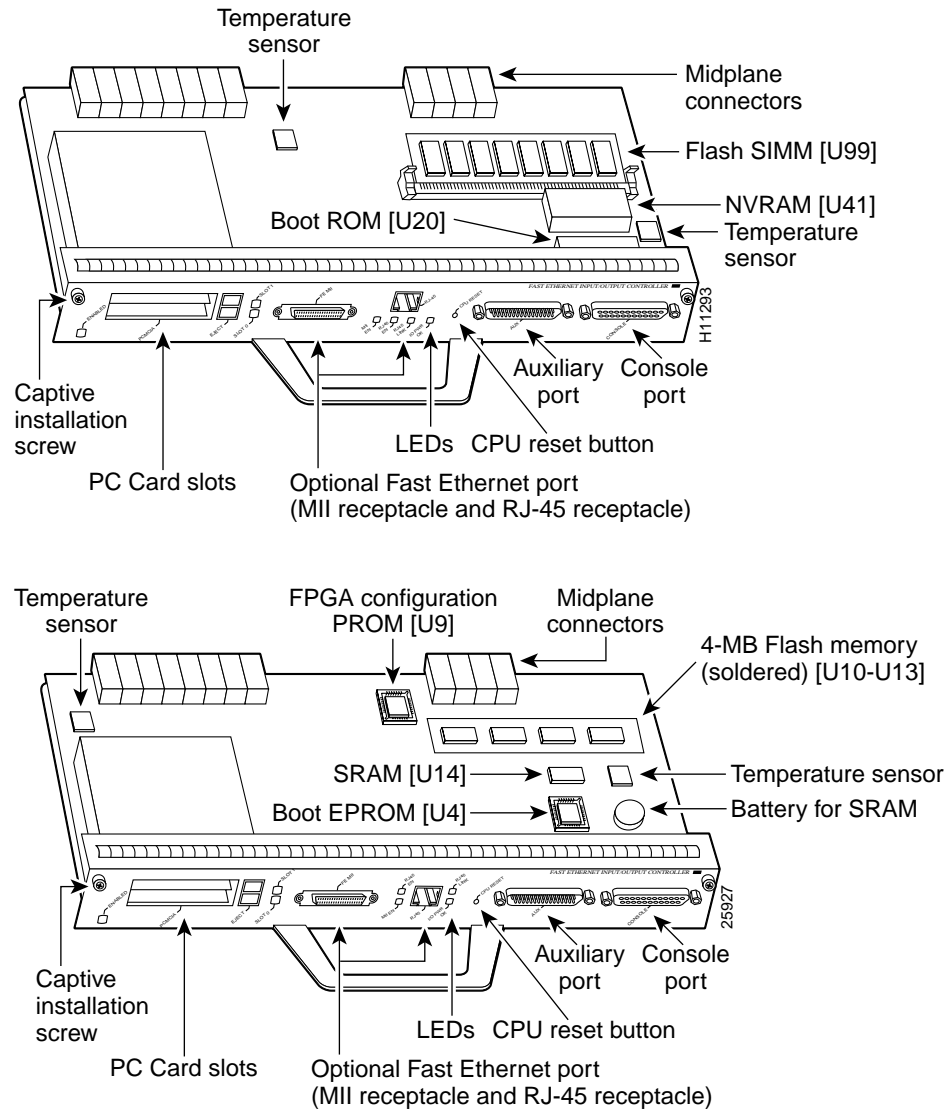
Note   There are currently two distinct I/O controller designs without a Fast Ethernet port. Your particular I/O controller will look like either of those displayed in Figure 1-18. There is no functional difference between these two I/O controllers without the Fast Ethernet port.
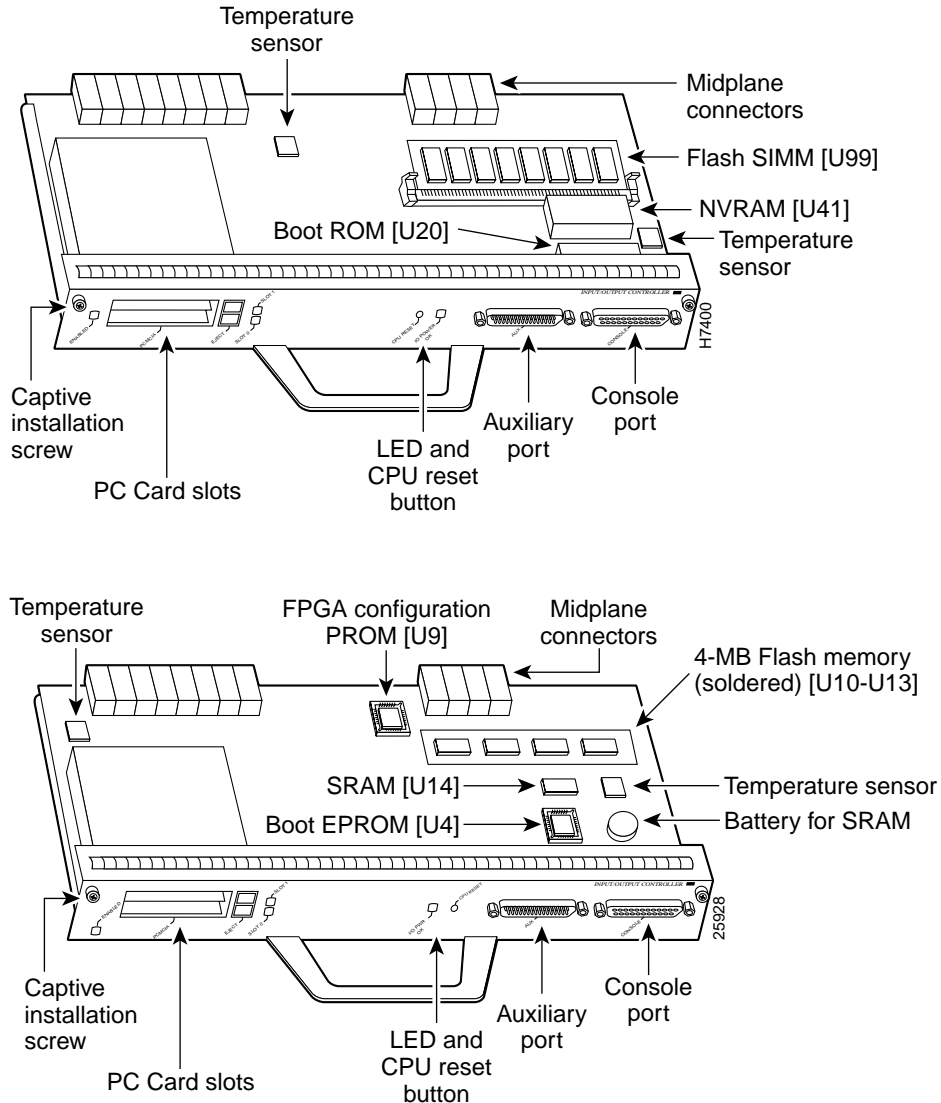

Figure 1-18   I/O Controller without Fast Ethernet Port

Table 1-5 lists the I/O controller memory components.

Table 1-5   I/O Controller Memory Components

Memory Type	Size	Quantity	Description	Location
Boot ROM	256 KB	1	EPROM for the ROM monitor program	Socket U20
Flash SIMM Flash memory card	4 MB 16 and 20 MB	1 Up to 2	Contains the default boot helper image Contains the default Cisco IOS image	Socket U99 PCMCIA slot 0 and slot 1
NVRAM	128 KB	1	Nonvolatile EPROM for the system configuration file	Socket U41

Depending on whether the Fast Ethernet port is present, either two or four LEDs on the I/O controller faceplate indicate system status; two additional LEDs indicate the status of the Flash memory cards installed in either PCMCIA slot.

Figure 1-20 shows the LEDs on an I/O controller that does not have the Fast Ethernet port. Figure 1-19 shows the LEDs on an I/O controller with the Fast Ethernet port that is equipped with an MII receptacle and an RJ-45 receptacle. Table 1-6 lists I/O controller LEDs and their functions. To use the LEDs for troubleshooting the I/O controller, refer to the "Identifying Startup Problems" section on page 5-3.

A CPU reset button is located next to the IO power OK LED on the I/O controller faceplate. The CPU reset button resets the entire system.

⚠
Caution   To prevent system errors and problems, use the CPU reset button only at the direction of your service representative.

Figure 1-19   I/O Controller LEDs and CPU Reset Button with Fast Ethernet Port (MII and RJ-45 Receptacles)
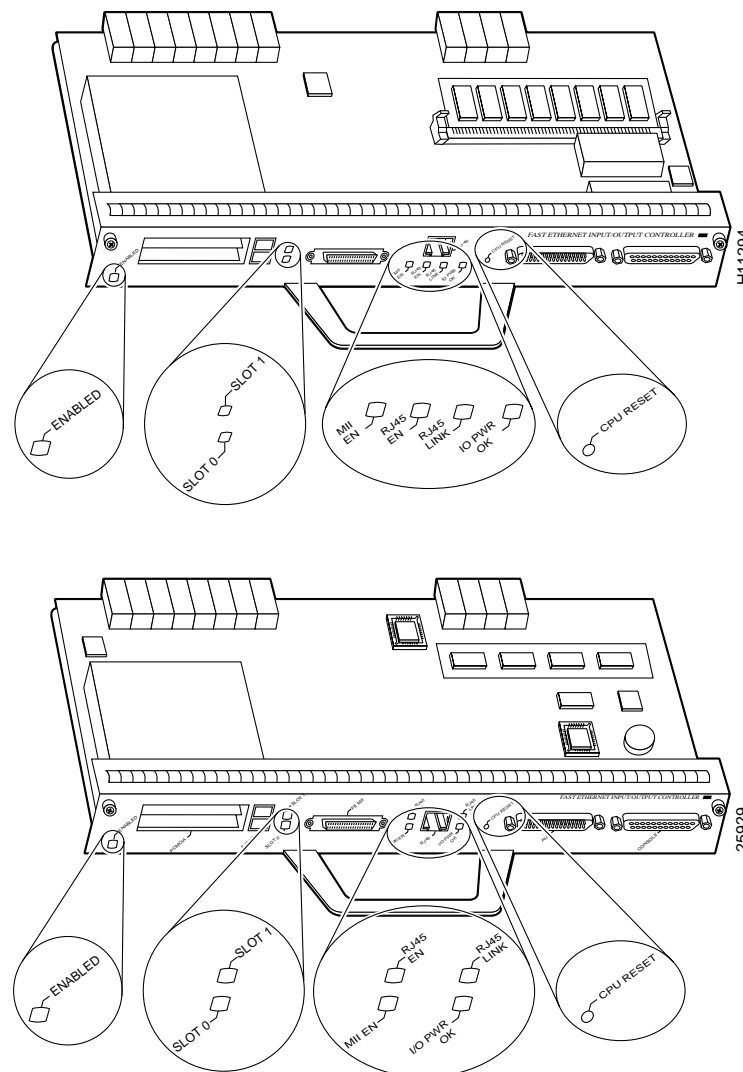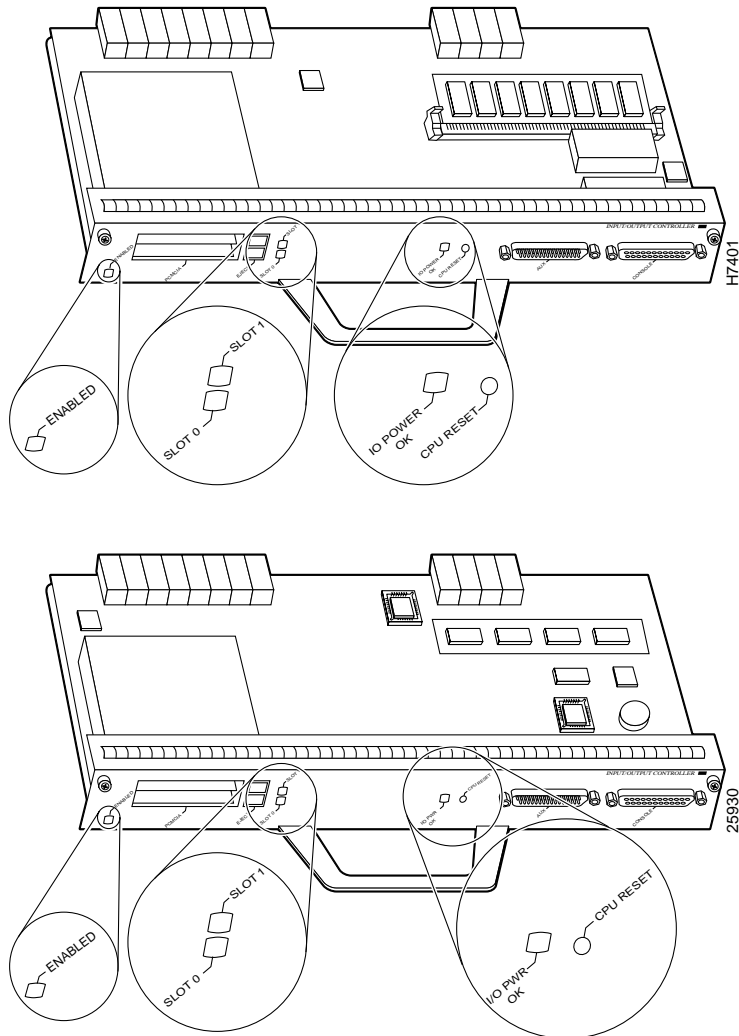
Figure 1-20   I/O Controller LEDs and CPU Reset Button without Fast Ethernet Port

Table 1-6   I/O Controller LEDs

LED	Function
Enabled	Indicates that the network processing engine and the I/O controller are enabled for operation by the system; however, it does not mean that the Fast Ethernet port on the I/O controller is functional or enabled. This LED goes on during a successful router boot and remains on during normal operation of the router.
IO Power OK	Indicates that the I/O controller is receiving DC power from the router midplane. This LED goes on during a successful router boot and remains on during normal operation of the router.
FE ENABLE	Indicates that the Fast Ethernet port is initialized and enabled for operation by the system. This LED goes on after the I/O controller has been enabled and remains on during normal operation of the router.

Table 1-6   I/O Controller LEDs (continued)

LED	Function
FE LINK	Indicates that the Fast Ethernet port has established a valid link with the network. This LED remains off during normal operation of the router, unless there is an incoming carrier signal.
MII EN	Indicates that the Fast Ethernet port's MII receptacle is initialized and enabled by the system, and is configured for operation. This LED goes on after the I/O controller has been enabled and the MII receptacle has been configured as the media type for the Fast Ethernet port (the RJ-45 receptacle is the default media type for the Fast Ethernet port). This LED remains on during normal operation of the router.
RJ45 EN	Indicates that the Fast Ethernet port's RJ-45 receptacle (the default media type for the Fast Ethernet port) is initialized and enabled by the system. This LED goes on after the I/O controller has been enabled and remains on during normal operation of the router.
RJ45 LINK	Indicates that the Fast Ethernet port's RJ-45 receptacle has established a valid link with the network. This LED remains off during normal operation of the router unless there is an incoming carrier signal.
Slot 0 Slot 1	These LEDs indicate which PCMCIA slot is in use by going on when either slot is being accessed by the system. These LEDs remain off during normal operation of the router.

Note An MII Link LED is not provided on the I/O controller because the LED is provided on external transceivers that are required for connecting to the MII receptacle on the I/O controller.

Note Refer to the *Input/Output Controller Replacement Instructions* (Cisco document number 78-3224-10) for instructions to remove or replace this component. This document accompanies every I/O controller shipped from the Cisco factory as a FRU. The document is also available on the Documentation CD-ROM and on CCO.

If you order an I/O controller as a spare for a Cisco uBR7200 series, use the product numbers UBR7200-I/O= (without a Fast Ethernet port) or UBR7200-I/O-FE= (with a Fast Ethernet port). These I/O controllers have the Cisco IOS software images used by the Cisco uBR7200 series loaded on the Flash memory SIMMs.

Cable Modem Cards

Cisco cable modem cards, together with IF-to-RF upconverters, serve as the radio frequency (RF) interface between the cable headend and Data Over Cable Service Interface Specifications (DOCSIS)-based cable modems or EuroDOCSIS-based cable modems and set-top boxes (STBs). Cisco cable modem cards separate downstream output and upstream input cable interfaces on the Cisco uBR7200 series universal broadband router to enable downstream and upstream signal combining and splitting arrangements.

Cisco cable modem cards can be used in both 6-MHz National Television Systems Committee (NTSC) standard and 8-MHz PAL/SECAM standard channel environments.

The cable modem cards connect directly to the universal broadband router's midplane. Cable modem cards installed in the Cisco uBR7200 series support OIR. The downstream ports must be connected to intermediate frequency IF-to-RF upconverter hardware.

Note   For detailed information regarding Cisco cable modem cards and procedures for their removal and installation, refer to the *Cisco uBR7200 Series Universal Broadband Router Cable Modem Card Hardware Installation* (Cisco document number 78-10494-01) FRU document.

Caution   To ensure adequate airflow across the router's cable modem cards, a cable modem card or a blank cable modem card must be installed in each cable modem card slot.

Port Adapters

Cisco port adapters connect directly to the Cisco uBR7200 series universal broadband router's midplane. Port adapters installed in the Cisco uBR7200 series support OIR. For a complete list of port adapters supported in the various Cisco uBR7200 series routers, refer to the *Cisco uBR7200 Series Universal Broadband Router Software Configuration Guide*.

Note   To install, remove, replace or configure Cisco port adapters, refer to the appropriate configuration note. For example, if you plan to replace a HSSI port adapter in your Cisco uBR7200 series, refer to the document *PA-H HSSI Port Adapter Installation and Configuration* (Cisco document number 78-3280-11).

Caution   To ensure adequate airflow across the router's port adapters, a port adapter or a blank port adapter must be installed in each port adapter slot.

Cisco Cable Clock Card

The Cisco Cable Clock Card is a dual-port field-replaceable component that is designed to provide a reliable national clock signal to the Cisco uBR7246 VXR. The primary and secondary DB-15 interfaces on the front of the clock card connect to external T1 clock signal sources.

When installed in the Cisco uBR7246 VXR chassis, the clock card can propagate a national clock signal throughout the router's midplane by locking onto an external T1 signal originating over the PSTN, locking onto a T1 clock signal originating from a port adapter installed in the same chassis, or by connecting to a Global Positioning System (GPS) receiver generating a T1 clock signal. The clock card does not support OIR.

Note   To install, remove, or replace a clock card, refer to the document *Cisco Cable Clock Card Hardware Installation* (Cisco document number 78-10634-01). To configure a clock card, refer to the *Cisco uBR7200 Series Universal Broadband Router Software Configuration Guide*.

Caution   To ensure adequate airflow across the router's components, a clock card or a blank clock card cover plate must be installed in the clock card slot on the Cisco uBR7246 VXR.

Note   Refer to Appendix G, "Manufacturers for Headend Provisioning Requirements" for a list of external T1 components to which Cisco recommends you connect the clock card.

Power Supplies

The power supply contains a main power switch, OK LED, and either an AC-input power receptacle, or two hardwired DC-input power leads and three M5 grounding connectors (depending on the type of installed power supply). Adjacent to the lower power supply bay, two M5 chassis grounding receptacles provide a chassis ground connection for electrostatic discharge (ESD) equipment or a two-hole grounding lug for the AC-input power supplies.

The Cisco uBR7200 series universal broadband router comes equipped with one 550W, AC-input or DC-input power supply. If you purchased a Cisco uBR7246 VXR or Cisco uBR7246 and you want to install a second power supply, you must order the second power supply separately. (The Cisco uBR7223 will not accommodate a second power supply.)

Note   Detailed instructions for handling and replacing the Cisco uBR7200 series universal broadband router power supplies are contained in the documents *Cisco uBR7200 Series Universal Broadband Router 550-Watt AC-Input Power Supply Replacement Instructions* (Cisco document number 78-4848-05) and *Cisco uBR7200 Series Universal Broadband Router 550-Watt DC-Input Power Supply Replacement Instructions* (Cisco document number 78-5358-03). These documents accompany every 550W, AC-input and DC-input power supply that is shipped from the factory as a FRU. These documents are also available on the Documentation CD-ROM and on Cisco Connection Online (CCO).

A handle on the AC-input and DC-input power supply units provides a grip point for removing and replacing the power supply. (Figure 1-21 shows the faceplate of the AC-input power supply. Figure 1-22 shows the faceplate of the DC-input power supply.) Two captive installation screws secure the power supply to the chassis and seat the power supply in the router midplane. A Power OK LED indicates that the power supply is delivering +5 VDC to the router midplane.

The AC-input power supply has a receptacle for an AC-input power cable. A modular power cable connects the AC-input power supply to the site AC power source. A cable-retention clip secures the power cable to the AC-input power supply.

Note   Each AC-input power supply has an electrical current rating of 7A.

Figure 1-21   Cisco uBR7200 Series AC-Input Power Supply
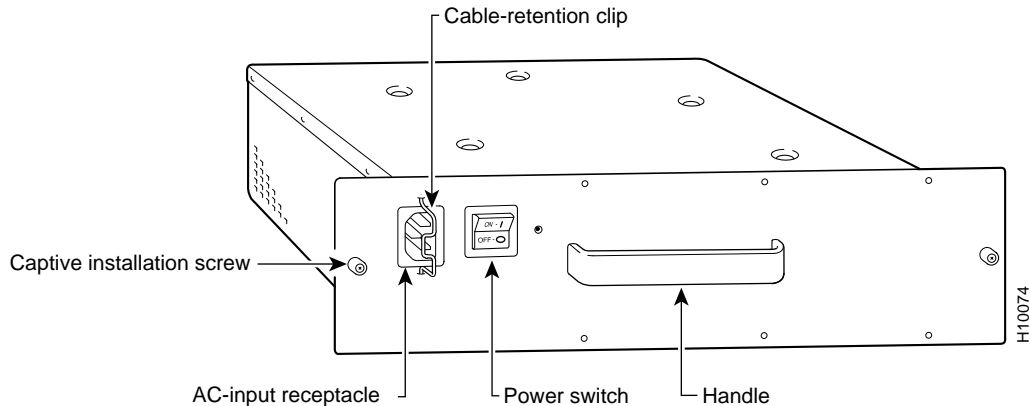
The DC-input power supply has a receptacle for two DC-input power leads. Three M5 grounding receptacles are located on the front of the DC-input faceplate to provide connection for a ground lead. A ground lead should be installed on two of the receptacles; either using the two receptacles that are aligned vertically or the two receptacles that are aligned horizontally. A cover is attached to two strain-relief studs on the power supply faceplate to secure the DC-input power leads running behind the cover.

Note   Each DC-input power supply has an electrical current rating of 14A, 700 VA. Use a minimum of 12 AWG (4 mm^2) wire for the input to each DC-input power supply. The power input must be protected by a 20A circuit breaker or fuse that is in compliance with your local electric regulations.

Figure 1-22   Cisco uBR7200 Series DC-Input Power Supply
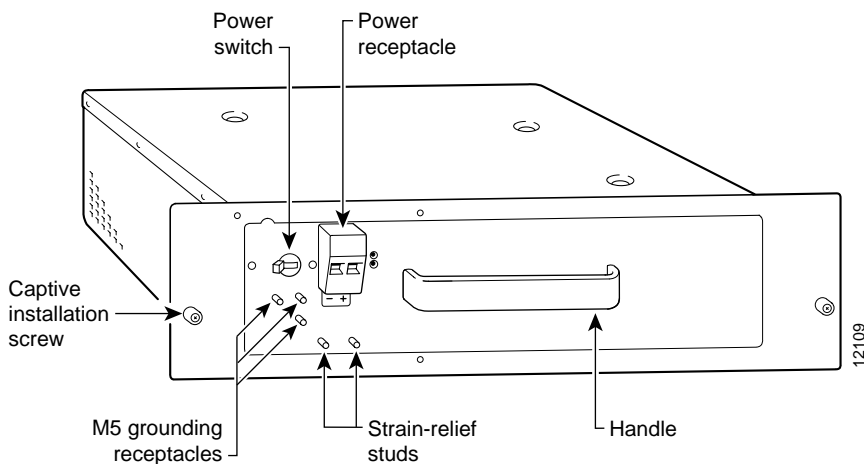
Caution   To ensure adequate airflow across the Cisco uBR7246 VXR and Cisco uBR7246 universal broadband routers' power supplies, a power supply or a power supply filler plate (with its attached air dam) must be installed in each power supply bay.

✎

Note   See Appendix A, "Specifications and Export Restrictions," for AC-input and DC-input power supply system power specifications, including input voltage and operating frequency ranges.

The Power OK LED goes off and the power supply will shut itself down when the internal DC voltages exceed allowable tolerances or the internal temperature of the power supply exceeds allowable tolerances. The power supply will then attempt to restart itself within 10 seconds of the shutdown. If the power supply cannot restart itself on the first attempt, it will repeat the automatic restart sequence until the power switch is manually switched to the OFF position, or the power cord is disconnected from the back of the power supply or the power source. For a description of power-supply shutdown conditions and thresholds, refer to the "Environmental Monitoring and Reporting Functions" section on page 6-2.

⚠

Caution   When the input power to a Cisco uBR7200 series universal broadband router power supply is disconnected or lost, the power supply will enter a reset cycle for 10 seconds. Wait at least 10 seconds or move the power switch from one position to the other to restart the power supply. For example, if the power supply was ON when the power was disconnected or lost, move the power switch to the OFF position then back to the ON position. If you do not wait the full 10 seconds or move the power switch from one position to the other, the power supply will not restart.

Fan Trays

The fan tray for the Cisco uBR7223, shown in Figure 1-23, consists of four fans that are attached to a metal tray, and the fan tray for the Cisco uBR7246 VXR and Cisco uBR7246, shown in Figure 1-24, consists of seven fans that are attached to a metal tray. In each of the Cisco uBR7200 series universal broadband routers, the fan tray is located on the left side of the chassis (when viewing the router from the front) and receives 12 VDC through a DC power harness that connects directly to the router midplane. To remove the fan tray from the chassis, loosen the captive installation screw on the front of the fan tray and slide the tray out, using the attached handle.

✎

Note   Detailed instructions for removing and replacing the fan tray are contained in the document *Cisco uBR7200 Series Universal Broadband Router Fan Tray Replacement Instructions* (Cisco document number 78-4939-05). This document accompanies every fan tray that is shipped from the factory as a FRU. The document is also available on the Documentation CD-ROM and on Cisco Connection Online (CCO).

Figure 1-23   Cisco uBR7223 Fan Tray
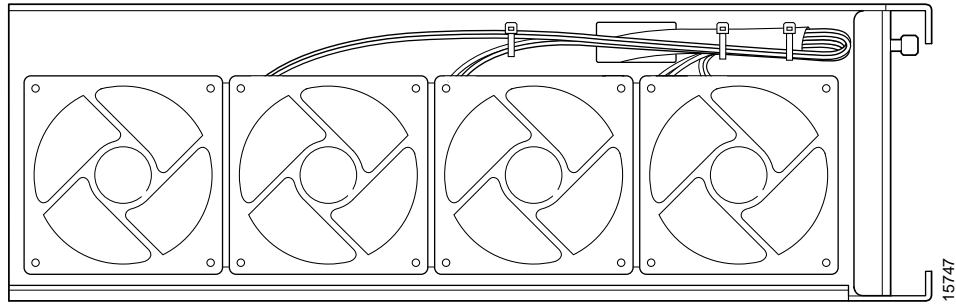
Figure 1-24   Cisco uBR7246 VXR and Cisco uBR7246 Fan Tray
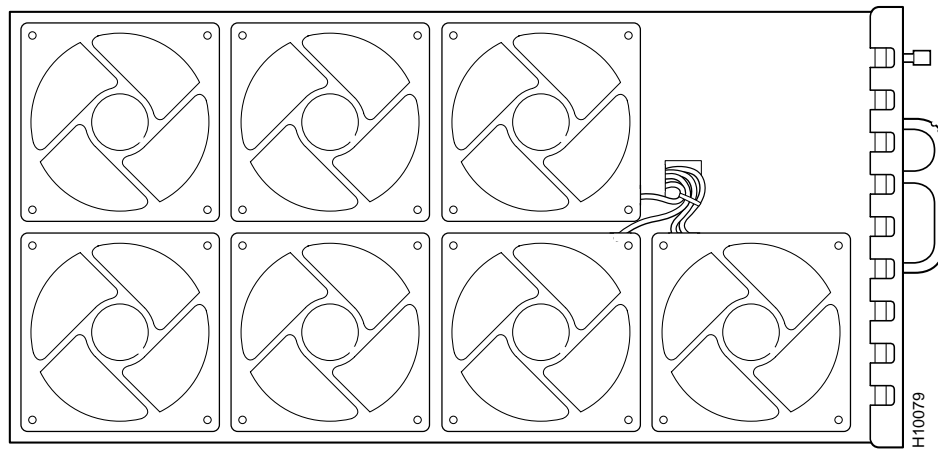
The fan tray draws cooling air in through the intake vent on the right side of the chassis (when viewing the router from the front), and moves the air across the internal components and out the exhaust vent on the left side of the chassis.

Figure 1-25 shows the airflow through the router.

Figure 1-25   Internal Airflow—Top View
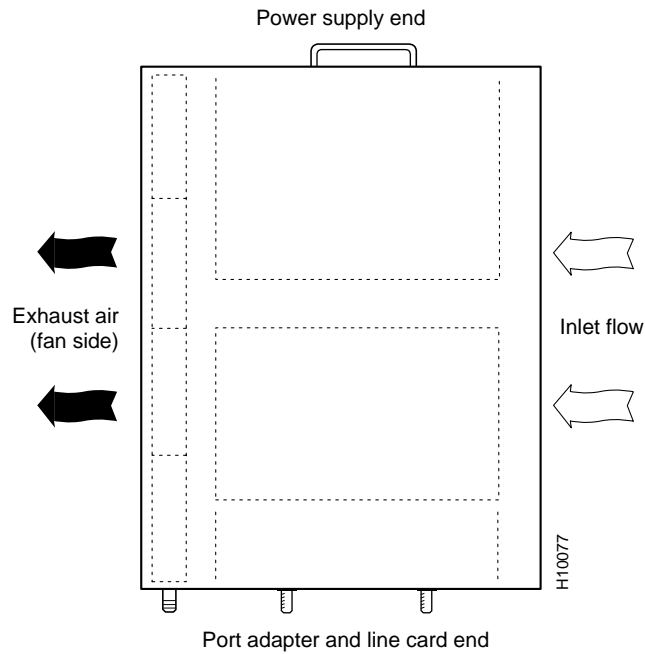
The left and right sides of the chassis must remain unobstructed to ensure adequate airflow and prevent overheating inside the chassis; Cisco recommends at least 3 inches of clearance. (See the "Site Requirements" section on page 2-5.)

Temperature sensors on the network processing engine and I/O controller monitor the internal air temperature and send warning messages when the internal air temperature approaches a specified threshold. If the internal temperature exceeds the specified threshold, the system environmental monitor shuts down all internal power to prevent equipment damage from excessive heat.

Chassis

The front of the Cisco uBR7223 chassis has one slot for a single-width port adapter, two slots for cable modem cards, one slot for an I/O controller, one slot for a fan tray, and one bay for the subchassis and midplane. (See Figure 1-26.)

Figure 1-26   Cisco uBR7223 Chassis
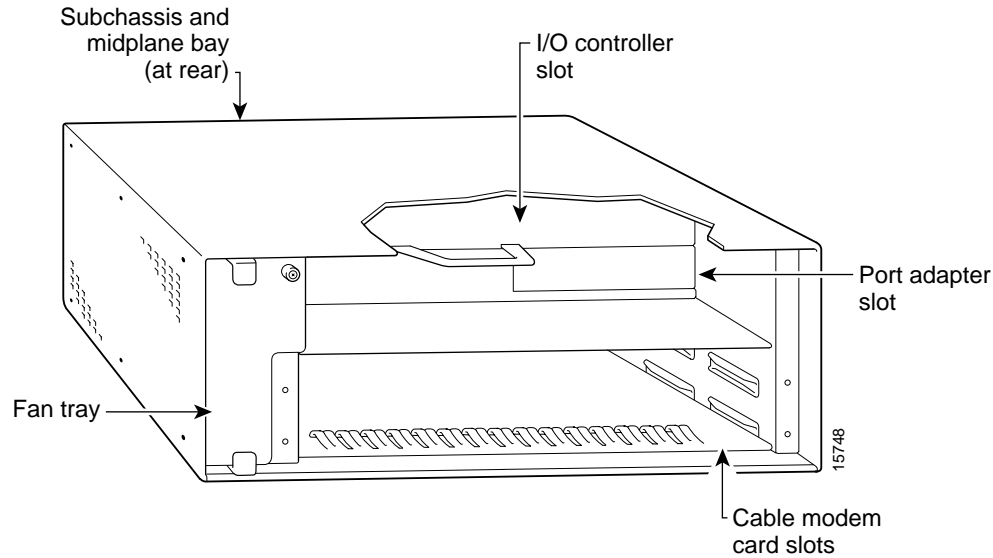
The front of the Cisco uBR7246 chassis has two slots for single-width port adapters (or one dual-width port adapter), four slots for cable modem cards, one slot for an I/O controller, one slot for a fan tray, and one bay for the subchassis and midplane. (See Figure 1-27.)

Figure 1-27   Cisco uBR7246 Chassis
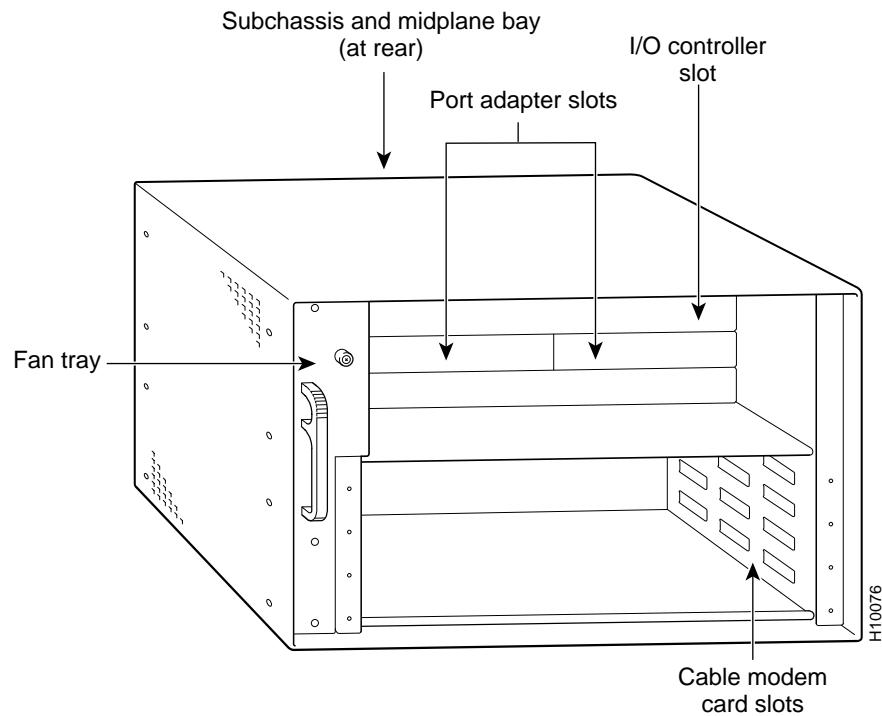
The front of the Cisco uBR7246 VXR chassis has two slots for single-width port adapters (or one dual-width port adapter), four slots for cable modem cards, one slot for an I/O controller, one slot for a national clock card, one slot for a fan tray, and one bay for the subchassis and midplane. (See Figure 1-28.)

Figure 1-28   Cisco uBR7246 VXR Chassis
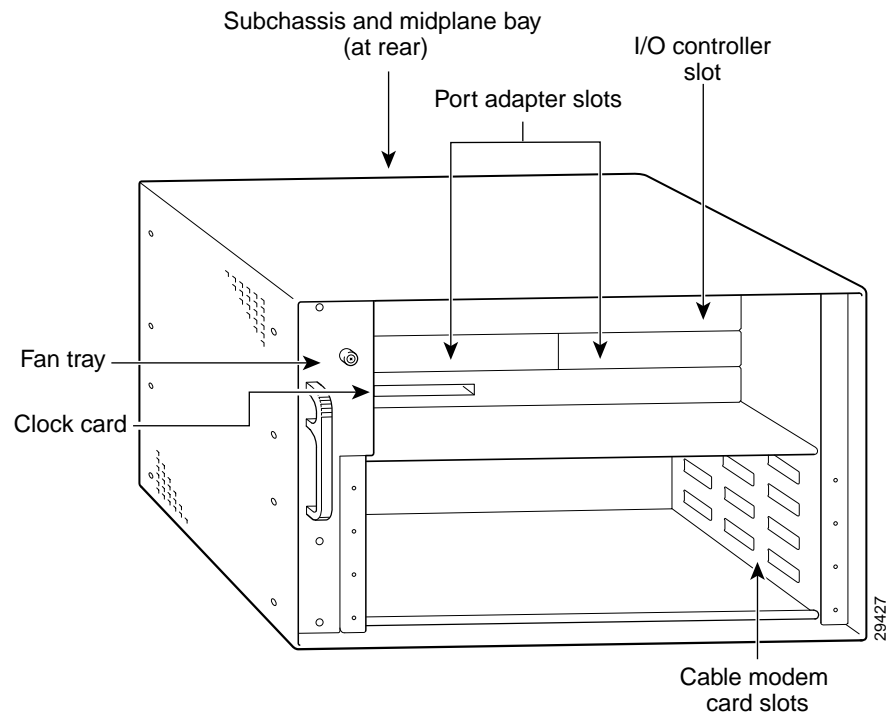
Note   To replace the Cisco uBR7200 series chassis, you must remove all of its internal components; therefore, when replacing the chassis, refer to the documents that explain how to remove and replace the internal components. These documents accompany every chassis that is shipped from the factory as a FRU. The documents are also available on the Documentation CD-ROM and on Cisco Connection Online (CCO).

Subchassis and Midplane

The following sections describe the subchassis and midplane characteristics for the Cisco uBR7200 series.

Cisco uBR7223

The Cisco uBR7223 subchassis (the rear of the Cisco uBR7223) has one bay for a power supply and one slot for a network processing engine. (See Figure 1-29.)

The cable-modem-card side of the Cisco uBR7223 midplane has two connectors for cable modem cards, one connector for a port adapter, one connector for an I/O controller, and one connector for a fan tray. The power supply side of the midplane has one connector for power supply and one connector for the network processing engine. The midplane supplies DC power to the router's internal components.

Figure 1-29   Cisco uBR7223 Subchassis and Midplane
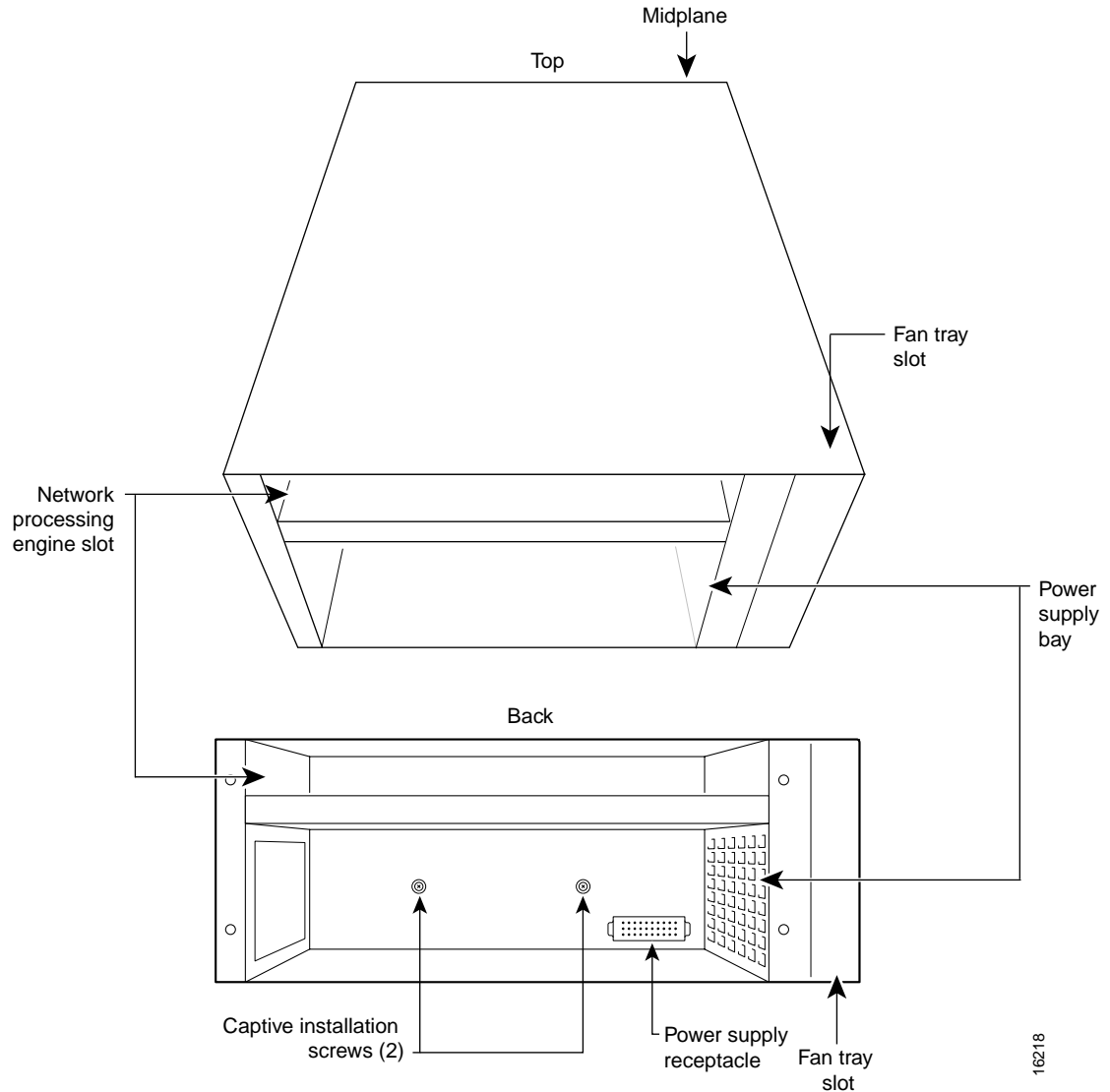
Cisco uBR7246 VXR and Cisco uBR7246

The Cisco uBR7246 VXR and Cisco uBR7246 subchassis (the rear of the Cisco uBR7246 VXR and Cisco uBR7246) have two bays for power supplies and one slot for a network processing engine. In both cases, the subchassis also houses the router midplane. (See Figure 1-30.)

The cable-modem-card side of the Cisco uBR7246 VXR and Cisco uBR7246 midplane has four connectors for cable modem cards, two connectors for port adapters, one connector for an I/O controller, and a connector for the fan tray. The Cisco uBR7246 VXR also features one connector for a clock card. The power supply side of the midplane has two connectors for power supplies and one connector for a network processing engine. The midplane supplies DC power to the router's internal components.

> **Note**   You must replace the entire subchassis in order to replace the router midplane in Cisco uBR7200 series universal broadband router.

> **Note**   Refer to the *Cisco uBR7200 Series Universal Broadband Router Subchassis and Midplane Replacement Instructions* (Cisco document number 78-5193-04) for instructions to remove or replace the subchassis or midplane. This document accompanies every subchassis and midplane shipped from the Cisco factory as a FRU. The document is also available on the Documentation CD-ROM and on CCO.

Figure 1-30   Cisco uBR7246 VXR and Cisco uBR7246 Subchassis and Midplane
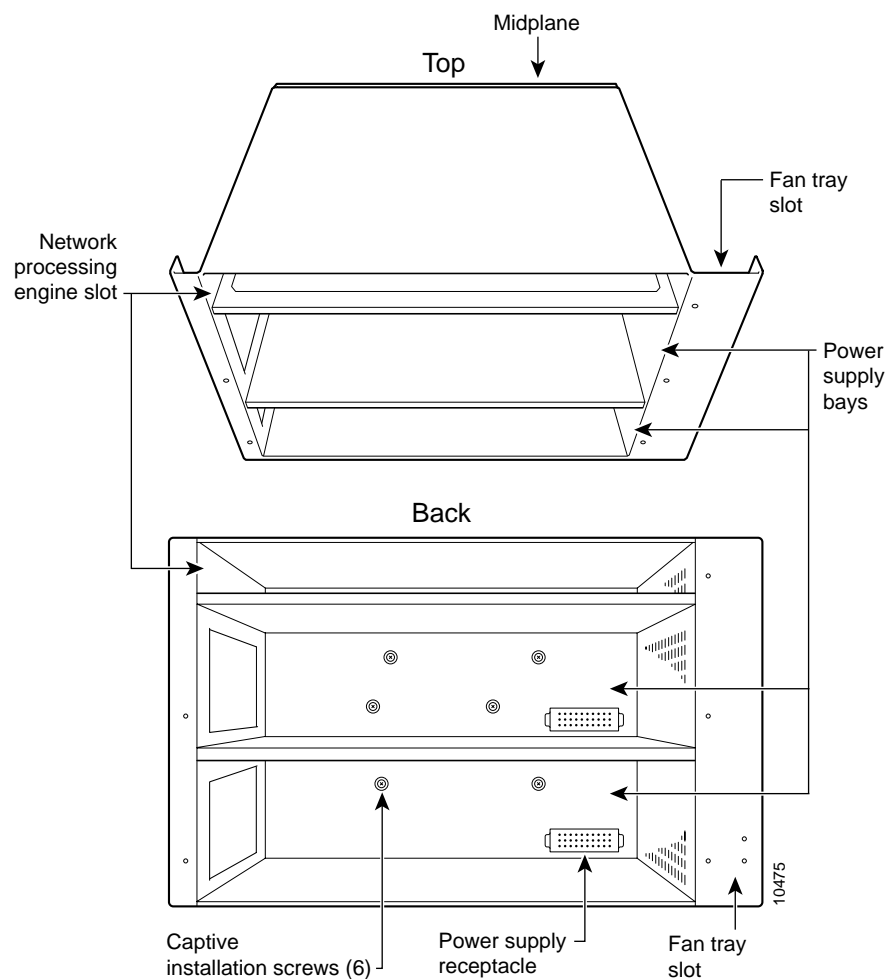
Flash Memory Cards

The Cisco uBR7200 series universal broadband router supports up to two installed Cisco-provided Type II PCMCIA Flash memory cards.

Flash memory (Flash memory cards and the Flash SIMM on the I/O controller) allows you to remotely load and store multiple system and boot helper images. You can download a new image over the network and then add the new image to Flash memory or replace existing files. You can also transfer images between Flash memory cards and the onboard Flash memory SIMM. You can then boot the router either manually or automatically from any of the stored images. Flash memory can also function as a TFTP server to allow other routers to boot remotely from stored images or copy them into their own Flash memory.

Note Refer to the *Memory Replacement Instructions for the Network Processing Engine and Input/Output Controller* (Cisco document number 78-3226-13) for instructions to remove or replace Flash memory cards and memory SIMMs. This document accompanies every Flash memory card shipped from the Cisco factory as a FRU. The document is also available on the Documentation CD-ROM and on CCO.

Table 1-7 lists the Flash memory card options supported by the Cisco uBR7200 series.

Table 1-7   Flash Memory Card Options

Memory Size	Product Number
16 MB	MEM-I/O-FLC16M[1]
20 MB	MEM-I/O-FLC20M[1]

1. These products are also available as Flash memory card upgrades. To order an upgrade, add an equal sign (=) after the product number, for example, MEM-I/O-FLC16M=.