CHAPTER 1

Hardware Description

This chapter describes the major components of the Cisco 6400 Carrier-Class Broadband Aggregator.

This chapter includes the following sections:

Note The illustrations in this guide depict the original Cisco 6400 chassis. Your chassis may appear or look slightly different.

Cisco 6400 Overview

The Cisco 6400 is a broadband concentrator that features Cisco end-to-end ATM services, Point-to-Point Protocol (PPP) termination, and tunneling. The Cisco 6400 combines Cisco IOS ATM switching and routing capabilities in a modular, scalable, redundant, Network Equipment Building Systems/European Telecommunication Standards Institute (NEBS/ETSI)-compliant chassis.

Cisco 6400 Physical Description

This section includes detailed information about the following Cisco 6400 components and features:

- Chassis:
  - Module Compartment
  - Blower Compartment
  - Power Entry Module (PEM) Compartment
  - Backplane
- Node Switch Processor (NSP)
- Node Route Processor (NRP)
- Node Line Card (NLC)

Chassis

The Cisco 6400 chassis, designed for mounting in 19-inch or 23-inch equipment racks, consists of the following:

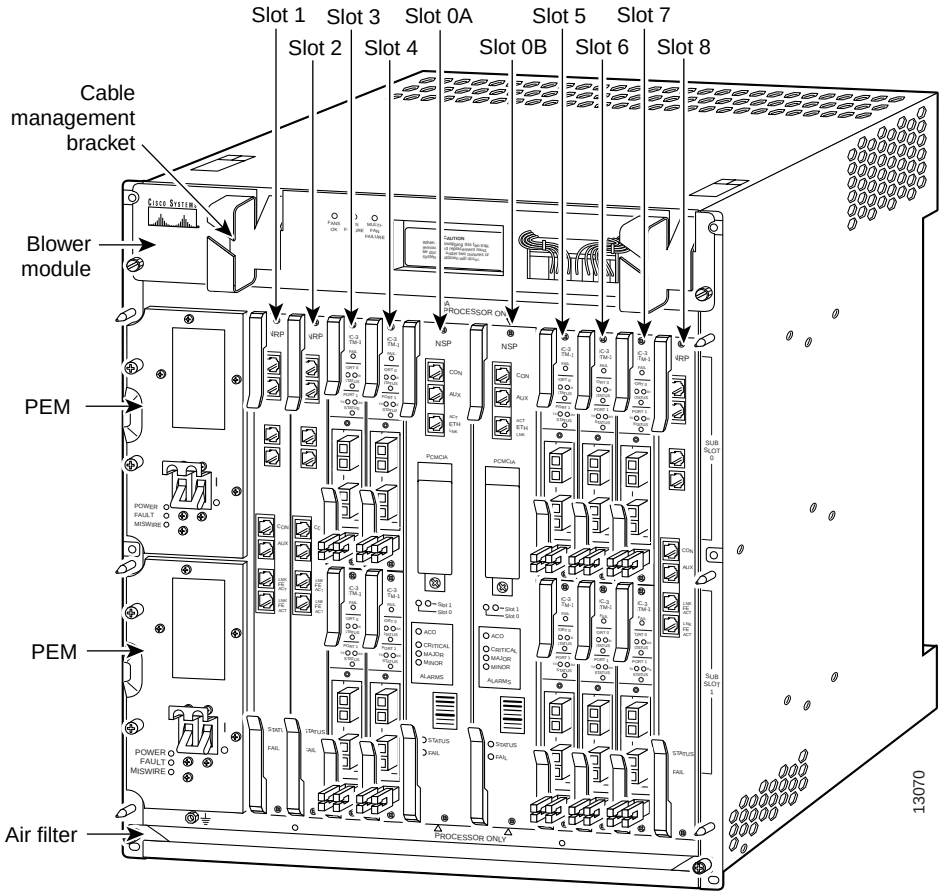
- Module Compartment
- Blower Module
- PEM Compartment
- Backplane

Module Compartment

The module compartment has ten slots: two central slots that are reserved for NSP cards, and eight slots that can accommodate a mixture of full-height NRP cards, and full-height and half-height NLCs. All cards support hot-swapping and redundancy. Figure 1-1 shows a fully-loaded chassis with redundant cards and power entry modules (PEMs).

Note The NSP card supports hot-swapping. One NSP is required for the system to operate, so hot-swapping a nonredundant NSP will result in a system outage. A standby NSP in a redundant configuration can be hot-swapped without impacting system operation.

Figure 1-1 Cisco 6400 Chassis—Front View

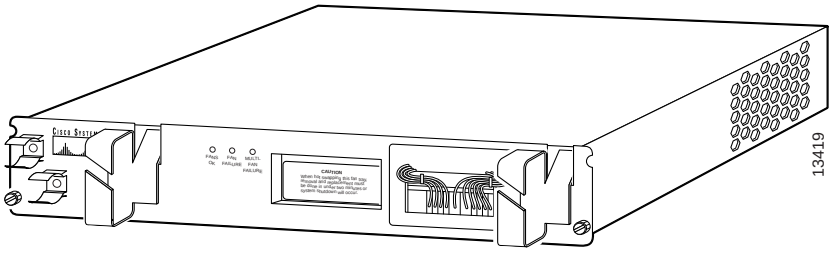


Blower Module

The blower module (Figure 1-2) is located on the top of the chassis and is connected to the backplane. The module provides airflow throughout the system. The air intake is located at the bottom of the chassis, and there is an exhaust in the top rear of the chassis through the blower module. The blower module supports hot-swapping and can be replaced without interruption to system operation.

Note The system will shut down after two minutes if the blower module is removed and not replaced.

Figure 1-2 Blower Module



Blower Module LEDs

Table 1-1 describes the blower module LEDs on the front center panel.

Table 1-1 Blower Module LEDs

LED	Status	Condition
Fans OK	Steady green	Fans are operational.
Single Fan Failure	Steady yellow	One fan has failed and alarms are triggered.
Multiple Fan Failure	Steady yellow	Two or more fans have failed and the system will shut down.

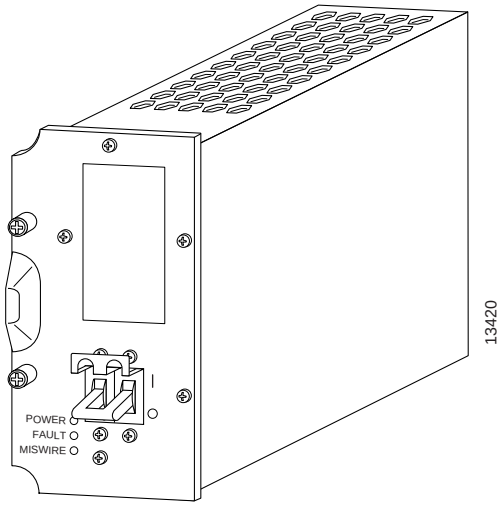
Power Entry Module

The DC PEM (Figure 1-3) provides filtering, and supplies DC power to the chassis electronics. There are two PEM bays in the chassis; however, only one PEM is required. An additional PEM can be used for redundancy. The PEMs are located on the left side of the chassis and are installed from the front. Input source power (-48 VDC from building centralized power source) enters the chassis through screw terminals on the rear of the chassis and is supplied to the PEMs when they are plugged into the backplane.

The AC PEM (Figure 1-4) provides power conversion directly from the facility VAC input power to the -48 VDC used internally in the Cisco 6400 chassis. AC power comes into the AC PEM through a power cord attached to the front faceplate.

Note The Cisco 6400 no longer features the AC-Input Power Shelf. If your Cisco 6400 chassis has an AC-Input Power Shelf and this component requires replacement, Cisco will send you the new AC PEM (Cisco part number PEM-PWR-AC=) to replace the older unit. If you want to use AC power as the sole input and your Cisco 6400 chassis contains DC PEMs, you must remove the DC PEMs and replace them with the AC PEMs. Instructions for removing and installing DC PEMs and AC PEMs are provided in Chapter 5, “Maintaining the Cisco 6400.”

Figure 1-3 DC Power Entry Module



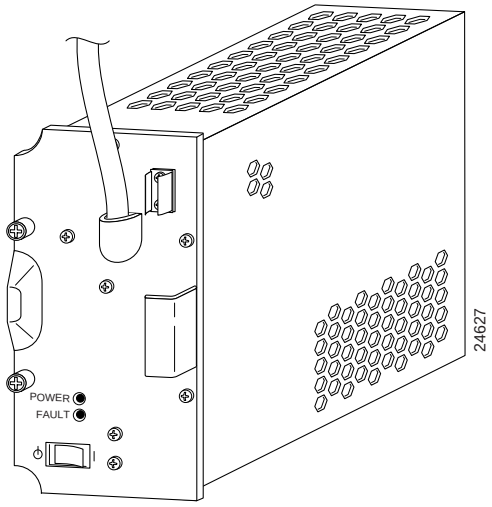
DC Power Entry Module LEDs

Table 1-2 describes the LEDs located on the front panel of the PEM.

Table 1-2 DC Power Entry Module LEDs

LED	Status	Condition
Power	Steady green	Power is available.
Fault	Steady yellow	The PEM has failed or is turned off.
Miswire	Steady yellow	Cables are attached incorrectly and should be reversed.

Figure 1-4 AC Power Entry Module



AC Power Entry Module LEDs

Table 1-3 describes the LEDs located on the front panel of the PEM.

Table 1-3 Power Entry Module LEDs

LED	Status	Condition
Power	Steady green	Power is available.
Fault	Steady yellow	The PEM has failed or is turned off.

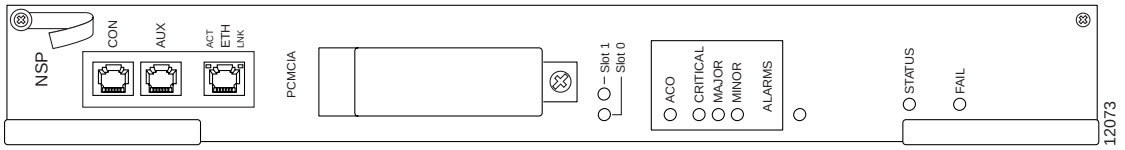
Backplane

The backplane is attached to the rear of the Cisco 6400 chassis and provides system interconnect.

Node Switch Processor

The Node Switch Processor (NSP) (Figure 1-5) is the main system processor card in the Cisco 6400, residing in chassis slot 0A or 0B. The NSP contains the ATM switch engine and processor, and most memory components. The NSP runs the system software, which maintains and executes the management functions that control the system.

Figure 1-5 NSP Faceplate



The NSP is a three-card module, which supports the following functions and features:

- 64-bit, 100-MHz RISC central processor unit (R4700)
- 64-MB parity-protected DRAM memory (upgradeable to 128 MB)
- 5-Gbps nonblocking ATM switch fabric:
  - CBR, VBR-RT, VBR-NRT, ABR, UBR, and GFR traffic classes
  - Per flow virtual connection (VC) or virtual path (VP) queuing with strict priority, rate, and weighted round-robin scheduling
  - Up to 32,000 point-to-point VCs
  - Up to 32,000 point-to-multipoint VC roots; up to 254 leaves per root
  - Dual leaky bucket usage parameter control (UPC) (ITU-T I.371/ATM Forum UNI compliant)
  - Early packet discard (EPD)/partial packet discard (PPD)
  - Per VC/VP CBR shaping
- 64,000 cells of shared ATM payload memory (parity-protected SRAM)
- Out-of-band ATM traffic management
- 8 MB boot Flash memory
- 512 KB NVRAM for storing system configuration information

- Console and auxiliary serial (EIA/TIA-232) ports
- Network management Ethernet (10BASE-T) port
- Dual PCMCIA card slots
- 1+1 NSP redundancy based on EHSA protocols
- Digital thermometers for monitoring temperature
- Custom-designed PLL to attentuate clock jitter, meeting jitter and wander requirements of the GR253 standard
- Network timing derived from any NLC interface
- Stratum 4 accuracy when internally timed

Node Switch Processor LEDs

The LEDs on the NSP indicate the module status conditions (Table 1-4).

Table 1-4 NSP Indicators

LED	Status	Condition
STATUS	Steady yellow Blinking yellow Steady green Blinking green Off	Cisco IOS software is not running. System is booting. NSP is active (primary). NSP is standby (secondary). NSP has no power.
FAIL	Yellow Off	NSP has failed. NSP has not failed.
ETH		
ACT (Activity)	Green Off	Packets are being transmitted and received. No activity.
LNK (Link)	Steady green Off	Port is operational. No carrier is detected.
PCMCIA Slot 0	Steady green	Slot is active.
PCMCIA Slot 1	Steady green	Slot is active.
ALARMS		
CRITICAL	Yellow Off	Alarm is active. No alarm is active.
MAJOR	Yellow Off	Alarm is active. No alarm is active.
MINOR	Yellow Off	Alarm is active. No alarm is active.

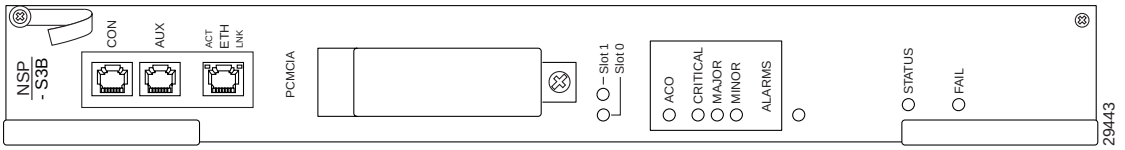
Optional Stratum 3 BITS Timing

The NSP with Stratum 3 BITS timing (NSP-S3B) supports the same functions and features as the standard NSP, as well as the following:

- Network timing derived from CO BITS or from any NLC interface
- Stratum 3 accuracy when internally timed

Figure 1-6 shows the faceplate of the NSP with Stratum 3 BITS timing.

Figure 1-6 NSP-S3B Faceplate



By default, the NSP-S3B functions exactly the same as the standard NSP. You must specifically configure the NSP-S3B to implement the Stratum 3 BITS timing features. All content in this document that refers to the NSP also applies to the NSP-S3B.

Dual PCMCIA Card Slots

The two PCMCIA card slots can be used to store Cisco IOS software or system configuration information on a PCMCIA disk memory card. The system can also boot from the software stored on the PCMCIA disk memory card.

Alarm Cut-Off Switch

The alarm cut-off (ACO) switch is located near the center of the NSP faceplate. Press the switch to turn off audible alarms. You can also disable audible alarms by using the command-line interface (CLI). For more information, refer to *Cisco 6400 Command Reference*.

Connectors

The NSP card has three ports with RJ-45 connectors:

- Console port—This asynchronous EIA/TIA-232 serial port can be used to connect the NSP to a terminal, for local administrative access. The RJ-45 connector for the console port is labeled CON.
- Auxiliary port—This asynchronous EIA/TIA-232 serial port can be used to connect the NSP to a modem for remote administrative access. The RJ-45 connector for the auxiliary port is labeled AUX.
- Ethernet port—This port can be used to connect the NSP to a 10BASE-T network management LAN. The RJ-45 connector for the Ethernet port is labeled ETH.

Console Port Signals

The console port is a serial EIA/TIA-232 interface. Table 1-5 lists the signals for the console port connector.

Note The console port on the NSP does not support hardware flow control. To ensure proper operation, please configure any terminal equipment connected to the console port for no hardware flow control or no flow control.

Table 1-5 Console Port Connector Signals

Pin	Signal	Direction	Description
1	RTS	–	Hard wired to pin 8
2	DTR	Output	Data terminal ready (for modem control)
3	TxD	Output	Transmit data
4	GND	–	Signal ground
5	GND	–	Signal ground
6	RxD	Input	Receive data
7	DSR	Input	Data set ready (for modem control)
8	CTS	–	Hard wired to pin 1

Auxiliary Port Signals

The auxiliary port supports hardware flow control and modem control. Table 1-6 lists the signals for the auxiliary port connector.

Table 1-6 Auxiliary Port Connector Signals

Pin	Signal	Direction	Description
1	RTS	Output	Request to send (hardware flow control)
2	DTR	Output	Data terminal ready (modem control)
3	TxD	Output	Transmit data
4	GND	–	Signal ground
5	GND	–	Signal ground
6	RxD	Input	Receive data
7	DSR	Input	Data set ready (modem control)
8	CTS	Input	Clear to send (hardware flow control)

Network Management Ethernet Port Signals

The network management Ethernet (NME) port provides out-of-band network management of the NSP. Table 1-7 lists the signals for the NME port connector.

Table 1-7 NME Port Connector Signals

Pin	Signal	Direction	Description
1	TxD+	Output	Transmit data +
2	TxD–	Output	Transmit data –
3	RxD+	Input	Receive data +
4	NC	–	No connection
5	NC	–	No connection
6	RxD–	Input	Receive data –
7	NC	–	No connection
8	NC	–	No connection

Node Route Processors

The node route processor (NRP) receives traffic from one or more NSP ATM switch ports, reassembles the ATM cells into packets, routes the packets, segments the routed packets, and sends them back to the ATM switch. The Cisco 6400 can contain multiple NRP modules, configured to operate independently or as redundant pairs (1+1). You can insert NRPs into slots 1 through 8 in the Cisco 6400 chassis.

The Cisco 6400 supports two node route processors, designated as NRP-2SV and NRP-1:

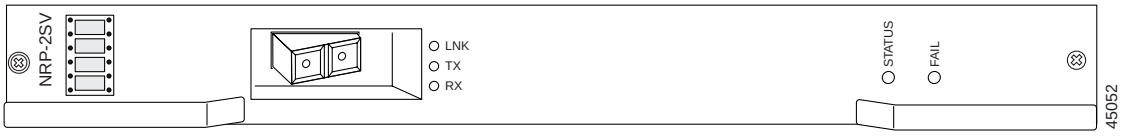
- NRP-2SV—Provides a Gigabit Ethernet interface and sufficient processing capability for handling OC-12 rate of user traffic (Figure 1-7).
- NRP-1— Incorporates a 100-Mbps Fast Ethernet interface for connecting into an IP network and has processing capability for OC-3 rate of user traffic (Figure 1-8).

These two types of NRPs can be used together in any combination in a single Cisco 6400 chassis.

NRP-2SV Module

This section describes the hardware components for an NRP-2SV module.

Figure 1-7 NRP-2SV Faceplate



Warning **Class 1 laser product. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

NRP-2SV LEDs

The LEDs on the NRP-2SV indicate port and module status (Table 1-8).

Table 1-8 NRP-2SV LED Indicators

LED	Status	Condition
STATUS	Steady green Blinking yellow Steady yellow Off	NRP-2SV is active. System is booting. Cisco IOS software is not running. NRP-2SV has no power.
FAIL	Steady yellow Off	NRP-2SV has failed. Normal operation.
GBIC		
TX	Blinking green Off	Packets are being transmitted. No activity.
RX	Blinking green Off	Packets are being received. No activity.
LNK	Steady green Off	Port is operational. No carrier is detected.

GBIC Port Cabling Specifications

Table 1-9 lists the 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
1000BASE-SX 6400-GBIC-SX	850	MMF	62.5 62.5 50.0 50.0	160 200 400 500	722 ft (220 m) 902 ft (275 m) 1640 ft (500 m) 1804 ft (550 m)
1000BASE-LX/LH 6400-GBIC-LH	1300	MMF[1] SMF	62.5 50.0 50.0 8 to 10	500 400 500 —	1804 ft (550 m) 1804 ft (550 m) 1804 ft (550 m) 32,808 ft (10 km)

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).

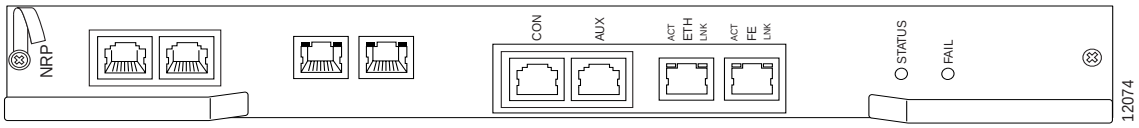
Alphanumeric Display

The NRP-2SV faceplate also has a four-digit alphanumeric display that indicates status information and error codes.

NRP-1 Module

This section describes the hardware components on the NRP-1 module.

Figure 1-8 NRP-1 Faceplate



NRP-1 LEDs

The LEDs on the NRP-1 indicate port and module status (Table 1-10).

Table 1-10 NRP-1 LED Indicators

LED	Status	Condition
STATUS	Steady green Blinking green Steady yellow Blinking yellow Off	NRP is active (primary). NRP is standby (secondary). Cisco IOS software is not running. System is booting. NRP has no power.
FAIL	Steady yellow Off	NRP has failed. Normal operation.
ETH		
ACT (Activity)	Blinking green Off	Packets are being transmitted and received. No activity.
LNK (Link)	Steady green Off	Port is operational. No carrier is detected.
FE		
ACT (Activity)	Blinking green Off	Packets are being transmitted and received. No activity.
LNK (Link)	Steady green Off	Port is operational. No carrier is detected.

Connectors

The NRP-1 card has four ports with RJ-45 connectors:

- Console port—Asynchronous EIA/TIA serial port can be used to connect the NRP to a terminal for local administrative access. The RJ-45 connector for the console port is labeled CON.
- Auxiliary port—Asynchronous EIA/TIA serial port can be used to connect the NRP to a modem for remote administrative access. The RJ-45 connector for the auxiliary port is labeled AUX.
- Ethernet port—Can be used to connect the NRP to a 10BASE-T network management LAN. The RJ-45 connector for the Ethernet port is labeled ETH.
- Fast Ethernet port—Can be used to connect the NRP to a 100BASE-T LAN. The RJ-45 connector for the Fast Ethernet port is labeled FE.

Console Port Signals

The console port is a serial EIA/TIA-232 interface. Table 1-11 lists the signals for the console port connector.

Table 1-11 NRP-1 Console Port Connector Signals

Pin	Signal	Direction	Description
1	NC	–	No connection
2	DTR	Output	Data terminal ready (for modem control)
3	TxD	Output	Transmit data
4	GND	–	Signal ground
5	GND	–	Signal ground
6	RxD	Input	Receive data
7	DSR	Input	Data set ready
8	NC	–	No connection

Note The console port on the NRP does not support hardware flow control. To ensure proper operation, configure any terminal equipment connected to the console port for no hardware flow control or no flow control.

Auxiliary Port Signals

The auxiliary port supports hardware flow control and modem control. Table 1-12 lists the signals for the auxiliary port connector.

Table 1-12 Auxiliary Port Connector Signals

Pin	Signal	Direction	Description
1	RTS	Output	Request to send (for hardware flow control)
2	DTR	Output	Data terminal ready (for modem control)
3	TxD	Output	Transmit data
4	GND	–	Signal ground
5	GND	–	Signal ground
6	RxD	Input	Receive data
7	DSR	Input	Data set ready (for modem control)
8	CTS	Input	Clear to send (for hardware flow control)

Ethernet Port Signals

Table 1-13 lists the signals for the Ethernet port connector.

Table 1-13 Ethernet Port Connector Signals

Pin	Signal	Direction	Description
1	TxD+	Output	Transmit data +
2	TxD–	Output	Transmit data –
3	RxD+	Input	Receive data +
4	NC	–	No connection
5	NC	–	No connection
6	RxD–	Input	Receive data –
7	NC	–	No connection
8	NC	–	No connection

Fast Ethernet

Table 1-14 lists the signals for the Fast Ethernet port connector.

Table 1-14 Fast Ethernet Port Connector Signals

Pin	Signal	Direction	Description
1	TxD+	Output	Transmit data +
2	TxD–	Output	Transmit data –
3	RxD+	Input	Receive data +
4	NC	–	No connection
5	NC	–	No connection
6	RxD–	Input	Receive data –
7	NC	–	No connection
8	NC	–	No connection

Node Line Cards

The Cisco 6400 supports three half-height and one full-height node line card (NLC) modules:

- OC-3/STM-1 SM half-height NLC (Figure 1-9) has two 155-Mbps fiber-optic ports for single-mode intermediate reach connection of uplink and downlink interfaces.
- OC-3/STM-1 MM half-height NLC (Figure 1-10) has two 155-Mbps fiber-optic ports for multimode connection on the front of each NLC.
- DS3 half-height NLC (Figure 1-11) has two 45-Mbps bidirectional ports for connection to network services using coaxial cable.
- OC-12/STM-4 full-height NLC (Figure 1-12) has one 622-Mbps fiber-optic port for the connection of uplink and downlink interfaces; single mode, intermediate reach.

The Cisco 6400 can contain multiple NLC modules, configured to operate independently or as redundant pairs. NLCs can be inserted into slots 1 through 8 (subslots 0 and 1) in the Cisco 6400 chassis.

The three types of NLC can be configured to support the following clocking options:

- Self-timing based on a Stratum 4 level clock
- Loop timing from the received data stream, which is ideal for public network connections
- Timing synchronized to the NSP network clock port; required for distribution of a single clock across a network

Figure 1-9 OC-3/STM-1 SM NLC Faceplate

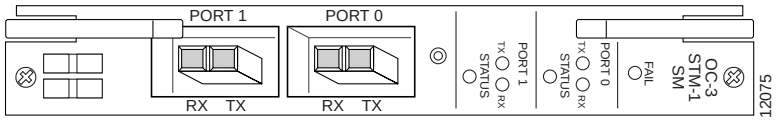
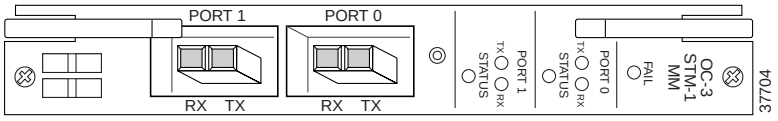


Figure 1-10 OC-3/STM-1 MM NLC Faceplate



Warning **Class 1 laser product. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

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. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning **Invisible laser radiation present. To see translations of this warning, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Warning Statement for Sweden

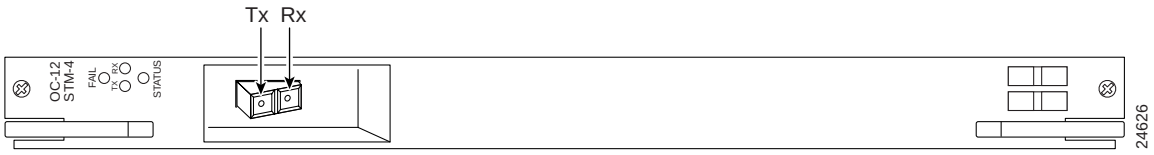
Varning! **Osynlig laserstrålning när denna del är öppen och förregleringen är urkopplad. Rikta inte blicken in mot strålen.**

Warning Statement for Finland

Varoitus **Alleviates ja suojalukitus ohitettaessa olet alttiina näkymättömälle lasersäteilylle. Äjä katso säteeseen.**

Figure 1-11 DS3 NLC Faceplate

Figure 1-12 OC-12/STM-4 NLC Faceplate



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Node Line Card LEDs

The LEDs on the three types of NLC provide status and operational information about port connections (Table 1-15 and Table 1-16).

Table 1-15 OC-3 and DS3 NLC LED Indicators

LED	Status	Condition
FAIL	Steady yellow Off	NLC has failed NLC is operational
PORT 0 (top connector)		
TX (transmit)	Green Off Steady yellow Flashing yellow	Transmit activity No traffic Far-end alarm Local loopback
RX (receive)	Green Off Steady yellow	Receive activity No traffic Loss of Signal
STATUS	Green Blinking green Off	Active (primary) Standby mode (secondary) No power
PORT 1 (bottom connector)		
TX (transmit)	Green Off Steady yellow Flashing yellow	Transmit activity No traffic Far-end alarm Local loopback
RX (receive)	Green Off Steady yellow	Receive activity No traffic Loss of Signal
STATUS	Steady green Blinking green Off	Active Standby mode No power

Table 1-16 OC-12 NLC LED Indicators

LED	Status	Condition
FAIL	Steady yellow Off	OC-12/STM-4 NLC has failed OC-12/STM-4 NLC is operational
TX (transmit)	Green Off Steady yellow Flashing yellow	Transmit activity No traffic Far-end alarm Local loopback
RX (receive)	Green Off Steady yellow	Receive activity No traffic Loss of signal
STATUS	Green Blinking green Off	Active (primary) Standby mode (secondary) No power

Connectors

The OC-3/STM-1 SM NLC has two 155-Mbps Synchronous Optical Network (SONET) Synchronous Transport Signal level 3, concatenated/Synchronous Digital Hierarchy (STS-3c/SDH) ports used as uplink and downlink interfaces; single mode, intermediate reach.

The OC-3/STM-1 MM NLC has two 155-Mbps Synchronous Optical Network (SONET) Synchronous Transport Signal level 3, concatenated/Synchronous Digital Hierarchy (STS-3c/SDH) ports for multimode fiber connections used as uplink and downlink interfaces.

The DS3 has two 45-Mbps bidirectional ports. The line media is 75 ohms coaxial cable, one for Tx and one for Rx. The BNC connectors are physically located on the backplane. The maximum cable length is 450 feet (137.16 meters).

The OC-12/STM-4 has one 622-Mbps Synchronous Optical Network (SONET) Synchronous Transport Signal level 12, concatenated/Synchronous Digital Hierarchy (STS-12c/SDH) ports used as uplink and downlink interfaces; single mode, intermediate reach.