CHAPTER 2

Preparing for Installation

This chapter describes how to prepare your site before you install modules in the Cisco 7600 series Internet Router and contains these sections:

This chapter does not contain the instructions to install the Cisco 7600 series Internet Router chassis. Refer to the following documents for installation procedures:

- *Cisco 7603 and 7606 Internet Router Installation Guide*
- *Cisco 7609 Internet Router Installation Guide*

Limiting Connection Distances

The length of your networks and the distances between connections depend on the type of signal, the signal speed, and the transmission media (the type of cabling used to transmit the signals). For example, fiber-optic cable has a greater channel capacity than twisted-pair cabling. The distance and rate limits in this chapter are the IEEE-recommended maximum speeds and distances for signaling. You can get good results with rates and distances greater than those described here, although you do so at your own risk. You need to be aware of the electrical problems that may arise and can compensate for them.

Determining Cable Distances

When preparing your site for network connections to the modules, you need to consider two factors for each type of interface:

- Type of cabling required for each interface
- Distance limitations for each interface

Note See Appendix B, "Cable Specifications," for connector pinouts for the modules.

This section contains these topics:

Ethernet and Fast Ethernet

Table 2-1 lists the IEEE maximum transmission distances for Ethernet and Fast Ethernet.

Table 2-1 Ethernet and Fast Ethernet Maximum Transmission Distances

Transceiver Speed	Cable Type	Duplex Mode	Maximum Distance Between Stations
10 Mbps	Category 3 UTP	Full and half	328 ft (100 m)
10 Mbps	Multimode fiber	Full and half	1.2 mi (2 km)
100 Mbps	Category 5 UTP	Full and half	328 ft (100 m)
100 Mbps	Single-mode fiber	Full	6.2 mi (10 km)
100 Mbps	Multimode fiber Single-mode fiber	Half	1312 ft (400 m)

OC-3, OC-12, and OC-48 POS

The specification for optical fiber transmission defines two types of fiber: single-mode and multimode. Within the single-mode category, three transmission types are defined: short reach, intermediate reach, and long reach. Within the multimode category, only short reach is available.

Table 2-2 lists the specifications for OC-3 Optical Services Module (OSM) interfaces; Table 2-3 lists the specifications for OC-12 OSM interfaces; and Table 2-4 lists specifications for OC-48 OSM interfaces.

Table 2-2 OC-3 Fiber Interface Specifications

Fiber Interface	Power Budget	Output Power		Input Power		Wavelength	Cable Distance[1]
		Min	Max	Min	Max		
Single-Mode Long Reach	29.0 dB	–5.0 dBm	0 dBm	–34.0 dBm	–8.0 dBm	1310 nm	40 km
Single-Mode Intermediate Reach	16.0 dB	–15.0 dBm	–8.0 dBm	–31.0 dBm	–8.0 dBm	1310 nm	15 km
Multimode Short Reach	11.0 dB	–19.0 dBm	–14.0 dBm	–30.0 dBm	–14.0 dBm	1310 nm	2 km

1. Cable distances noted are typical maximum lengths.

Table 2-3 OC-12 Fiber Interface Specifications

Fiber Interface	Power Budget	Output Power		Input Power		Wavelength	Cable Distance[1]
		Min	Max	Min	Max		
Single-Mode Long Reach	29.0 dB	–5.0 dBm	0 dBm	–34.0 dBm	–8.0 dBm	1310 nm	40 km
Single-Mode Intermediate Reach	13.0 dB	–15.0 dBm	–8.0 dBm	–28.0 dBm	–8.0 dBm	1310 nm	15 km
Multimode Short Reach	7.0 dB	–19.0 dBm	–14.0 dBm	–26.0 dBm	–14.0 dBm	1310 nm	500 m

1. Cable distances noted are typical maximum lengths.

Table 2-4 OC-48 Fiber Interface Specifications

Fiber Interface	Power Budget	Output Power		Input Power		Wavelength	Cable Distance[1]
		Min	Max	Min	Max		
Single-Mode Long Reach	26.0 dB	–2.0 dBm	+3.0 dBm	–28.0 dBm	-9.0 dBm	1550 nm	80 km
Single-Mode Intermediate Reach	13.0 dB	–5.0 dBm	0 dBm	–18.0 dBm	0 dBm	1310 nm	15 km
Single-Mode Short Reach	8.0 dB	–10.0 dBm	–3.0 dBm	–18.0 dBm	–3.0 dBm	1310 nm	2 km

1. Cable distances noted are typical maximum lengths.

ATM OC-12

The maximum distances for ATM fiber-optic network connections are determined by the transmitter output power, receiver sensitivity, and type of optical source. Table 2-5 lists the maximum transmission distances for multimode fiber (MMF) and single-mode fiber (SMF) cables.

Table 2-5 ATM OC-12 Optical Specifications for MMF and SMF Cables

Characteristic	Specification	
	MMF Cable	SMF Cable
Optical source	LED	Laser
Wavelength	1300 nm	1300 nm
Transmitter output power	–19 to –14 dBm	–15 to –8 dBm
Receiver sensitivity	–26 to –14 dBm	–28 to –8 dBm
Maximum cabling distance	1640 ft (500 m)	9.3 miles (15 km)

Gigabit Ethernet

Table 2-6 provides cabling specifications for the 1000BASE-X interfaces, including the OSMs, Gigabit Ethernet switching modules, and the Gigabit Ethernet uplink ports on the supervisor engines. All Gigabit Interface Converter (GBIC) interfaces have SC connectors, and the minimum cable distance for all GBICs listed (MMF and SMF) is 6.5 feet (2 meters).

Table 2-6 Gigabit Ethernet Maximum Transmission Distances

GBIC	Wavelength (nm)	Fiber Type (MHz km)	Core Size[1] (micron)	Modal Bandwidth (MHz km)	Cable Distance[2]
SX[3]	850	MMF	62 62 50 50	160 200 400 500	722 ft (220 m) 902 ft (275 m) 1640 ft (500 m) 1804 ft (550 m)
LX/LH	1300	MMF[4] SMF (LX/LH)	62 50 50 9/10	500 400 500 –	1804 ft (550 m) 1804 ft (550 m) 1804 ft (550 m) 6.2 mi (10 km)
ZX[5]	1550	SMF SMF[6]	9/10 8	– –	43.5 mi (70 km)[7] 62.1 mi (100 km)

1. The number given refers to the core diameter. The cladding diameter is usually 25 microns.
2. Distances are based on fiber loss.
3. MMF only.
4. Patch cord required.
5. You can have a maximum of 24 1000BASE-ZX GBICs per system to comply with FCC Class A.
6. Dispersion-shifted single-mode fiber-optic cable.
7. The minimum link distance for ZX GBICs is 6.2 miles (10 km) with an 8-dB attenuator installed at each end of the link. Without attenuators, the minimum link distance is 24.9 miles (40 km).

Patch Cord

When using the long wavelength/long haul (LX/LH) GBIC with 62.5-micron diameter MMF, you must install a mode-conditioning patch cord (Cisco product no. CAB-GELX-625 or equivalent) between the GBIC and the MMF cable on both the transmit and receive ends of the link. The patch cord is required for link distances greater than 984 feet (300 meters).

Note We do not recommend using the LX/LH GBIC and MMF without a patch cord for very short link distances (10 to 100 meters). The result could be an elevated bit error rate (BER).

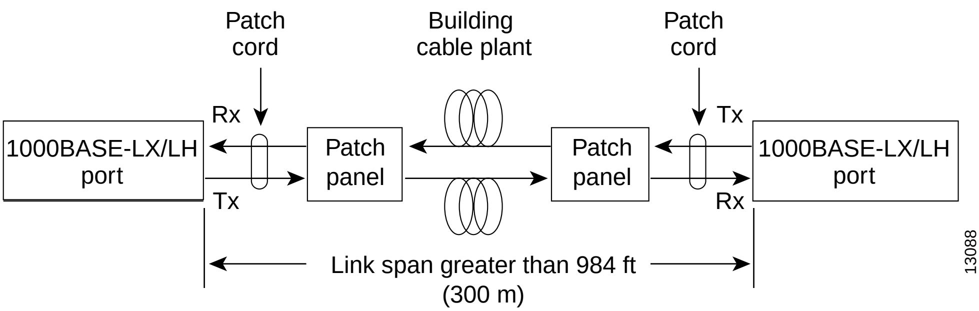
Note The patch cord is required to comply with IEEE standards. IEEE found that link distances could not be met with certain types of fiber-optic cable due to a problem in the center of some fiber-optic cable cores. The solution is to launch light from the laser at a precise offset from the center by using the patch cord. At the output of the patch cord, the LX/LH GBIC complies with the IEEE 802.3z standard for 1000BASE-LX. For a detailed description of this problem, see the "Differential Mode Delay" section on page 2-9.

Note Cisco Gigabit Ethernet products have been tested and evaluated to comply with the standards listed in Appendix A, "Technical Specifications." Equivalent cables should also meet these standards.

Patch Cord Configuration Example

Figure 2-1 shows a typical patch cord configuration.

Figure 2-1 Patch Cord Configuration

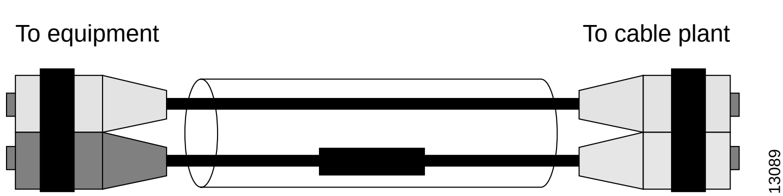


Patch Cord Installation

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

Plug the end of the patch cord labeled “To Equipment” into the GBIC. (See Figure 2-2.) Plug the end labeled “To Cable Plant” into the patch panel. The patch cord is 9.84 feet (3 meters) long and has duplex SC male connectors at each end.

Figure 2-2 Patch Cord Installation



Differential Mode Delay

When an unconditioned laser source designed for operation on a single-mode fiber (SMF) cable is directly coupled to a multimode fiber (MMF) cable, differential mode delay (DMD) might occur. DMD can degrade the modal bandwidth of the fiber-optic cable. This degradation causes a decrease in the link span (the distance between the transmitter and the receiver) that can be reliably supported.

The Gigabit Ethernet specification (IEEE 802.3z) outlines parameters for Ethernet communications at a gigabit-per-second rate. The specification offers a higher-speed version of Ethernet for backbone and server connectivity using existing deployed MMF cable by defining the use of laser-based optical components to propagate data over MMF cable.

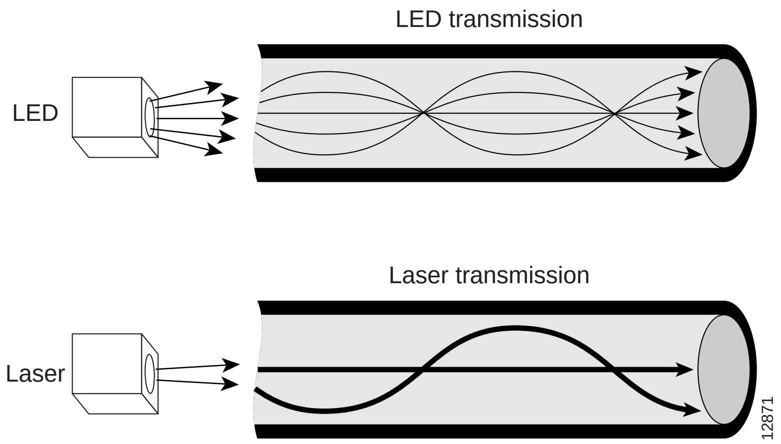
Lasers function at the baud rates and longer distances required for Gigabit Ethernet. The 802.3z Gigabit Ethernet Task Force has identified the DMD condition that occurs with particular combinations of lasers and MMF cable. The results create an additional element of jitter that can limit the reach of Gigabit Ethernet over MMF cable.

With DMD, a single laser light pulse excites a few modes equally within an MMF cable. These modes, or light pathways, then follow two or more different paths. These paths might have different lengths and transmission delays as the light travels through the cable. With DMD, a distinct pulse propagating down the cable no longer remains a distinct pulse or, in extreme cases, might become two independent pulses. Strings of pulses can interfere with each other making it difficult to recover data.

DMD does not occur in all deployed fibers; it occurs with certain combinations of worst-case fibers and worst-case transceivers. Gigabit Ethernet experiences this problem because of its very high baud rate and its long MMF cable lengths. SMF cable and copper cable are not affected by DMD.

MMF cable has been tested for use only with LED sources. LEDs can create an *overfilled launch condition* within the fiber-optic cable. The overfilled launch condition describes the way LED transmitters couple light into the fiber-optic cable in a broad spread of modes. Similar to a light bulb radiating light into a dark room, the generated light that shines in multiple directions can overfill the existing cable space and excite a large number of modes. (See Figure 2-3.)

Figure 2-3 LED Transmission Compared to Laser Transmission



Lasers launch light in a more concentrated fashion. A laser transmitter couples light into only a fraction of the existing modes or optical pathways present in the fiber-optic cable. (See Figure 2-3.)

The solution is to condition the laser light launched from the source (transmitter) so it spreads the light evenly across the diameter of the fiber-optic cable making the launch look more like an LED source to the cable. The objective is to scramble the modes of light to distribute the power more equally in all modes and prevent the light from being concentrated in just a few modes.

An unconditioned launch, in the worst case, might concentrate all of its light in the center of the fiber-optic cable, exciting only two or more modes equally.

A significant variation in the amount of DMD is produced from one MMF cable to the next. No reasonable test can be performed to survey an installed cable plant to assess the effect of DMD. Therefore, you must use the mode-conditioning patch cords for all uplink modules using MMF when the link span exceeds 984 feet (300 meters). For link spans less than 300 meters, you can omit the patch cord (although there is no problem using it on short links).

Note For link spans less than 984 feet (300 meters), you can omit the patch cord. (We do not recommend using the LX/LH GBIC and MMF without a patch cord for very short link distances less than 100 meters. The result could be an elevated bit error rate [BER].)

Supervisor Engine Console Port Cabling Specifications

This section describes the port cabling specifications for the supervisor engine.

Note The accessory kit that shipped with your Cisco 7600 series Internet Router contains the necessary cable and adapters to connect a terminal or modem to the front-panel console port of the supervisor engine. These cables and adapters are the same as those shipped with the Cisco 2500 series routers and other Cisco products.

The supervisor engine front-panel console port mode switch allows you to connect a terminal or modem to the console port using the cable and adapters provided, or you can connect your terminal using a Catalyst 5000 family Supervisor Engine III cable (not provided).

Table 2-7 lists the maximum transmission distances for console port cables.

See Appendix B, "Cable Specifications" for console port and cable pinout information.

Table 2-7 EIA/TIA-232 Transmission Speed Versus Distance

Rate (bps)	Distance (feet)	Distance (meters)
2400	200	60
4800	100	30
9600	50	15
19,200	25	7.6
38,400	12	3.7
56,000	8.6	2.6

Port Connector Requirements

Table 2-8 describes the connector types that you need to cable to the specified ports.

Table 2-8 Port Connector Requirements

Modules	Connectors
1-port OC-48 POS OSM 2-port and 4-port OC-12 POS OSM 2-port OC-12 ATM Gigabit Ethernet WAN Services Module Gigabit Ethernet switching modules with GBICs	SC connectors. (See Figure 2-4.)[1, 2]
1-port and 2-port channelized OC-48 OSM 4-port and 8-port channelized OC-12 OSM	LC fiber-optic connectors. (See Figure 2-5.)
8-port and 16-port OC-3 POS OSM	MT-RJ fiber-optic connectors. (See Figure 2-6.)
48-port 10/100TX RJ-45 modules	RJ-45 male connectors. (See Figure 2-7.)

1. When you plug the SC connector into the GBIC, make sure that both the Tx and Rx fiber-optic cables are fully inserted into the SC connector.
2. If you are using the LX/LH GBIC with MMF, you need to install a patch cord between the GBIC and the MMF cable. See the “Patch Cord” section on page 2-7 for details.

Figure 2-4 SC Fiber-Optic Connector

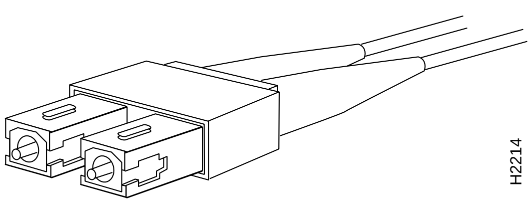


Figure 2-5 LC Fiber-Optic Connector

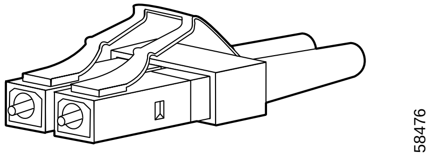


Figure 2-6 MT-RJ Interface Cable Connector

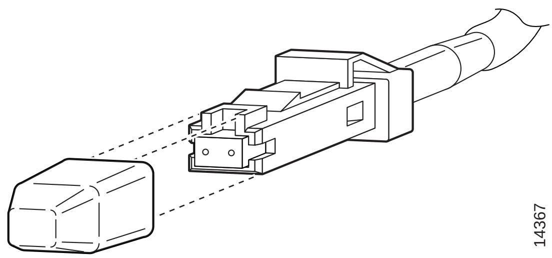
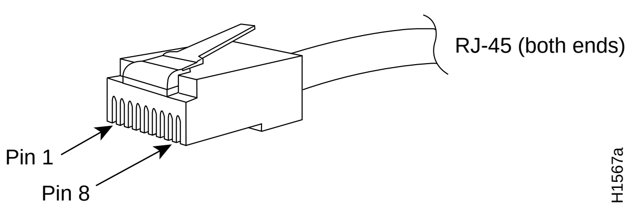


Figure 2-7 RJ-45 Interface Cable Connector



Port Densities

Table 2-9 lists the bandwidth and port densities of the Cisco 7600 series Internet Routers.

Table 2-9 Cisco 7600 Series Internet Router Bandwidth and Port Density

Architecture	Cisco 7603 Internet Router	Cisco 7606 Internet Router	Cisco 7609 Internet Router
Backplane bandwidth	32 Gbps	32 to 256 Gbps	32 to 256 Gbps
Number of Gigabit Ethernet ports	34	82	130
Number of OC-48c POS ports	2	5	8
Number of OC-12c POS ports	8	20	32
Number of OC-3c POS ports	32	80	128
Number of OC-12 ATM ports	4	10	16
Number of channelized OC-12 ports	16	40	64
Number of channelized OC-48 ports	4	10	16
Number of 10/100 Ethernet ports	96	240	384
Number of FlexWAN modules	2	5	8

Software Requirements

For information on the minimum, recommended, and default software versions for the Cisco 7600 series Internet Router, supervisor engines, OSMs, and Catalyst 6000 family modules, refer to the applicable release notes:

- Cisco 7600 Series Internet Router release notes

  http://www.cisco.com/univercd/cc/td/doc/product/core/cis7600/relnotes/index.htm

- Catalyst 6000 Family release notes

  http://www.cisco.com/univercd/cc/td/doc/product/lan/cat6000/relnotes/index.htm