CISCO SYSTEMS

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Catalyst 5000 Series Mode-Conditioning Patch Cord Installation Note

Product Number: CAB-GELX-625

This document describes the Catalyst 5000 series mode-conditioning patch cord. When using longwave/long-haul (LX/LH) Gigabit Interface Carriers (GBICs) with 62.5-micron diameter multimode fiber (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 transmit and receive ends of the link. The patch cord is required for link distances greater than 984 feet (300 meters).

Note Using the LX/LH GBIC with MMF and no patch cord for very short link distances (tens of meters) is not recommended. The result could be an elevated bit error rate (BER).

Note The patch cord is required to comply with IEEE standards. The 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, which is accomplished by using the patch cord. At the output of the patch cord, the LX/LH GBIC is compliant with the IEEE 802.3z standard for 1000Base-LX. For a detailed description of this problem, refer to the "Differential Mode Delay" section on page 2.

Note Cisco Gigabit Ethernet products have been tested and evaluated to comply with the standards listed in the "Standards Compliance Specifications" section on page 4. Equivalent cables should also meet these standards.

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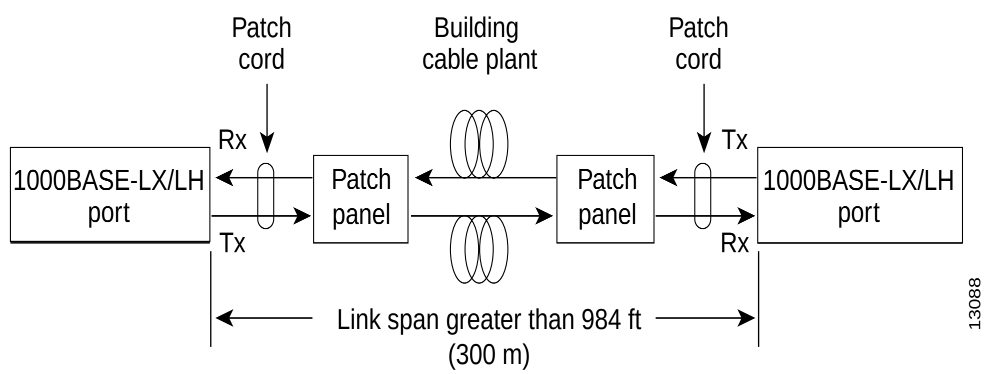
Patch Cord Configuration Example

Figure 1 shows a typical configuration using the patch cord.

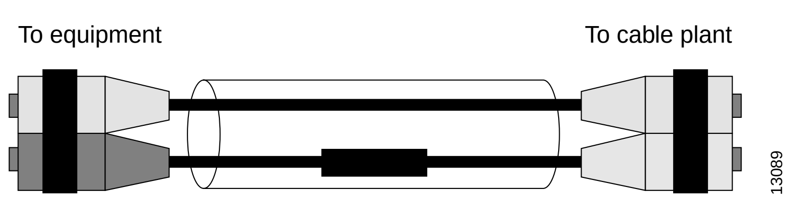
Figure 1 Patch Cord Configuration



Patch Cord Installation

Plug the end of the patch cord labeled “To Equipment” into the GBIC (see Figure 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 Patch Cord Installation



Differential Mode Delay

When an unconditioned laser source (LX/LH GBIC) designed for operation on single-mode fiber (SMF) cable is directly coupled to an MMF cable, an effect known as Differential Mode Delay (DMD) might occur. DMD can degrade the modal bandwidth of the fiber-optic cable, which 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. Its initial intent is to offer a higher-speed version of Ethernet for backbone and server connectivity using existing deployed MMF cable. To accomplish this, the specification defines the use of laser-based optical components to propagate data over MMF cable.

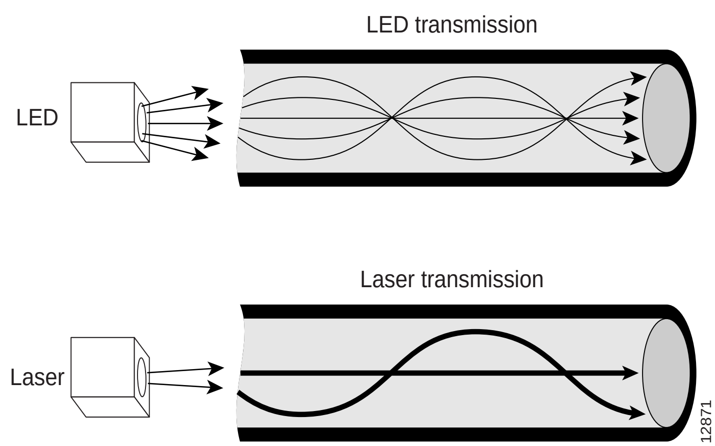
Lasers are specified because they function at the baud rates and longer distances required for Gigabit Ethernet. The IEEE 802.3z Gigabit Ethernet Task Force has identified the DMD condition that occurs in certain circumstances with particular combinations of lasers and MMF cable. The resulting characteristics create an additional element of “jitter” which limits 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 may 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, may become two independent pulses. Strings of pulses tend to interfere with each other making it difficult to recover data in a reliable fashion.

DMD is not experienced in all deployed fibers. It occurs with certain combinations of worst-case fibers and worst-case transceivers. Gigabit Ethernet is the first technology to experience this problem due to its very high baud rate and its long MMF cable lengths. SMF cable and copper cable are not affected by DMD.

Historically, MMF cable has only been tested for use with light-emitting diode (LED) sources. LEDs create a condition within a fiber-optic cable referred to as an *overfilled launch condition*. 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 shines in multiple directions. This light “overfills” the existing cable space and “excites” a large number of modes (see Figure 3).

Figure 3 LED Transmission Compared to Laser Transmission



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

The solution to DMD 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 in a way that distributes the power equally in all modes. This prevents the light from being concentrated in just a few modes. This is in contrast to an unconditioned launch, which, in the worst case, might concentrate all of its light in the center of the fiber-optic cable, thereby exciting only two or more modes equally.

There is a significant variation in the amount of DMD produced from one MMF cable to the next. There is no reasonable test that 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 LX/LH GBICs 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).

Standards Compliance Specifications

Table 1 lists standards compliance specifications for Cisco Gigabit Ethernet products.

Table 1 Standards Compliance Specifications

Agency Approvals	
Safety	UL[2] 1950, CSA[3]-C22.2 No. 950, EN[4]60950, and IEC[5] 950, TS[6] 001, AS/NZS[7] 3260 CE[8] Marking
EMI[1]	FCC[9] Part 15, Class A (CFR[10] 47) (USA), ICES[11]-003 Class A (Canada), EN55022 Class A (Europe), CISPR22 Class A (International), AS/NZS 3548 Class A (Australia), and VCCI Class A (Japan) with UTP[12]
	EN55022 Class B (Europe), CISPR22 Class B (International), AS/NZS 3548 Class B, and VCCI[13] Class B (Japan) with STP[14] cables

1 EMI = electromagnetic interference
2 UL = Underwriters Laboratory
3 CSA = Canadian Standards Association
4 EN = European Norm
5 IEC = International Electrotechnical Commission
6 TS = Technical Specification
7 AS/NZS = Standards Australia/Standards New Zealand
8 CE = European Compliance
9 FCC = Federal Communications Commission
10 CFR = Code of Federal Regulations
11 ICES = International Commerce Exchange Systems
12 UTP = unshielded twisted-pair
13 VCCI = Voluntary Control Council for Information Technology Equipment
14 STP = shielded twisted-pair

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Note If you are a network administrator and need personal technical assistance with a Cisco product that is under warranty or covered by a maintenance contract, contact Cisco's Technical Assistance Center (TAC) at 800 553-2447, 408 526-7209, or tac@cisco.com. To obtain general information about Cisco Systems, Cisco products, or upgrades, contact 800 553-6387, 408 526-7208, or cs-rep@cisco.com.

This document is to be used in conjunction with the *Catalyst 5000 Series Gigabit EtherChannel Switching Module Installation and Configuration Note* publication.

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