

# **LinkBuilder® FDDI Workgroup Hub User Guide**

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**A member of the LinkBuilder FDDI family**

**For 3Com User Group Information  
1-800-NET-3Com  
or your local 3Com office**

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3Com Corporation  
5400 Bayfront Plaza  
Santa Clara  
California, USA  
95052-8145

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Manual written by John Jeter. Edited by Nancy Kurahashi. Technical illustrations and production by Tim Buckreus.

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(408) 764-5000  
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- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from the one which the receiver is connected to.
- Consult the dealer or an experienced radio/TV technician for help.

The user may find the following booklet prepared by the Federal Communications Commission helpful:  
*The Interference Handbook*

This booklet is available from the U.S. Government Printing Office, Washington, D.C. 20402. Stock No. 004-000-00345-4.



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- Thin Ethernet (50 ohm) for BNC connections: 3C530-xxx or equivalent
- Thick Ethernet (50 ohm) for AUI connections: 3C120-xxx or equivalent
- For UTP and STP connections:
  - Unshielded twisted-pair (100 ohm):
    - Level 3 LAN and high speed data cable. Example, Anixter® CM-00424BAG-3 or equivalent.
    - Level 4 extended distance LAN cable. Example, Anixter® CM-00424BAG-4 or equivalent.
  - Shielded twisted-pair (100 ohm):
    - Level 5 data grade media cable. Example, AT&T® type 2061, 1061, or equivalent.
  - Shielded twisted-pair (150 ohm):
    - Suggested cable type IBM® type 1, specification no. 4716748, type CL2, CM or MP, or equivalent.



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Der Deutschen Bundespost wurde das Inverkehrbringen dieses Gerätes angezeigt und die Berechtigung zur Überprüfung der Serie auf Einhaltung der Bestimmungen eingeräumt.

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We hereby certify that the 3C781, 3C782, 3C783 comply with the RFI Suppression Requirements of Vfg 1046/1984. The German Postal Service was notified that the equipment is being marketed. The German Postal Service has the right to re-test the equipment and to verify that it complies.

3Com Corporation  
5400 Bayfront Plaza  
Santa Clara, California, U.S.A.  
95052-8145

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## 3Com's FDDI Training and Reference Manual

Understanding FDDI (3CS-360) is a pragmatic independent study course and reference manual written for professionals involved in the design, implementation, or support of multivendor FDDI networks.

Chapters 1 through 5 contain core information about FDDI. These chapters explore critical elements of an FDDI environment, including attachment stations, MAC interfaces, concentrators, and optical bypass switches. Port keying and configuration, internetworking, ring startup, operation, fault isolation and ring recovery, light properties, fiber media, and optics are also covered.

Chapters 6 through 12 constitute a 250-page technical reference that takes you down to the engineering level. Here 3Com interprets the FDDI standards to provide tangible and accessible information on all four FDDI protocol layers and the SMT Management Information Base.

This text-based course comes with a testing diskette to guide and reinforce the learning process. Students who pass the test receive a certificate of completion.

For ordering information and details about other courses in 3Com's data networking technology series, turn the page.



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Introduction to Bridging and Routing (3CS-011)

Network Architectures, Standards and Protocols (3CS-330)

Introduction to SNMP (3CS-350)

Understanding TCP/IP (3CS-340A)

WAN Technologies for Internetworking (3CS-370)

Order through your authorized 3Com reseller or local 3Com office. Availability in self-study format may vary outside the U.S. To order directly from 3Com Education Services, call 1-800-876-3266, press option 7, then option 3. Callers outside the U.S. should call 408-492-1790 or contact the 3Com office in their area for local pricing and delivery.

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To ensure the very best 3Com service and support, take advantage of our One-Year Warranty on 3Com's LinkBuilder<sup>®</sup> FDDI Workgroup Hub.

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# Quick Start

Use this Quick Start procedure if:

- You are experienced in installing and operating LinkBuilder FDDI hubs.
- You have an FDDI segment running with other network devices attached to it.

## Road Map to Hub Operations

The steps listed below summarize the procedures needed to make the 3Com® LinkBuilder® FDDI Workgroup Hub operational. The list also shows where each step is discussed in this user guide.

1. Unpacking the hub and modules
  - Quick Start
  - Chapter 2: “Unpacking the Hub”; “Installing Modules”
2. Installing the modules
  - Quick Start
  - Chapter 2: “Installing Modules”
3. Connecting a terminal
  - Chapter 2: “Accessing the Hub”
4. Determining legal port connections
  - Chapter 2: “Planning Connections”
  - Chapter 3: “Attachment Options”; “Port Connections”
5. Attaching the hub to the ring
  - Chapter 2: “Connecting to the Dual Ring”
6. Attaching other devices to the hub
  - Chapter 2: “Data Flow Specifications”

7. Configuring attachment ports
  - Chapter 3: “Configuring Modules”
8. Setting up the hub for network operations
  - Chapter 4: “Setting Addresses”;
  - “Using Station Management Parameters”;
  - “Downloading New Images”
9. Monitoring hub operations
  - Chapter 5: “Getting Hub Information”;
  - “Interpreting the LEDs”;
  - “Using Miscellaneous Commands”

## Unpacking the Hub

The FDDI Workgroup Hub is shipped separately from the management module and media port modules. To unpack the hub, follow these steps:

1. **Open the shipping container and carefully remove its contents.**
2. **Return all packing materials to the shipping container and save it.**

If the hub must be returned, ship it in its original shipping container (or equivalent), or the warranty will be voided.

3. **Verify that you have received all items on the packing list, and inspect each item for damage.**

The basic package includes the following items:

- LinkBuilder FDDI Workgroup Hub (base unit)
- *LinkBuilder FDDI Workgroup Hub User Guide*
- *LinkBuilder FDDI System Software* diskette, version 1.0
- Standard ac power cord
- Two brackets and eight screws for rack mounting
- Four rubber pads for tabletop placement

The *LinkBuilder FDDI System Software* diskette, version 1.0, contains a readme file and a backup image for the flash EPROM.

A 3-volt lithium battery is shipped with the management module. The battery is in a small bag inside the management module shipping container.

If you ordered an STP media port module, one cascade connector will be shipped with the module.

For complete instructions on installing the hub, the modules, and the battery, see Chapter 2, "Installing the Hub."

**4. Place the hub either in an EIA 19-inch rack or on a table or desk.**

- For rack mounting, attach the two brackets to the front sides of the hub. Then attach the brackets to the front mounting rails of the rack. Use the eight screws that are supplied with the hub. (See Figures 2-1 and 2-2.)
- For tabletop placement, fasten the rubber pads that come with the hub on the four bottom corners of the base unit.

## Unpacking the Modules

The management modules and media port modules are packaged and shipped separately. Two modules (the management module and at least one media port module) plus the hub constitute the minimum functional setup. To unpack the modules, follow the steps below:



**CAUTION:** *Each module is packed in an antistatic bag to protect it during shipment. To avoid damaging any highly static-sensitive components on the module or the hub, be sure to reduce any static electricity on your person. One way to do this is to touch the metal part of the hub. You can maintain grounding by wearing a wrist strap attached to the hub.*

- 1. Carefully remove each module from its shipping container and set it aside.**

**2. Keep all packing and shipping materials.**

If a module must be returned, ship it in its original shipping container (or one providing equivalent protection), or the warranty will be voided.

**3. One at a time, remove each module from its antistatic bag.**

**4. Check the modules for any visible signs of damage.**

If you detect damage, immediately notify your network supplier and the carrier that delivered the module.

**5. Place the modules back in their antistatic bags until you are ready to install them.**

## Installing the Modules



**NOTE:** You must install the management module first. It can only be installed in slot 0. It will not function in any other slot. Install the remaining modules in adjacent slots (in numerically ascending order) so there are no empty slots between modules.

When you install the management module for the first time, be sure that power to the hub is off. There is no power switch on the hub. Power to the hub is provided by connecting the power cord to the hub and to an ac outlet.



**NOTE:** The hub allows “power-on insertion,” which means that you do not have to unplug the power cord for module insertion or removal. After removing or inserting a module, press the **RESET** button, which is recessed on the management module, or enter the reset command on the command line. This reinitializes the ring and causes the system to run its power-on self-tests (POST).

To install the modules, follow these steps:

- 1. Remove all jewelry from your hands and wrists.**
- 2. If necessary, remove blanking plates from the module slots.**  
  
Keep the removed blanking plates in a safe place for possible future use.
- 3. Remove the module from its antistatic bag.**  
  
Prepare a clean, level work area nearby on which to place the module.  
Avoid contact with any of the module's components.
- 4. Insert the module slowly into its slot.**
- 5. Gently align and push the module's bus connector into its slot in the backplane of the hub.**
- 6. When the module is completely seated, tighten the captive thumb screws on each end of the module.**
- 7. To turn on the hub, plug one end of the ac power cord into the back of the hub and the other end into an electrical socket.**

The green PWR LED lights, indicating the hub is on and ready for configuration.

After installing the management module and one or more media modules, one or two empty slots may remain in the base unit. Insert a blanking plate into each of these empty slots. This keeps objects from falling into the hub and prevents RF emissions from an open slot.

## Connecting to the Ring

After installing the modules and plugging in the power cord, you are ready to connect the hub to the ring by attaching the appropriate cables to the attachment ports, which are the two leftmost ports on the module installed in slot 1. To complete the connection to the ring, you must configure the attachment ports. For detailed information on connecting the hub to the ring, see the references in the “Road Map to Hub Operations” section earlier in this chapter.

# Chapter 1

## Overview

The 3Com® LinkBuilder® FDDI Workgroup Hub brings Fiber Distributed Data Interface (FDDI) high-speed LAN technology to the desktop. (Throughout this guide, the LinkBuilder FDDI Workgroup Hub will be referred to as “the hub.”)

The hub supports remote management via Station Management (SMT) 7.3 or Telnet protocol. Local management is provided via a console interface or a modem attached to the management module’s serial port. The SMT 7.3 standard specifies the format of management information so that it is consistent with the object-oriented approach defined by OSI management standards. The standard SMT Management Information Base (MIB) variables are present in the LinkBuilder FDDI Workgroup Hub software.

A modular stand-alone device, the hub provides four module slots and a passive backplane. When installed and equipped with the appropriate modules, the hub can be connected to the FDDI backbone ring, to other FDDI hubs, and to other stations. The RS-232-based console interface provides the capability to configure and monitor the media port modules installed in the chassis.

The hub chassis contains an integrated internal power supply and a fan. It requires a single management module and supports one to three media modules for ring and station attachment.

The hub is an intelligent device with a unique FDDI MAC (Media Access Control) address implemented with National Semiconductor® Corporation’s BMAC (FDDI Media Access Controller) technologies. In addition, National’s BSI (FDDI System Interface) implements an interface between the BMAC device and the host system, providing a multiframe, MAC-level interface to one or more MAC users. The hub’s single MAC supports dual, single, or null attachment and dual homing.

The management module is based on the Motorola® 68EC020 processor, which provides the following:

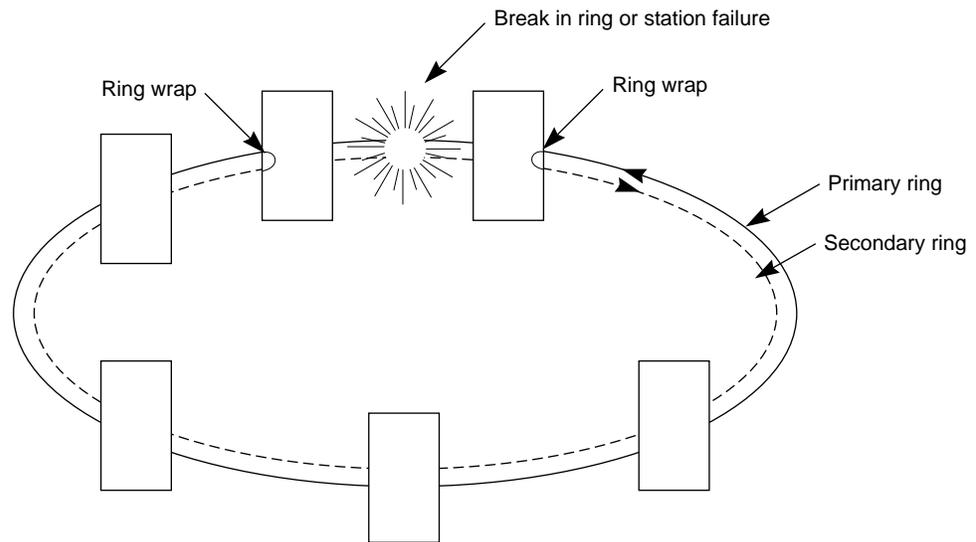
- 256 KB of nonvolatile RAM
- 1 MB of local RAM
- 512 KB of EPROM
- 1 MB of flash memory
- 128 KB of RAM for frame buffer and descriptors

This guide is intended for network installers and operators who are familiar with FDDI technology and experienced in installing hubs. The next section contains a brief summary of FDDI technology; it is intended as an overview only. (For detailed information about FDDI architecture and its functionality, 3Com recommends that you secure the FDDI self-paced study course, *Understanding FDDI*, 3CS-360, available through 3Com Education Services.)

## FDDI Technology

FDDI technology is an American National Standards Institute (ANSI) standard that supports data transfer rates of 100 million bits per second (100 Mbps). Advancements in fiber technology allow modulated beams of light to be carried in dual counter-rotating token rings made of glass fiber-optic cable. The FDDI standard now includes the definition of other types of cabling media, including shielded twisted pair (STP) and unshielded twisted pair (UTP). FDDI provides for up to 500 nodes operating over tens of kilometers. The maximum network length is 100 km.

FDDI's dual-ring architecture provides a high level of reliability and fault tolerance. Under normal operation one of the rings, called the primary ring or the trunk ring, carries data traffic. The other ring, called the secondary ring, is generally used for automatic recovery in the event of a break in the primary ring. If a fault occurs, as shown in Figure 1-1, the dual attached stations on either side of the fault detect and automatically bypass it. This ring reconfiguration is known as a ring wrap.



**Figure 1-1. Ring Wrap**

The FDDI standard developed by the American National Standards Institute (ANSI) defines four protocols:

- Physical Medium Dependent (PMD)
- Physical (PHY)
- Media Access Control (MAC)
- Station Management (SMT)

Each of these protocols is briefly defined below.

## **Physical Medium Dependent (PMD) Protocol**

The Physical Medium Dependent protocol provides all of the services necessary to exchange data across the cable medium. PMD also specifies an optional optical bypass facility that enhances reliability. This bypass capability is invoked when an FDDI station is powered off. (For information on the optical bypass switch, see Chapter 2, “Installing the Hub.”)

The PMD services included for each type of media supported by the LinkBuilder FDDI Workgroup Hub are listed below.

### **Fiber-Optic**

The PMD standard provides these services for fiber media:

- Optical power and cable requirements for 62.5/125  $\mu\text{m}$  fiber-optic cables
- Power requirements for optical bypass switches and fiber-optic transceivers
- FDDI cable connector (the Media Interface Connector [MIC]), mating requirements, and keying
- Light wavelength of 1300 nm (nanometers)

### **Shielded Twisted Pair (STP)**

The PMD standard uses the SDDI de facto standard and provides these services for STP:

- Transmit signal amplitude of 350–700 mV, peak-to-peak
- Cable fault detect
- DB-9 cable connector, specifying M as a male connector and A, B, and S as female connectors

### **Unshielded Twisted Pair (UTP)**

The ANSI TP-PMD standard provides these services for UTP:

- Cable requirements for category 5 UTP as defined by EIA/TIA-568
- Electrical requirements for UTP transceivers
- FDDI-UTP cable connector

### **Physical (PHY) Protocol**

The Physical protocol is responsible for encoding and decoding of data and control information on the FDDI network. It specifies the following:

- 4B/5B nonreturn to zero inverted (NRZI) encoding scheme (for fiber and STP modules)
- MLT-3 with stream cipher encoding scheme (for UTP modules)
- Clocking rules
- Clocking frequency of 125 MHz
- Serial-to-parallel conversion rules

### **Media Access Control (MAC) Protocol**

The Media Access Control protocol controls the flow of data on the FDDI ring. The MAC typically exists in every hub and station accessed by the FDDI ring, but stations without MACs are allowed. This protocol specifies the following:

- Token-passing protocol
- Capture and retransmission of token
- Packet formation and framing of data
- Address generation and recognition
- 32-bit cyclic redundancy check (CRC) verification and error detection
- Recovery mechanisms



**NOTE:** *In contrast to the PMD protocol, the PHY and MAC protocols are media-independent; that is, the same protocols function regardless of the medium being used (fiber, STP, or UTP).*

## Station Management (SMT) Protocol

The Station Management protocol is involved in network management and monitoring for all layers of the FDDI stack. Every node on an FDDI ring participates in the management of the ring. As such, all nodes exchange SMT information to control network operation. SMT specifies the following:

- Status of links between nodes
- Error detection and fault isolation algorithms
- Monitoring of all ring and station activities
- Ring maintenance
- Ring initialization, control, and performance

## Features and Functions

The LinkBuilder FDDI Workgroup Hub performs the following tasks in an FDDI network:

- Connects end stations, bridges, routers, and other FDDI devices as well as additional hubs to the network
- Isolates segment breaks through an attachment configuration called dual homing and dual attachment
- Bypasses nodes that have been turned off or are experiencing problems
- Extends the network's geographical diameter by regenerating all received signals when repeating them onto the network

The hub provides the following features:

- **Media flexibility.** You can use any mix of one, two, or three of these port modules in the hub:
  - FDDI media port module supporting 62.5/125  $\mu\text{m}$  fiber-optic cable per the ANSI FDDI standard
  - STP media port module supporting shielded twisted-pair (STP) type 1 cable and the SDDI de facto standard
  - UTP media port module supporting level 5 and screened level 5, data grade unshielded twisted-pair (UTP) cabling system per the ANSI TP-PMD standard
- **Upgradeability.** You can easily change from copper media to fiber media and vice versa using the available port modules.
- **Configurability.** You can configure the two leftmost ports of the slot 1 module to meet any one of four network configurations: dual attachment, single attachment, null attachment, and dual homing.
- **Serviceability with power-on insertion.** You can insert and remove the media port modules without removing power from the hub.
- **Flash EPROM.** The presence of the flash EPROM makes the hub's software easily upgradeable because future software images can be downloaded into flash memory over the network via the Trivial File Transfer Protocol (TFTP). (See the section "Downloading New Images" in Chapter 4 for information on downloading images into the flash EPROM.)
- **FDDI benefits.** You can take advantage of the many benefits provided by FDDI technology, including:
  - Increased data rate of 100 Mbps
  - Longer distance between nodes via fiber-optic cable
  - Immunity to electronic "noise" (fiber only)
  - Support of large networks comprising up to 500 nodes
  - Fault tolerance and fault isolation
  - Improved network management

Figure 1-2 shows the LinkBuilder FDDI hub with the management module and all three types of media modules installed.

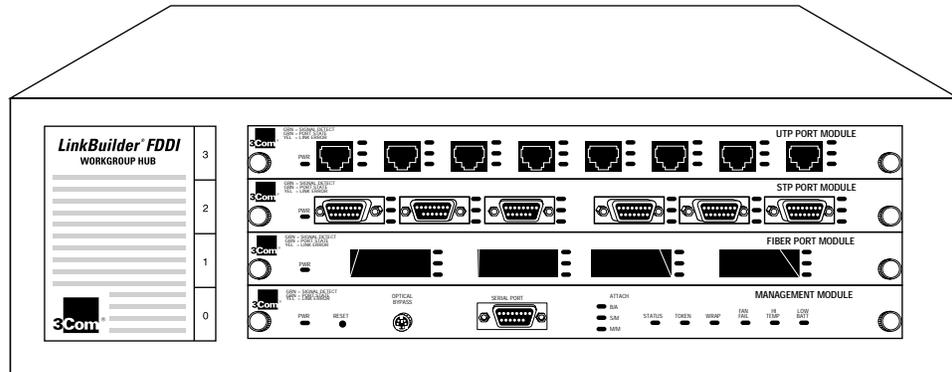


Figure 1-2. The LinkBuilder FDDI Workgroup Hub

## Site Selection

The hub is housed in a 16.8 x 11.6 x 5.2 inch chassis that can be placed on a tabletop or easily mounted in an Electronics Industries Association (EIA) standard 19-inch rack. You can mount more than one hub in a rack depending on your network needs.

Included with the chassis are four small rubber pads (to be inserted on the bottom four corners for tabletop placement) and two attachable brackets (to be attached on two sides for rack mounting) for your choice of placement.

When selecting a site for the hub, remember that the hub can be connected to an external terminal for initial configuration. In this case you will need room in front of the chassis to place and access the terminal.

Instead of attaching a terminal to the hub, you can configure the hub over the network by using the TCP Telnet protocol. You can also access the hub via a modem attached to the serial port.

## Typical FDDI Ring Setups

The hub can be used singly or in groups to bring FDDI to the desktop. Figure 1-3 shows a typical ring setup, in which:

- Two dual attachment stations (DAS) are connected to the trunk ring.
- Two dual attachment hubs (DAC) are connected to the trunk ring.
- Two single attachment stations (SAS) are connected to each of the hubs.



**NOTE:** 3Com uses the standard acronym DAC (for dual attachment concentrator) shown above but calls the concentrator a hub rather than a concentrator.

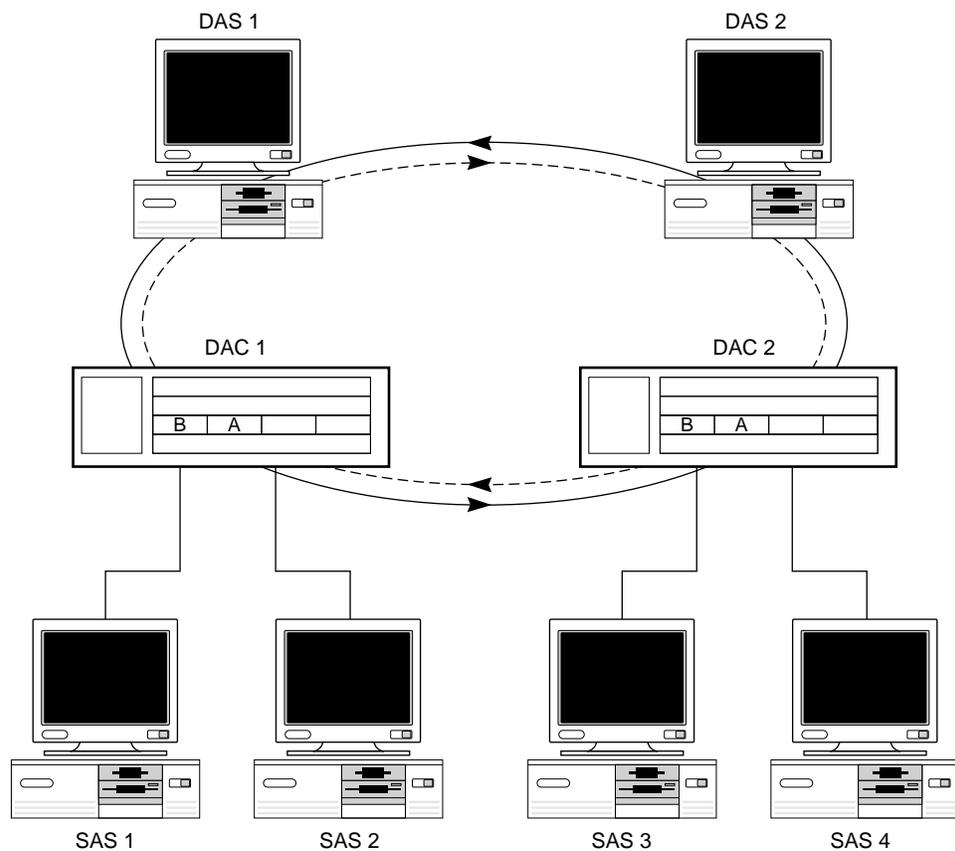


Figure 1-3. Physical Topology for Typical FDDI Ring

The most common “FDDI to the desktop” configuration is the ring of trees topology, shown in Figure 1-4. This figure illustrates the connecting of stations using a hub to form a tree-like structure that branches off the main trunk ring.

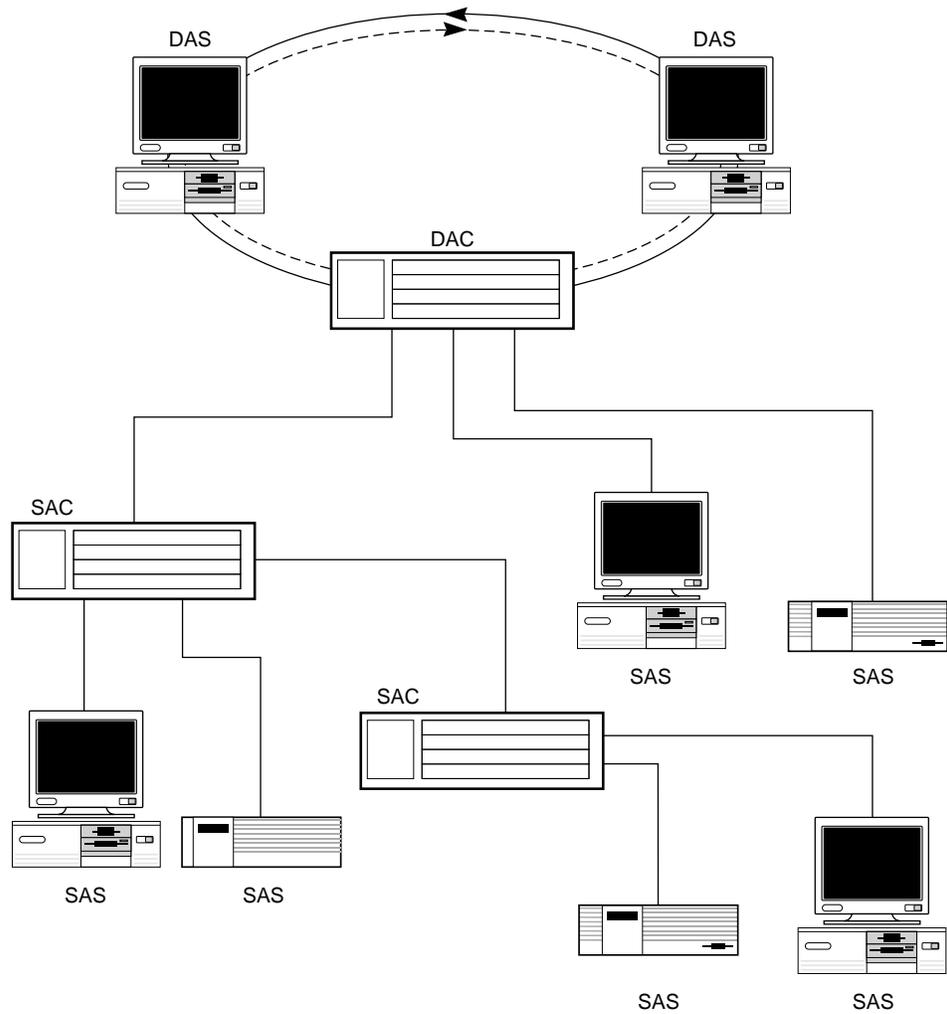


Figure 1-4. FDDI Ring of Trees

## Management and Media Modules

The hub chassis provides slots for one management module (required) and three media modules, which can be mixed or matched. This section briefly describes each of these modules. (For information about the operation of the management and media modules, see Chapter 5, “Using the Hub.”)

### Management Module

The LinkBuilder FDDI Management Module, hereafter called the “management module,” must be inserted in slot 0 (the bottom slot) of the hub. Its main purpose is to run the Station Management (SMT) 7.3 software that is required for FDDI operations.

The management module provides management and configuration functions through a console interface. Access to this interface is either by a 9-pin RS-232C console serial port for a terminal or modem connection or via a TCP Telnet protocol connection over the network.

Figure 1-5 shows the front panel of the management module, which provides a 6-pin mini-DIN receptacle for the connection to an optical bypass switch (OBS).



**Figure 1-5. Management Module, Front Panel**

The management module contains a recessed RESET button for reinitializing the hub’s software, running the power-on self-tests (POST), and running the flash EPROM. You can also use the RESET button to access the primitive console mode. (Refer to “Accessing Configuration Commands” in Chapter 3 for information on accessing the two console command modes.)

By interpreting the LEDs on the management module, you can:

- Monitor network activity
- Determine chassis environmental factors
- Discover ring attachment configuration

Refer to “Interpreting the LEDs” in Chapter 5 for detailed information about the LEDs on all hub modules.

## Media Modules

Three media modules are currently available. Each module can be placed in any slot, but the modules must be installed from the bottom up, beginning with slot 1. Do not leave empty slots between modules.

The two leftmost ports on any module installed in slot 1 are designated as attachment ports. The module in slot 1 is given a default configuration of dual attachment, B/A connection. Only the two leftmost ports of modules installed in slot 1 can be configured.

The three modules are:

- LinkBuilder FDDI 4-port Optic Module (fiber media port module)
- LinkBuilder FDDI 6-port STP Module (STP media port module)
- LinkBuilder FDDI 8-port UTP Module (UTP media port module)

## Fiber Media Port Module

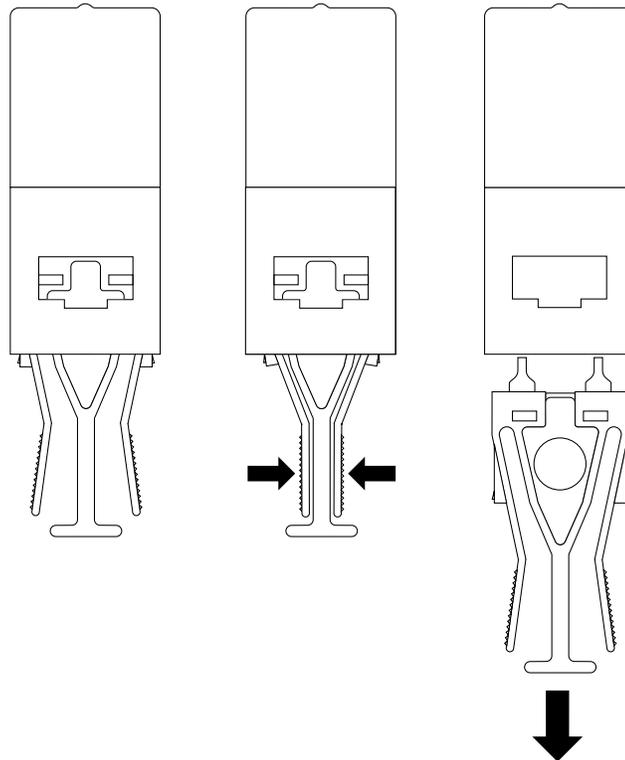
The fiber media port module provides four ports, as shown in Figure 1-6. When this module is installed in slot 1, you can configure the attachment ports (the two leftmost ports) as B and A, S and M, or M and M as necessary to support a given attachment. (Refer to Chapter 4 for instructions for configuring the attachment ports.) The remaining two ports are M (master) ports by default.



**Figure 1-6. Fiber Media Port Module, Front Panel**

If you insert the module in slots 2 or 3, all ports are automatically configured as M ports. With three fiber modules installed in the hub, 12 fiber MIC ports are available.

The fiber media port module is shipped with dust plugs inserted in its transceivers to protect the fiber-optic connectors from contamination. Keep a dust plug in each port until you are ready to insert a fiber cable into the port. Figure 1-7 shows how to remove a dust plug from a fiber transceiver.



**Figure 1-7. Removing a Dust Plug from a Fiber Transceiver**

### STP Media Port Module

Figure 1-8 shows the front panel of the six-port STP media port module. All of its ports are configured as M ports by default. You can specify any port configuration for the attachment ports, but you must use a special connector called the STP cascade connector to configure the leftmost attachment port as S. To configure the attachment ports as B and A requires two cascade connectors. Refer to Chapter 2 for additional information on the STP cascade connector.

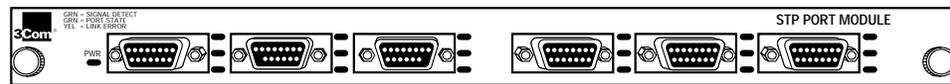


Figure 1-8. STP Media Port Module, Front Panel

If you install an STP module in each of the three hub slots, 18 STP ports are available.

### UTP Media Port Module

Figure 1-9 shows the front panel of the UTP media port module, which provides eight ports configured as M ports by default. You can specify any port configuration (B/A, S/M, or M/M) for the attachment ports. No adapter or special connector is needed for the UTP module. If you install three UTP modules in the hub, 24 UTP ports are available.



Figure 1-9. UTP Media Port Module, Front Panel

# Chapter 2

## Installing the Hub

This chapter describes installation of the LinkBuilder FDDI Workgroup Hub. It includes the following topics:

- Unpacking the hub
- Rack mounting the hub
- Equipping the hub
- Installing and removing modules
- Accessing the hub
- Understanding data flow
- Installing an optional optical bypass switch



***NOTE:** For a step-by-step procedure for installing the hub and preparing it for network operations, see the *Quick Start* chapter at the beginning of this guide.*

### Unpacking the Hub

To unpack the hub, follow these steps:

- 1. Open the shipping container and carefully remove its contents.**
- 2. Return all packing materials to the shipping container and save it.**

If the hub must be returned, ship it in its original shipping container (or one providing equivalent protection), or the warranty will be voided.

- 3. Verify that you have received all items on the packing list, and inspect each item for damage.**

If you find any omissions or damage, contact your network supplier and the carrier that delivered the package.

## Mounting the Hub in a Rack

Mounting the hub in a rack involves installing mounting brackets onto the hub and mounting the hub in the rack. To mount the hub in a 19-inch distribution rack, follow these instructions:

- 1. Lift the hub from its packing container and place it on a table or other flat surface.**

You should get help lifting the hub; it weighs slightly more than 15 pounds (6.8 kg). You will also need help when screwing the hub into the rack.

- 2. Determine where you will attach the hub to the rack.**

Align the mounting brackets to the holes in the vertical rails of the rack and mark the holes where you will screw the mounting brackets.

- 3. Attach the two supplied mounting brackets to the hub, using the screws that came with the hub. See Figure 2-1.**

Locate the holes on each side of the hub into which you will attach the mounting brackets.

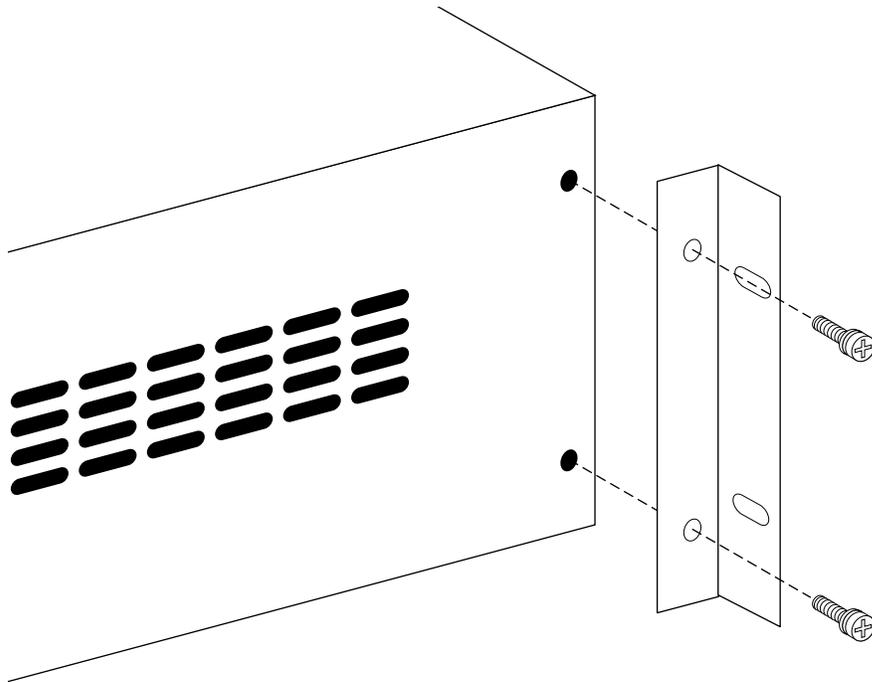
If you lose one of the screws, replace it with a 10/32 x 3/8 inch pan-head cross-recessed screw with an integral lock washer.

- 4. With the help of at least one other person, carefully lift the hub into position in the rack.**

Align the mounting brackets to the holes you designated for mounting.

While holding the hub in place, insert the four mounting screws supplied with the hub into the mounting holes in each bracket (two screws per bracket).

5. **Fasten the brackets to the rails by screwing in the screws.**
6. **Tighten each screw.**



**Figure 2-1. Attaching Mounting Brackets to the Hub**

The hub is now installed in the distribution rack, as shown in Figure 2-2.

2-4 Installing the Hub

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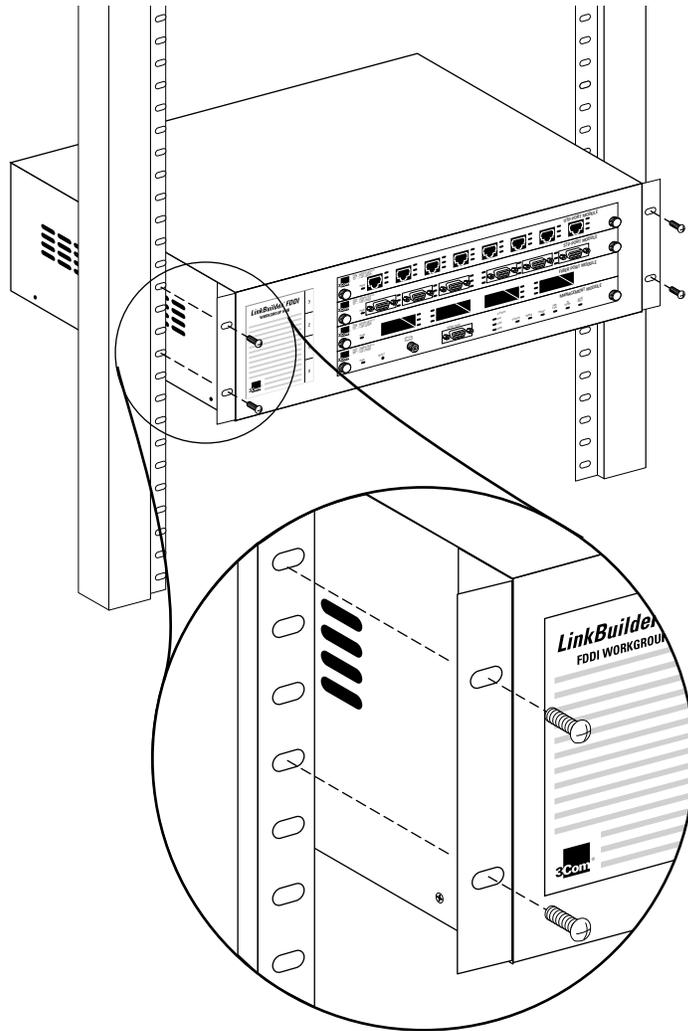


Figure 2-2. LinkBuilder FDDI Workgroup Hub Installed in a Distribution Rack

## Equipping the Hub

This section discusses the following hub equipment:

- Hub chassis
- Management module
- Lithium battery
- Media port modules
- Fiber port keys (optional)
- Cascade connector (optional)

### Basic Contents

The basic package includes the following items:

- LinkBuilder FDDI Workgroup Hub (base unit)
- *LinkBuilder FDDI Workgroup Hub User Guide*
- *LinkBuilder FDDI System Software* diskette, version 1.0
- Standard ac power cord
- Two brackets and eight screws for rack mounting
- Four rubber pads for tabletop placement

The *LinkBuilder FDDI System Software* diskette, version 1.0, contains a readme file and a backup image for the flash EPROM.

One LinkBuilder Management Module, which is shipped separately, is required for each hub.

A 3-volt lithium battery is shipped with the management module. The battery is in a small bag inside the management module shipping container. For battery functions and installation instructions, see the section “Installing the Battery” later in this chapter.

If you ordered a fiber media module, four small packets of fiber port module keys will be included with the module. For information on installing these keys, see the section “Keys for Fiber Port Modules” later in this chapter.

If you ordered an STP media port module, one cascade connector will be shipped with the module. For information about the cascade connector, refer to the section “STP Cascade Connector” later in this chapter.



**NOTE:** Remember to fill out the Product Registration Card at the back of this manual and return it to 3Com, or call 1-800-NET-3Com for immediate registration.

## Hub Chassis

The LinkBuilder FDDI hub is shipped with no modules installed; the modules you ordered are shipped separately and packaged individually. The hub is shipped with two blanking plates attached over slots 2 and 3.

Install the management module in slot 0. Install one of the media port modules in slot 1. To install additional modules, remove the blanking plates and insert the modules. Retain the blanking plates for possible future use when modules are removed. (Refer to the section “Installing Modules” later in this chapter for complete information about mounting the modules in the hub.)

## Media Port Modules

Depending on your order, you should also have received one or more of the following modules:

- LinkBuilder FDDI 4-port fiber port module
- LinkBuilder FDDI 6-port STP port module
- LinkBuilder FDDI 8-port UTP port module

## Installing the Battery

A lithium battery, which powers the nonvolatile memory bank, is supplied with the management module. The hub's nonvolatile memory preserves the following:

- Boot parameters
- Last download status
- Set command parameters
- Fault log entries

The lithium battery is a 3-volt, 550 mA-hr battery in a 2450 blister pack. It can last up to 10 years before it must be replaced. However, its actual lifetime depends on the number and duration of power outages that may occur. It has enough capacity to last up to 5500 hours after power is lost.

Replace the battery when the LOW BAT LED lights. You can purchase replacements in most computer and electronic retail stores. Ask for a type 2450 battery. Be sure to replace the battery with one made by the same manufacturer.



**CAUTION:** *The battery may explode if it is replaced incorrectly. Replace the battery only with the same or equivalent type as described above. Used lithium batteries can be considered other household waste and disposed of accordingly.*

*Do not incinerate, disassemble, or deform batteries. Do not attempt to recharge the battery. Do not heat the battery over 100° C.*

*Failure to follow these handling instructions may result in battery failure, including seal breakdown, leakage, internal shorting, fire, and potential explosion.*



**ACHTUNG:** *Diese Batterie kann explodieren, wenn sie falsch installiert wird. Verwenden Sie nur den gleichen oder entsprechenden vom Hersteller empfohlenen Typ. Verbrauchte Batterien sind nach den Angaben des Herstellers zu entsorgen.*

You must insert the battery on the management module before installing the module in the hub. To install the battery in the management module, follow these steps:

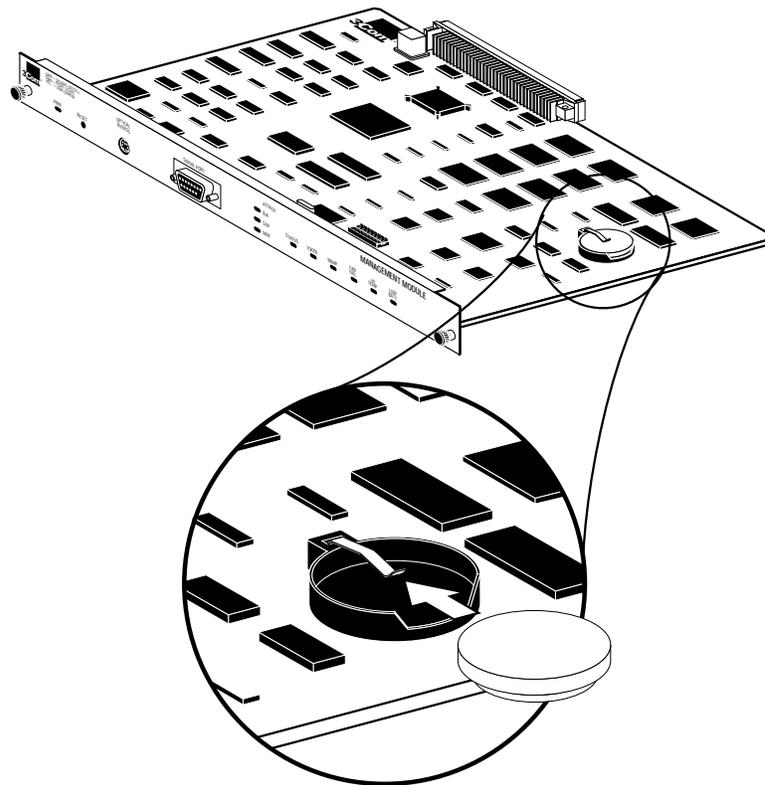
**1. Remove the battery from its container.**

Each management module is shipped with its battery in a small bag inside the shipping container.

**2. Remove the management module from its antistatic bag.**

**3. Locate the circular battery holder on the module.**

Figure 2-3 shows where to insert the battery.



**Figure 2-3. Battery Location on the Management Module**

**4. Carefully slide the battery into its circular holder.**

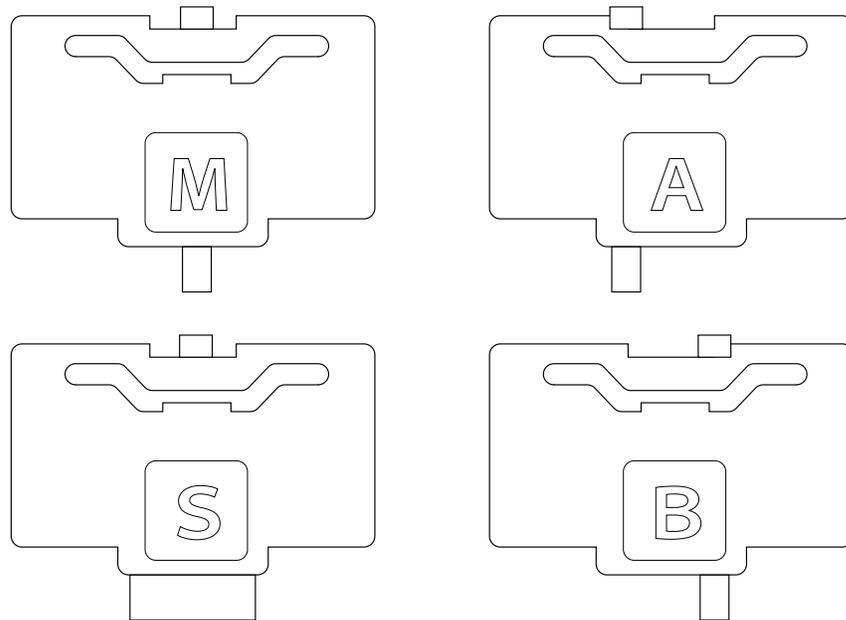
Ensure that the “+” sign on the battery faces up and makes contact with the positive clip that holds the battery in place.

The management module is now ready to be installed in slot 0. Follow the instructions given in the section “Installing Modules” later in this chapter.

To remove the battery for replacement, reverse the procedure above.

### Keys for Fiber Port Modules

Four sets of media port module keys, packaged in small plastic bags, are included with each fiber port module. Use the keys to specify the port configuration of each fiber-optic transceiver. The keys are identified as A, B, S, or M port types, as shown in Figure 2-4.



**Figure 2-4. Media Module Keys Identified by Port Type**

Use of media module keys is optional. They can be used to ensure that the correct cable is inserted into each fiber transceiver.

Once a key is in place, you can only insert the cable connector specified by that key into the transceiver. However, if the cable connector is universally keyed, it will fit into any transceiver regardless of its inserted key.

You should insert the keys into the transceivers before installing the fiber module. Insert one key into the top of each transceiver as described below and shown in Figure 2-5:

- 1. Determine the type of configuration that you want for the two attachment ports on the fiber module.**

Refer to the sections “Planning Connections” later in this chapter and “Port Connections” in Chapter 3 for help in determining your hub connection plan.

- 2. Choose the appropriate key (A, B, M, or S).**

The key types are identified by letters on the top of the key.

- 3. Insert the tabbed end of the key through the opening in the top of the transceiver receptacle, and fit it in place.**

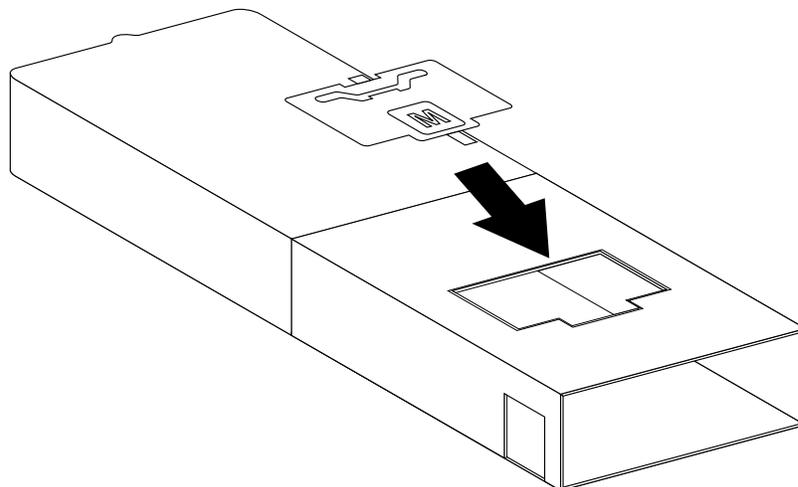


Figure 2-5. Inserting a Type M Key into a Fiber Transceiver

**4. Push the back of the key down until it snaps into place.**

The key sits flush with the top of the transceiver.

If you decide to change the configuration of a fiber module attachment port, you must change the key in the transceiver receptacle. To remove a key from the receptacle, follow these steps:

**1. Remove the attached cable from the transceiver.**

**2. Remove the module from the hub.**

Refer to the section “Removing Modules” later in this chapter.

**3. Place the tip of a small, flat screwdriver in the slot at the back of the key and exert gentle but firm pressure on the screwdriver.**

**4. Remove the key.**

Replace the removed key in its plastic bag for possible future use.

**5. Insert the appropriate key into the transceiver.**

Reinsert the module into the hub and insert the different cable into the rekeyed transceiver.

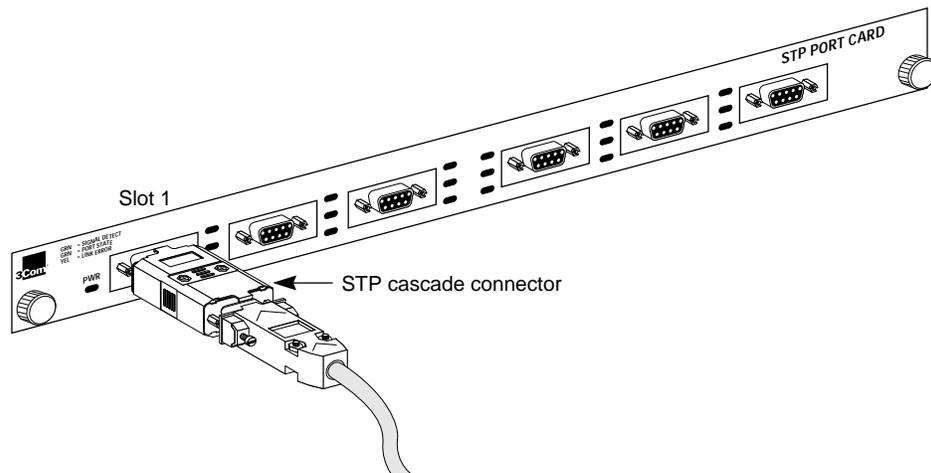
## STP Cascade Connector

By default, all ports on the STP module are physically configured as M ports. If you want to configure the STP module’s attachment ports differently, you must use an STP cascade connector to allow the use of these ports as B, A, or S port types.



**NOTE:** A module’s attachment ports are the two leftmost ports when a module is installed in slot 1. Whenever a module is installed in a slot other than slot 1, the two leftmost ports are no longer designated “attachment ports.”

One cascade connector is supplied with each STP media port module. You can purchase additional cascade connectors by contacting your 3Com sales representative. Figure 2-6 shows a cascade connector attached to the first port of an STP module installed in slot 1.



**Figure 2-6. STP Module Cascade Connector**

Refer to the section “Using the STP Cascade Connector” in Chapter 3 for cascade connector configuration instructions.

## Installing Modules



**NOTE:** You must install the management module first. It can only be installed in slot 0. It will not function in any other slot. Install the remaining modules in adjacent slots (in numerically ascending order) so there are no empty slots between modules.

Do not insert the management module into the hub until you have installed the battery, which is shipped with the module. Refer to the section “Installing the Battery” earlier in this chapter for installation instructions.

To install the management module and the media modules for the first time, follow these steps:

- 1. Remove all jewelry from your hands and wrists.**
- 2. If you are installing modules in slots 2 or 3, remove the blanking plates from those slots.**

Keep the removed blanking plates in a safe place for possible future use.



**CAUTION:** *Each module is packed in an antistatic bag to protect it during shipment. To avoid damaging any highly static-sensitive components on the module or the hub, be sure to reduce any static electricity on your person. One way to do this is to touch the metal part of the hub. You can maintain grounding by wearing a wrist strap attached to the hub.*

- 3. Remove the module from its antistatic bag.**

Prepare a clean, level work area nearby on which to place the module. Avoid contact with any of the module's components.

- 4. Insert the module slowly into its slot.**

The printing on the module's front panel indicates its correct horizontal orientation.

- 5. Gently align and push the module's bus connector into its slot in the backplane of the hub.**
- 6. When the module is completely seated, tighten the captive thumb screws on each end of the module.**
- 7. To turn on the hub, plug one end of the ac power cord into the back of the hub and the other end into an electrical outlet.**

The PWR LED turns green, indicating the hub is on and ready for configuration.

There is no power switch on the hub. Power to the hub is provided by connecting the power cord to the hub and to an ac outlet.



**NOTE:** *The hub allows “power-on insertion,” which means that you do not have to unplug the power cord for module insertion or removal. When you replace a module, reset the hub by pressing the RESET button or entering the reset command. Resetting the hub reinitializes the hub and causes the system to run its power-on self-tests (POST).*



**CAUTION:** *When the hub is reinitialized, any devices connected to the hub are momentarily disconnected. This could result in serious data loss unless you take preventative measures before changing installed modules. To avoid potential problems, enter the disconnect command before activating the reset function.*

After you install the management module and one or more media modules, one or two empty slots may remain in the base unit. Insert a blanking plate into each of these empty slots. This keeps objects from falling into the hub and prevents RF emissions from an open slot.

## Removing Modules

To remove modules from the hub, follow these steps:



**CAUTION:** *Observe the same precautions outlined above regarding discharge of static electricity and potential loss of data.*

- 1. Disconnect all cables connected to the module that you want to remove.**

You do not have to unplug the hub from its power source.

- 2. Enter the *disconnect* command.**

This disconnects the hub from the ring.

- 3. Remove all jewelry from your hands and wrists.**

4. Turn the thumb screws on each end of the module counterclockwise to loosen them.
5. Holding a thumb screw in each hand, slowly pull the module from its slot.
6. Place the module on a clean surface, or replace the module in its original antistatic bag.
7. Place a blanking plate over the empty slot.



**NOTE:** There must be no empty slots between modules. For example, if you remove a module from slot 2 and there is a module in slot 3, you must move the module in slot 3 into slot 2 or else replace the removed module with a new module. Otherwise, an error condition will exist, and the hub will not function properly.

**8. Reset the hub.**

You can either enter the *reset* command or press the RESET button that is recessed on the management module.

## Accessing the Hub

To monitor hub activity and (optionally) configure the hub to suit your particular network environment, you must set up an interface with the hub. You can access the hub in several ways:

- Connect a terminal such as a VT100 or similar dumb terminal to the RS-232 serial port on the management module, using a null-modem connector to the terminal.
- Connect a PC running terminal emulation software to the RS-232 serial port on the management module, using a null-modem connector to the PC.
- Attach a modem to the serial port on the management module. (Refer to the section “Installing an Optional Modem” later in this chapter.)
- Access the hub across the network using the TCP Telnet protocol. (Refer to the section “Using Telnet to Access the Hub” later in this chapter.)

Once one of these connection is made, you can use the console commands to monitor and configure the hub. Two console command sets are available: the management console command mode and the primitive console command mode. These command modes are discussed in Chapter 3. The commands in these command sets are listed and described in Appendix C, “Commands.” Instructions for using the commands are provided in Chapter 4, “Setting Up the Hub.”

### Changing the Serial Port’s Baud Rate

When you connect a terminal or modem to the hub, you may need to change the baud rate of the serial port. The serial port’s default baud rate is 9600.

To display the serial port’s baud rate, enter the *show baud* command.

To change the hub's baud rate to match the baud rate of a terminal or modem, follow these steps:

**1. Enter the *set baud* command. Type:**

```
set baud
```

This selection prompt appears:

```
Select one of the following:
```

- 1. 1200
- 2. 2400
- 3. 4800
- 4. 9600

```
Baudrate?
```

**2. Type a number to select a baud rate. For example, type:**

```
3 [Enter]
```

This confirmation appears:

```
Baud rate changed to 4800
```

**3. Reset the hub by pressing the recessed RESET button on the management module front panel.**

The new baud rate will take effect when the self-tests are finished.



**NOTE:** The other default parameters of the serial port are Parity = None, Data Bits = 8, and Stop Bits = 1.

## Installing an Optional Modem

If you want to access the hub via a Hayes modem, you must prepare the modem correctly for use with the hub. Follow these steps:

1. **If necessary, change the hub's baud rate to match the modem's baud rate.**

Refer to the preceding section, "Changing the Serial Port's Baud Rate," for instructions on changing the baud rate.



**NOTE:** Before you install a modem, you should set a password to restrict access to the hub.

2. **Log out from the hub by entering the *logout* command. Type:**

```
logout [Enter]
```

3. **Be sure the modem is turned off.**
4. **Connect the modem to the hub's serial port.**

The serial port requires a female DB-9 connector. The modem requires a male DB-25 connector.

5. **Power-on the modem.**

Within 2 minutes the modem will be programmed to auto-answer within two rings. The modem is ready to respond to the hub when the AA LED comes on.

## Using Telnet to Access the Hub

To use the Telnet protocol to access the hub, the hub must be connected to the network and must be running. You must also have the Telnet protocol running on some device on your network. Follow these steps:

1. **Enter the *telnet* command followed by the hub's IP address. For example, type:**

```
telnet 123.45.67.89 [Enter]
```

When the connection is completed, the hub prompt appears. You now have access to the management console commands. You cannot access primitive console commands via a Telnet connection.

2. **When finished, exit Telnet by typing:**

```
logout [Enter]
```

3. **Press any key and enter the password at the prompt.**

## Planning Connections

As you plan the network layout of the FDDI ring with its connections to one or more hubs and various other devices, you must be aware of the following:

- FDDI cabling rules
- FDDI data flow specifications
- Port attachment rules and connection restrictions

This section discusses FDDI cabling rules and data flow specifications. Chapter 3 contains detailed information about port connections and port attachment rules.

## FDDI Cabling Rules

The type of cabling you use depends on the media modules that you ordered. When installing the hub and the modules, observe these FDDI cabling rules:

### Fiber-Optic Cable

- All cabling media must conform to the American National Standard *FDDI Physical Layer Medium Dependent (PMD) Standard*, ISO 166-1990, American National Standards Institute.
- The standard FDDI cabling type supported by the LinkBuilder FDDI Workgroup Hub is multimode 62.5/125  $\mu\text{m}$ .
- The maximum length of this cable from the hub to any potential end station is approximately 2 km (1.25 mi) per the ANSI X3T9.5 specification. Attenuation must not exceed 11 dBm on any link between nodes regardless of distance.



**NOTE:** When you insert the fiber-optic cable's media interface connector (MIC) into a fiber module port, the MIC must click twice to ensure a complete connection.

### Shielded Twisted-Pair Cable

- The standard STP cabling type supported by the LinkBuilder FDDI Workgroup Hub is category 1 STP cable with DB-9 connectors. No cross-over wiring is required.
- The maximum length of this cable from the hub to any potential end station is 100 m (328 ft) per the SDDI de facto STP standard.
- The STP cable connectors must conform to IBM token ring standards or their equivalent. The specifications for this standard are contained in AMP document number 6609, revision 11/01/88. Contact AMP Inc., Harrisburg, PA 17105, for a copy of this document.
- The pin assignments for the type DB-9 FDDI shielded twisted-pair interface connector are shown in Table 2-1.

**Table 2-1. DB-9 STP Connector Pin Assignments**

Pin No.	Function
1	Transmit (+)
2	Not used
3	Not used
4	Not used
5	Receive (+)
6	Transmit (-)
7	Not used
8	Not used
9	Receive (-)

### Unshielded Twisted-Pair Cable

- The standard UTP cabling type supported by the LinkBuilder FDDI Workgroup Hub is category 5 screened UTP cross-over cable with screened RJ-45 connectors, as specified by ANSI X3T9.5. The cross-over cable connections and color scheme are shown in Figure 2-7.
- The maximum length of this cable from the hub to any potential end station is 100 m (328 ft). The cross-over cable connects the LinkBuilder FDDI hub and the punchdown block. ANSI standards specify the operating distances, as shown in Figure 2-8.
- The pin assignments for the type RJ-45 FDDI unshielded twisted-pair interface connector are shown in Table 2-2.

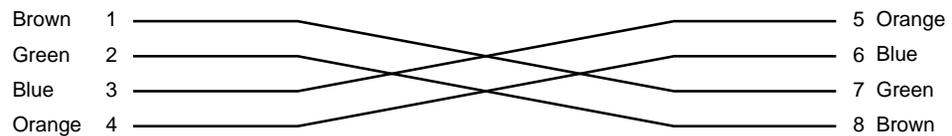
**Figure 2-7. Cross-over Connections on a UTP Cable**

Table 2-2. RJ-45 UTP Connector Pin Assignments

Pin No.	Function
1	Transmit (+)
2	Transmit (-)
3	Not used
4	Not used
5	Not used
6	Not used
7	Receive (+)
8	Receive (-)



**NOTE:** To minimize RF emissions, the connector shell must be connected to hub ground. Also, the connector shell must completely surround the cable shield.

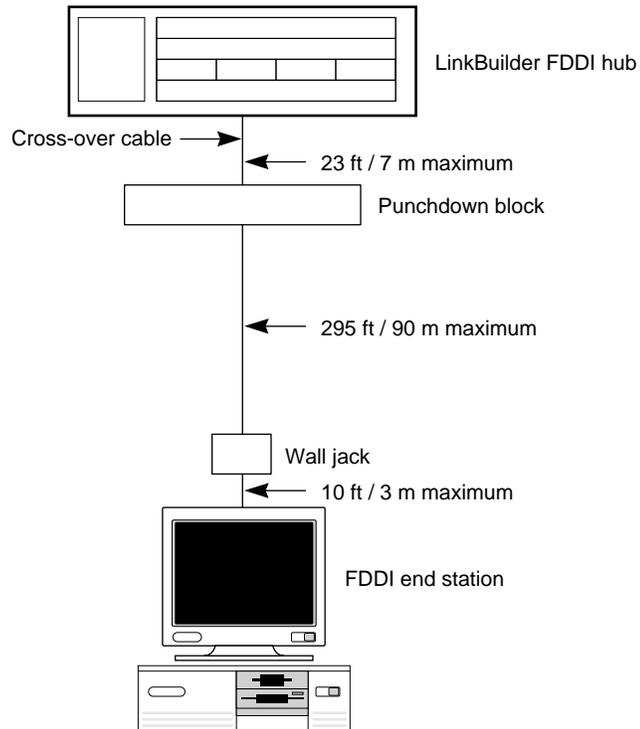


Figure 2-8. UTP Cabling Distances per ANSI Standards

## Data Flow Specifications

The FDDI standard specifies that data travels on the primary ring in a counterclockwise direction, and that data traveling on the secondary ring rotates clockwise. (Refer to Figure 3-1.) As you attach the hub to the ring and network devices to the hub, be aware of the data flow direction.

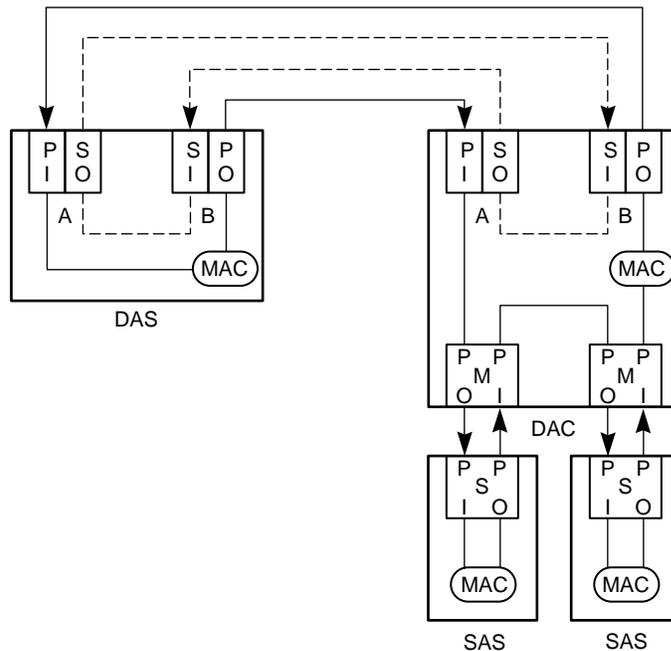
Table 2-3 shows the four supported port types and the direction of data flow through each port. Figure 2-9 illustrates the various port types and the data flow direction allowed by the FDDI standard.

**Table 2-3. FDDI Port Types**

Port	Data Flow Direction	Use
A	Primary In/Secondary Out (PI/SO)	Connects dual attachment devices to the trunk ring
B	Primary Out/Secondary In (PO/SI)	Connects dual attachment devices to the trunk ring
M	Master (PO/PI)	Connects single attachment devices to the hub port; uses the primary ring only
S	Slave (PI/PO)	Connects single attachment devices to the hub; uses the primary ring only

Table 2-3 and Figure 2-9 show that the primary ring (solid line) enters the A port as Primary In (PI) and exits as Primary Out (PO) through port B. The secondary ring (dashed line) enters through port B as Secondary In (SI) and exits through port A as Secondary Out (SO).

For both master (M) and slave (S) ports, the primary ring enters the port as PI and exits as PO. The secondary ring never connects to these two ports.



**Figure 2-9. Direction of Data Flow Through a Hub and Stations**

The acronyms used in Figure 2-9 are defined below and described in Chapter 3:

- DAS      Dual attachment station
- DAC      Dual attachment concentrator (hub)
- SAS      Single attachment station

### Connecting to the Dual Ring

To attach the hub to an FDDI dual ring, follow these steps:

1. **Install a fiber module in slot 1 on the hub.**
2. **Insert two fiber-optic cables from the dual ring into the two leftmost ports (B and A) of the fiber module.**

The fiber-optic cables must terminate in MIC connectors.

The default configuration of the attachment ports (the two leftmost ports on the module installed in slot 1) is B/A. If the attachment ports have been configured differently (as shown by the ATTACH LEDs on the management module), you must reconfigure them, as detailed below:

**1. Configure the attachment ports as B and A. Type:**

```
set attach
```

This selection prompt appears:

```
Select one of the following:
```

1. B/A
2. S/M
3. M/M

```
Attachment port configuration?
```

**2. Select the attachment port configuration that you want. For example, type:**

```
1 [Enter]
```

These confirmation lines appear:

```
Current configuration:           M/M
Initialize attachment as:       B/A
```

**3. Reset the hub by pressing the recessed RESET button on the management module front panel.**

The attachment ports will be initialized as B/A.

## Installing an Optical Bypass Switch

In many network environments, mission-critical devices such as bridges, routers, and hubs should be connected to the primary dual ring only if they are equipped with an optical bypass switch (OBS). An optical bypass switch is a device that prevents ring wrap in the event a node is powered off. Using an optical bypass switch protects the integrity of the dual ring by rerouting the signal in case of a station malfunction: the trunk ring is not broken.

If you want the protection provided by an optical bypass switch, purchase an optical bypass switch with the plug configuration shown in Figure 2-10. 3Com does not supply this device.

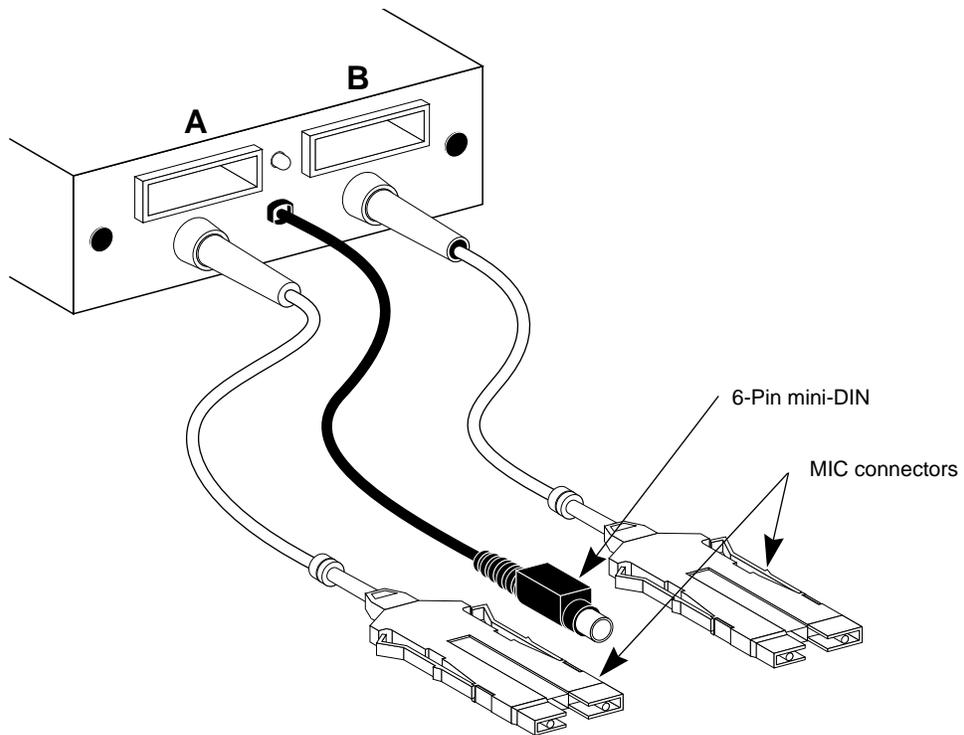


Figure 2-10. Optical Bypass Switch

To detect the presence of an optical bypass switch on your system, enter the *show obs* command. To install an optical bypass switch with the configuration shown in Figure 2-11, follow these steps:

1. **Plug the A and B Media Interface Connectors (MIC connectors) from a network device or another hub into the B and A receptacles on the optical bypass switch.**

The device's A connector must be placed in the B receptacle and the B connector in the A receptacle.

2. **Plug the A and B MIC connectors of the optical bypass switch into the A and B ports on the FDDI hub (A to A and B to B).**

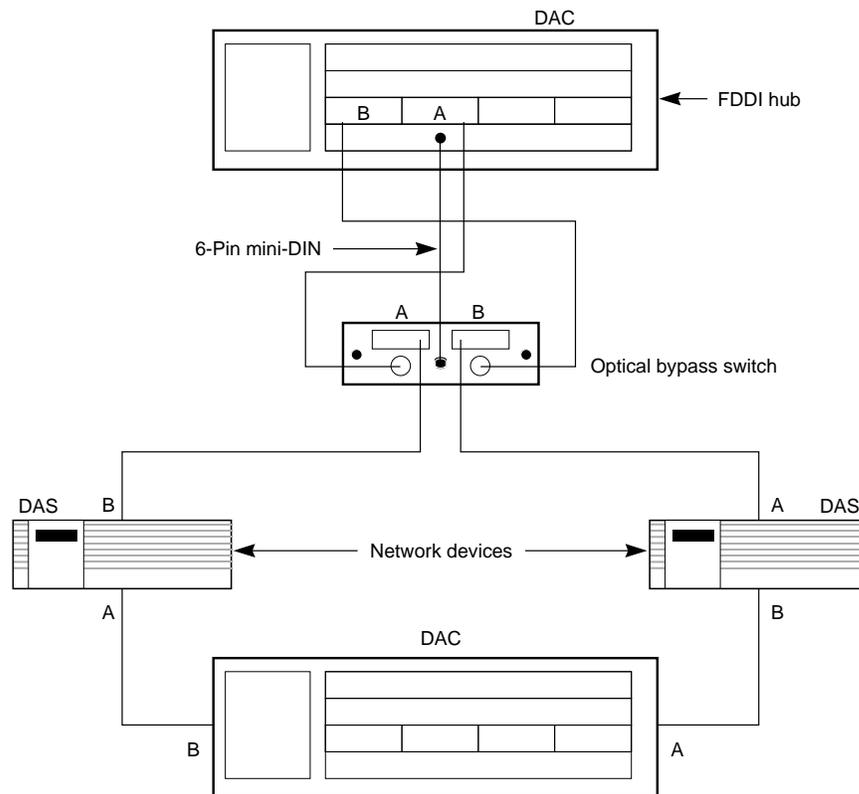
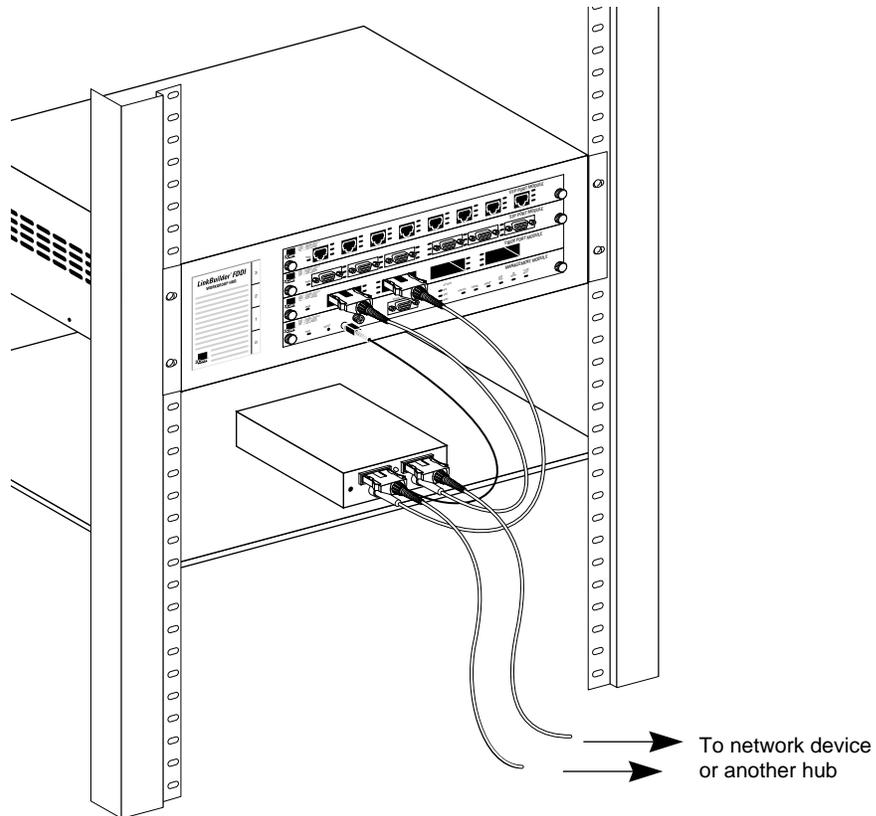


Figure 2-11. Cabling for Installing an Optical Bypass Switch

3. **Plug the optical bypass switch's power connector (a 6-pin mini-DIN plug) into the optical bypass interface receptacle on the management module.**

If you are installing the hub in a rack, you can purchase a cable tray to support the optical bypass switch unit, as shown in Figure 2-12, or you can rest the unit on one of the rack-mounted components.



**Figure 2-12. Rack Mounting a Hub with an Attached Optical Bypass Switch**

# Chapter 3

## Configuring the Hub

After you have installed the hub and its modules and physically connected it to the ring, you can configure the hub to operate in your network environment. This chapter discusses the following topics:

- Attachment options supported by the hub
- Default configuration of the hub and its modules
- Console command access modes
- Rules for media module port connections

### Attachment Options

The LinkBuilder FDDI Workgroup Hub supports four types of standard configurations:

- Dual attachment concentrator (DAC)
- Single attachment concentrator (SAC)
- Null attachment concentrator (NAC)
- Dual homing (DH)



**NOTE:** 3Com uses the standard acronyms shown above but calls the concentrator a hub.

Each type of configuration is discussed in this section. (Refer to the section “Configuring Modules” later in this chapter for information about using the *set attach* command to configure the hub.)

## Dual Attachment Hub

A dual attachment hub (DAC) attaches to both the primary and the secondary rings. Figure 3-1 shows a hub functioning as a dual attachment hub.

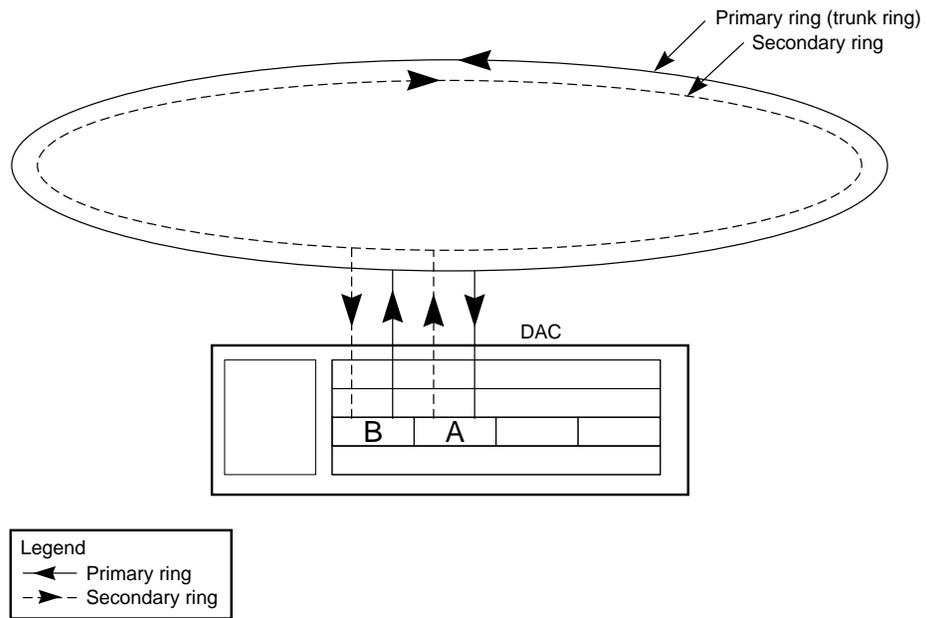


Figure 3-1. Dual Attachment Hub (DAC)

You can place a dual attachment hub directly on the trunk ring. This allows it to participate in ring wrapping if a segment of the trunk fails. Figure 3-2 shows dual attachment hubs in wrap state.

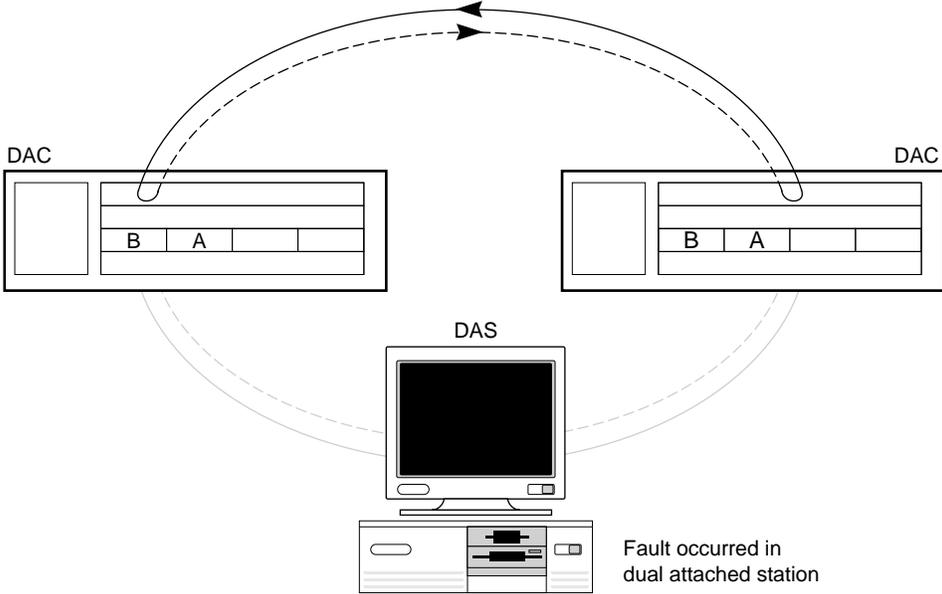


Figure 3-2. Dual Attachment Hubs (DACs) in Wrap State

### Single Attachment Hub

A single attachment hub (SAC) is never attached directly to the dual trunk ring. Instead, it is attached to another hub, which is connected to the main ring. Figure 3-3 shows a single attachment hub connected to the network via a dual attachment hub. The single attachment hub in this example is connected to three single attachment stations.

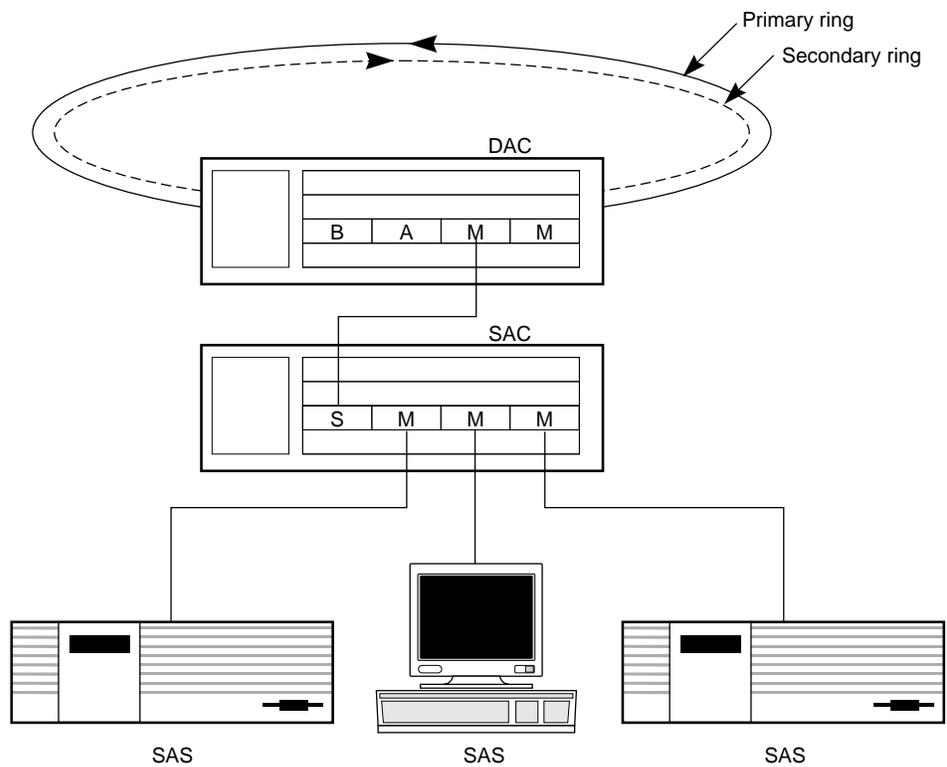


Figure 3-3. Single Attachment Hub (SAC)

### Null Attachment Hub

A null attachment hub (NAC) functions as a self-contained FDDI network. It is an FDDI backbone but is not connected to a dual ring backbone. The network is concentrated in the hub, and all of the attached devices communicate through it using FDDI. Null attachment hubs do not support A, B, or S ports.

Figure 3-4 shows a null attachment hub with several connected devices.

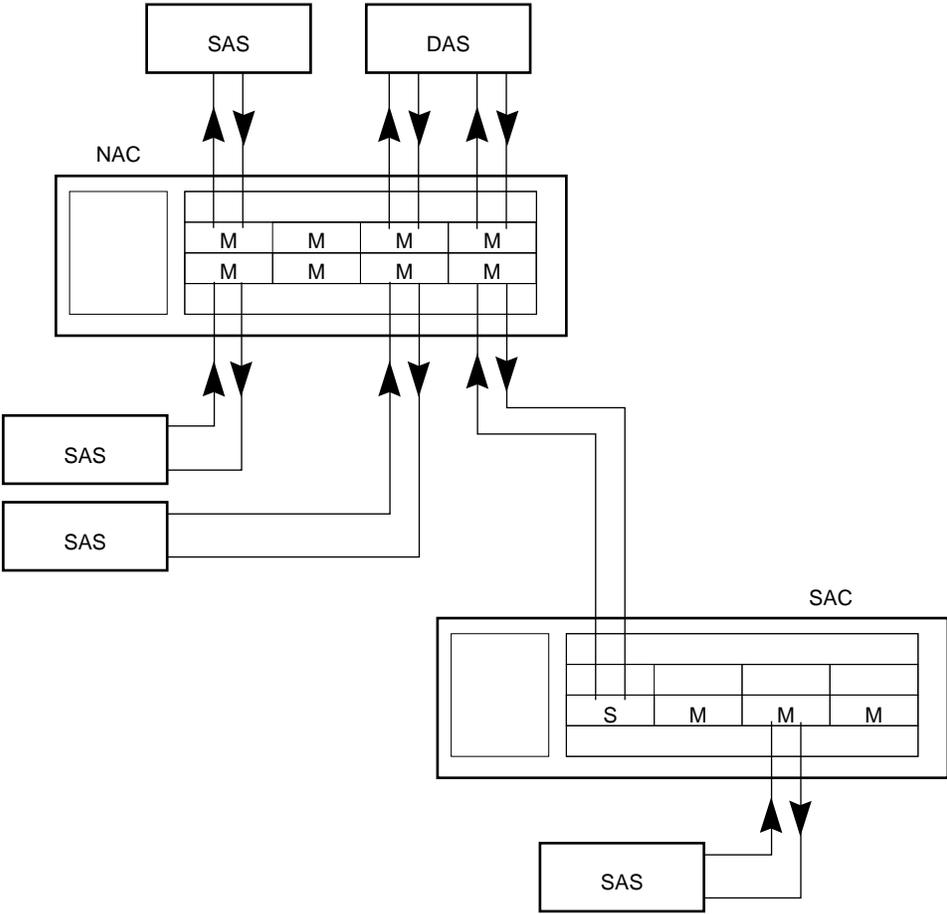
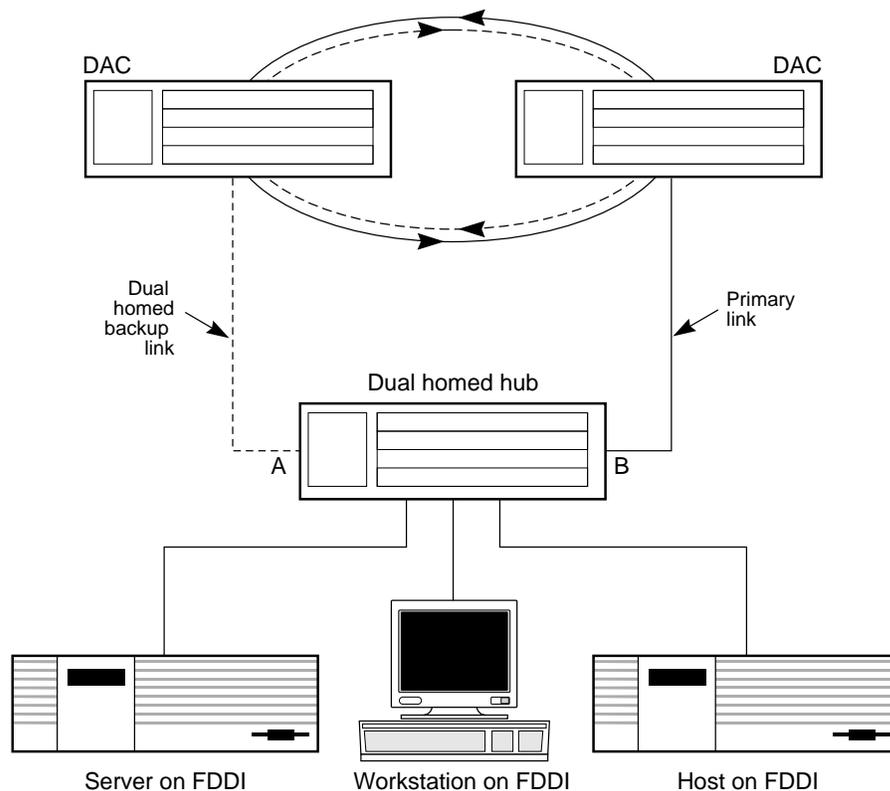


Figure 3-4. Null Attachment Hub (NAC) and Connected Stations (SAS and DAS)

## Dual Homing

Dual homing (DH) configuration provides two attachments to the FDDI network. One of them functions as a backup link if the primary link fails. This type of attachment is especially useful for connecting to mission-critical devices.

Figure 3-5 illustrates valid connections for a dual homed hub.



**Figure 3-5. Dual Homing Connections**

Ports A and B are both connected to the primary ring. Following the B precedence rule, the B port always takes precedence and becomes the primary link. If the connection to the B port fails, the A port serves as the backup and automatically becomes the primary port. The dual homed hub shown in Figure 3-5 is actually a dual attachment hub, but only one port is active at a time.

## Default Configuration

Table 3-1 shows the hub's factory default configuration on start-up.

**Table 3-1. LinkBuilder FDDI Workgroup Hub Default Configuration**

<b>Description</b>	<b>Factory-Set Default</b>
T-Notify	30 seconds
TVX	2.6214 milliseconds*
T-Req	165 milliseconds
LER cutoff	10.E-07
LER alarm	10.E-08
Attachment	B/A
IP address	0.0.0.0
IP netmask	255.0.0.0
IP broadcast	0.255.255.255
IP default gateway	0.0.0.0
Boot server IP address	0.0.0.0
Boot method	LOCAL
Boot file	Null
Password	Null
Baud rate	9600

\*This value cannot be changed.

You can operate the hub using its default configuration without making any changes whatsoever. However, you may want to change various parameters to suit your particular network environment. Refer to Chapters 4 and 5 and Appendix C for information about making changes to the hub's default configuration.

If you should want to return the hub to its default configuration (after making changes), use the *set defaults* command, which is accessible only in the primitive command mode.

## Accessing Configuration Commands

You can configure the hub using the commands in two command modes:

- Management console commands
- Primitive console commands

### Management Console Commands

Management console commands allow you to:

- Display current parameter settings and configuration information
- Set or change certain configuration-related parameters
- Display a list and descriptions of the command set
- Invoke several TCP/IP network troubleshooting commands

You can access the management console command mode by doing one of the following:

- Attaching a terminal to the RS-232 serial port on the management module
- Connecting a Hayes-compatible modem to the RS-232 serial port on the management module
- Using the TCP Telnet protocol over the network

## Primitive Console Commands

The “primitive” console commands, which are a subset of the management console commands, are accessible in case of unusual system situations. For example, you can access the primitive console command mode if:

- You forget the password. (You do not need a password to access the primitive console command mode. Once in this mode, you can set a new password.)
- You have downloaded a faulty image into the flash EPROM, and you must reset the hub.
- You have configured the hub with illegal parameters and nothing can operate. You must reset the hub.

Unlike the management console command mode, when the primitive console command mode is active, no connection to the ring exists. In primitive mode you can change only those parameters that involve nonvolatile RAM.

You can access the primitive console command mode only via a terminal attached to the serial port on the management module. Remote access through a modem or via Telnet is not supported.

### Accessing the Primitive Console Command Mode

To access the primitive console command mode, follow these steps:

**1. Press the RESET button once.**

The RESET button is recessed on the management module. Use a bent paper clip or other small, pointed object to press the RESET button.



**NOTE:** You cannot access the primitive console command mode by typing the reset command.

**2. Watch the STATUS LED on the management module.**

The STATUS LED is normally amber. When the STATUS LED flashes amber/green, you have 10 seconds to press the RESET button again.

If you do not press the RESET button during the 10 seconds that the STATUS LED is flashing amber/green, you are denied access to the primitive console command mode, and this message appears:

```
Primitive console entry has timed out.
```

**3. Press RESET again.**

This message appears:

```
Press Ctrl-P to enter Primitive Console.
```

**4. Hold down the [Control] and [P] keys.**

The hub is now in the primitive console command mode. The STATUS LED flashes amber/green continuously while you are in the primitive console command mode.

If you do not enter a primitive console command within 15 seconds, an inactivity timeout will cause the hub to return to the management console command mode.

If you do not press [Ctrl]+P within 10 seconds, the system times out.

If your attempt to enter the primitive console command mode fails and the timeout occurs, you can try again by following the steps above.

### Returning to the Management Console Command Mode

To return to the management console command mode without reattempting to enter the primitive console command mode, follow these steps:

**1. Press [Enter].**

This message appears:

```
3Com LinkBuilder® FDDI Workgroup Hub
```

The password prompt appears.

**2. Enter the password and press [Enter].**

To return to the management console command mode from the primitive console command mode, reset the hub.

## Port Connections

The two leftmost ports on any module installed in slot 1 serve as attachment ports. You can configure these ports to be any of the following:

- B/A (dual attachment)
- S/M (slave/master)
- M/M (master/master)

The way you configure these ports determines the type of attachment supported by the hub. The configurable attachment types are as follows:

- Dual attachment
- Dual homing attachment
- Single attachment
- Null attachment

Table 3-2 shows how to configure the attachment ports for the desired attachment type.

**Table 3-2. Selecting Port Configurations for Attachment Types**

<b>Attachment Type</b>	<b>Attachment Ports Configuration</b>
Dual attachment	B/A*
Dual homing attachment	B/A*
Single attachment	S/M
Null attachment	M/M

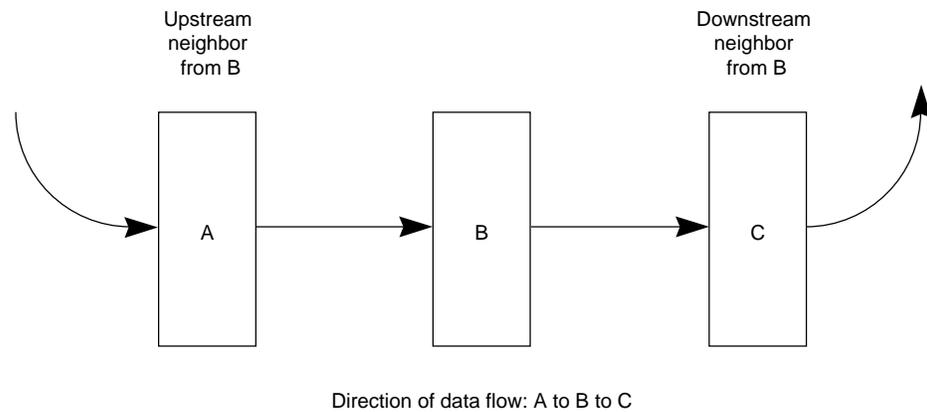
\*The B/A configuration supports both dual attachment and dual homing.

The B and A ports are used to dual attach the hub to the trunk ring or dual home to other hubs.

The FDDI connection rules connect the MAC and the attachment ports to the primary ring. The secondary ring is used only to complete the primary ring through the hub and wrap the ring if a fault occurs or a station fails on the primary ring.

If you attach the hub in a dual homed configuration, the B port is used as the primary link (B precedence rule), and the A port becomes the backup link. If the primary link fails, the backup link is enabled. To achieve a dual homed configuration, connect the A and B ports to neighbor M ports on one or two other hubs or other devices.

The concept of neighbor is shown in Figure 3-6.



**Figure 3-6. Upstream and Downstream Neighbors**

To display the addresses of the hub's upstream and downstream neighbors, enter the *show neigh* command.

A single attachment to the ring occurs when you use the S/M attachment port configuration. Because the S port restricts the hub to single attachment, the S port is never attached directly to the primary trunk ring and cannot participate in wrap configuration.

The M/M attachment port configuration restricts the hub to a null attachment type.

Tables 3-3 and 3-4 define and summarize the port connection rules supported by the FDDI specification.

Table 3-3. Port Connection Rules

Attachment Ports	Neighbor Ports			
	A	B	M	S
A	V, U, T	V	V, P, W	V, U, W
B	V	V, U, T	V, P, W	V, U, W
M	V, W	V, W	X	V
S	V, U, W	V, U, W	V	V

Table 3-4. Definitions for the Port Connection Rules

Condition Indicator	Port Connection Condition	Definition of Port Condition
P	Prevents thru state	Exists when both rings are not fully functional. Thru state is the normal condition of an FDDI station.
U	Undesirable connection	Exists because the connection creates undesirable hub configurations, such as a twisted ring; not prevented by the connection rules.
V	Valid connection	Creates two logical token rings; provides a consistent designation of the primary ring among all stations.
X	Illegal connection	Exists when an M-to-M connection is formed. It isolates a portion of the network onto a separate token ring nested in the tree of rings.

(continued)

**Table 3-4. Definitions for the Port Connection Rules (continued)**

<b>Condition Indicator</b>	<b>Port Connection Condition</b>	<b>Definition of Port Condition</b>
W	Wrap state	Exists when a break in the primary ring occurs and the stations on either side of the break join the primary and secondary rings. It can also indicate that the ring is wrapped at a particular port.
T	Twisted ring	Exists when an A-to-A or a B-to-B connection is formed. It divides the network into two groups of stations that disagree on which token ring is the primary ring.

The connections listed below are not allowed:

- M to M: an illegal connection
- A to A: an undesirable connection that creates a twisted ring
- B to B: an undesirable connection that creates a twisted ring

The connection rules do not necessarily prevent undesirable connections. An “undesirable connection” designation reflects the connection status of the sending node only. The connection can still be made if the receiving node exhibits an acceptable connection status.

## Configuring Modules

You can only configure the module inserted in slot 1, and you can only configure the two leftmost ports (the attachment ports) of that module. The attachment port configuration is stored in nonvolatile RAM. Any attachment port configuration changes that you make take effect when the system is reinitialized. To reinitialize the hub, execute the *reset* command.

All three types of port modules can be installed in slot 1. The type of module you install depends on the medium you are using to connect the hub to the next node.

Table 3-5 shows how to configure each module for the type of attachment desired and what additional equipment or action is necessary to complete the connection. (Refer to the section “Setting Attachment Port Configurations” in Chapter 4 for information about configuring the attachment ports.)

For example, if you want to establish either a dual attachment or a dual homed connection, configure the module’s attachment ports as B/A. For a single attachment connection, configure the module’s attachment ports as S/M. For a null attachment, set the attachment ports as M/M.

To discover the configuration of the attachment ports on the module in slot 1, check the ATTACH LED display on the management module or enter the *show attach* command. The ATTACH LED is lit whenever there is a module installed in slot 1.

**Table 3-5. Configuring Modules**

<b>Module</b>	<b>Attachment Type</b>	<b>Attachment Port Configuration</b>	<b>Additional Equipment Required</b>
Fiber	Dual	B/A	None
	Dual homing	B/A	None
	Single	S/M	None
	Null	M/M	None
STP	Dual	B/A	2 Cascade connectors
	Dual homing	B/A	2 Cascade connectors
	Single	S/M	1 Cascade connector
	Null	M/M	None

(continued)

Table 3-5. Configuring Modules (continued)

Module	Attachment Type	Attachment Port Configuration	Additional Equipment Required
UTP	Dual	B/A	Cross-over cable
	Dual homing	B/A	Cross-over cable
	Single	S/M	Cross-over cable
	Null	M/M	Cross-over cable

To change the configuration of the attachment ports, follow these steps:

**1. Enter the *set attach* command. Type:**

```
set attach
```

This selection prompt appears:

```
Select one of the following:
```

1. B/A
2. S/M
3. M/M

```
Attachment port configuration?
```

**2. Select the attachment port configuration that you want. For example, type:**

```
2 [Enter]
```

These confirmation lines appear:

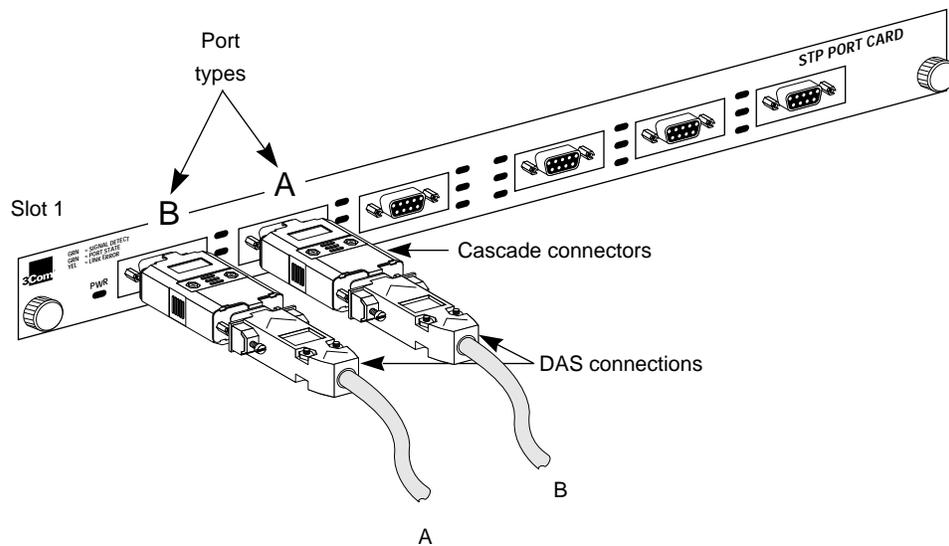
```
Current configuration:           B/A
Initialize attachment as:      S/M
```

When you reset the hub, the attachment ports will be configured as S/M.

### Using the STP Cascade Connector

By default, all ports on an STP media module are physically configured as M ports. If you want to configure the module for a B/A or S/M connection, you must use one or two STP cascade connectors to allow the new configuration. (The STP cascade connector gets its name from its use in connecting a series of rack-mounted hubs in which the connecting cascade cables “flow” from one hub down to the next.)

Figure 3-7 shows two STP cascade connectors installed on an STP module to allow dual attachment configuration.



**Figure 3-7. Using Two STP Cascade Connectors to Allow a Dual Attachment Configuration**

To use an STP module in a dual attachment configuration, for example, follow these steps:

- 1. If the attachment ports are not currently configured as B/A, configure the attachment ports to be B/A by invoking the *set attach* command.**

- 2. Reset the hub.**

This step is unnecessary if the attachment ports are already set as B/A.

- 3. Install two cascade connectors.**

Insert one cascade connector in each of the two leftmost ports of the STP module in slot 1.

- 4. Attach the appropriate cables to the two cascade connectors.**

The cable from port number 1 (the B port) should attach to port A on the device to be dual attached. The cable from port number 2 (the A port) should attach to port B on the device.

# Chapter 4

## Setting Up the Hub

The LinkBuilder FDDI Workgroup Hub is shipped ready to plug in and use without the need to change any parameters. In all probability, however, you will want to make a number of changes to adapt the hub to your network environment. This chapter discusses how to use the management console commands to set up the hub and make any desired parameter changes. Topics include:

- Using commands to:
  - Set addresses
  - Set the password
  - Set attachment port configuration
  - Set station management parameters
- Downloading new images

### Commands

The commands supported by the management console command mode and the primitive console command mode enable you to set and display the basic parameters needed to configure and operate the hub. The commands are grouped into three functional categories that are defined below:

- Use *set* commands to institute various functions.
- Use *show* commands to display default parameter settings and reflect any changes you make.
- Use miscellaneous commands to support various diagnostic and troubleshooting functions.

## Command Descriptions

For a complete listing and detailed description of all the commands, refer to Appendix C, “Commands.”

- For a list of the *set* commands with brief definitions, type:

```
set ? or  
set help
```

- For a list of the *show* commands with brief definitions, type:

```
show ? or  
show help
```

- To display a list of the miscellaneous commands with brief definitions, type:

```
help or  
?
```

## Display of Command Results

You can use the *set* commands to change various parameters. The results of several management console command actions are shown in a two-line display, as follows:

```
Current . . . .  
Initialize . . . .
```

Where Current is the present parameter setting and Initialize is the desired parameter setting that will take effect when the hub is reset.

## Setting Addresses

The hub management module uses the TCP/IP network environment for downloading images and managing the hub. Refer to the section “Downloading New Images” later in this chapter for a discussion of downloading procedures.

The console command `set` provides for setting and displaying TCP/IP-related addresses. To display these addresses, enter the `show ip` command.

### IP Address

The IP address is a unique 32-bit identifier for a specific TCP/IP host or other device. Contact your network administrator for the IP addresses that you need.

- To set the IP address, type `set ip` followed by the hub’s IP address, the netmask (optional), and the broadcast IP address (optional). For example, type:

```
set ip 128.45.87.25 255.255.0.0 128.45.255.255 [Enter]
```

Your input is echoed after you press [Enter], as shown below:

```
IP address    :128.45.87.25
Netmask      :255.255.0.0
Broadcast    :128.45.255.255
```

- If you type only `set ip`, this usage message appears:

```
Usage: set ip address [netmask] [broadcast]
where address is the IP address for this hub
      netmask is the IP network mask [optional]
      broadcast is the IP broadcast address [optional]
e.g. set ip 128.45.87.25 255.255.0.0 0.0.255.255
```

- If you type `set ip` followed by only one IP address, the netmask and broadcast address are automatically calculated, as shown below:

```
set ip 128.45.87.25
IP address    :128.45.87.25
Netmask      :255.255.0.0
Broadcast    :128.45.255.255
```



**NOTE:** In this manual, the address format used (three digits in each octet) is assumed to be decimal representation. If you prefer hexadecimal representation, the address format would be 0x12.0x34.0x56.0x78. The “0x” indicates that the subsequent digits represent hexadecimal values.

## Netmask

The netmask, also known as the subnet mask, is used when multiple physical networks share the same IP address. The bits in the mask determine those bits of the IP address that specify various subnetworks. The mask is determined locally.

## Broadcast Address

The broadcast address is a special group address. It denotes all stations on the network, and all the bits are set to one. For example, if you entered 128.45.255.255, the message would be broadcast to all IP hosts on network 128.45.

## Default Gateway Address

The default gateway address is the Internet address of the gateway used when there are multiple IP networks. The default gateway address is administered locally, usually by an MIS department.

To set the default gateway address, enter the *set gateway* command followed by the default address. If you omit the address, this message appears:

```
Usage:  set gateway address
        where address is the IP default gateway address
        e.g. set gateway 128.45.76.10
```

## Setting the Password

Access to the hub is password-protected. To display the password prompt when the hub is first powered up, press any key. The modem init string (AT&F) appears briefly. You are then prompted for the password. The hub is shipped with no password installed. At the password prompt, press [Enter].

You can set the password using either the management or the primitive console command mode. (Refer to the section “Accessing Configuration Commands” in Chapter 3 for information about these two console command modes.) Once you enter a password, it will be required every time you reset the hub.

To set your own password, follow these steps:

- 1. Enter the *set pwd* command from the terminal that is connected to the management module’s serial port.**

You will be prompted for the old password if you are in the management console command mode.



**NOTE:** *In the primitive console command mode you will not be prompted for the old password. Skip to step 3.*

- 2. Enter the old password.**

You will be prompted for a new password.

- 3. Enter the new password.**

The password can be one to eight alphanumeric characters. Passwords are case sensitive.

- 4. At the next prompt, confirm the new password by reentering it.**

If you entered the new password correctly, this message appears:

```
Password changed
```

If you entered the password incorrectly, this message appears:

```
Password not changed.
```

## Setting Attachment Port Configurations

To configure the attachment ports, use the *set attach* command.

**1. Type the command:**

```
set attach
```

This selection prompt appears:

```
Select one of the following:
```

1. B/A
2. S/M
3. M/M

```
Attachment port configuration?
```

**2. Enter the configuration you want. For example, type:**

```
2 [Enter]
```

A confirmation message similar to the following appears:

```
Current configuration is : B/A  
Initialize attachment as : S/M
```

This message means that the hub's current attachment port configuration is B/A (dual attachment). When you reset the hub, the attachment ports will be initialized as S/M. (Refer to Chapter 3, "Configuring the Hub," for descriptions and diagrams of the attachments supported by the LinkBuilder FDDI Workgroup Hub.)

## Using Station Management Parameters

The hub supports a number of station management (SMT) parameters to help you understand and manage the processes occurring in the FDDI ring. You can set and display three of these parameters. You can display three other parameters, but you cannot set them.

### Setting SMT Parameters

Using the console interface, you can display and change these SMT parameters:

- Neighbor Notification Timer (T-Notify)
- Target Rotation Time (T-Req)
- Link Error Rate (LER) alarm and cutoff values

### Neighbor Notification Timer (T-Notify)

The T-Notify parameter functions as one element of the Neighbor Notification protocol. This protocol allows a MAC to determine the address of its logical upstream and downstream neighbors. The Neighbor Notification process is performed independently for each MAC in a station. The process facilitates the detection of, isolation of, and recovery from network errors by supplying each MAC with logical fault information.

The protocol performs these functions by periodically initiating a request-response frame exchange between a MAC and its nearest downstream neighbor. The T-Notify parameter determines how frequently Neighbor Information Frames (NIFs) are broadcast to the ring.

The T-Notify parameter is stored in nonvolatile RAM. You can set it using the *set tnotify* command. The factory-set default for T-Notify is 30 seconds, but it can be set in the range of 2 to 30 seconds. A change to T-Notify takes effect immediately.

To show the current value of T-Notify, enter the *show tnotify* command. A display similar to the following appears:

```
T-Notify = 20 seconds
```

### Target Token Rotation Time (T-Req)

The FDDI ring is initialized every time a station joins or leaves the ring. During the initialization process, all stations on the ring agree on a “token rotation time.” This is the maximum amount of time that any station has to wait for a token to arrive, and it establishes the minimum level of service on the ring. (Level of service relates to how often a station requires access to the token.)

The Target Token Rotation Time (TTRT) is the service level required by an individual station. During the initialization process, each station makes a request for a level of service that is identical to its local TTRT. This service level request is called T-Req.

T-Req is stored in nonvolatile RAM and can be set using the *set treq* command. The factory-set default is 165 milliseconds. Changes to T-Req take effect only when the system is reset.

To display the current value of the Target Token Rotation Time parameter, enter the *show treq* command. This display appears:

```
Current T-Req = 165000 microseconds
Initialize T-Req as = 160000 microseconds
```

### Link Error Rate (LER)

The Link Error Monitor (LEM) examines the Link Error Rate (LER) per active port as part of its responsibility for keeping link quality at an acceptable level. The LEM uses a threshold test to compare the current LER cutoff threshold to the LER alarm threshold.



**NOTE:** You must always keep the *LER\_Alarm* parameter larger than the value entered for the *LER\_Cutoff* parameter.

These two thresholds are explained below:

**LER\_Alarm.** This threshold is the LER at which a link connection exceeds the present threshold and will generate an alarm. The factory-set default is 10.E-08 (10<sup>-8</sup>). This error rate is equivalent to about one error per second.

Set this value higher if the link between stations must handle higher error levels. This can be necessary if you are waiting for minor unit or cable repairs but the ring is still operational. Set this value lower if you are confident of the quality of the link.

To change the LER\_Alarm parameter, follow these steps:

**1. Enter the *set ler alarm* command. Type:**

```
set ler alarm [Enter]
```

You are prompted for the module number and the port number.

```
Module?
```

```
Port?
```

The current LER values are displayed, followed by a prompt for your response. For example:

```
Current LER Alarm exponent = 8
```

```
Current LER Cutoff exponent = 7
```

```
LER alarm [7...15]?
```

**2. Enter the new LER alarm value. For example, type:**

```
7 [Enter]
```

If you enter an alarm value that is less than the current cutoff value, this message appears:

```
Error: The alarm exponent must be >= current cutoff  
exponent.
```

```
Set alarm exponent >= 7 or change the cutoff  
value.
```

**LER\_Cutoff.** This threshold is the link error rate at which a faulty or poor link connection will be broken. The factory-set default is 10.E-07 ( $10^{-7}$ ). If the LER exceeds the limits set by this option, the hub will automatically reestablish the connection to this port. If this is not possible, the port will be bypassed until the fault is corrected.

To change the LER\_Cutoff parameter, follow these steps:

**1. Enter the *set ler cutoff* command. Type:**

```
set ler cutoff [Enter]
```

You are prompted for the module number and the port number.

```
Module?
```

```
Port?
```

The current LER values are displayed, followed by a prompt for your response. For example:

```
Current LER Alarm exponent = 8
```

```
Current LER Cutoff exponent = 7
```

```
LER cutoff [4...8]?
```

**2. Enter the new LER cutoff value. For example, type:**

```
7 [Enter]
```

If you enter a cutoff value that is more than the current alarm value, this message appears:

```
Error: The cutoff exponent must be <= current alarm
       exponent.
       Set cutoff exponent <= 8 or change the alarm
       value.
```

If you enter a cutoff value greater than 15, this message appears:

```
Error: Cutoff must be in the range 4 to 15
```

Changes to these parameters take effect immediately. The *show ports* command displays the current values of these parameters.

## Displaying SMT Parameters

These three SMT parameters, which you can display but cannot change, provide additional information about ring timer functions:

- Maximum Token Rotation Time (T-Max)
- Negotiated Time (T-Neg)
- Valid Transmission Timer (TVX)

### Maximum Token Rotation Time (T-Max)

The Maximum Token Rotation Time (T-Max) is the maximum length of time allowed for the token to move around the ring. The factory-set default is 167.77 milliseconds. To view the value of the T-Max parameter, enter the *show tmax* command. A display similar to the following appears:

```
T-Max = 167772 microseconds
```

### Negotiated Time (T-Neg)

The Negotiated Time (T-Neg) is the ring's operational Target Token Rotation Time that results from the stations' bidding process in which the station requesting the fastest token rotation time wins the right to initialize the ring. To view the current value of T-Neg, enter the *show neg* command. A display similar to the following appears:

```
T-Neg = 83886 microseconds
```

### Valid Transmission Timer (TVX)

The Media Access Control (MAC) protocol is responsible for all frame-based functions and controls a station's access to the ring. Each MAC is required to maintain a Valid Transmission Timer (TVX). The expiration threshold of the TVX indicates the maximum time allowed between the receipt of valid frames or tokens.

The factory-set default is 2621.40 microseconds. You cannot adjust the value of TVX, but you can display its value. To display the current value of TVX, enter the *show tvx* command. A display similar to the following appears:

```
TVX Value in use = 2.62 milliseconds
```

## Downloading New Images

When you power up the hub, it runs a series of self-tests and then executes the software image stored in the flash EPROM.

Whenever you receive a software upgrade from 3Com, you will store the new image in an accessible network server that supports TFTP (Trivial File Transfer Protocol). You must download the new image from the server into the hub's flash EPROM.

Using the TFTP option to download new images requires you to enter certain variables individually. This downloading method is described below.



**NOTE:** You cannot load the flash image over the serial link via a modem.

### Downloading from the TFTP Option

To download an image from a TFTP server, follow these steps:

**1. Set the server location of the information to be downloaded. Type:**

```
set boot method [Enter]
```

This selection prompt appears:

```
Select one of the following:
```

```
1. LOCAL
```

```
2. TFTP
```

```
Boot Method?
```

**2. Select the TFTP server option. Type:**

```
2 [Enter]
```

This display appears, confirming your selection and showing that you also need to enter the TFTP server's IP address and the image filename.

```
Boot parameters
Method      :TFTP
Server      :
Filename    :
```

**3. Set the TFTP server's IP address. Type:**

```
set boot server [Enter]
```

This prompt appears:

```
Enter server IP address in dot notation?
```

**4. Type the server's IP address. For example, type:**

```
123.44.55.66 [Enter]
```

This confirmation appears:

```
Boot parameters
  Method      : TFTP
  Server      : 123.44.55.66
  Filename    :
```

**5. Set the image filename to be used. Type:**

```
set boot filename
```

The file name prompt appears:

```
Enter filename?
```

**6. Type the name of the image file after the question mark. For example, type:**

```
newimage [Enter]
```

This display appears, showing your entries:

```
Boot parameters
  Method      : LOCAL
  Server      : 123.44.55.66
  Filename    : newimage
```

Optionally, if connection to the TFTP server is through a gateway, you must enter the gateway address.

**7. Enter the default gateway's IP address. For example, type:**

```
set gateway 123.44.66.88 [Enter]
```

Your local administrator should provide the gateway address you need.

**8. Reset the hub.**

Press the RESET button.

The new image is now downloaded and stored in the flash EPROM. If no errors are encountered, the hub is reset and the new image is executed.

## Displaying the Current Download Method

To display the current download method, enter the *show boot method* command. This command displays the current download method, the IP address of the boot server, and the filename of the image, as shown below:

```
Boot parameters
  Method      : TFTP
  Server      : 128.34.56.78
  Filename    : newimage
```

To display the status of the last download, enter the *show boot load* command. An example of the resulting display is shown below:

```
Last download
  Status      : TFTP download completed successfully
  Method      : TFTP
  Server      : 128.34.56.78
  Filename    : newimage
```



**NOTE:** For a list of the last download status messages that may be displayed, refer to the section “Download Messages” in Appendix A.

Table 4-1 summarizes the available boot methods.

**Table 4-1. Definition of Boot Methods**

<b>Boot Method</b>	<b>Definition</b>
LOCAL	Runs flash EPROM (default)
TFTP	Uses the TFTP protocol and local configuration parameters to load a new image across the network

# Chapter 5

## Using the Hub

This chapter discusses how to use the available commands and LED indicators to operate the LinkBuilder FDDI Workgroup Hub. This includes:

- Getting information about hub operation
- Interpreting LED behavior
- Using miscellaneous commands

### Getting Hub Information

To get information about data flow on the FDDI ring through the hub, enter the *show* commands described in this section.



**NOTE:** You can abbreviate the display command *show* as *sh*.

#### Show Hub Configuration

To display the configuration of the attachment ports on the port module in slot 1, enter the *show attach* command. An example of the resulting display is shown in Figure 5-1.

```
>sh attach
  Current configuration is:   B/A
  Initialize attachment as:  B/A
```

**Figure 5-1. Display of Attachment Port Configuration**

#### Show MAC Frame Statistics

To display the raw frame statistics for the hub's MAC, enter the *show fstats* command. An example of the resulting display is shown in Figure 5-2.

```
>sh fstats
  Raw frame statistics for primary MAC:
    Total transmit frames      = 632
    Total received frames     = 1561
    Total transmit SMT frames = 550
    Total received SMT frames = 1513
    Total transmit LLC frames  = 83
    Total received LLC frames  = 48
    Total received short frames = 0
    Total received invalid frames = 0
    Total aborts               = 0
    Received resets            = 0
    Directed beacons entered    = 0
    Directed beacons sent      = 0
```

**Figure 5-2. Display of MAC Frame Statistics**

Table 5-1 defines the elements for which MAC statistics were collected and displayed in Figure 5-2.

**Table 5-1. Components Polled by the *show fstats* Command**

---

<b>MAC Statistical Components</b>	<b>Functions of Listed Components</b>
SMT (station management) frames	Provide network statistics, detect network faults, and tune configuration and operational parameters
LLC (logical link control) frames	Provide an interface between the MAC and the higher-level protocols operating in the hub
Short frames	Indicate invalid data length
Invalid frames	Contain incorrect contents
Aborts	Indicate the termination of the operation, which may be caused by lack of memory
Resets	Reinitialize the hub
Directed beacons	Inform the management station that the local MAC is stuck at beacon (indicating a serious ring failure)

---

## Show IP Addresses

To display the current IP address, IP netmask, and the Internet broadcast address of the hub, enter the *show IP* command. An example of the resulting display is shown in Figure 5-3.

```
>sh ip
  IP address : 128.56.87.25
  Netmask    : 255.255.0.0
  Broadcast  : 128.56.255.255
```

**Figure 5-3. Display Produced by *show IP* Command**

## Show MIB Counters

The *show mib counters* command illustrates one type of command used by the optional SNMP management application. An example of the display produced by the *show mib counters* command is shown in Figure 5-4.

```
>sh mib counters

Primary MAC fddiMACCounters Grp:

fddiMACFrame-Ct      = 6417      fddiMACError-Ct      = 0
fddiMACCopied-Ct     = 765       fddiMACLost-Ct       = 0
fddiMACTransmit-Ct   = 732       fddiMACNotCopied-Ct  = 0
fddiMACToken-Ct      = 45202063  fddiMACRingOp-Ct    = 0
```

**Figure 5-4. Display Produced by *show MIB counters* Command**

The MIB counters shown in Figure 5-4 are defined in Table 5-2.

**Table 5-2. Definition of MIB Counters**

<b>MIB Counter</b>	<b>Definition</b>
fddiMACFrame-Ct	Number of frames received
fddiMACCopied-Ct	Number of frames copied
fddiMACTransmit-Ct	Total number of frames transmitted
fddiMACToken-Ct	Number of tokens
fddiMACError-Ct	Number of error frames
fddiMACLost-Ct	Number of frames with format errors
fddiMACNotCopied-Ct	Number of frames not copied
fddiMACRingOp-Ct	Number of ring recoveries

## Show Neighbor Stations

To determine the hub's upstream and downstream neighbor station addresses, enter the *show neigh* command. Figure 5-5 illustrates the 48-bit addresses of a hub's neighbors.

```
>sh neigh
  MAC Upstream Neighbor   : 40:0A:1F:B3:CC:24
  MAC Downstream Neighbor : 40:0D:4F:33:40:AE
```

**Figure 5-5. Display of Neighbors' Addresses**

## Show Station Identification

To discover the station's FDDI identifier and MAC address, enter the *show sid* command. Figure 5-6 shows the results of entering this command.

```
>sh sid
  Station ID:   00 00 02 60 8C EA EB EE
  MAC/SMT Addr: 02:60:8C:EA:EB:EE (noncanonical)
  LLC Addr:    40-06-31-57-D7-77 (canonical)
```

**Figure 5-6. Display of Station Identifier**



**NOTE:** The canonical form is a hexadecimal string, written from left to right, with hyphens separating the individual octets. The noncanonical form uses colons instead of hyphens as separators.

## Show Ports Information

To view the details of a port module, enter the *show ports* command, followed by the slot number of the specified module. If you enter this command using the number of an empty slot, this message appears:

```
That port module slot is empty.
```

If you enter 0 (zero) for the slot number, this message appears:

```
There are no ports in the management module slot.
```

If you do not specify a slot number, you will be prompted for one.

Figure 5-7 shows the results of entering this command with a fiber media module in slot 1 and two additional modules in the remaining slots.

```
>sh ports 1

Module: 1 of 3
Port          1          2          3          4
PMD Class:   Fiber      Fiber      Fiber      Fiber
PHY Type:    B          A          M          M
Neighbor:    A          B          U          U
PCM State:   Active     Active     Connect    Connect
ConnectState:Active Active     Connect    Connect
LER Alarm:   10.E-08    10.E-08    10.E-08    10.E-08
LER Cutoff:  10.E-07    10.E-07    10.E-07    10.E-07
LER Estimate:10.E-11  10.E-09    10.E-09    10.E-11
LEM Rejects: 0          0          0          0
LEM Count:   0          0          0          0
```

**Figure 5-7. Example of *show ports* Command Information**

The Station Management (SMT) acronyms and other line items used in the *show ports* display are defined below along with the values that may appear.

### Module Designation

The first line in the *show ports* display gives the slot number of the module represented by the display and the number of modules installed in the hub. These combinations are possible:

- 1 of 1 one module installed; display describes module in slot 1
- 1 of 2 two modules installed; display describes module in slot 1
- 1 of 3 three modules installed; display describes module in slot 1
- 2 of 2 two modules installed; display describes module in slot 2
- 2 of 3 three modules installed; display describes module in slot 2
- 3 of 3 three modules installed; display describes module in slot 3

### PMD Class

The PMD (Physical Layer Medium Dependent) protocol defines the medium that provides the physical link between two adjacent FDDI stations. Table 5-3 lists and defines the port media types for the PMD Class line in Figure 5-7.

**Table 5-3. Port Media Types**

Medium	Definition
Fiber	62.5 micron multimode fiber
STP	Shielded twisted pair
UTP	Unshielded twisted pair
LCF	Low-cost fiber
N/S	Not specified
Unknown	Unknown connecting medium
Sonet	Synchronous optical network

## PHY Type

The PHY (Physical Layer) protocol specifies the rules for encoding data for transmission from one FDDI station to another. Table 5-4 lists and defines the physical port types for the PHY Type line in Figure 5-7.

**Table 5-4. Physical Layer Port Types**

Physical Port Type	Definition
A	The port in a dual attachment station or hub that attaches to the Primary In and the Secondary Out when attaching to the dual ring
B	The port in a dual attachment station or hub that attaches to the Secondary In and the Primary Out when attaching to the dual ring
M	A port in a hub that serves as a Master to a connected station or hub
S	A port in a single attachment station or hub designated as a Slave
U	Unknown port type

## Neighbor

Neighbor displays the port type when PCM (Physical Connection Management) State is Active. When PCM State is no longer Active and you enter the *show ports* command again, the Neighbor field displays the last reported port type. This is true even if you have physically removed the cable that was previously connected to the port.

## PCM State

The PCM (Physical Connection Management) protocol initializes the connection of neighboring ports and manages the signaling between ports. Table 5-5 lists and defines the Physical Connection Management states for the PCM State line in Figure 5-7.

**Table 5-5. Physical Connection Management States**

<b>Physical Connection Management States</b>	<b>Definition</b>
Active	The port is incorporated into the token ring path.
Break	A port connection has been broken and a restart process has begun.
Connect	Both ends of the port's requested connection are synchronized.
Join	This signal ensures that both ends of a connection can enter the active state together.
Next	The port is exchanging connection information with its neighboring ports.
Off	The port is in an Off state.
Signal	The port is ready to transmit data.
Trace	The port recognizes a fault condition and is trying to detect its location.
Verify	The port is in the process of entering the Active state.
Maintenance (Maint)	The port has moved from the Off state to the Maint state, which can be used to determine the status of the neighboring machine.

### Connect State

The Connect State indicates the state of each ports' connection. Table 5-6 lists the values and defines the connect states for the Connect State line in Figure 5-7.

**Table 5-6. Connect States**

Connect State Value	Definition
Active	The port is incorporated into the token ring path.
Connect	Both ends of the port's requested connection are in the process of being synchronized.
Disabled	The port is nonoperational.
Standby	The port is waiting for initialization to finish before completing the requested connection. In the case of a dual homing configuration, the A port is held in Standby while the B port is Active.

### LER Alarm and LER Cutoff

The LER alarm value is the Link Error Rate (LER) at which a link connection exceeds the present threshold and generates an alarm.

The LER cutoff is the link error rate at which a faulty or poor link connection will be broken.

For a complete description of these two link error rate parameters and their values, refer to the section "Setting SMT Parameters" in Chapter 4.

### LER Estimate

This parameter provides a long-term average Link Error Rate estimate. LER Estimate ranges from  $10^{-4}$  to  $10^{-15}$ .

### **LEM Rejects**

This parameter lists the number of times a link is removed because the error rate has exceeded the threshold test, as determined by the link error monitor (LEM).

### **LEM Count**

This parameter provides the aggregate link error count, which is set to zero only on station initialization. The aggregate link error count is determined by the link error monitor (LEM).

### **Show Ring State**

To determine the Ring Management (RMT) state of the primary MAC, enter the *show ring* command. Figure 5-8 shows a sample MAC RMT state, in which the ring is operational.

```
>sh ring
    Current RMT state: Ring_Op
```

**Figure 5-8. Display of a MAC's Ring Management State**

The Ring Management (RMT) values that can appear in the *show ring* display are defined in Table 5-7.

**Table 5-7. Ring Management States**

<b>Ring Management State</b>	<b>Definition</b>
Isolated	The initial RMT state.
Non_Op	The MAC is participating in ring recovery, and the ring is not operational.
Ring_Op	The MAC is part of an operational FDDI ring.
Detect	The ring has not been operational for a specified period.
Non_Op_Dup	The address of the MAC under control duplicates the address of another MAC on the ring. The ring is not operational.
Ring_Op_Dup	The address of the MAC under control duplicates the address of another MAC on the ring. The ring is operational.
Directed	The MAC under control is sending beacon frames notifying the ring of a stuck condition.
Trace	RMT has discovered a stuck beacon condition and is initiating a trace to recover.

## Interpreting the LEDs

The LEDs located on the faceplates of the management module and the various media modules provide information about the configuration and operation of the hub.

### Management Module LEDs

The interpretation of the management module LEDs is shown in Table 5-8.

Table 5-8. Interpreting Management Module LEDs

LED	Color Indicators	Meaning
PWR	Green	Hub is on.
ATTACH		Only one attachment exists at any one time. Configuration refers only to module in slot 1:
B/A	Green	Port 1= B, port 2 = A, other ports = M
S/M	Green	Port 1= S, other ports = M
M/M	Green	All ports = M
STATUS	Amber	From 0 to 20 seconds after reset: power-on self-test (POST) is in progress.
		20+ seconds after reset: hardware failure has occurred in management module, backplane, or critical parts of port modules.
	Flashing amber/green	Access to the primitive command mode is available now. If a reset occurs during this limited period, you are instructed to press [Ctrl]+P to enter primitive console mode
	Flashing amber/off	Failure has occurred during download operation.
	Flashing green/off	TFTP download is in progress.
TOKEN	Green	Normal operation.
	Green	The token is circulating and the ring is operational.
	Off	A ring operation is occurring.
WRAP	Amber	The ring is wrapped.
FAN FAIL	Amber	A fan failure has occurred.
HI TEMP	Amber	A high-temperature condition exists (above 50° C inside the chassis).
LOW BATT	Amber	A low battery voltage condition exists.

Additional information about the last four LEDs in Table 5-8 is provided below.

### WRAP LED

If the WRAP LED is on, a ring wrap condition exists on the hub. To determine where the wrap has occurred, enter the *show cfm* command. This command displays the Configuration Management (CFM) state of the dual ring inside the hub. Table 5-9 defines the possible CFM states. A path in this definition represents the segment of a logical ring that passes through a station.

**Table 5-9. CFM State Values Displayed by the *show cfm* Command**

CFM State	Definition
Wrap_a	The secondary path is wrapped to the A port.
Wrap_b	The primary path is wrapped to the B port.
Wrap_s	The primary path is wrapped to the S port.
C_wrap_a	The primary and secondary paths are joined internally to the station and wrapped to the A port.
C_wrap_b	The primary and secondary paths are joined internally to the station and wrapped to the B port.
C_wrap_s	The primary and secondary paths are joined internally to the station and wrapped to the S port.
Isolated	The MAC or port is not inserted into any path.
Thru	The primary path enters the A port and emerges from the B port. The secondary path enters the B port and emerges from the A port. This is normal FDDI operation.

Not all wrap conditions activate the WRAP LED. The WRAP LED lights when a wrap condition involves a peer-mode connection. A, B, and S ports are considered peer ports, and any connection between two peer ports is a peer-mode connection. (An S-to-S connection is the exception and is not considered a peer-mode connection.)

Any connection of an A, B, or S port with an M port is a tree-mode connection. When the wrap condition involves a port connected in tree mode (an M port), the WRAP LED remains off.

### **FAN FAIL LED**

If the FAN FAIL LED shows amber, the fan has failed and must be replaced. You must send the hub base unit back to 3Com to replace the fan. Contact your 3Com representative for a Return Materials Authorization (RMA).

### **HI TEMP LED**

If the HI TEMP LED shows amber, it means that the temperature in the hub exceeds 50° C. Check to be sure that nothing is blocking air flow around the chassis. If the temperature in the wiring closet exceeds 50° C and nothing is blocking the flow of air into the hub, you should install a cooling system for the closet.

### **LOW BATT LED**

If the LOW BATT LED is on, a low battery condition exists and nonvolatile RAM will not retain data if power is lost. You must replace the battery. See the instructions in the section “Installing the Battery” in Chapter 2.

### **Dangerous Environmental Conditions Display**

If any of the environmental dangers exist (Fan Fail, Hi Temp, or Low Batt), the appropriate LED listed in Table 5-8 will show amber. In addition, an appropriate message appears on a terminal directly or remotely (Telnet) connected to the hub.

When one or more of these conditions exist, a message is appended to any displayed command string or new line followed by [Enter] that you type. For example, if all conditions were to exist, you would see the following alert message after you entered a command and the terminal displayed the command's response:

```
Hardware: (FAN FAILURE) (HIGH TEMP) (LOW BATTERY)
```

Only those conditions that exist will be displayed. If none exist, nothing is displayed.

If a high temperature condition existed but no longer does, this message appears:

```
Hardware: (HIGH TEMP SEEN)
```

To remove this message, enter the *clear alarm* command, as shown below:

```
clear alarm [Enter]
```

This is the only environmental condition that requires you to invoke the *clear alarm* command. The other two danger conditions are cleared only when the condition no longer exists. Otherwise, the warnings reappear with every subsequent command and new line that you type.

### Reset Function

The reset function reinitializes the hub and runs the power-on self-tests (POST). You should perform a reset before removing or adding a module to the hub. Any devices connected to the hub when a reset is performed are momentarily disconnected until the tests are completed. The hub then attempts to reconnect the devices.

Before the reset begins, you are prompted to confirm the reset request. This gives you the opportunity to make changes in network connections, such as entering the *disconnect* command, which disconnects the hub from the ring. This allows you to avoid other problems that could occur with an unexpected interruption of service.

You can perform the reset function in one of two ways:

- Enter the *reset* command on the command line.
- Press the RESET button on the management module.

The RESET button on the management module is recessed behind the faceplate. To access the RESET button, insert a small pointed object, such as the tip of a sharp pencil or end of a bent paper clip, into the hole below the RESET label.

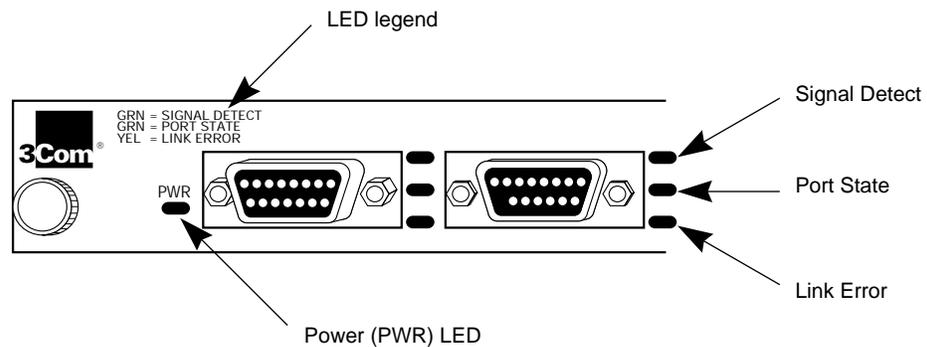
Pressing the RESET button performs the two functions described below:

**Reinitialize.** If you press the RESET button only briefly, the hub reinitializes and performs the power-on self-tests (POST). The tests take several seconds to complete.

**LED Check.** If you hold down the RESET button, all functioning LEDs on all installed modules light. This allows you to determine whether any LEDs are not functioning. When you release the RESET button, the reinitialize function begins.

### Media Module LEDs

Each port connector on each module is equipped with three LEDs. The Signal Detect LED indicates whether or not a received signal is present. The Port State LED indicates the port's connection state. The Link Error LED indicates the existence of a link error or a marginal connection. Figure 5-9 shows the location of the LEDs on the STP module. The LED locations are the same on the other media port modules. Table 5-10 interprets the meaning of the LED colors.



**Figure 5-9.** LEDs on the STP Module

**Table 5-10. Interpreting Media Module LEDs**

<b>LED</b>	<b>Color Indicators</b>	<b>Meaning</b>
Signal Detect	Green	The signal is detected.
	Off	No signal exists.
Port State	Green	Port is in active connection state.
	Flashing green/off	Port is in standby connection state.
	Off	Port is in disabled or connecting state.
Link Error	Amber	Link confidence test failure: link error rate cutoff threshold has been exceeded, triggering an alarm.
	Off	Port is operating normally.

In addition to the functional LEDs, each module has a power (PWR) LED, which turns green to indicate the module is on.

## Using Miscellaneous Commands

Several commands provide diagnostic and connectivity functions.

### Diagnosing Network Problems

The commands described in this section provide statistical information that may help solve network problems.

### ***ping* Command**

The *ping* command sends echo frames to a host and expects to receive a like number of echo frames in return. Use the *ping* command to find out whether or not a host on the network is operational. For example, type:

```
ping 128.45.87.20
```

where 128.45.87.20 is the host address in Internet dot notation. The address can either be a specific station IP address or a broadcast address.

If the host is operational, this reply is displayed:

```
128.45.87.20 is alive
```

If the host is not operational, this reply is displayed:

```
no answer from 128.45.87.20
```

You can specify two options with the *ping* command:

- **size** This optional argument has a default value of 56 bytes and specifies the number of data bytes in the echo frames.
- **cnt** This optional argument (count) has a default value of one (1) and specifies the number of echo frames to be sent.

If you type the *size* option with the *ping* command, the echoing display includes the host address and the number of bytes in the frame, which should equal the *size* data bytes plus eight frame header bytes. For example, if you type this string, in which 64 is the *size* option variable:

```
ping 128.45.87.10 64
```

this response is displayed:

```
PING 128.45.87.10: 64 data bytes
```

```
128.45.87.10 is alive
```

If you type the *count* option with the *ping* command, the resulting display contains the *ping* statistics, which include the number of packets sent, the number of packets received, and the percentage of packets lost. For example, if you type this string, in which 64 is the *size* option variable and 5 is the *count* option variable:

```
ping 128.45.87.10 64 5
```

this response is displayed:

```
PING 128.45.87.10: 64 data bytes

72 bytes from 128.45.87.10: icmp_seq=0.
72 bytes from 128.45.87.10: icmp_seq=1.
72 bytes from 128.45.87.10: icmp_seq=2.
72 bytes from 128.45.87.10: icmp_seq=3.
72 bytes from 128.45.87.10: icmp_seq=4.

—128.45.87.10 PING STATISTICS—
5 packets transmitted, 5 packets received, 0% packet loss
```

To stop the transmission of echo frames before the specified number of responses has been achieved, press [Ctrl]+D. If you request a very large *count* option and the command has not completed its run, the transmission of echo frames will be aborted by a logout or a timeout.

### **route Command**

The *route* command allows you to add and delete entries in the routing table for the specific host indicated by the destination and gateway addresses. You can also display the destination and gateway addresses.

- To add a destination and gateway to the routing table, use this format:

```
route add xxx.xxx.xxx.xxx yyy.yyy.yyy.yyy
```

where *xxx.xxx.xxx.xxx* is the destination IP address and *yyy.yyy.yyy.yyy* is the gateway IP address.

By including a *metric* option, you can indicate the number of hops (number of gateways separating the source and destination) to the designated destination network. For example, to indicate five hops in the above command line, type:

```
route add 128.87.45.12 128.87.45.33 5
```

- To delete a route from the routing table, use the IP address in Internet dot notation. For example, type:

```
route del 128.87.45.12 128.87.45.33
```

- To determine the IP addresses of the destination and gateway, enter the *route dump* command. For example, type:

```
route dump [Enter]
```

This display appears:

```
DESTINATION    GATEWAY
128.87.0.0     128.87.45.15
```

### **arp Command**

The *arp* command allows you to display and change information in the Address Resolution Protocol (ARP) table of the hub. The Address Resolution Protocol maps known IP addresses (32 bits long) to MAC addresses (48 bits long).

- To display the contents of the ARP table, type:

```
arp dump
```

- To delete the IP address of the host, type:

```
arp del xxx.xxx.xxx.xxx
```

where *xxx.xxx.xxx.xxx* is the IP address of the host in Internet dot notation.

- To add an entry to the ARP table, type:

```
arp set xxx.xxx.xxx.xxx hh.hh.hh.hh.hh.hh
```

where *xxx.xxx.xxx.xxx* is the IP address of the host and *hh.hh.hh.hh.hh.hh* is the host 48-bit MAC address in noncanonical format.

### ***show log* and *clear log* Commands**

The fault log keeps a limited history of recent faults that have occurred in the system.

- To display the fault log, type:

```
show log
```

A typical fault log is shown below:

Fault Log:

1.	10000001	0#	0
2.	10000002	0#	0

The first column shows the order of all faults since the last *clear log* command. The second column is the code specifying the type of fault. (Refer to “Fault Log Error Code Messages” in Appendix A for explanations of the error codes.) The third column is a time stamp (in seconds), showing when the fault occurred. (The timer is restarted after each reset.) The fourth column is the number of resets since the last recorded reset.

- To clear the fault log, type:

```
clear log
```

- To display the fault log in reverse order, type:

```
show log last
```

This could be helpful when there are a large number of faults in the log and you want to see the last one first.

## Using Connectivity Commands

Three connectivity commands deal with connecting the hub to the FDDI ring, disconnecting the hub from the ring, and logging out of a console session.

### ***connect* and *disconnect* Commands**

Once you have installed the hub and attached it to the ring and to other network devices, you have established a *connect* condition. You do not have to enter the *connect* command to effect the connection to the ring.

When you enter the *disconnect* (*discon*) command, you disable the ports on the installed modules and disconnect the hub from the ring. The TOKEN LED on the management module turns off to indicate the hub is no longer receiving tokens on the ring.



**CAUTION:** *To avoid the possible loss of data on devices connected to the hub, invoke the disconnect command before removing or adding a module.*

When the *connect* or *disconnect* function has been completed, this notification appears:

Done .

### ***logout* Command**

When you want to close a session from the console, enter the *logout* command. This command also closes a Telnet session if access to the console was through Telnet.

# Appendix A

## System Messages

This appendix lists the error and information messages that may be displayed on the terminal attached to the hub. The messages are listed alphabetically. Each message includes a brief explanation and suggested action.

### Error Messages

#### Bad route command

Meaning: You entered a route command with incorrect syntax.

Action: Follow this syntax for the *route* command:

```
route add destination/gateway [metric]
route delete destination/gateway [metric]
route dump
```

#### Baud rate must be 1200, 2400, 4800, or 9600

Meaning: You entered an invalid baud rate for the serial port.

Action: Enter the *set baud* command again using one of the valid baud rates.

#### Change failed with error xx

Meaning: The change you were attempting to make failed because of the error specified by *xx*.

Action: Take care of error *xx* first; then attempt to make the change again.

**Invalid IP address xxxxxx**

Meaning: You entered an IP address using an incorrect format.

Action: Reenter the address using the dotted decimal notation format *xxx.xxx.xxx.xxx* where *xxx.xxx.xxx.xxx* is the syntactic representation for a 32-bit integer consisting of four 8-bit numbers written in base 10 with dots separating them.

**Invalid port number xx**

Meaning: You entered a port number for a port that does not exist.

Action: Check the module you are using to determine the number of ports it has. The fiber module has four ports. The STP module has six ports. The UTP module has eight ports.

**Invalid response xxxxxxxx**

Meaning: You entered an invalid choice in response to a menu prompt.

Action: Display the menu again. Read the displayed instructions carefully. In most cases you should enter a number.

**Invalid slot number xx**

Meaning: You entered a slot number for a slot that does not exist.

Action: The LinkBuilder FDDI Workgroup Hub has four slots. Slot 0 can only be used for the management module. You can insert any of the media modules in slots 1, 2, and 3.

**Network is unreachable**

Meaning: The IP address that you entered does not match your current network.

Action: Reenter the correct network address.

**Route already exists**

Meaning: The route you attempted to add with the *route* command duplicates a route that already exists in the routing table.

Action: Reenter the *route* command with a different route specification.

**Route does not exist**

Meaning: The route you attempted to delete with the *route* command does not exist in the routing table.

Action: Reenter the *route* command with the correct route specification.

**That port module slot is empty**

Meaning: No module is installed in the selected slot.

Action: Examine the hub to determine where each module is installed and enter a correct slot number.

**The path/filename is more than xx characters in length**

Meaning: The path/filename that you entered is too long.

Action: Reenter the path/filename using no more than *xx* characters.

**The xx exponent must be <= the current alarm exponent**

Meaning: The LER cutoff exponent must be less than the LER alarm exponent.

Action: Set the cutoff exponent to be less than the alarm exponent.

**The xx exponent must be >= the current cutoff exponent**

Meaning: The LER alarm exponent must be greater than the LER cutoff exponent.

Action: Set the alarm exponent to be greater than the cutoff value.

**There are no ports in the management module slot**

Meaning: You entered the slot number 0 (zero) in the *show ports* command.

Action: Examine the hub to see where the media modules are installed and enter a correct slot number.

**xx must be in the range xx to xx**

Meaning: An exponent must fall within the given range of values. For example, the LER Cutoff parameter must be set to a value between 4 to 15.

Action: Change the value of the exponent to be within the range shown.

## Download Messages

**Download image requested has invalid format!**

Meaning: You have requested and received the wrong filename. The image that was downloaded is not an executable image for this filename. You no longer have an executable image in flash memory.

Action: Reissue the download request.

**Download image unusable — corrupted!**

Meaning: A serious error occurred during download. You no longer have an executable image in flash memory.

Action: Reissue the download request.

**Download image unusable — not executable!**

Meaning: A serious error occurred during download, or you may have requested the wrong filename. You no longer have an executable image in flash memory.

Action: Reissue the download request.

**No response from TFTP server.**

Meaning: The TFTP download request could not be completed because the requested server did not respond.

Action: Check the server's IP address. Check also to be sure the server is connected to the network and is operational. If the server is on a remote network, check the gateway's IP address that is saved in nonvolatile RAM.

**TFTP Abort - Flash memory error**

Meaning: The requested image could not be written to flash memory because of a flash chip problem. You no longer have an executable image in flash.

Action: Contact 3Com technical support. Refer to Appendix D for instructions on getting 3Com support.

**TFTP Abort - invalid NVRAM parameters.**

Meaning: The TFTP download request could not be completed because the requested IP address, server IP address, or image filename was incorrect. The existing image will not be changed.

Action: Make sure that you have entered the correct the IP addresses or image filename. Then reissue the download request.

**TFTP Attempt using NVRAM parameters.**

Meaning: The TFTP download request was interrupted. The existing image will not be changed.

Action: Check to be sure the TFTP server is operating properly, and reissue the download request.

**TFTP download completed successfully.**

Meaning: The software image has been downloaded successfully.

Action: Proceed with normal hub operations.

## Fault Log Error Code Messages

The *x*'s in each designation represent any hexadecimal digit.

**00xxxxxx**

Meaning: Nonvolatile RAM error on the management module.

Action: Check LOW BATT LED. If the battery is low, replace it and try the operation again. If the problem persists, contact 3Com support.

**01xxxxxx**

Meaning: Flash memory error on the management module.

Action: Contact 3Com support.

**0xxxxxxx**

Meaning: Management module failure.

Action: Replace the module.

**1pxxxxxx**

Meaning: Media module failure in slot 1.

Action: If  $p$  is 0 or a value greater than the maximum number of ports on this module, replace this module.

If  $p$  is a value between 1 and the maximum number of ports on the module, an error exists on the port number indicated by  $p$ . Do not use this port. 3Com recommends replacing the entire module.

**2pxxxxxx**

Meaning: Media module failure in slot 2.

Action: If  $p$  is 0 or a value greater than the maximum number of ports on this module, replace this module.

If  $p$  is a value between 1 and the maximum number of ports on the module, an error exists on the port number indicated by  $p$ . Do not use this port. 3Com recommends replacing the entire module.

**3pxxxxxx**

Meaning: Media module failure in slot 3.

Action: If  $p$  is 0 or a value greater than the maximum number of ports on this module, replace this module.

If  $p$  is a value between 1 and the maximum number of ports on the module, an error exists on the port number indicated by  $p$ . Do not use this port. 3Com recommends replacing the entire module.

**8xxxxxxx**

Meaning: Backplane error.

Action: You must replace the backplane.

**FExxxxxx**

Meaning: Software error.

Action: Check for the correct version number and the last download status.

# Appendix B

## Technical Specifications

This appendix provides the physical, electrical, and environmental specifications for the LinkBuilder FDDI Workgroup Hub.

### Physical Characteristics

Width	16.8 in (42.6 cm)
Depth	11.6 in (29.4 cm)
Height	5.2 in (13.3 cm)
Weight (empty)	15 lb 2 oz (6.86 kg)
Weight (fully loaded)	19 lb (8.5 kg)

### Power Requirements

AC line frequency	100 to 240 Vac, 47 to 63 Hz
Current consumption	3.2 amps (RMS) 115 Vac, 240 watts

### Environmental Requirements

Storage temperature	22° to 194° F (–30° to 90° C)
Operating temperature	32° to 122° F (0° to 50° C)
Altitude	To 10,000 ft (3,050 m)
Storage humidity	5-95% noncondensing @ 104° F (40° C)
Operating humidity	5-95% noncondensing @ 104° F (40° C)

### Battery Specifications

3V 2450 lithium  
Approved manufacturers are Duracell, Sanyo, Renata, and Seiko.

**Standards Compliance**

FCC approval: FCC/VDE Class B (for LinkBuilder FDDI Management Module, Fiber-Optic Module, and STP [SDDI] Module)

FCC approval: FCC Class A (for LinkBuilder FDDI UTP Module)

If no UTP modules are installed in the hub, the hub complies with the limits of a Class B digital device. If a UTP module is installed in the hub, the entire hub complies with the limits of a Class A digital device.

# Appendix C

## Commands

This appendix describes the commands in the two command sets used to manage and configure the hub. The two command sets are:

- Management console commands
- Primitive console commands

The commands in each set are grouped into categories and arranged alphabetically within each category.

### Management Console Commands

The management console command set contains three categories of commands:

- Set commands
- Display commands
- Diagnostic and connectivity commands

#### Set Commands

##### **set attach**

##### **Syntax**

set attach

##### **Description**

The *set attach* command allows you to set the configuration of the two leftmost ports on the module in slot 1.

### Example

When you enter the *set attach* command, you are prompted to select an attachment configuration, as shown below:

```
Select one of the following:
```

1. B/A
2. S/M
3. M/M

```
Attachment port configuration?
```

The possible selections are defined below:

- B/A Sets ports as B and A for dual attachment or dual homing
- S/M Sets ports as S and M for single attachment
- M/M Sets ports as M ports for null attachment only

### set baud

#### Syntax

```
set baud
```

#### Description

The *set baud* command allows you to set the baud rate for the serial (console) port.

#### Examples

When you enter the *set baud* command, you are prompted to select a baud rate, as shown below:

```
Select one of the following:
```

1. 1200
2. 2400
3. 4800
4. 9600

```
Baudrate?
```

You can also enter the baud rate on the same line with the *set baud* command, as shown below:

```
set baud 4800 [Enter]
```

## set boot

### Syntax

```
set boot [method | filename | server]
```

### Simplified Syntax

```
set boot method
```

```
set boot filename
```

```
set boot server
```

### Description

The *set boot method* command allows you to select the method to use when downloading an image to the flash EPROM. The available options are:

**LOCAL** Loads and runs the flash EPROM code (default)

**TFTP** Uses TFTP and local configuration parameters to load a new image over the network

The *set boot filename* command allows you to set the filename of the software image to be loaded when using TFTP.

The *set boot server* command allows you to set the IP address of the boot server.

### Examples

An example of each option is shown below:

- When you enter the *set boot method* command, you are prompted to select the server location of the information to be downloaded, as shown below:

```
Select one of the following:
```

```
1. LOCAL
```

```
2. TFTP
```

```
Boot Method?
```

- When you enter the *set boot filename* command, you are prompted to enter a filename for the software image, as shown below:

```
Enter filename?
```

- When you enter the *set boot server* command, you are prompted to select a boot server, as shown below:

```
Enter Servers IP address in dot notation?
```

- When you select a boot method, enter a boot filename, or supply a server address, your response is confirmed, as shown in the following example:

```
Boot parameters
Method      : LOCAL
Server      : 123.44.55.66
Filename    : newimage
```

## set gateway

### Syntax

```
set gateway ggg.ggg.ggg.ggg
```

### Description

The *set gateway* command allows you to set the IP address (*ggg.ggg.ggg.ggg*) for the default gateway.

## set help

### Syntax

```
set [help | ?]
```

### Description

The *set help* command displays the options available for the set commands.

## set ip

### Syntax

```
set ipxxx.xxx.xxx.xxx [yyy.yyy.yyy.yyy][zzz.zzz.zzz.zzz]
```

**Description**

The *set ip* command allows you to set the IP address, netmask, and broadcast address for IP services.

**set ler****Syntax**

```
set ler [alarm | cutoff]
```

**Simplified Syntax**

```
set ler alarm
```

```
set ler cutoff
```

**Description**

The *set ler alarm* command sets the link error rate (LER) alarm threshold (fddiPORTLER-Alarm).

The *set ler cutoff* command sets the link error rate (LER) cutoff threshold (fddiPORTLER-Cutoff).

**Example**

When you enter either command, you are prompted for the module number and the port number.

```
Module?  
Port?
```

The current settings of the LER alarm and LER cutoff are then displayed:

```
Current LER Alarm exponent = 7  
Current LER Cutoff exponent = 6
```

You are then prompted to enter a value for either the LER alarm or the LER cutoff.



**NOTE:** You must always keep the *LER\_Alarm* parameter larger than the value entered for the *LER\_Cutoff* parameter.

## **set pwd**

### **Syntax**

set pwd

### **Description**

The *set pwd* command allows you to set and change the password:

- You are prompted for the old password.
- You are then prompted for a new password.
- You are prompted for the new password again.

Passwords can be one to eight alphanumeric characters and are case sensitive. Null passwords are allowed.

## **set tnotify**

### **Syntax**

set tnotify *val*

### **Description**

The *set tnotify* command sets T-Notify (fddiSMTT-Notify) to the decimal value specified by *val*. This value is used in the Neighbor Notification protocol. T-Notify must be in the range of 2 to 30 seconds. The default is 30 seconds.

## **set treq**

### **Syntax**

set treq *val*

### **Description**

The *set treq* command sets the Target Token Rotation Time (fddiMACT-Req) for the MAC on the primary ring. The time is set to the decimal value specified by *val*. The default is 165000 microseconds (165 milliseconds).

## Show Commands

### show attach

#### Syntax

show attach

#### Description

The *show attach* command displays the configuration of the attachment ports (the two leftmost ports) on the module in slot 1.

The configuration is not restricted regardless of the slot 1 module type. If the module type physically creates an illegal connection, a warning is displayed. The possible attachment port configurations are:

- B/A B and A for dual attachment or dual homing
- S/M S and M for single attachment
- M/M M ports for null attachment only

### show baud

#### Syntax

show baud

#### Description

The *show baud* command displays the baud rate for the serial port.

### show boot

#### Syntax

show boot [method | load]

#### Description

The *show boot method* command displays the boot parameters (method, image filename, and IP address of the boot server). The *show boot load* command displays the status of the last download.

The boot method can be one of the following:

- LOCAL Runs flash EPROM (default)
- TFTP Uses the TFTP protocol and local configuration parameters to load a new image across the network

The *show boot load* command displays the parameters used and the status of the last download to the flash EPROM.

## **show cfm**

### **Syntax**

show cfm

### **Description**

The *show cfm* command displays the Configuration Management (CFM) state (fddiSMTCF-State) of the dual ring inside the hub.

### **Values**

CFM states are listed below:

- Wrap\_A
- Wrap\_B
- Wrap\_S
- C\_Wrap\_A
- C\_Wrap\_B
- C\_Wrap\_S
- Isolated
- Thru

## **show fstats**

### **Syntax**

show fstats

### **Description**

The *show fstats* command displays the following raw frame statistics for the hub's MAC:

- Total transmit frames
- Total received frames
- Total transmit SMT frames
- Total received SMT frames
- Total transmit LLC frames
- Total received LLC frames
- Total received short frames
- Total received invalid frames
- Total aborts
- Received resets
- Directed beacon entered
- Directed beacons sent

## **show gateway**

### **Syntax**

show gateway

### **Description**

The *show gateway* command displays the IP address of the default gateway.

## **show help**

### **Syntax**

show [help | ?]

### **Description**

The *show help* or *show ?* command displays the options available for the *show* commands.

## **show ip**

### **Syntax**

show ip

### **Description**

The *show ip* command displays the current IP address, IP netmask, and the Internet broadcast address.

## **show log**

### **Syntax**

show log [last]

### **Description**

The *show log* command displays the contents of the fault log.

The *show log last* command displays the fault log entries in reverse order.

## **show mib counters**

### **Syntax**

show mib counters

### **Description**

The *show mib counters* command displays the number of the entities counted by the fddiMAC-CounterGrp, as shown below:

- Total number of frames received (fddiMACFrame-Ct)
- Number of frames copied (fddiMACCopied-Ct)
- Number of frames transmitted (fddiMACTransmit-Ct)
- Number of tokens (fddiMACToken-Ct)
- Number of error frames (fddiMACError-Ct)
- Number of frames with format errors (fddiMACLost-Ct)
- Number of frames not copied (fddiMACNotCopied-Ct)
- Number of ring recoveries (fddiMACRingOp-Ct)

## **show neigh**

### **Syntax**

show neigh

### **Description**

The *show neigh* command displays the 48-bit address of the upstream (fddiMACUpstreamNbr) and downstream (fddiMACDownstreamNbr) neighbor stations in noncanonical format.

## **show obs**

### **Syntax**

show obs

### **Description**

The *show obs* command displays the presence or absence of an optical bypass switch.

### **Values**

NOT PRESENT	No bypass switch exists on the hub.
PRESENT	A bypass switch is connected to the hub.

## show ports

### Syntax

show ports #

### Description

The *show ports* command displays information about the ports on the media port module specified by the slot number. After entering *show ports*, specify the slot number of the module. If you do not specify a slot number, you will be prompted for one.

The information provided is listed below:

- Number of modules installed on the hub
- Number of ports on the module
- Port media type (fddiPORTPMDClass)
  - Fiber = 62.5  $\mu$ m multimode fiber
  - STP = shielded twisted pair
  - UTP = unshielded twisted pair
  - LCF = low-cost fiber
  - N/S = not specified
  - Unknown = unknown connecting medium
  - Sonet = synchronous optical network
- Port PHY type (fddiPORTMy\_Type)
  - A = PHY A
  - B = PHY B
  - M = PHY M
  - S = PHY S
  - U = PHY unknown
- Port neighbor type (fddiPORTNeighborType)
  - A = PHY A
  - B = PHY B
  - M = PHY M
  - S = PHY S
  - U = PHY unknown

- Port PCM state (fddiPORTPCMState)
  - Active
  - Break
  - Connect
  - Join
  - Next
  - Off
  - Signal
  - Trace
  - Verify
  - Maintenance (abbreviated as “Maint”)
- Port status (fddiPORTConnectState)
  - Active
  - Connecting (abbreviated as “Connect”)
  - Disabled (abbreviated as “Disable”)
  - Standby
- LER Alarm
- LER Cutoff
- LER Estimate
- LER Rejects
- LER Count

## **show rev**

### **Syntax**

show rev

### **Description**

The *show rev* command displays the version number and the release date of the EPROM (firmware) and software.

## **show ring**

### **Syntax**

show ring

### **Description**

The *show ring* command displays the Ring Management (RMT) state (fddiMACRMTState) for the MAC on the primary ring.

The possible RMT states are listed below:

- Isolated
- Non\_Op
- Ring\_Op
- Detect
- Non\_Op\_Dup
- Ring\_Op\_Dup
- Directed
- Trace

## **show sid**

### **Syntax**

show sid

### **Description**

The *show sid* command displays the 64-bit FDDI station identifier (fddiSMTStationId), the 48-bit MAC address (fddiMACSMTAddress), and the 48-bit LLC address.

## **show tmax**

### **Syntax**

show tmax

**Description**

The *show tmax* command displays the value of T-Max (fddiMACT-Max), the maximum length of time allowed for the token to move around the ring.

**show tneg****Syntax**

```
show tneg
```

**Description**

The *show tneg* command displays the current value of T-Neg (fddiMACT-Neg), the ring's operational Target Token Rotation Time.

**show tnotify****Syntax**

```
show tnotify
```

**Description**

The *show tnotify* command displays the value of T-Notify (fddiSMITT-Notify) for the hub, which determines how frequently Neighbor Information Frames (NIFs) are broadcast to the ring.

**show treq****Syntax**

```
show treq
```

**Description**

The *show treq* command displays the value of T-Req (fddiMACT-Req), which is the requested Target Token Rotation Time for the MAC on the primary ring.

**show tvx****Syntax**

```
show tvx
```

### **Description**

The *show tvx* command displays the value of the Valid Transmission Timer (fddiMACTvxValue), which is the maximum time allowed by the MAC on the primary ring for the receipt of valid frames or tokens.

## **Diagnostic and Connectivity Commands**

### **arp**

#### **Syntax**

arp [dump | del | set]

#### **Simplified Syntax**

arp dump  
arp del host\_address  
arp set host\_address hardware\_address

### **Description**

The *arp* command displays information contained in the Address Resolution Protocol (ARP) table. It also allows you to change information stored in the ARP table.

- *arp dump* Displays the current contents of the ARP table
- *arp del* Deletes the IP host address
- *arp set* Adds the host IP address and the host 48-bit FDDI address in noncanonical format to the ARP table

### **clear**

#### **Syntax**

clear [log | alarm]

### **Description**

The *clear log* command clears the fault log, which contains a limited history of recent faults that have occurred in the system.

The *clear alarm* command clears the (HIGH TEMP SEEN) alarm that appears on the console when the condition existed previously but is no longer present.

## **connect**

### **Syntax**

connect

### **Description**

The *connect* command connects the hub to the FDDI ring.

## **disconnect**

### **Syntax**

discon | disconnect

### **Description**

The *disconnect* command disconnects the hub from the FDDI ring. It also removes all ports from the ring.

## **help**

### **Syntax**

help | ?

### **Description**

The *help* or *?* command displays a list of commands with brief command descriptions.

## **logout**

### **Syntax**

logout

### **Description**

The *logout* command logs the user out of a console session. In addition to closing a console session, it also closes a Telnet session if access to the console has been through Telnet.

## ping

### Syntax

ping *host\_address* [*size*] [*cnt*]

### Simplified Syntax

ping *host\_address*                      The host address in Internet dot notation.

ping *host\_address size*                (Optional). Specifies the number of data bytes (defaults to 56 bytes).

ping *host\_address cnt*                (Optional). Specifies the number of echo frames to be sent. (The default is one [1].)

### Description

The *ping* command sends echo frames, composed of random data bits, to a host to test the IP stack.

## reset

### Syntax

reset

### Description

The *reset* function reinitializes the hub and performs the power-on self-tests (POST).

Before the reset begins, you are asked this question:

Are you sure [y/n]?

You can enter the *reset* command on the command line or press the RESET button that is recessed on the management module.

## route

### Syntax

route [add | delete] *destination gateway* [*metric*]  
route dump

**Simplified Syntax**

route add *destination*  
route add *destination gateway*  
route add *destination gateway metric*  
route delete *destination*  
route delete *destination gateway*  
route delete *destination gateway metric*  
route dump

**Description**

The *route* command adds or deletes a path to a particular device or hub, where:

- *destination* is the destination IP address.
- *gateway* is the gateway IP address.
- *metric* is the number of hops (number of gateways separating the source and destination) to the network. (Optional)

The *route dump* command displays the current IP addresses of the destination and gateway.

## Primitive Console Commands

The primitive console command set contains three categories of commands:

- Set commands
- Display commands
- Miscellaneous commands



**NOTE:** The primitive console commands are a subset of the management console commands. The command descriptions are therefore abbreviated. For complete command descriptions, refer to the section “Management Console Commands” earlier in this appendix.

## **Set Commands**

### **set attach**

Sets the configuration of the first two ports of the module in slot 1.

### **set baud**

Sets the console (serial) port baud rate.

### **set boot**

Sets the boot method, filename of the software image, or server IP address.

### **set defaults**

Sets the factory defaults.

### **set gateway**

Sets the IP address for the default gateway.

### **set help | ?**

Lists the *set* commands and gives information about them.

### **set ip**

Sets the IP address, IP netmask, and the Internet broadcast address.

### **set pwd**

Sets the new password. In primitive command mode, you will not be prompted for your old password.

### **set tnotify**

Sets the T-Notify value used in the Neighbor Notification protocol.

**set treq**

Sets the Target Token Rotation Time (T-Req).

**Display Commands****show attach**

Displays the configuration of the attachment ports on the module in slot 1 of the hub.

**show baud**

Displays the baud rate setting for the serial port.

**show boot**

Displays the boot method, filename of the software image, and boot server IP address.

**show gateway**

Displays the default gateway address.

**show help | ?**

Lists the *show* commands and gives information about them.

**show ip**

Displays the current IP address, netmask, and broadcast address.

**show log**

Displays the contents of the fault log.

**show obs**

Detects the presence or absence of an optical bypass switch.

**show rev**

Displays the revision number of the EPROM and software.

**show sid**

Displays the 64-bit station ID and the 48-bit MAC address.

**show tnotify**

Displays the value of T-Notify.

**show treq**

Displays the value of T-Req.

**show tvx**

Displays the value of TVX.

**Miscellaneous Commands**

**clear**

Clears the fault log.

**help | ?**

Lists the miscellaneous commands and gives information about them.

**reset**

Reinitializes the hub and runs the power-on self-tests (POST).

# Appendix D

## Technical Support

This appendix explains how to obtain worldwide support for 3Com products.

### On-line Product Support

3Com offers worldwide product support 24 hours a day, seven days a week, through automated on-line systems.

#### CardBoard<sup>SM</sup> Bulletin Board Service

CardBoard is 3Com's menu-driven bulletin board service. It contains the most current adapter information in downloadable files. CardBoard provides:

- Software drivers
- Technical tips
- Product information
- Diagnostic programs
- Software patches and fixes

These files are easy to access through a modem connection. Call the CardBoard telephone number nearest you:

Australia	(61) (2) 955 2073 Up to 2400 baud, 8 data bits, no parity, 1 stop bit
France	(33) (1) 69 86 69 54 Up to 9600 baud, 8 data bits, no parity, 1 stop bit
Germany	(49) 89 62732-188/189 Up to 9600 baud, 8 data bits, no parity, 1 stop bit
Italy	(39) (2) 27 30 06 80 Up to 9600 baud, 8 data bits, no parity, 1 stop bit

U.K.	(44) 442 278278 Up to 14400 baud, 8 data bits, no parity, 1 stop bit
U.S.	(1) (408) 980-8204 Up to 19200 baud, 8 data bits, no parity, 1 stop bit

For information on international CardBoard access numbers added since this manual was published, contact your local 3Com office. Refer to the list of international sales offices later in this appendix.

### **Automated Fax Service**

3Com's interactive fax service provides data sheets, technical articles, diagrams, and troubleshooting instructions on 3Com products 24 hours a day, seven days a week. To access this service, dial **(1) (408) 727-7021** from anywhere in the world using your touch-tone telephone.

Within this service you may choose to access CardFacts<sup>SM</sup> (containing adapter information) or 3ComFacts<sup>SM</sup> (containing network system product information).

- CardFacts provides adapter installation diagrams, configuration drawings, troubleshooting instructions, and technical articles. Document 9999 provides you with an index of adapter documents.
- 3ComFacts<sup>SM</sup> provides data sheets and technical articles on 3Com's hub, bridge, router, terminal server, and software products. Document 8888 provides you with an index of system product documents.

### **Ask3Com<sup>SM</sup> On-line Service**

Ask3Com is an on-line service, located on CompuServe<sup>SM</sup>. This service is accessible worldwide. Ask3Com contains extensive technical and marketing information on all 3Com products. To use Ask3Com, you must first obtain a CompuServe account. To open an account, contact your local CompuServe office.

To use Ask3Com, log into CompuServe, type:

GO THREECOM

and press [Enter] to see the Ask3Com main menu.

### 3Com Documentation on CD-ROM

An extensive library of 3Com product documentation is available in CD-ROM format through Support on Site for Networks subscription service. This multivendor CD-ROM service, offered by Computer Library, a division of Ziff Communication, contains technical information and documentation from major data networking hardware and software manufacturers. Stand-alone and concurrent user network subscriptions are available. To order, call Computer Library at (800) 827-7889, extension 515. Outside the U.S. call (212) 503-4400 or use fax number (212) 503-4487.

## Support from Your Network Supplier

If additional assistance is required, contact your network supplier. Many suppliers are authorized 3Com service partners who are qualified to provide a variety of services, including network planning, installation, hardware maintenance, application training, and support services.

### U.S. and Canada

Call the following number to locate your local 3Com sales office:

U.S. (1) (800) NET-3Com

The 3Com sales office will refer you to the nearest 3Com authorized service partner.

### Outside the U.S. and Canada

To locate a 3Com authorized service partner near you, contact your local 3Com sales office.

Australia	(61) 2 959 3020
Belgium/Netherlands	(31) 25 032 2120
France	(33) 1 698 66800
Germany	(49) 89 678210
Hong Kong	(852) 868 9111
Italy	(39) 22 7302041
Japan	(81) 3 546 62233

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Nordic	(46) 8 703 4870
Singapore	(65) 321 8929
Taiwan	(886) 2 775 4352
U.K.	(44) 628 890 670

When you contact a 3Com authorized service partner for assistance, have the following information ready:

- Diagnostic error messages
- A list of system hardware and software, including revision levels
- Detail on recent configuration changes, if applicable

3Com's service partner will determine what action needs to be taken to resolve the problem. 3Com service partners can verify hardware failures and advise you when it is more cost-effective to replace, rather than repair, a product.

## Returning Products for Repair

A product sent directly to 3Com for repair must first be assigned a Return Materials Authorization number (RMA). A product sent to 3Com without an RMA number will be returned to the sender unopened, at the sender's expense.

When you call for an RMA number, be prepared to provide the product name, serial number, and diagnostic error messages. Payment, shipping instructions, and turnaround time will be confirmed when the RMA number is assigned.

To obtain an RMA number, call or fax:

Europe	<i>Phone</i>	(44) (0) 442 231000
	<i>Fax</i>	(44) (0) 442 236824
U.S.	<i>Phone</i>	(800) 876-3266, press option 2
	<i>Fax</i>	(408) 764-7290



**NOTE:** RMA forms (except Europe) are available on CardFacts. Dial (408) 727-7021.

Outside Europe and the U.S.

<i>Phone</i>	(408) 492-1790
<i>Fax</i>	(408) 764-7290

# Glossary

<b>Attachment</b>	The capability of a station or concentrator (or FDDI hub) for connection into an FDDI network. Stations and concentrators are classified as dual attachment, single attachment, or null attachment.
<b>Beacon</b>	A special type of frame transmitted when a station detects a logical problem on the ring. It is automatically transmitted during the ring initialization sequence when the claim token process does not finish in the time allotted for it. The beacon process can indicate either a station hardware or software failure.
<b>Broadcast</b>	A packet delivery system that delivers a copy of a given packet to all hosts that attach to it.
<b>Bypass</b>	The ability of a node to optically isolate itself from the FDDI network while maintaining the continuity of the cable plant. <i>See also</i> Optical bypass.
<b>Canonical order</b>	The agreed upon bit order of transmission. Canonical addressing is when the least significant bit of the most significant byte is always transmitted first. The FDDI hub's LLC (logical link control) address appears in canonical order when the <i>show sid</i> command is issued.
<b>CDDI</b>	Copper Distributed Data Interface. FDDI over twisted-pair copper wire.

<b>Concentrator</b>	A sophisticated multiplexer or hub device that has additional ports beyond those required for its own attachment to the main ring of an FDDI network. These additional ports are for attaching other FDDI nodes (including single attachment stations [SASs] and other concentrators) in a tree topology. Concentrators may be stand-alone (null attachment) and not connected to the main ring; they may support only the interconnection of a few SASs.
<b>DAC</b>	Dual Attachment Concentrator. A concentrator with A and B ports for attachment to both the primary and secondary rings.
<b>DAS</b>	Dual Attachment Station. A station with A and B ports for attachment to the primary ring only.
<b>Dotted decimal notation</b>	The syntactic representation for a 32-bit integer that consists of four 8-bit numbers written in base 10 with periods (dots) separating them.
<b>Downstream</b>	The normal direction of data flow on a token ring network. Also, the adjacent station in the transmission (ring) path.
<b>Dual counter-rotating ring</b>	A dual-ring LAN topology in which two separate fiber or copper cables provide signal paths on which information travels in opposite directions. The second ring provides a backup for the first ring in the event of failure of the first (primary) ring.
<b>Dual ring</b>	A pair of counter-rotating logical rings.
<b>Dual homing</b>	An FDDI redundant topology. This refers to one of two situations: in the first, a dual-MAC station is connected to (is homed on) both rings at the same time. The second situation involves redundant attachments of a dual-attached station or concentrator to the ring(s), with one attachment functioning as a backup link.

<b>Dual ring of trees</b>	One of the FDDI-supported topologies in which only one ring is permitted to have multiple trees of any depth (consisting of single-attached concentrators and stations), which are cascaded off the main ring.
<b>FDDI</b>	<p>Fiber Distributed Data Interface. The local area networking standard that provides high bandwidth for interconnecting computers and peripheral devices using a fiber-optic medium in a ring configuration.</p> <p>The FDDI specification is made up of standards that correspond to the IEEE OSI model layers (on the physical and data link levels). These standards specify the physical interfaces, functions, and operations needed to support interoperability between devices.</p>
<b>Fiber-optic cable</b>	A fiber-optic cable consists of a glass center, cladding, a buffer layer, strength members, and a cable sheath. The glass center supports the transmission of light signals.
<b>Gateway</b>	A special-purpose, dedicated computer that attaches to two or more networks and routes packets from one to another.
<b>IP</b>	Internet protocol, which defines the Internet datagram as the unit of information passed across the Internet and provides the basis for the Internet connectionless, best-effort packet delivery service.
<b>ISO</b>	International Standards Organization. The international agency that develops information-exchange standards implementation.
<b>Logical ring</b>	A set of MACs serially connected to form a single ring. A fault-free FDDI network provides two logical rings.

<b>MAC</b>	Media Access Control. MAC, the OSI access layer, specifies the access mechanism used by FDDI nodes for transmitting and receiving data on the ring. The MAC is responsible for receiving frames and transmitting frames according to the rules of a timed token rotation protocol, a dynamic protocol unique to FDDI.
<b>MIB</b>	Management Information Base. A set of FDDI-managed objects. The MIB defines the data that a network manager can expect to get about a managed device. It defines the access permissions for each data item, and the size, type, and semantics of each data item.
<b>MIC</b>	Media Interface Connector. A mated connector pair that provides an attachment between an FDDI node and a fiber-optic cable. MIC connectors are normally keyed, both to prevent accidental reversal of transmit and receive fibers and to ensure connection only to ports of the correct type.
<b>Noncanonical order</b>	The agreed upon bit order of transmission. Noncanonical addressing is when the most significant bit of the most significant byte is transmitted first. The FDDI hub's MAC/SMT address appears in noncanonical order when the <i>show sid</i> command is issued.
<b>Null attachment concentrator</b>	A concentrator that can be considered a self-contained FDDI network but is not connected to a dual ring backbone. It does not contain an A, B, or S port.
<b>Optical bypass</b>	An optional facility that allows the FDDI optical signal to bypass FDDI nodes when they are powered off.
<b>Peer-mode connection</b>	A connection between peer ports (A, B, and S ports).

- PHY** Physical Layer Protocol. The sublayer that describes the medium-independent portion of the OSI Physical layer and specifies the rules for encoding digital data for transmission from one FDDI station to another. It also provides the link between the PMD and the MAC layer.
- Ping** Packet InterNet Groper. A program used in the Internet to find out whether or not a host on the network is operational by sending it echo frames and waiting to receive the same number of frames in return.
- PMD** Physical Layer Medium Dependent. The sublayer in the FDDI architecture that specifies the optical fiber hardware components that create the physical link between two adjacent FDDI stations.
- Port** A point of access where a physical connection is made between a device and cabling to another device, network, etc. The FDDI standard defines four port types: A, B, M, and S.
- Port type A (Primary IN/Secondary OUT) allows attachment to the incoming primary ring and to the outgoing secondary ring.
- Port type B (Secondary IN/Primary OUT) allows attachment to the outgoing primary ring and to the incoming secondary ring.
- Port type M (Master) allows attachment between a concentrator and a single-attach station. Uses the primary ring only. *See* SAS.
- Port type S (Slave) allows attachment between an SAS or SAC and a concentrator. Uses the primary ring only.

<b>Primary path</b>	The segment(s) of the primary ring that pass through a station. Conditions may exist in parts of the network that may cause the path to be in a different ring (that is, secondary instead of primary).
<b>Primary ring</b>	In the dual counter-rotating token ring architecture, the ring that carries data traffic.
<b>Ring</b>	A set of stations through which information is passed sequentially between stations, each station in turn examining or copying the information, until the information is returned to the originating station.
<b>Ring wrap</b>	The ring reconfiguration that takes place when a break occurs in the primary ring and the dual attached hubs and stations on either side of the fault detect and automatically bypass it.
<b>SAC</b>	Single Attachment Concentrator. A concentrator that connects a single ring only (usually the primary ring) to the FDDI network.
<b>SAS</b>	Single Attachment Station. A station that offers a single attachment to the FDDI network. The connection is to one ring only (usually the primary ring), and that attachment is made through a concentrator; there is no direct attachment to the trunk ring.
<b>SDDI</b>	Shielded [Twisted-Pair] Distributed Data Interface. FDDI over shielded twisted-pair per the SDDI de facto STP standard.
<b>Secondary ring</b>	In the dual counter-rotating token ring architecture, the ring that is generally used for automatic recovery in the event of a break in the primary ring.
<b>SMT</b>	Station Management. The function within an FDDI node responsible for managing, maintaining, and controlling all the local and remote station functions.

<b>Station</b>	An addressable node on an FDDI network capable of transmitting, repeating, and receiving information. A station has exactly one SMT, at least one MAC, at least one PHY, and at least one PMD.
<b>STP</b>	Shielded Twisted-Pair. Shielded four-conductor electrical cable that can be used as the communication medium on an FDDI ring in place of optical fiber.
<b>Telnet</b>	The Internet standard protocol for remote terminal connection service. Telnet lets a user interact with a remote time-sharing system at another site as though the user's terminal connected directly to the hub or concentrator.
<b>TFTP</b>	Trivial File Transfer Protocol. A simplified version of the File Transfer Protocol (FTP) used to transfer files.
<b>Thru state</b>	The condition in which both rings are fully functional.
<b>Token</b>	The special frame that passes from station to station on an FDDI ring any time the ring can carry data. The token is captured by a station that is ready to transmit data, and is released back to the ring at the end of the allotted transmission time. During token-capture time, only the station possessing the token can transmit data.
<b>Tree</b>	A physical topology consisting of a hierarchy of master-slave connections between a concentrator and other FDDI nodes (including subordinate concentrators).
<b>Tree-mode connection</b>	A connection between tree ports (M ports).
<b>Trunk</b>	A physical loop topology, either open or closed, employing two optical fiber signal paths, one in each direction, forming a sequence of peer connections between FDDI nodes.

<b>Upstream</b>	The direction on a token ring network that is contrary to the normal direction of data flow (that is, downstream).
<b>UTP</b>	Unshielded Twisted-Pair. A cable consisting of two twisted-pair conductors that are not insulated.
<b>Wrap</b>	A ring recovery condition that is automatically activated when a downstream station detects a fault in the primary ring, and the stations on either side of the fault connect the two rings to create a single ring. When this occurs, the primary and secondary rings have been concatenated.

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