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V/FDDI 4211SN Peregrine

Single or Dual Attach

Systems Integration Guide

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Using This Guide

Introduction

This manual describes the installation of the V/FDDI 4211SN controller on a Sun station; however, experience with Sun workstations and SunOS is required. Necessary skills include installation of boards and installation of software from tape or CD-ROM. Depending on your particular installation, modification of configuration files and generation of a new kernel may be required.

Organization of This Manual

This manual contains instructions for the installation of the 4211SN.

Chapter 1, Introduction introduces the document. It describes the organization of the manual, how to use it, and reference documents to help readers understand the product.

Chapter 2, Software Installation contains step-by-step instructions for installing the Interphase 4211SN software, including the building of a new UNIX kernel.

Chapter 3, Hardware Installation contains detailed descriptions and illustrations for installing the 4211SN hardware.

Chapter 4, Utilities describe some beneficial tools for maintaining the board.

The Appendices contain supplemental information which may be useful during the installation process of the Interphase 4211SN.

Conventions and Terminology

The term ì4211SNî refers to the Interphase V/FDDI 4211SN Peregrine hardware and software.

The installation procedures are divided into a series of numbered steps.

Directories and *filenames* in text are printed in italics. *Variables* are printed in italics.

Examples of program output, commands and prompts, and sections of code are printed in `fixed-width font`.

```
This is an example of program output or sections of code.
```

Commands to be entered exactly as they appear in the text are printed in **boldface** type. Pressing **Return** at the end of the command is assumed when not literally expressed.

Keys to be pressed are shown in **boldface** type. For example, the carriage return key is shown in boldface type as **Return**. (On many keyboards, this key is labeled ìEnterî.)

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User entries when mixed with program output are printed in **`Bold Fixed-Width`** font. User entries in text are printed in **boldface**.

User entries may be entered in either upper- or lower-case font when *in* the Installation program.

References to UNIX programs and their man page entries follow the standard UNIX conventions (e.g., **man(1)**). Options in commands are printed in boldface type and are enclosed in brackets ([ ]).

Metasymbols and other text which must be replaced before they can be keyed in are printed in ***bold italic***.

Notes of importance are signified as follows:

> **Note**: In a ìnoteî, the heading is centered above in boldface type. The text is indented on both left and right margins. The note text contains information that is useful and explanatory. A ìcautionî contains important information which, if ignored, may result in loss of data or damage to hardware or software.

Overview of the Installation Process

The following outlines the steps to install the 4211SN in a server:

1. Load 4211SN software from tape or CD-ROM, and install 4211SN software.
2. Shut down the server, turn off its power and disconnect the power.
3. Remove the covers to gain access to the slots and backplane.
4. Install 4211SN hardware.
5. Boot the server 4211SN kernel.
6. If the topology of your network is changed, update the network configuration files.

Product Compatibility

The 4211SN is currently available for use with SunOS versions 4.1.1 through 4.1.3 and can be installed in the following Sun file servers:

- 4/300 series
- 4/400 series
- 600 MP series

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Related Documents

Sun Microsystems publications that may be useful include the following:

- Sun System and Network Administration.

  This manual is supplied by Sun Microsystems and contains information that all system administrators of Sun NFS servers should be familiar with and have available for consultation.

- SunOS 4.1.1/4.1.2/4.1.3 Reference Manuals.

  The reference manual is supplied by Sun Microsystems and contains information needed by Sun system users.

- Sun Cardcage Slot Assignments and Backplane Configuration Procedures.

  This manual is supplied by Sun Microsystems and contains information needed to add hardware to a Sun file server.

Product Support

To place an order for an Interphase product, send in a product for repair or upgrade, or for technical assistance, call Interphase Corporation Customer Service:

In the U.S.: (214) 919-9111

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Software Installation 1

Introduction

This section describes the installation procedure for the Interphase V/FDDI 4211SN software.

If a previous version of the 4211SN driver is installed, the software automatically detects the prior installation and users are prompted to perform the Update procedure.

Users installing the Peregrine board with the default configuration values should use the Auto installation. All other situations require a Custom installation.

Please read through the entire procedure before beginning to become familiar with the entire sequence. Ensure that disk space, operating system and installation media requirements are met prior to initiating the installation process.

If any questions regarding the installation, usage, or troubleshooting of 4211SN software or hardware during the warranty period arise, please call Interphase Customer Service. Save all packing materials in case you need to return an item to Interphase Corporation for service.

Before You Start

Several requirements must be fulfilled to ensure a successful installation. Interphase Corporation recommends that your system be backed up prior to installing or updating your board. Review the steps to install the software and have the necessary information before beginning the process.

Disk Space Requirements

- Approximately 1.5 megabytes of disk space in */usr* for binaries and to build a new kernel.
- Approximately 3.0 megabytes of disk space in / for a new kernel.
- At least 1.25 megabytes of free disk space in either the */usr*/*tmp*, */var*/*tmp* or */tmp* file system. If space is unavailable, the Installation program will prompt for another file system with enough free space. Use df(1) to find an appropriate file system.

Operating System Requirements

- SunOS version 4.1.1, 4.1.2 or 4.1.3 on the target server on which the 4211SN will be installed.

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Hardware Requirements

- The device name of the tape drive or CD-ROM from which you are installing the 4211SN software. If the tape drive is remote, the node name of the remote host that controls the tape drive is also required.
- The 4211SN software product installation tape or CD-ROM installation disk.

Security Requirements

If these conditions can not be ensured, the installation process should not be started.

- If the installation media is mounted remotely, the files must be accessible with root privileges from the local host.
- If using a tape drive on a remote host, be sure that the local host is in the remote hostís */.rhosts* file.

The installation program loads the software distribution into any user-specified directory. By default, files are placed in the */usr/tmp/unbundled/PG* subdirectory.

Once the files are loaded, the installation program is executed, files are placed in their ultimate location and the 4211SN software is installed.

> **Note**: The original copy of any system file replaced or modified is preserved in the original directory by the install program under the name *./PG/file.orig*.

If installation aborts for any reason, an informative error message is printed. Correct the problem and run the installation program again.

Loading and Installing the 4211SN Software

The software installation is largely automated. If for any reason the installation should fail, fix the problem and restart the process. Running the install program several times in succession should cause no harm. The correct remedy for most failures (e.g., a write-protected directory or a filled file system) is to re-run the installation program (*/usr/etc/extract_unbundled*).

1. To begin the installation process, log in as *root*.
2. Load the tape or CD-ROM in the drive and execute the installation command. (# denotes the Unix prompt.)

a. To install from a local CD-ROM drive, load the installation CD-ROM disk in the CD-ROM drive. If necessary create a mount point and mount the CD-ROM drive.

```
#mkdir /cdrom
#mount -r /dev/sr0 /cdrom
```

Change working directories to the mount point, and execute *cdinstall*.

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```
#cd /cdrom
#./cdinstall
```

If using *cdinstall* to install your software proceed to Step 4.

b. If the CD-ROM is remote, load the installation CD-ROM disk in the CD-ROM drive, mount the CD-ROM and export the CD-ROM file system. This is done on the system to which the CD-ROM is attached.

```
hostprompt# rlogin remotesystem
remoteprompt# mount -r /dev/sr0 /cdrom
remoteprompt# exportfs -i -o ro /cdrom
remoteprompt# logout
```

Create a mount point on the system on which the 4211SN will be installed and mount the CD-ROM via NFS.

```
hostprompt# mkdir /cdrom
hostprompt# mount -r remotesystem:/cdrom /cdrom
```

Change working directories to the mount point and execute *cdinstall*.

```
hostprompt# cd /cdrom
hostprompt# ./cdinstall
```

If using *cdinstall* to install your software proceed to Step 4.

c. For installation from a tape, place the tape in the drive and execute the *extract_unbundled* command.

```
#/usr/etc/extract_unbundled
```

The following shows the beginning of a typical installation using *extract_unbundled*.

3. Identify the installation media.

```
Enter media drive location [local | remote]: local
```

d. Enter **local** if the installation media is directly connected to the machine being updated.

Enter **remote** to access the installation media across a network. The local host should be in the remote hostís /*.rhosts* file.

If the device is remote, the following prompt is displayed.

```
Enter the hostname of remote drive:
```

e. Enter the name of the device where the installation media will be located. The following prompt is displayed.

```
Enter Device Name (e.g. rst0, rmt0, rfd0c) : /dev/rst0
```

f. Press **Return** when the media is in place.

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```
**Please mount the release media if you haven't done so already.**
Press return when ready:
```

4. The installation program is starting. The product and files to be installed on your system are identified. The file sizes and dates detailed in the following screen may vary from the examples depending on the release version installed.

```
The following product will be installed:
2+0 records in
2+0 records out

Interphase V/FDDI Peregrine Software Release 1.0.1
(Wed Jan 20 15:45:03 CST 1993) for SunOS 4.1.1 and higher
Copyright (c) 1992, Interphase Corporation. All Rights Reserved.

 Type KBytes File
-------------------------------------------------------
file 1: ascii 1 This_File
file 2: tar 48 install_unbundled.tar
file 3: tar 1104 VFDDI_A01_BIN.sun4.tar
file 4: tar 1104 VFDDI_A01_BIN.sun4m.tar
file 5: tar 1104 VFDDI_A01_BIN.sun4_300.tar
file 6: ascii 2 COPYRIGHT_NOTICE
-------------------------------------------------------

Do you want to continue [y|n]? y
```

Options are indicated in brackets ì `[]` î.

To install this product, enter **y** at the prompt `Do you want to continue [y | n]?`.

To halt installation, enter **n** and the Unix prompt is displayed.

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5. If a recent backup of your system has not been performed, it is highly recommended that a backup be done now.

```
/usr/etc/extract_unbundled : Extracting Installation Scripts
tar: blocksize = 96
x ./install_unbundled, 4522 bytes, 89 tape blocks

/usr/etc/extract_unbundled : Begin Install Script Execution

 Although the following installation is expected to install and
 work normally, Interphase Corporation strongly recommends you
 make backups (i.e. copies) of your Operating System files
 prior to performing the following installation.


Do you wish to continue the installation [y|n] ?
```

To exit the installation process, enter **n**. The Unix prompt is returned.

To continue the installation procedure, enter **y**.

```
   CONTINUING INSTALLATION

Please enter product number being installed, 4211 or 5211 [4211]:
```

6. Enter 4211 or press **Return** to select the 4211 Peregrine board.

The following is displayed.

```
                .
                .   (list of files omitted for brevity)
                .

Finished reading tape into /usr/tmp/unbundled/PG ...

Starting Interphase V/FDDI Peregrine installation.

Initializing. OK.
```


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7. The Peregrine software programs are installed.

g. **If this is a new installation**, the following is displayed.

```
Verifying that enough room exists to install the Interphase V/FDDI Peregrine

Installing Interphase V/FDDI Peregrine software .../
Interphase V/FDDI Peregrine software installed OK.

Current kernel is named "GENERIC".

Do you wish to use GENERIC_PG as the new configuration file name? [y/n] y
```

To allow the system to automatically name the kernel configuration file (current.*config.file_PG*), please enter **y** (yes).

To name the new kernel configuration file, please enter **n** (no). The following prompt is displayed:

```
Please Enter New Name, default: [GENERIC_PG] :
```

Press **Return** to use the default name or enter a unique name for the new kernel configuration file. Proceed to Step 8.

h. **If this is an update to the software**, the software detects a prior installation on your system.

The update process uses your current configuration. The Peregrine device driver, the fddimon and the Peregrine Configuration Utilities are installed an a new kernel is built.

To modify your devices, use the *fddi_cfg* utility after the update is performed.

The following message and prompt are displayed.

```
It appears that the Interphase V/FDDI Peregrine has already been installed
on this machine

Do you wish to update the Interphase V/FDDI Peregrine? [y|n] y
```

To retain the previous version, enter **n** (no). The installation program is exited and the Unix prompt is returned.

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To update the software and to continue with the installation, enter **y** (yes).

The following information is displayed.

```
Verifying that enough room exists to install the V/FDDI 4211SN Peregrine

Installing Interphase V/FDDI Peregrine software ...-

Interphase V/FDDI Peregrine software installed OK.

To complete the Interphase V/FDDI Peregrine installation, it is necessary to
build a new Unix kernel.

Would you like the kernel named "GENERIC_PG" built automatically now [y|n] y
```

The program uses the name of the previous kernel configuration file.

Please proceed to proceed to Page -16, Step

8. The new kernel configuration file name is identified and the changes made with the Auto installation are detailed on the following screen.

```
You may select the AUTO configuration or the CUSTOM configuration
for your system changes.

V/FDDI 4211SN      Base Address      Interrupt Vector
    pg0             8000 hex            f0 hex


The AUTO configuration is the default. If you wish to use a
configuration other than the AUTO configuration, you must select the
CUSTOM configuration option.

How do you wish to install (AUTO, CUSTOM or exit [AUTO] : auto
```

To perform the Auto installation, allowing the program to perform the installation, enter **a** or press **Return** to accept the default. The above configuration is yielded. Proceed to the section, ìAutomatic Installation Procedureî.

To do a Custom or manual installation, enter **c**. Proceed to the section, ìCustom Installation Procedureî.

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To halt installation, enter **exit**. The installation program will abort and the Unix prompt is returned.

Automatic Installation Procedure

The automatic installation streamlines the installation process. A new configuration file is built. The *conf.c* file and *files* file are modified. Device nodes are created for the devices shown in Figure .

A new kernel based on the new configuration file must be built and linked. The program will build and link the kernel automatically or allow the user to do so. The manual procedure requires system administration knowledge.

9. If the Auto configuration is selected, The following is displayed. Enter the controller name and the IP address for the FDDI controller.

```
Editing /sys/sun/conf.c
Making device node /dev/pg0 major: 105 minor: 0

Would you like to make the /etc/hostname file and /etc/hosts
file entries for controller pg0 now ? [y|n]
```

The *hostname* file names the controller and the *hosts* file associates the given name for the controller with a network address.

i. To enter the controller name and address, enter **y**. The following prompt is displayed.

```
Enter the hostname your computer will use with this device on your
FDDI network : server_fddi
```

Enter a unique name for the controller. The IP address is requested.

```
Enter the IP address for this device : 128.01.02.01
```

Enter a user-defined address. The system verifies the format for the address entered and checks the address entered to ensure that it is not used for another machine in the */etc*/*hosts* file.

If the host ethernet interface (ie0 or le0) remains active, the hostname.ie0/le0 and hostname.pg0 files must contain distinct hostnames. The fddi interface (pg0) and the ethernet interface (ie0 or le0) also must have IP addresses assigned so that each has a *different network* address. An IP address consists of a network field and a host field. A class determines

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the network field of an IP address.

Class ìAî Network: ìn1.00.00.00î, where n1 <128

Class ìBî Network: ìn1.n2.00.00î, where 128 ≤n1 < 192

Class ìCî Network: ìn1.n2.n3.00î, where 192 ≤n1

A subnet mask locally extends the network field to determine physical networks.

For example:

- Class B network with address ì128.1.0.0î
- Class C netmask of ì255.255.255.0î
- /etc/hostname.le0 on ìserverî has hostname ìserverî
- /etc/hostname.pg0 on ìserverî has hostname ìserver_fddiî

The /etc/hosts file on ìserverî has the entries:
128.01.01.01 server
128.01.02.01 server_fddi

The /etc/netmasks file on ìnismasterî should have the entry:
128.01.0.0 255.255.255.0

Manpage *hosts(5)* provides additional instructions to define the IP address.

The following prompt is displayed.

```
Enter a comment for this IP address: test entry
```

Enter any additional information desired about the controller. The information you have entered is displayed in the next prompt:

```
Is the entry:


128.1.2.1 server_fddi # test entry


the entry you wish to use ? [y|n] y
```


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Enter **y** to affirm that the entries are correct. If corrections are required, enter n and reenter the information defined in this step. When entries are affirmed correct by the user, the following information is displayed.

```
Your FDDI hostname has been set to server_fddi for this device

The entry:

128.01.012.01 server_fddi test entry

was added to the /etc/hosts file.

Editing /sys/sun4/conf/files
```

To build and link the kernel, proceed to Page -16, Step

j. If you do not wish to name the controller and assign the IP address at this time, enter **n** at the prompt.

The following messages are displayed:

```
You need these files to be able to communicate over networks.
You will have to add your /etc/hostname and /etc/hosts file entries manually.

The installation of Interphase V/FDDI Peregrine will continue. These files
are not needed to install the Interphase V/FDDI Peregrine. They are needed
for it to function properly after it is installed.

Editing /sys/sun4/conf/files
```

You may stop to make the new kernel manually or allow the program to build and link the kernel for you. To build and link the *GENERIC_PG* kernel, proceed to Step 16.

Custom Installation Procedure

To use an Interrupt Vector or SHIO (short I/O) address different from the default in the Auto Installation, perform a Custom installation. Refer to Appendix A for a description of files added and changes to existing files.

A new configuration file is created as the Peregrine controller is installed. The *conf.c* file is modified, and entries are added to the *files* file to support the Peregrine device driver.

A new kernel based on the new configuration file must be built and linked. The program will build and link the kernel automatically or allow the user to do so.

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```
                Controller Configuration Menu
                ---------- ------------- ----

V/FDDI-4211SN Peregrines Installed

Controller    Name    Address in hex    Interrupt Vector    Status
---------     ----    --------------    ----------------    ------
    0         >>> CONTROLLER NOT INSTALLED <<<

Controller Commands:
---------- --------
   install controller,             disable controller,
   enable controller,              modify controller entry,
   ! spawn shell,                  quit

Please Enter Command (i:d:e:m:!:q) :
```

Figure 1-1. Controller Configuration Menu

Information for the installed board is entered on the Controller Configuration Menu. Name, Address, Interrupt Vector and Status are displayed. If a board is not installed, the message >>> *CONTROLLER NOT INSTALLED* <<< is displayed.

The install controller option is used to install a controller.

The disable option deactivates a controller, changing the status from ìenabledî to ìdisabledî.

The enable option reactivates a controller that was disabled, changing the status from ìdisabledî to ìenabledî.

The modify controller option is used to change the values of an existing controller entry.

The ! spawn shell option permits the user to temporarily leave this program and run a Bourne shell.

The quit option allows the user to stop adding/modifying the controller and continue with the installation.

10. On the Controller Configuration Menu, enter **i** to install a controller.

The controller is named automatically as shown in the prompt below.

```
Install Controller 0

Please Enter Base I/O Address in hex: 0x8000
```

k. Enter a starting address (in hex) for the controller's short I/O space.

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The address must be a multiple of 512 (0x200) bytes (0x0000, 0x0200, 0x0400 ... 0xA000). The installation program checks if another controller is using the same base address and ensures that the address is a 512 byte multiple.

Important

The Peregrine board always uses 512 bytes of short I/O space. The program can only check for another controller using the same base address. It does not know if its base address falls into the range of memory used by an existing controller. If some other controller uses 0x8100 as a base address, the program can not detect 0x8000 as being a problem.

Using 0x8000 will work in most cases. If you have a problem or know that the address is in use, check your configuration file for the base addresses used and consult the manufacturerís specifications for the amount of short I/O (SHIO) space used by other controllers.

After entering the base address to be used, a screen is displayed indicating the pins in jumper block JA11 which need to be jumpered. Boards are jumpered to 0x8000 at the factory.

To jumper your board at this time, rotate the board to place P1 on the **bottom right** and set the jumpers as shown in the following screen.

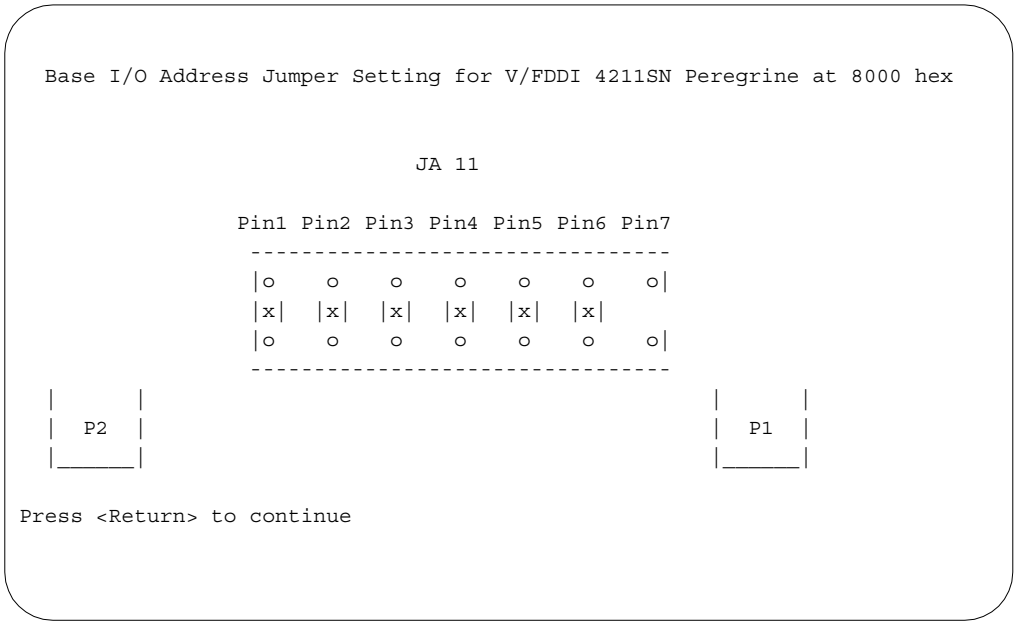


Figure 1-2. Default I/O Address Jumpers (0x8000)

Appendix B lists the jumper settings for all possible addresses (in hex).

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11. Enter the Interrupt Vector value (in hex). The recommended range for this setting is 0xc8 to 0xff. The program will check the value against the configuration file and request a new value if the value entered is in use. Each interrupt vector must be unique. Changing Interrupt Vectors does not require hardware changes.

```
Please Enter Interrupt Vector in hex, 0xf0
```

After hex values for the address and interrupt vector are accepted by the system, the following message is displayed.

```
Controller 0 Installed
```

The configuration files are modified and made to conform to the configuration.

12. Enter the controller name and the IP address for the FDDI controller.

```
Editing /sys/sun/conf.c
Making device node /dev/pg0 major: 105 minor: 0

Would you like to make the /etc/hostname file and /etc/hosts
file entries for controller pg0 now ? [y|n]
```

The *hostname* file names the controller and the *hosts* file associates the given name for the controller with a network address,

13. To enter the controller name and address, enter **y**. The following prompt is displayed.

```
Enter the hostname your computer will use with this device on your
FDDI network : server_fddi
```

Enter a unique name for the controller.

```
Enter the IP address for this device : 128.01.02.01
```

Enter a user-defined address. The system verifies that the address entered is a valid format and checks that the address entered is not used for another machine in the /*etc*/*hosts* file.

If the host ethernet interface (ie0 or le0) remains active, the hostname.ie0/le0 and hostname.pg0 files must contain distinct hostnames. The fddi interface (pg0) and the ethernet interface (ie0 or le0) also must have IP addresses assigned so that each has a *different network* address. An IP address consists of a network field and a host field. A class determines the network field of an IP address.

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Class ìAî Network: ìn1.00.00.00î, where n1 <128

Class ìBî Network: ìn1.n2.00.00î, where 128 ≤n1 < 192

Class ìCî Network: ìn1.n2.n3.00î, where 192 ≤n1

A subnet mask locally extends the network field to determine physical networks.

For example:

- Class B network with address ì128.1.0.0î
- Class C netmask of ì255.255.255.0î
- /etc/hostname.le0 on ìserverî has hostname ìserverî
- /etc/hostname.pg0 on ìserverî has hostname ìserver_fddiî

The /etc/hosts file on ìserverî has the entries:
128.01.01.01 server
128.01.02.01 server_fddi

The /etc/netmasks file on ìnismasterî should have the entry:
128.01.0.0 255.255.255.0

Manpage *hosts(5)* provides additional instructions to define the IP address.

```
Enter a comment for this IP address: test entry
```

Enter any additional information desired about the controller. The information you have entered is displayed in the next prompt:

```
Is the entry:

128.1.2.1 server_fddi # test entry

the entry you wish to use ? [y|n] y
```


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Enter **y** to affirm that the entries are correct. If corrections are required, enter n and reenter the information defined in this step. When entries are affirmed correct by the user, the following information is displayed.

```
Your FDDI hostname has been set to server_fddi for this device

The entry:

128.01.02.01 server_fddi test entry

was added to the /etc/hosts file.
```

14. If you do not wish to name the controller and assign the IP address at this time, enter **n** at the prompt.

The following messages are displayed:

```
You need these files to be able to communicate over networks.
You will have to add your /etc/hostname and /etc/hosts file entries manually.

The installation of Interphase V/FDDI Peregrine will continue. These files are
not needed to install the Interphase V/FDDI Peregrine. They are needed for
it to function properly after it is installed.
```

15. The Controller Configuration Menu is displayed, detailing the controllers added.

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```
                Controller Configuration Menu
                ---------- ------------- ----

V/FDDI-4211SN Peregrines Installed

Controller    Name    Address in hex    Interrupt Vector    Status
---------     ----    --------------    ----------------    ------
    0         pg0     8000              f0                  enabled

Controller Commands:
---------- --------
   install controller,             disable controller,
   enable controller,              modify controller entry,
   ! spawn shell,                  quit

Please Enter Command (i:d:e:m:!:q) :
```

Select the quit option. The following messages are displayed.

```
System configuration file, modification complete

Editing /sys/sun4/conf/files
```

Building the Kernel

16. The user has the option to allow the system to build and link the kernel or to manually build and link the kernel.

```
Interphase V/FDDI Peregrine edits were successful and complete.

To complete the Interphase V/FDDI Peregrine installation, it is necessary to
build a new Unix kernel.

Would you like the kernel named "GENERIC_PG" built automatically now [y|n]
```

Step a. details the system-generated process. Step b. outlines the instructions to manually build and link the kernel.

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a. Enter **y** to allow the program to build and link the kernel for you. The following details the process performed by the system. Please write down the name of your new kernel for future reference.

```
Verifying available space in "/sys" file system.

Building a new kernel. This may take a while.

cd /sys/sun4/conf
config GENERIC_PG
Doing a "make depend"
cd ../GENERIC_PG
make

cc -sparc -c -O -Dsun4 -DGENERIC -DSUN4_470 -DSUN4_330
-DSUN4_260 -DSUN4_110 -DWINSVJ -DOLDSCSI -DVDDRV -DASYNCHIO
-DLWP -DVFSSTATS -DRFS -DCRYPT -DTCPDEBUG -DIPCSHMEM -DIPCSEMAPHORE
-DIPCMESSAGE -DSYSAUDIT -DSYSACCT -DHSFS -DTMPFS -DTFS -DLOFS
-DNFSSERVER -DNFSCLIENT -DUFS -DQUOTA -DINET -DKERNEL -I. -I.. -I
../.. ../../netinet/in_proto.c

               .
               .       [ Complete listing has been omitted for brevity]
               .

confvmunix.c
loading vmunix
rearranging symbols
text         data          bss         dec         hex
```

```
Your new kernel has been built, installed as /vmunix.generic_pg,
and linked to /vmunix.

The current running kernel has been moved to
/vmunix.pre_pg

(Press RETURN to continue)
```

Press **Return** to continue.

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```
The man pages for the Interphase V/FDDI Peregrine utilities and software
is now available on this system. To access them when using the man
command, set the MANPATH shell environment variable to include the path
/usr/etc/install/PG/man before /usr/man.

You may need to export this directory for mounting by clients who need access
to these server specific man pages.

A basic level of ring monitoring is built into the driver which reports
ring status and event changes to the console and is written to the log file
'/usr/adm/messages'. Users should periodically purge their log file to
avoid unnecessary disk usage.

(Press RETURN to continue)
```

Press **Return** to continue. Appendix A contains a copy of the ìprgî manpage.

```
You will need to perform the following list of tasks to complete
the installation of the Interphase V/FDDI Peregrine.

 /usr/etc/shutdown -fh +5 to install GENERIC_PG kernel
 Power off the server.
 Install the Interphase V/FDDI Peregrine hardware.
 Restart the system.

Now please continue with the installation instructions in the
Interphase V/FDDI Peregrine Manual.
```

Proceed to Page -19, Step

b. Enter **n** to build and link the kernel manually.

```
Before you can use the new hardware, you must make and install the
new kernel. You can continue with the hardware installation now
or after you build the new kernel (the configuration filename is
GENERIC_PG).
```


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Caution

If the *n* option is selected, your hardware will not function properly until a new *vmunix* made from the new configuration file is built and installed.

Interphase Corporation highly recommends allowing the program to build and link the kernel. Only users who have a high degree of expertise with kernels and Unix configuration files should build and link the kernel manually.

To build the kernel, perform the following at the Unix prompt. (# denotes the Unix prompt.):

```
#cd /sys/architecture_directory/conf
#config [newkernelname]
```

To determine the correct architecture directory, use the *arch -k* command at the Unix prompt. The architecture directory may vary depending on the Sun Station on which the software is installed. See manpage config(8) for more information.

The message *doing make depend* is displayed on the screen.

```
#cd ../newkernelname
#make
```

To retain a copy of the old kernel (in the root directory), the kernel must be renamed to prohibit overwriting the file. If a link to *vmunix* exists, remove it. Rename the old kernel using the following command:

```
#mv /vmunix /vmunix.pre_pg
```

Move the new kernel to the root directory:

```
#mv vmunix /newkernelname
```

Create a symbolic link to the new kernel:

```
#ln -s /newkernelname /vmunix
```

Completing Your Software Installation

17. If the 4211SN software was installed from a tape, remove the tape from the drive and store it safely.

If you installed the 4211SN software from CD-ROM using *cdinstall*, eject the disk and store it safely. Use the following commands to eject the CD-ROM drive.

a. Change directories to root.

```
#cd  /
```


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b. Eject the disk from the CD-ROM drive.

```
#eject /dev/sr0
```

18. Modify your MANPATH environmental variable to include */usr/man/PG*. Your *.cshrc* or *.profile* file may require changes also. Export the 4211SN man pages.

19. Shutdown the system.

```
#/usr/etc/shutdown -fh +5
```

Once the software installation is completed, install the board in the server as described in Chapter 3.

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Hardware Installation 2

Introduction

Before attempting installation, read this chapter thoroughly to ensure the safe installation of the Peregrine board into your system. If any questions regarding installation are not answered in this chapter, please contact Interphase Customer Service.

Note

If the board was installed using the Auto software installation, your configuration file was set to use the factory default I/O address. Do not change the I/O address jumpered on your board. If the custom software installation was used, the jumpers are user-specified for the short I/O address that the board will use.

Install Prerequisites

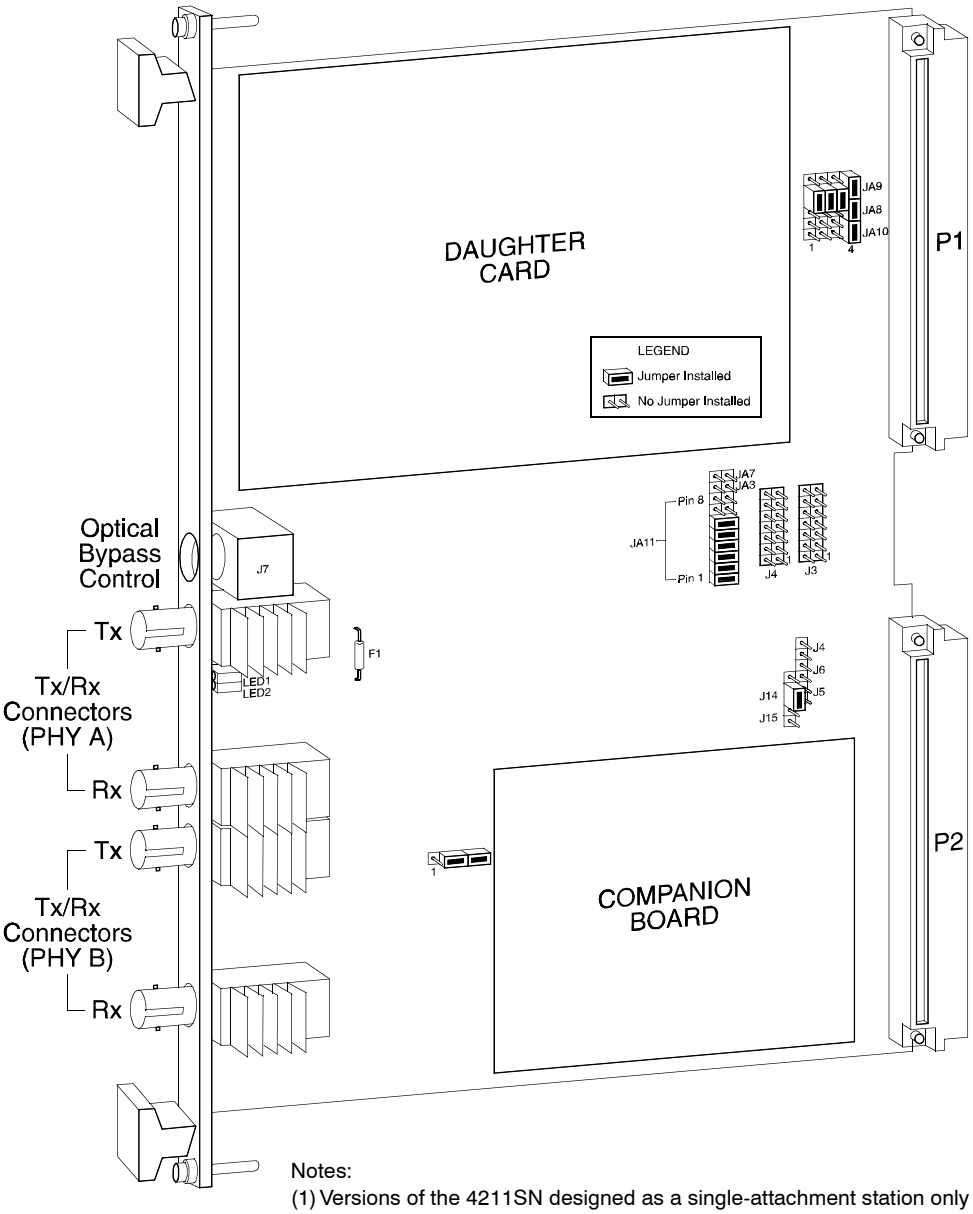
The following items may be needed when installing the 4211SN.

- A standard (flat blade) screwdriver
- A 2mm (or 5/64î) allen wrench
- Your Sun hardware manuals

Note

The Software installation portion of the installation process (Chapter 2) should be completed prior to installing the hardware.

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Notes:

(1) Versions of the 4211SN designed as a single-attachment station only have one pair of optical connectors (labelled ëPHY Aí above). For additional information on the PHY A/PHY B designation given above, please see ìCabling a Dual-Attachment Stationî.

(2) The jumper settings on your board may differ from those shown above.

(3) A second fuse, F2, is located beneath the companion board.

(4) LED3 - LED9 are provided on boards with hardware revision level HO-4211-xxx, REVD and earlier. Unlike LED1 and LED2, these LEDs are surface-mounted to the back of the board and are not visible unless they are lit.

Figure 2-1. V/FDDI 4211SN Controller

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Configuring the 4211SN

The 4211SN must be properly configured. The following steps must be performed:

- Verify switches and jumper settings
- Place the 4211SN board into the Sun chassis
- Remove backplane jumpers
- Install FDDI fiber optic cables

4211SN Hardware Installation Procedure

1. If the server is running, halt it and power down the system. If you have previously run the *deinstall* script, run the *reinstall* script before shutdown.

   a. Expel all users from the server and shut it down with *shutdown(8)*.

```
shutdown -fh +5
```

   b. Power the system down and unplug the unit from the power outlet.

   c. Remove the cosmetic covers for the server to gain access to the backplane jumpers and the card slots. This is described in the Sun hardware installation manual supplied with your server.

1. Inspect your 4211SN board and check the strapping (i.e., jumper settings).

   a. Remove the 4211SN from the anti-static bag, and visually inspect it to ensure no damage has occurred during shipment.

   b. Set all on-board jumpers so that the 4211SN is properly configured for operation within your system. To locate the jumpers, refer to the board layout in Figure 2-1. Jumper functions are summarized in Table 2-1.

Table 2-1. Mother Board Jumpers

Mother Board Jumpers	
Jumper	**Function**
JA1	Single/Dual PHY
JA2	(not used)
JA3	BCLK Termination
JA4	Local Clock

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Table 2-1. Mother Board Jumpers

Mother Board Jumpers	
Jumper	**Function**
JA5	Optical Bypass Control
JA6	Optical Bypass Control
JA7	Early BBSY[a] Release
JA8	Bus Request Level
JA9	Bus Request Level
JA10	Bus Request Level
JA11 (pins 1 - 7)	Short I/O Base Address
JA11 (pin 8)	VME Address Modifiers
JA12	Factory Test[a]

a. Jumper must be REMOVED for all board versions.

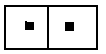
Some jumpers have default settings which should not (or cannot) be altered.

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Motherboard Jumper Settings

The following jumpers and default settings are used on the V/FDDI 4211SN Peregrine Motherboard.

JA1 Single/Dual PHY.



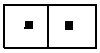
Single Attach Default Setting

Do not alter.



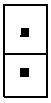
Dual Attach Default Setting

JA3 BCLK Termination



Default Setting. Do not alter.

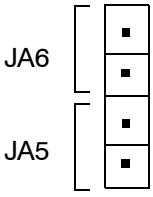
JA4 Local Clock



Default Setting. Do not alter.

JA5 and JA6 Optical Bypass Control

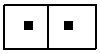
If the jumper is installed in JA5, the host is not able to control the bypass switch for the primary PHY. If the jumper is installed in JA6, the host is not able to control the bypass for the secondary PHY.



Default Setting

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JA7 Early BBSY Release



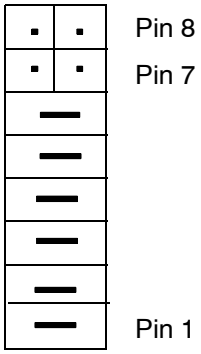
Default Setting

JA8, JA9 and JA10 Bus Request Level



Default Setting. Bus Request Priority 3

JA11 (Pins 1 ó 7) Short I/O Base Address. Pins 1 through 7 of jumper field JA11 are used to set the base address of the 512 bytes of short I/O space RAM on the 4211SN. Interaction between the host and the 4211SN board occurs in this 512-byte space.



First 4211SN (0x8000)

Figure 2-2. Jumper Setting Examples

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The jumpers correspond to VMEbus address lines A9-A15 respectively, as shown in the following table.

Table 2-2. Jumpers Used for Short I/O Base Address

JA11 Pin #	VMEbus Address Bit
7	A15
6	A14
5	A13
4	A12
3	A11
2	A10
1	A9

Removing a jumper sets the corresponding bit to ë1í. Installing a jumper clears the address bit to ë0í. The short I/O base address must be a multiple of 0x200. A complete list of short I/O addresses is in Appendix B.

For example:

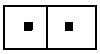
```
Jumper Setting*     VMEbus Address Bits**

  7654321           15  14  13  12  11  10   9  Base Address
  IIII0II            0   0   0   0   I   0   0    0x0800
  I0I00I0            0   I   0   I   I   0   I    0X5A00
  I00IIII            0   I   I   0   0   0   0    0x6000
  0IIIIII            I   0   0   0   0   0   0    0x8000

*     I = Jumper In
      0= Jumper Out
**    All bit definitions are binary (‘0’ or ‘1’).
      Address bits 8 through 0 are ‘0’.
```

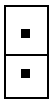

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JA11 (Pin 8) Address Modifiers Allowed in Short I/O. If the jumper is installed, only short supervisor accesses are permitted (address modifier 0x2D only). If no jumper is installed, both supervisor and user accesses (0x2D and 0x29) are allowed.



Default Setting

JA12 Test Jumper.



Default Setting. Do not alter.

1. Install 4211SN Board

   Once the board is configured, ensure that the host system and peripherals are turned OFF.

   Caution: System power and peripheral power must be turned OFF before attempting to install the 4211SN. Failure to do so may result in severe damage to the board and/or system.

   a. Carefully slide the 4211SN into the card slot. It should slide all the way in without any difficulty. If it does not, pull it out and check to make sure that no cables or other obstructions are in the slot.

   b. When the board is properly seated in the slot, tighten the captive mounting screws on each end of the front panel.

Changing Backplane Jumpers for Added Hardware

1. Configure the backplane jumpers for the board you have added.

   a. Open the backplane jumper access panel. Refer to the documentation received with your Sun system.

   b. Remove the interrupt acknowledge (IACK) and Bus Grant Level 3 (BG3) backplane jumpers for each slot in which you have added an 4211SN board.

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The figure below shows how the backplane jumpers should be configured for unoccupied slots and slots occupied by bus masters.

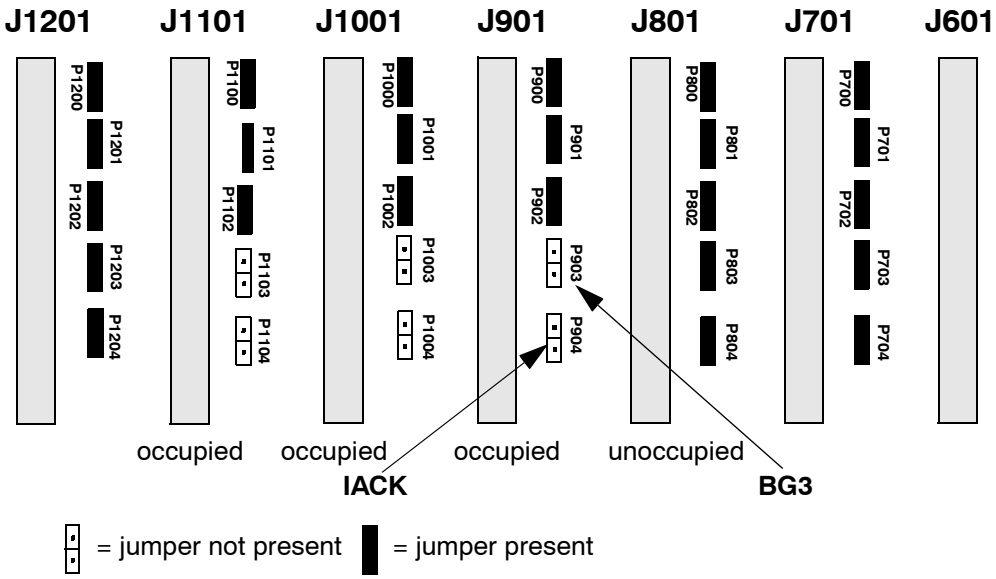


Figure 2-3. Setting Backplane Jumpers

1. Reassemble your serverís covers as described in the Sun hardware installation manuals.

Preparation for Cabling

Keep the dust caps on the cable ends, transmitter(s), and receiver(s) until you actually make the connections to prevent dirt and oils from getting on any important surfaces. Do not polish the connectors with a cloth made of synthetic fibers, as this will charge up the fiber and attract dust.

Connect the systems using the fiber optic cable(s). Do not stretch, puncture, or crush the cable(s) with staples, heavy equipment or doors, etc. Always maintain the minimum bend radii specified by the cable manufacturer. The fiber in fiber optic cable is damaged if the cables are bent into small radii. The minimum bend radii is usually 10-20 times a cableís outer diameter.

> **Warning**: Never look into an active fiber optic cable. Harmful optical radiation capable of causing permanent eye damage may be present. If necessary, user a fiber optic power meter to determine if a signal is present.

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1. Connect FDDI Cables

   a. Ensure that you have the correct cables for your configuration. Interphase currently offers the following options for the 4211SN:

   - 6U Single Attach with ST connector
   - 9U Single Attach with MIC receptacle
   - 6U Dual Attach with ST connectors
   - 9U Dual Attach with MIC receptacles

   The Sun 4/330 and 6/330 have both 6U or 9U slots; other chassis have only 9U slots.

   Depending on the version of the 4211SN, either ST™ -compatible optical connectors or MIC (Media Interface Connector) receptacles are used. The 9U version of the 4211SN has FDDI-standard MIC (Media Interface Connector) receptacles on the front panel of the adapter. The 6U version of the 4211SN has ST™-compatible optical connectors. Figure 2-4 depicts both connector types.

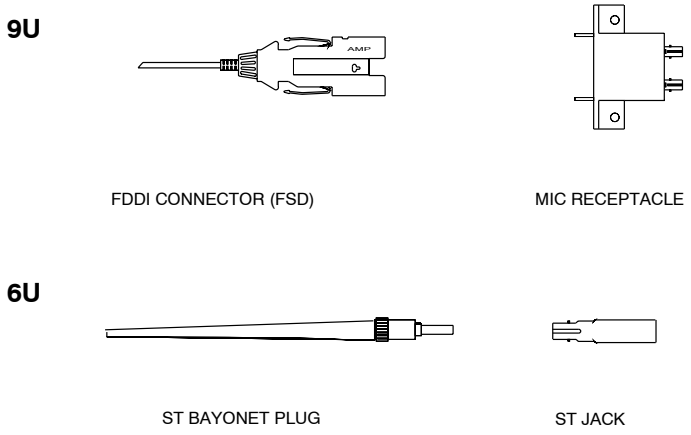


Figure 2-4. ST- and FDDI-Standard Connectors

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The following provides generic cabling instructions for different types of boards. An example of cabling a board using an optical bypass switch is also provided. For information on selecting the optimum cables and connectors for your installation, contact your FDDI cable manufacturer. For sample parts, see Appendix F.

Please proceed to the section corresponding to your board configuration.

Cabling a Single-Attachment Station (6U board)

The following describes one method for cabling the 4211SN as a single-attachment station. The parts required are:

- ST-to-MIC Cable with M keying. (See Appendix F for keying instructions.)
- MIC receptacle with M keying

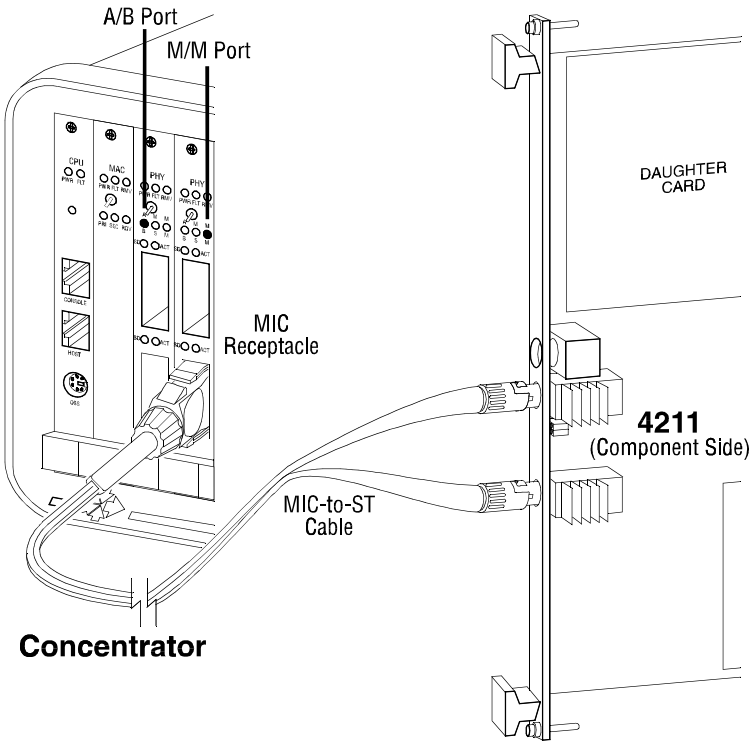


Figure 2-5. Cabling a Single-Attachment Station, 6U board

The above drawing (Figure 2-5) illustrates the setup.

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1. Connect the ST bayonet end of the ST-to-MIC cable to the transmit and receive connectors on the 4211SN.

   a. Locate the Tx and Rx connectors on the 4211SN. The single-PHY version of the 4211SN has a single Tx/Rx connector pair. In the board layout (Figure 2-1), this is the pair of Tx/Rx connectors located closest to the J7 connector (optical bypass control).

   b. Identify the ST connector which should be plugged into the Tx connector, and the one which should be plugged into the Rx connector. Signals must be routed so that the Tx output of one station is routed to the Rx input of its downstream neighbor.

      There is no physical difference between the ST connectors on the cable, but they are usually marked to distinguish them. These marks should be used consistently to cable all stations in your installation. For example, if the ST connector marked with a blue ring is used to route Tx signals from this station, use a blue ring to route Tx signals from all other stations.

   c. Each transmitter and receiver on the 4211SN has a gold jack with a slit from the edge to its base. Key the ST connectors to the appropriate jack and firmly press in place. Turn the connectors clockwise to lock the bayonet mechanism.

1. Connect the FDDI connector end of the ST-to-MIC cable to a MIC receptacle. This adapter is typically installed inside the concentrator.

The hardware installation procedure is completed for the 4211SN.

Cabling a Single-Attachment Station (9U board)

The following describes one method for cabling the 9U 4211SN as a single-attachment station. Figure 2-6 illustrates this setup. The parts required are:

- MIC-to-MIC Cable with M keying. (See Appendix F for keying instructions.)
- MIC receptacle with M keying.

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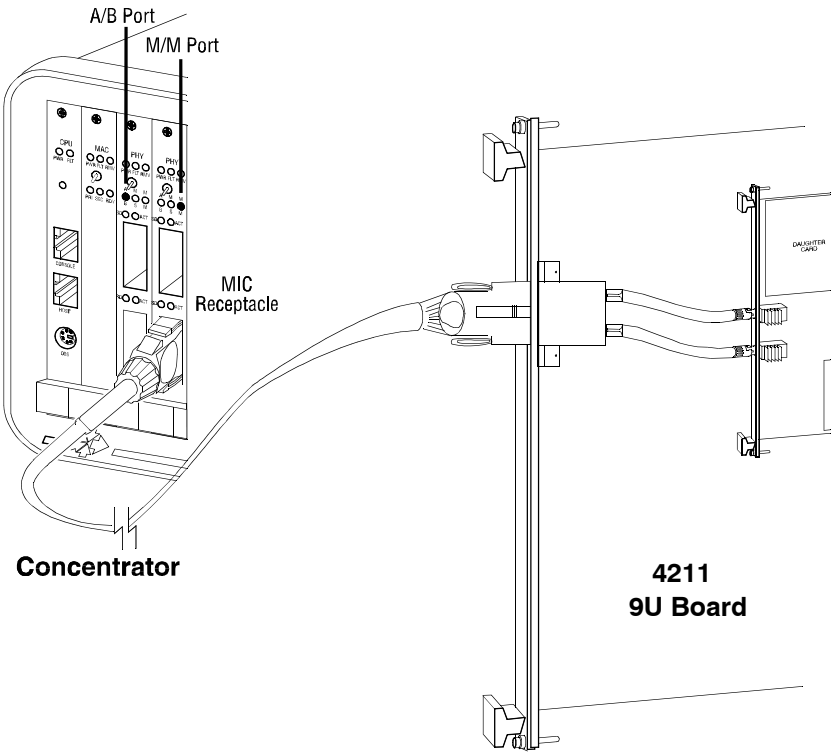


Figure 2-6. Cabling a Single-Attachment Station (9U board)

1. Connect one FDDI connector end of the MIC-to-MIC cable to the MIC receptacle on the 4211SN.

1. Connect the other FDDI connector end of the MIC-to-MIC cable to a MIC receptacle. This adapter is typically installed inside the concentrator.

The hardware installation procedure is completed for the 4211SN.

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Cabling Dual Attachment Stations

When cabling the 4211SN as a dual-attachment station, note how Tx/Rx signals are routed to/from the board. For example, if you have three dual-attachment stations connected to form a standard, counter-rotating FDDI ring and no fault has occurred, the flow of Tx and Rx signals between PHYs is as shown in Figure 2-7.

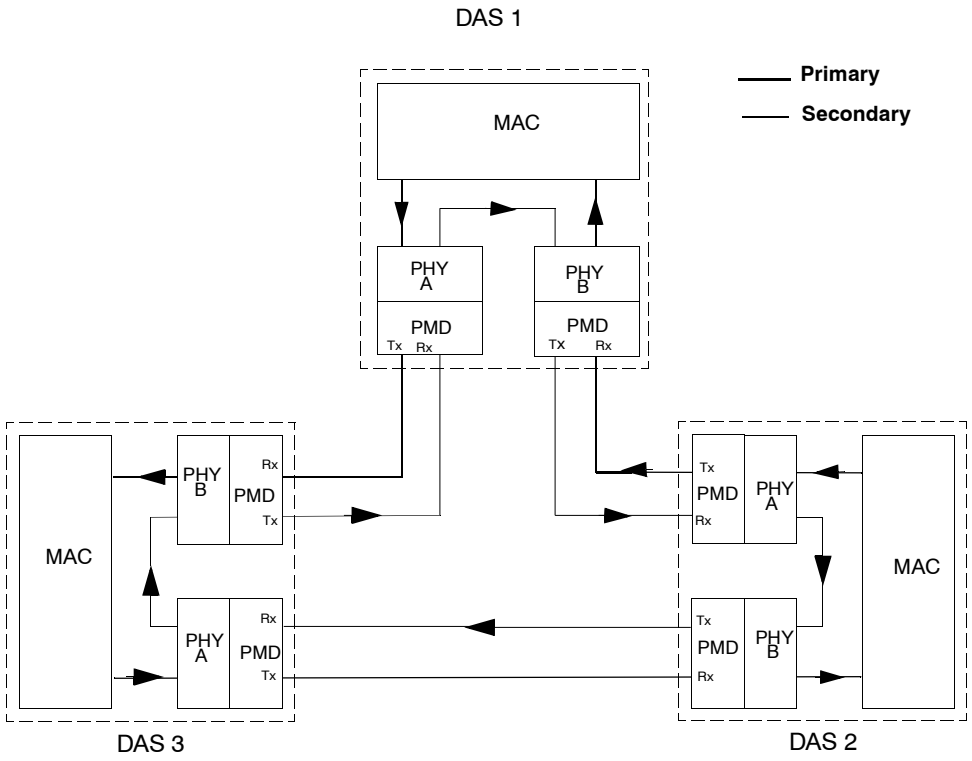


Figure 2-7. Flow of Tx/Rx Signals between PHYs of Dual-Attachment Stations (No Fault in Ring)

In Figure 2-7 outgoing data from one stationís PHY A feeds into its downstream neighborís PHY B as incoming data. Likewise, data that comes in a stationís PHY B goes out through its PHY A. This allows the ring to be reconfigured if a fault occurs.

PHY A vs. PHY B on the 4211SN. Versions of the 4211SN designed for use as a dual-attachment station have two Tx/Rx connector pairs. From a hardware standpoint, either of these connector pairs could be used as PHY A or PHY B.

Please note that the board layout illustrated in Figure 2-1 associates the two Tx/Rx connector pairs with a specific PHY. Certain components of the 4211SNís firmware expect the host system to use this designation. It also matches the lettering printed on the 4211SN front panels available from Interphase.

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In some networks it may be necessary to reverse this designation and use the Tx/Rx connector pair labelled ìPHY Aî as ìPHY Bî, and vice versa. If necessary in your configuration, please ensure that all affected components of the FDDI system are modified accordingly.

In each of the following cabling examples, it is also assumed that the Tx/Rx connector pair closest to the J7 connector (optical bypass control) is used for PHY A. The other Tx/Rx connector pair is used for PHY B. This coincides with the way in which the Tx/Rx connectors are labelled in the board layout in Figure 2-1.

Cabling a 6U Dual-Attachment Station

The following describes one method for cabling the 6U 4211SN as a dual-attachment station. In our example the upstream and downstream neighbors are also 6U dual attachment stations. The parts required are:

- 2 ST-to-ST cables.

1. Connect the ST-to-ST cables to the Tx/Rx connector pairs of PHY A and PHY B on the 6U 4211SN.

   a. Locate the connector pairs using Figure 2-8. Also see the board layout (Figure 2-1).

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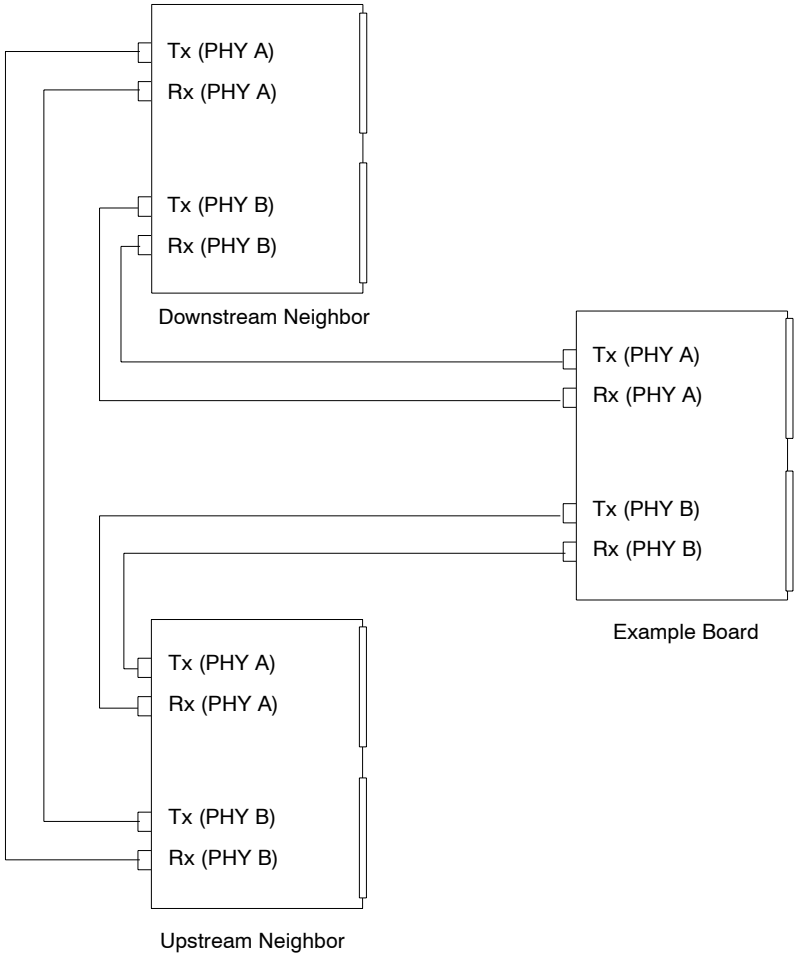


Figure 2-8. Cabling a 6U Dual-Attachment Station

b. Plug the ST connectors into the appropriate Tx or Rx connector on each 4211SN. Route signals so that each stationís PHY A Tx output feeds to the PHY B Rx input of its downstream neighbor. Likewise, route each stationís PHY B Tx output to the PHY A Rx input of its upstream neighbor. Refer to Figure 2-8.

   The ST connectors on the cable are not physically different, but usually, they are marked to distinguish each type. These marks should be used to consistently cable all stations in your installation. For example, if the ST connector marked with a blue ring is used to route Tx signals from this station, use a blue ring to route Tx signals from all other stations.

c. Each transmitter and receiver on the 4211SN has a gold jack with a slit from the edge to its base. Key the ST connectors to the appropriate jack and push firmly in place. Turn the connector clockwise to lock the bayonet mechanism.

The hardware installation procedure is complete for the 4211SN.

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Cabling a 9U Dual-Attachment Station

The following describes one method for cabling the 9U 4211SN as a dual-attachment station. In our example, the upstream and downstream neighbors are also 9U dual attachment stations. The parts required are:

- 2 MIC-to-MIC cables, each with ìType Aî keying on one end and ìType Bî keying on the other end. Refer to Appendix F for keying instructions.

1. Connect the MIC-to-MIC cables to PHY A and PHY B on the 9U 4211SN and its upstream and downstream neighbors.

   a. Locate the MIC receptacles for PHY A and PHY B using Figure 2-9. Also see the board layout (Figure 2-1).

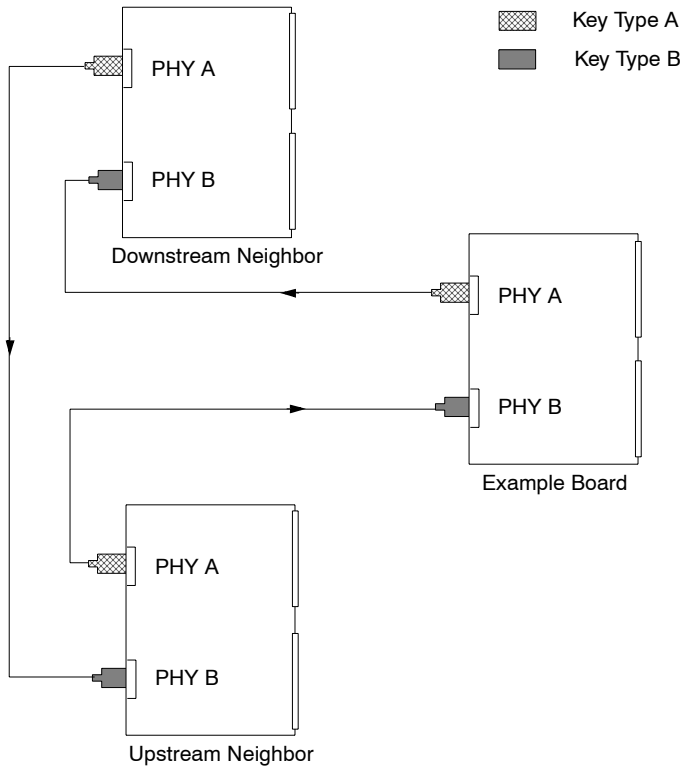


Figure 2-9. Cabling a 9U Dual-Attachment Station

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b. Using one of the MIC-to-MIC cables, connect the socket with ìType Aî keying into PHY A of the 4211SN and connect the socket with ìType Bî keying into PHY B of its downstream neighbor.

With another MIC-to-MIC cable, connect the socket with ìType Bî keying into PHY B of the 4211SN and connect the socket with ìType Aî keying into PHY A of its upstream neighbor

The hardware installation procedure is complete for the 4211SN.

Using Optical Bypass with your 6U Dual-Attachment Station

Optical Bypass keeps the ring intact in the event of a system failure. The following describes one method for cabling the 6U 4211SN as a dual-attachment station using optical bypass. The parts required are:

- Optical Bypass Switch with ST connectors
- 2 MIC-to-MIC cables. One cable has ìType Aî keying on one end; one cable has ìType Bî keying. Refer to Appendix F for keying instructions.

These cables connect the optical bypass switch to other units on the network. Keying is only specified for the end of the cable which connects to the bypass switch; connector requirements at the other end can vary.

1. Connect the optical bypass switch to the 4211SN.

   a. Locate the 4211SNís Tx/Rx connector pairs for PHY A and PHY B. Also see the board layout (Figure 2-1).

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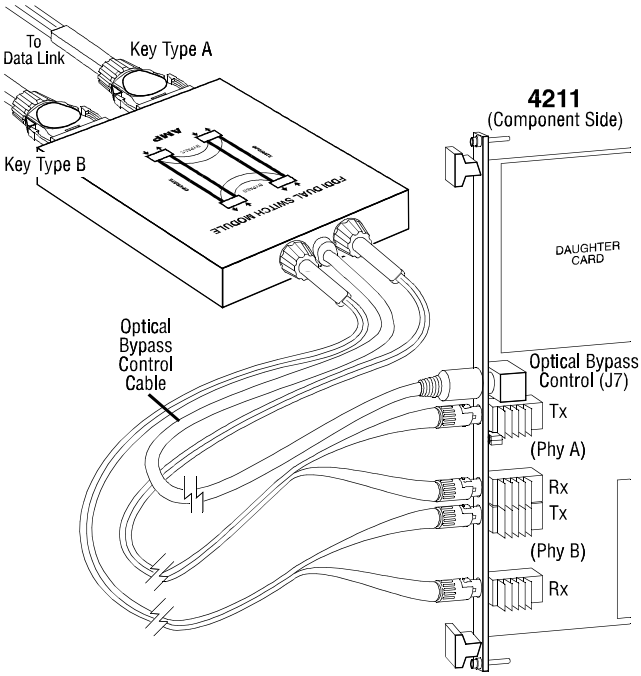


Figure 2-10. Cabling a 6U Dual Attachment Station with Optical Bypass

b. Plug the ST connectors on the bypass switch into the appropriate Tx or Rx connector on the 4211SN. *Each ST connector must be plugged into the correct Tx or Rx connector on the 4211SN.* (Route signals so that each stationís PHY A Tx output feeds to the PHY B Rx input of its downstream neighbor. Likewise, route each stationís PHY B Tx output to the PHY A Rx input of its upstream neighbor.)

   To identify the connectors, examine the two strand-pairs of ST connectors on the optical bypass switch. Each should be marked by the cable manufacturer (e.g., with a number or color coding) to help in identification.

c. Assuming that the connectors are labelled ì1î, ì2î, ì3î and ì4î or ìP Txî, ìS Rxî, ìS Txî and ìP Rxî, connect cables as shown below.

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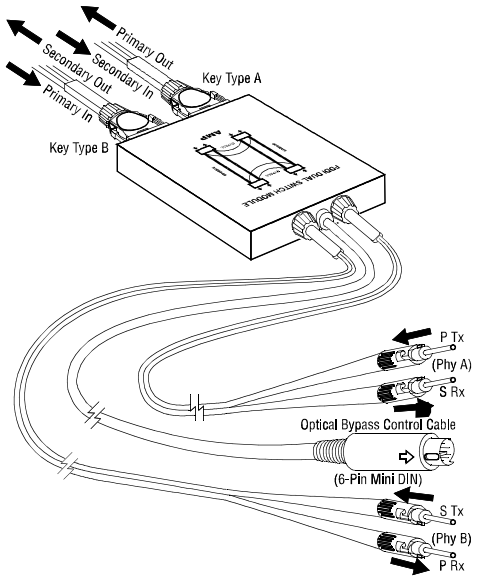


Figure 2-11. Example Optical Bypass Switch with ST connectors

d. Pull the dust caps off the transmitter, receivers and bayonet connectors.

e. Note that each transmitter and receiver each has a gold jack with a slit running from the edge to its base. Key the bayonet connectors to the appropriate jack and push them on. Turn the connectors clockwise to lock the bayonet mechanism.

f. The bypass switch has a control cable with a 6-pin mini DIN connector on the end. Plug this connector into the optical bypass control connector (J7) on the 4211SN. To locate the optical bypass switch, refer to Figure 2-10 or the board layout (Figure 2-1).

1. Connect the optical bypass switch to the data link. To do so:

   a. Locate the two MIC receptacles on the optical bypass switch. These are on the end of the switch opposite from the cables discussed in Step 1. One socket has ì Type Aî keying, and the other has ì Type Bî .

   b. Using the MIC-to-MIC cable with ì Type Aî keying on one end, connect the socket with ì A Typeî keying to the data link.

   c. Using the MIC-to-MIC cable with ì Type Bî keying on one end, connect the socket with ì B Typeî keying to the data link.

The hardware installation procedure is complete for the 4211SN**.**

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Using Optical Bypass with your 9U Dual-Attachment Station

Optical Bypass keeps the ring intact in the event of a system failure. The following describes one method for cabling the 9U 4211SN as a dual-attachment station using optical bypass. The parts required are:

- Optical Bypass Switch with FDDI connectors (FSD)
- 2 MIC-to-MIC cables. One cable has ìType Aî keying on one end; one cable has ìType Bî keying. Refer to Appendix F for keying instructions.

These cables connect the optical bypass switch to other units on the network. Keying is only specified for the end of the cable which connects to the bypass switch; connector requirements at the other end can vary.

1. Connect the optical bypass switch to the 4211SN.

   a. Locate the MIC receptacles for PHY A and PHY B using Figure 2-12. Also see the board layout (Figure 2-1).

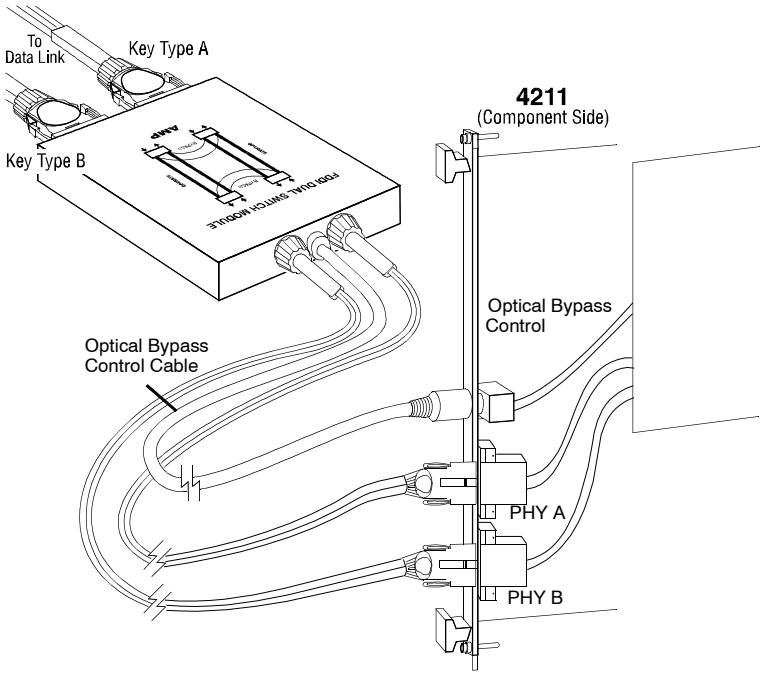


Figure 2-12. Cabling a 9U Dual Attachment Station with Optical Bypass

   b. Key the connectors on the optical bypass switch. Plug the ìType Aî connector into PHY A and the ìType Bî connector into PHY B.

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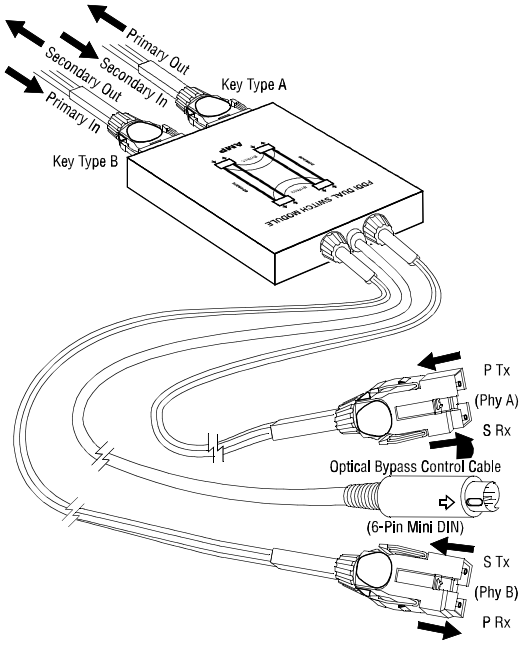


Figure 2-13. Example Optical Bypass Switch with MIC connectors

c. The bypass switch has a control cable with a 6-pin mini DIN connector on the end. Plug this connector into the optical bypass control connector (J7) on the 4211SN. To locate the optical bypass connector, refer to Figure 2-12 or the board layout (Figure 2-1).

1. Connect the optical bypass switch to the data link. To do so:

   a. Locate the two MIC receptacles on the optical bypass switch. These are on the end of the switch opposite from the cables discussed in Step 1. One socket has ì Type Aî keying, and the other has ì Type Bî.

   b. Using the MIC-to-MIC cable with ì Type Aî keying on one end, connect the socket with ì A Typeî keying to the data link.

   c. Using the MIC-to-MIC cable with ì Type Bî keying on one end, connect the socket with ì B Typeî keying to the data link.

The hardware installation procedure is complete for the 4211SN**.**

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Verify Installation

1. Recheck all your connections. Ensure that each connector is plugged into the correct receptacle/jack.

1. Connect your system to the power supply, and power it up.

1. Verify that the system is correctly configured and that installation is successful.

   a. Run the *verify* utility located in the */usr/etc/install/PG* directory. Reboot the system and check if the controller is listed in the booting routine.

The 4211SN controller installed on the system is displayed. The screen below is a sample listing produced via the *dmesg* command.

```
SunOS Release 4.1.2 (PG) #1: Mon Oct 26 13:35:18 CST 1992
Copyright (c) 1983-1991, Sun Microsystems, Inc.
cpu = Sun SPARCsystem 400
mem = 32768K (0x2000000)
avail mem = 30875648
Ethernet address = 8:0:20:a:bc:6a
isc0 at vme32d32 0x1080000 vec 0x4c
is0 at isc0 slave 0
idc0: ctlr message: 'FW revision date = 8/28/90 , level = 254 '
id000: <CDC IPI 9722 cyl 1630 alt 1 hd 7 sec 156>
id000 at idc0 facility 0
idc0 at ipi 0xff
si0 at vme24d16 0x200000 vec 0x40
st0 at si0 slave 32
st1 at si0 slave 40
sr0 at si0 slave 48
sd0 at si0 slave 0
sd2 at si0 slave 8
zs0 at obio 0xf1000000 pri 3
zs1 at obio 0xf0000000 pri 3
ie0 at obio 0xf6000000 pri 3
bwtwo0 at obio 0xfb300000 pri 4
bwtwo0: resolution 1152 x 900
pg0 at vme16d32 0x8000 vec 0xf0
root on id000a fstype 4.2
swap on id000b fstype spec size 66066K
dump on id000b fstype spec size 66040K
Interphase V/FDDI 4211 controller
    Driver ID: SX00066-X13 BETA RELEASE 13.1 10/23/92
    Firmware ID: V4211/2211 A16
    Release Date: 10/23/92 12:47
    Static RAM: 524288, Buffer RAM: 1048576
```


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Utilities 3

Introduction

In addition to the installation program, Interphase provides several other programs for verifying, deinstalling, and reinstalling your configuration files.

The verify Program

The *verify* program checks that all 4211SN files were properly installed and that the 4211SN kernel is running on the system. This utility should be used immediately after installation is complete.

Change directory to */usr/etc/install/PG*. The syntax for the program is shown below:

```
#verify
```

The following information is displayed upon running this utility. Enter the product number and press **Return**.

```
Please enter product number, 4211 or 5211 [4211]:

Interphase V/FDDI Peregrine verification script.

Initializing .....OK.

Installation of Interphase V/FDDI Peregrine in kernel /vmunix verified OK.

Verifying Interphase V/FDDI Peregrine software installation...

Interphase V/FDDI Peregrine software verified OK.

Software verification finished.
```

The *deinstall* Program

The 4211SN *deinstall* program is used to remove the Peregrine configuration from the kernel if the user needs to use the previous kernel.

The 4211SN *deinstall* program restores the original copies of the system configuration and data files back to their original locations and moves the 4211SN versions of the files into an PG subdirectory. For example, *deinstall* moves the current */usr/sys/sun/conf.c* file to

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/usr/sys/sun/PG/conf.c.pg, and it moves the original copy located in */usr/sys/sun/PG/conf.c.orig* to its original location. The *deinstallation* process is not complete until you reboot the server with the original (non-4211SN) kernel.

Note

If the configuration files are changed after the 4211SN software is installed, the system reverts to the state it was in immediately before the 4211SN installation when *deinstall* is run. Any changes made to the system after installing the 4211SN and prior to deinstalling are lost.

A subsequent execution of the *reinstall* program will restore the 4211SN files to their proper locations.

Before you execute the *deinstall* program you must change directory to */usr/etc/install/PG*. The syntax for the program is shown below:

```
deinstall [-n]
```

The *-n* switch prevents the *deinstall* program from executing any commands. Instead it prints each of the commands it would have executed at the standard output.

The following information is displayed. At the prompt requesting product number, enter the number of your board and press **Return**.

```
Please enter product number, 4211 or 5211 [4211]:

Interphase V/FDDI Peregrine deinstallation script.

Initializing.....OK.

You are about to deinstall the Interphase V/FDDI Peregrine software.
This process will not delete any files, but will move them into
a place from which they may be reinstalled later.

Are you sure you really want to do this? [y|n]

Deinstalling Interphase V/FDDI Peregrine software...

Interphase V/FDDI Peregrine software deinstalled OK.

Make sure to re-install your previous UNIX kernel as /vmunix
before rebooting.
```

Enter **y** at the prompt *Are you sure you really want to do this?* to continue the deinstallation process.

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The *reinstall* Program

The 4211SN *reinstall* program is the complement to the 4211SN *deinstall* program. It restores all of the copies of the 4211SN executable, data, and configuration files that were moved by *deinstall*.

The 4211SN *reinstall* program moves the original copies of the 4211SN system configuration and data files back to their original locations and moves the original versions of the files into an PG subdirectory. For example, *reinstall* moves the current */usr/sys/sun/conf.c* file to */usr/sys/sun/PG/conf.c.orig*, and it moves the 4211SN copy located in */usr/sys/sun/PG/conf.c.pg* to its installed location */usr/sys/sun/conf.c*.

Note

The reinstallation process is not complete until you reboot the server with the original (PG) kernel.

A subsequent execution of the *deinstall* program will restore the SunOS files to their original locations.

Before executing the *reinstall* program, change directory to */usr/etc/install/PG*. The syntax for the program is shown below:

```
reinstall [-n]
```

The *-n* switch prevents the *reinstall* program from executing any commands. Instead it prints each of the commands it would have executed at the standard output.

The following information is displayed.

```
Interphase V/FDDI Peregrine reinstall script.

Initializing.....OK.

You are about to reinstall the Interphase V/FDDI Peregrine software.
This process will not delete any files, but will move them into
a place from which they may be deinstalled later.

Are you sure you really want to do this? [y|n]

Reinstalling Interphase V/FDDI Peregrine software...

Interphase V/FDDI Peregrine software reinstalled OK.

Make sure to re-install the UNIX kernel you built during the
installation phase.
```

Enter **y** at the prompt, *Are you sure you really want to do this?*, to continue reinstallation.

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The *fddi_cfg* Utility

The *fddi_cfg* utility is used to install, enable and modify a controller after installation is completed.

The system automatically uses the current kernel configuration file name and adds the suffix *_pg*. The system allows the user to assign a unique name for the new configuration file.

To access the utility, enter the following:

```
cd /usr/etc/install/PG
fddi_cfg
```

The following messages and prompts are displayed:

```
Interphase V/FDDI Peregrine FDDI Configuration Utility.

Current kernel configuration file is named GENERIC_PG
New kernel configuration file will be named GENERIC_PG_PG

Do you wish to name the new configuration file yourself? [y|n] y

Please Enter New Name To Use, default:[GENERIC_PG_PG] GENERIC_PG2
```

Enter the new name of the kernel. The Controller Menu is displayed. Go to page -11 for information about the Controller Menu.

fddimon

The *fddimon* utility provides the system administrator with information to maintain the FDDI network. The monitor provides information about the node on which the program is loaded and the upstream and downstream neighbor addresses.

The user can remote shell *fddimon* from all nodes on the ring if a window application is running. This allows the user to monitor more than one node.

This section addresses the most commonly used functions of the *fddimon* utility. To access the utility, enter the following:

```
cd /usr/etc
fddimon pg0
```


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The *fddimon* composite menu is displayed.

```
/:Poll Rate = 500 MS              Composite Data
  StationID: 0000 EE41 7934        ECM-IN       CFM-THRU  RMT-RING_OP

  ManufactureData: XDI623-Interphase Corp.
  UserData       : V4211/V2211-Interphase Corp.             (SPACE)=More \/

  SMT Version Op: 0x0001    Hi: 0x0001  Lo: 0x0001

  MAC:  UpStreamNbr    DownStreamNbr  :  OldUpStreamNbr  OldDownStreamNbr
   1   0000 EE41 EB24  0000 EE28 41E6 :  0000 0000 0000  0000 0000 0000

  PHY: ConPol Cutoff Alarm ConState    RemoteType RemoteMAC   PCM    LER
   A    0000     7     8   ACTIVE          B          1     ACTIVE   15
   B    0000     7     8   ACTIVE          A          0     CONNECT  15

  T-MAX Low:   4.001 ms                    MAC Attribute Counts
  TVX   Low:   2.500 ms    Frame    : 0x00F8567B    Error     : 0x00000000
  T-Req    : 165.002 ms    Copied   : 0x00E2E51B    Lost      : 0x00000003
  T-MAX    : 165.002 ms    Transmit : 0x00152E99    TvxExpired: 0x00000001

--------------------------------------------------------------------------------
MENU: '1' = COMPOSITE '2' = SMT   '3' = MAC_CFGS '4' = MAC_CNTRS '5' = PORT A
      '6' = PORT B    '7' = PATH  '8' = ATTACH   '9' = SET_DLY   '0' = EXIT
--------------------------------------------------------------------------------
```

Figure 3-1. *fddimon* Composite Menu/Opening Screen

Each menu window contains an upper screen and a lower screen. Pressing the **spacebar** switches the screen from upper to lower and from lower to an upper screen. To access another menu, enter the number of the menu from the choices at the bottom of the screen. To exit the *fddimon* utility, enter **0**.

The Main Menu

The opening screen is the main menu or Composite Data screen. It contains most of the information needed to monitor the condition of the ring. It identifies the upstream and downstream neighbors, the ring state and the token rotation times. The main menu parameters most commonly used are defined below:

Poll Rate ~ The rate at which values are updated. This value can be changed by the Set-Delay function (selection 9 at the bottom of the screen).

StationID ~ The fddi address (in ì non-canonicalî order) of the station from which the fddimon utility is initiated.

ECM ~ Entity Coordination Management. The ì Inî state is the normal state for a completed connection.

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CFM ~ Configuration Management. Configuration Management describes the internal configuration of ports and MACs within a station or concentrator. Some possible states are as follows:

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.

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.

RMT ~ Ring Management (RMT) receives status information from the MAC and CFM and reports the status of the MAC. The ring operational (ì RING_OPî) state is the normal state.

ManufactureData ~ The manufacturer of the communication board.

UserData ~ The communication board used by the node.

SMT Version Op ~ The field in the SMT header that identifies the structure of the SMT Info field. This field, with others in the header, allows all protocol versions to recognize version mismatches. The value of the Version ID for NIFs (Neighbor Information Frames), SIFs (Status Information Frames) and ECFs (Echo Frames) is a constant value of 0x0001.

MAC ~ Media Access Control.

UpStreamNbr ~ The individual MAC address of the unit from which data is received.

DownStreamNbr ~ The individual MAC address of the unit to which data is transmitted.

OldUpStreamNbr ~ The previous MAC address of the unit from which the MAC received data.

OldDownStreamNbr ~ The previous MAC address of the unit to which the MAC transmitted data.

PHY ~ Physical Layer Protocol. Identifier for the PHY.

ConPol ~ Connection Policy. A 16-bit string representing the connection policies in effect for a node. *0000* means that all possible connections are allowed.

Cutoff ~ The link error rate estimate at which a connection is broken. The range is 10^{-4} to 10^{-15}. It is displayed as the absolute value of the base 10 logarithm. The default is 7 (10^{-7}).

Alarm ~ The link error rate at which a link connection generates an alarm. The range is 10^{-4} to 10^{-15}. The default is 8 (10^{-8}).

ConState ~ The state of the connection. Values are: Disabled, Connecting, Standby, and Active.

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RemoteType ~ The type of port connector at the other end of the physical connection. Values are A, B, M, S or ? (an question mark).

RemoteMAC ~ Indicates the presence (1) or absence (0) of a MAC whose transmit path exits the station via this port. There can be only one present at any one time.

PCM ~ The state of the Physical Connection Management (PCM) for this node. Values are Disable, Connect, Standby and Active.

LER ~ Link Error Rate. It ranges from 10^{-4} to 10^{-15}. LER is displayed as the absolute value of the base 10 logarithm.

The SMT Menu

This menu displays the configuration policy and paths available plus other SMT features.

The MAC-CFGS and MAC-CNTRS Menus

These menus show detailed MAC information. Some of the basic information is provided in the Composite Data screen.

The Port A and Port B Menus

These menus provide detailed information about the ports. Some of the basic information is provided in the Composite Data screen.

The Path Menu

This menu contains path information, Trace_Max expiration, and TVX and Max lower bound times.

The Attach Menu

The information displayed on this menu includes whether the node is a single or dual attach station, if an optical bypass is present and the I_Max Expiration time.

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The Set Delay Menu

This feature allows the user to set the rate, measured in milliseconds, at which the information on *fddimon* screens is updated.

```
Current Rate:500 MS
(5000 Max, 100 Min)

Enter New Time MS:
```

Enter the desired rate and press **Return**. The Composite Data screen is returned.

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Man Pages A

Man Pages

Name

prg ñ Interphase V/FDDI 4211SN driver

Availability

The **FDDI** driver is available from Interphase software distribution. This driver is specific to the 4211SN product. The 4211SN is NOT a bootable Sun supported device. For information about installing the software distribution, refer to the *Interphase V/FDDI 4211SN Installation Guide.*

Config

The following should be added to the system configuration file:

```
device pg0 at vme16d32 ? csr 0x8000 priority 3 vector pgintr 0xf0
```

The device line shown above specifies the 4211SN controllers in a Sun system. Only one (1) host adapter per system is supported.

For more information on making device entries, refer to the *Interphase V/FDDI 4211SN Installation Guide.*

Tuning

The file */usr/sys/sunif/pg_conf.c* contains tuning parameters for VME and FDDI parameters. The DMA burst rate, controller load adjust, VME timeout value, and the FDDI maximum transmission unit (MTU) can be tuned for a specific Sun system.

Kernel Building

The following should be added to the */usr/sys/sun/conf.c* file:

```
#include "pg.h"
#if NPG > 0
extern int pgopen(), pgclose(), pgdioctl();
#else
#define pgopen       nodev
#define pgclose      nodev
#define pgdioctl     nodev
#endif
```

Add the following entries to the cdevsw table:

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```
{
  pgopen,    pgclose,        nodev,       nodev, /*major #*/
  pgdioctl,      nodev,        nodev,       0,
  0,0,
},
```

The following should be added to the end of the */usr/sys/ëarch -kë/conf/files* file:

```
sunif/if_pg.c     optional pg device-driver
sunif/pg_conf.c   optional pg device-driver
```

Configure and make the new kernel, then copy to /.

Description

pg is the device driver software that controls the Interphase V/FDDI 4211SN host adapter.

/usr/sys/sunif/pg_conf.c
driver configuration file.

/usr/sys/sunif/if_pgreg.h
driver header file.

/usr/sys/sun[4|4m]/OBJ/if_pg.o
FDDI driver.

/etc/hostname.pg0
automatic configuration file.

See Also

For information about installing the software distribution, refer to the Interphase V/FDDI 4211SN Installation Guide.

System and Network Administation Manual

config(8)

Interphase V/FDDI 4211SN Installation Guide.

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Tuning B

Tuning the 4211SN

For optimal performance on Sun systems for FDDI networks, the following may be fine tuned.

Tuning the Sun System for FDDI

In the configuration file, the variable maxusers should be defined to 32.

The following variables can be changed in */usr/sys/netinet/in_proto.c*.

- The parameter **tcp_default_mss** is the default TCP maximum segment size - 512 to be conservative. Higher (e.g., 2048) is recommended for FDDI networks.
- The parameters **tcp_sendspace** and **tcp_recvspace** are the send and receive buffer spaces the system reserves for all TCP traffic. These variables should be changed from:

```
tcp_sendspace = 1024*4;
```

to:

```
tcp_sendspace = 1024*24;
```

and from:

```
tcp_recvspace = 1024*4;
```

to:

```
tcp_recvspace = 1024*24;
```

- The parameter **udp_recvspace** is the UDP receive buffer space the system reserves for all UDP traffic. This variable should be changed from:

```
udp_recvspace = 2*(9000+sizeof(struct sockaddr));
```

to:

```
udp_recvspace = 4*(9000+sizeof(struct sockaddr));
```

Warning

Do not increase this parameter above 4.

Tuning pg_conf.c

The factory set parameters have been tuned for optimal performance on Sun systems.

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The parameter **pgburst** defines the maximum number of bytes transferred during DMA bursts. Values may range from 0 to 255 (0 equals 256). The recommended value is 32 bytes.

The optimum value for the parameter **pgloadadjust** depends on a wide range of variables. These include the speed of the host processor, the size of the buffers received, the amount of network traffic addressed to the host, and other factors. Values may range from 0 to 32. The recommended value is 16.

The parameter **pgloadadjust** tells the 4211 controller when to read the receive buffer list. If network traffic is using small packets, the **pgloadadjust** parameter should be set above 16. The 4211 controller will be reading the receive buffer list fewer times, and the controller to host traffic is decreased. If network traffic is generated by a file server which is transferring large packets, the **pgloadadjust** parameter should be set below 16. The 4211 controller will be reading the receive buffer list a greater number of times. This will prevent the controller from losing receive buffers.

The parameter **pgvmetimeout** sets the amount of time in milliseconds the controller will wait for a VMEbus cycle to complete. If a VMEbus cycle does not finish within this time, a DMA timeout message is sent to the host. A value of zero means infinite time.

The parameter **fddimtu** defines the maximum transmission unit for FDDI. RFC1188 specifies 4352 bytes as the maximum. Some systems use a larger value (4470). To inter-operate with these hosts, the maximum MTU value on the ring must be used.

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Base Address Jumper Settings

Address	Pin1	Pin2	Pin3	Pin4	Pin 5	Pin 6	Pin 7
0x0000	In	In	In	In	In	In	In
0x0200	Out	In	In	In	In	In	In
0x0400	In	Out	In	In	In	In	In
0x0600	Out	Out	In	In	In	In	In
0x0800	In	In	Out	In	In	In	In
0x0A00	Out	In	Out	In	In	In	In
0x0C00	In	Out	Out	In	In	In	In
0x0E00	Out	Out	Out	In	In	In	In
0x1000	In	In	In	Out	In	In	In
0x1200	Out	In	In	Out	In	In	In
0x1400	In	Out	In	Out	In	In	In
0x1600	Out	Out	In	Out	In	In	In
0x1800	In	In	Out	Out	In	In	In
0x1A00	Out	In	Out	Out	In	In	In
0x1C00	In	Out	Out	Out	In	In	In
0x1E00	Out	Out	Out	Out	In	In	In
0x2000	In	In	In	In	Out	In	In
0x2200	Out	In	In	In	Out	In	In
0x2400	In	Out	In	In	Out	In	In
0x2600	Out	Out	In	In	Out	In	In
0x2800	In	In	Out	In	Out	In	In
0x2A00	Out	In	Out	In	Out	In	In
0x2C00	In	Out	Out	In	Out	In	In
0x2E00	Out	Out	Out	In	Out	In	In
0x3000	In	In	In	Out	Out	In	In
0x3200	Out	In	In	Out	Out	In	In

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Address	Pin1	Pin2	Pin3	Pin4	Pin 5	Pin 6	Pin 7
0x3400	In	Out	In	Out	Out	In	In
0x3600	Out	Out	In	Out	Out	In	In
0x3800	In	In	Out	Out	Out	In	In
0x3A00	Out	In	Out	Out	Out	In	In
0x3C00	In	Out	Out	Out	Out	In	In
0x3E00	Out	Out	Out	Out	Out	In	In
0x4000	In	In	In	In	In	Out	In
0x4200	Out	In	In	In	In	Out	In
0x4400	In	Out	In	In	In	Out	In
0x4600	Out	Out	In	In	In	Out	In
0x4800	In	In	Out	In	In	Out	In
0x4A00	Out	In	Out	In	In	Out	In
0x4C00	In	Out	Out	In	In	Out	In
0x4E00	Out	Out	Out	In	In	Out	In
0x5000	In	In	In	Out	In	Out	In
0x5200	Out	In	In	Out	In	Out	In
0x5400	In	Out	In	Out	In	Out	In
0x5600	Out	Out	In	Out	In	Out	In
0x5800	In	In	Out	Out	In	Out	In
0x5A00	Out	In	Out	Out	In	Out	In
0x5C00	In	Out	Out	Out	In	Out	In
0x5E00	Out	Out	Out	Out	In	Out	In
0x6000	In	In	In	In	Out	Out	In
0x6200	Out	In	In	In	Out	Out	In
0x6400	In	Out	In	In	Out	Out	In
0x6600	Out	Out	In	In	Out	Out	In
0x6800	In	In	Out	In	Out	Out	In
0x6A00	Out	In	Out	In	Out	Out	In
0x6C00	In	Out	Out	In	Out	Out	In
0x6E00	Out	Out	Out	In	Out	Out	In

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Address	Pin1	Pin2	Pin3	Pin4	Pin 5	Pin 6	Pin 7
0x7000	In	In	In	Out	Out	Out	In
0x7200	Out	In	In	Out	Out	Out	In
0x7400	In	Out	In	Out	Out	Out	In
0x7600	Out	Out	In	Out	Out	Out	In
0x7800	In	In	Out	Out	Out	Out	In
0x7A00	Out	In	Out	Out	Out	Out	In
0x7C00	In	Out	Out	Out	Out	Out	In
0x7E00	Out	Out	Out	Out	Out	Out	In
0x8000	In	In	In	In	In	In	Out
0x8200	Out	In	In	In	In	In	Out
0x8400	In	Out	In	In	In	In	Out
0x8600	Out	Out	In	In	In	In	Out
0x8800	In	In	Out	In	In	In	Out
0x8A00	Out	In	Out	In	In	In	Out
0x8C00	In	Out	Out	In	In	In	Out
0x8E00	Out	Out	Out	In	In	In	Out
0x9000	In	In	In	Out	In	In	Out
0x9200	Out	In	In	Out	In	In	Out
0x9400	In	Out	In	Out	In	In	Out
0x9600	Out	Out	In	Out	In	In	Out
0x9800	In	In	Out	Out	In	In	Out
0x9A00	Out	In	Out	Out	In	In	Out
0x9C00	In	Out	Out	Out	In	In	Out
0x9E00	Out	Out	Out	Out	In	In	Out
0xA000	In	In	In	In	Out	In	Out
0xA200	Out	In	In	In	Out	In	Out
0xA400	In	Out	In	In	Out	In	Out
0xA600	Out	Out	In	In	Out	In	Out
0xA800	In	In	Out	In	Out	In	Out
0xAA00	Out	In	Out	In	Out	In	Out

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Address	Pin1	Pin2	Pin3	Pin4	Pin 5	Pin 6	Pin 7
0xAC00	In	Out	Out	In	Out	In	Out
0xAE00	Out	Out	Out	In	Out	In	Out
0xB000	In	In	In	Out	Out	In	Out
0xB200	Out	In	In	Out	Out	In	Out
0xB400	In	Out	In	Out	Out	In	Out
0xB600	Out	Out	In	Out	Out	In	Out
0xB800	In	In	Out	Out	Out	In	Out
0xBA00	Out	In	Out	Out	Out	In	Out
0xBC00	In	Out	Out	Out	Out	In	Out
0xBE00	Out	Out	Out	Out	Out	In	Out
0xC000	In	In	In	In	In	Out	Out
0xC200	Out	In	In	In	In	Out	Out
0xC400	In	Out	In	In	In	Out	Out
0xC600	Out	Out	In	In	In	Out	Out
0xC800	In	In	Out	In	In	Out	Out
0xCA00	Out	In	Out	In	In	Out	Out
0xCC00	In	Out	Out	In	In	Out	Out
0xCE00	Out	Out	Out	In	In	Out	Out
0xD000	In	In	In	Out	In	Out	Out
0xD200	Out	In	In	Out	In	Out	Out
0xD400	In	Out	In	Out	In	Out	Out
0xD600	Out	Out	In	Out	In	Out	Out
0xD800	In	In	Out	Out	In	Out	Out
0xDA00	Out	In	Out	Out	In	Out	Out
0xDC00	In	Out	Out	Out	In	Out	Out
0xDE00	Out	Out	Out	Out	In	Out	Out
0xE000	In	In	In	In	Out	Out	Out
0xE200	Out	In	In	In	Out	Out	Out
0xE400	In	Out	In	In	Out	Out	Out
0xE600	Out	Out	In	In	Out	Out	Out

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Address	Pin1	Pin2	Pin3	Pin4	Pin 5	Pin 6	Pin 7
0xE800	In	In	Out	In	Out	Out	Out
0xEA00	Out	In	Out	In	Out	Out	Out
0xEC00	In	Out	Out	In	Out	Out	Out
0xEE00	Out	Out	Out	In	Out	Out	Out
0xF000	In	In	In	Out	Out	Out	Out
0xF200	Out	In	In	Out	Out	Out	Out
0xF400	In	Out	In	Out	Out	Out	Out
0xF600	Out	Out	In	Out	Out	Out	Out
0xF800	In	In	Out	Out	Out	Out	Out
0xFA00	Out	In	Out	Out	Out	Out	Out
0xFC00	In	Out	Out	Out	Out	Out	Out
0xFE00	Out	Out	Out	Out	Out	Out	Out

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Specifications D

Introduction

The firmware specifications are detailed below:

VMEbus Specifications

VMEbus data transfers in excess of 30 Mbytes/sec.

Supports DMA word aligned longword and word transfers. No unaligned byte transfer capability.

Options (VMEbus Master)

Addressing	16-, 24- and 32-bit addressing 16- and 32-bit data transfers
Address Modifiers	all options
Requester options	any one of R(0), R(1), R(2), R(3) (jumper selectable)
RWD	(Release When Done)

Options (VMEbus Slave)

Addressing	A16:D16
Address Modifiers	0x29, 0x2D
Interrupter options	any one or IR (x-y) where 1 < = x < = 7 and < = y < = 7 D08 any vector

Dual priority interrupt controllers (Am9519A) provide a unique interrupt vector for each individual interrupt source.

FDDI Specifications

One board implements either a single PHY single MAC (SASSM) or a dual PHY single MAC (DASSM) FDDI station.

The 4211 supports the complete set of SMT functions, as documented in the FDDI Station Management (SMT) standards, Rev. 6.2.

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Includes an I/O port with high current sink (up to 300 mA) capability for controlling an external optical bypass switch.

STô - compatible optical connectors

Timer Defaults

The default value of TVX is 2.5 milliseconds.

The default for T_req is 165 milliseconds.

The value of T_Min is 4 msec., and T_Max is 165 msec.

Power Requirements

V/FDDI 4211	8 A typical at +5 V_{DC} / 25 degrees C 1 A typical at +12 V_{DC} / 25 degrees C

Mechanical (nominal)

The 4211 occupies one 6U single-height VMEbus slot.

Width:	9.20®(233 mm)
Height:	6.30®(160 mm)

Operating Environment

Temperature:	0 - 55 degrees C
Relative Humidity	10 - 95% noncondensing
Altitude	0 - 15,000 feet

Storage

Storage Temperature	0 - 125 degrees C
Storage Humidity	10 - 95% noncondensing
Storage Altitude	0 - 50,000 feet

LEDs

The 4211 has nine LEDs ó labelled LED1 through LED9 in the board drawing (Figure 2-1, p. -24).

LED1 and LED2 are mutually exculsive (i.e., when one turns on, the other turns off). When the board is powered-up or reset, the LEDs will toggle on and off for about 10 seconds

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while the 4211 performs its power-up diagnostics. Once the 4211 firmware has booted up and the Common Boot Interface is active, the red LED (LED1) turns off the green LED (LED2) turns on. When the host boots the RC Interface, the LEDs return to toggling on/off again.

LED3, LED4 and LED5 indicate the state of the ring. LED 4 signals THRU, LED3 signals the status of the primary ring, and LED5 signals the status of the secondary ring. If the THRU bit is set (i.e., LED4 is lit), one of the other bits indicates the THRU condition. If the THRU bit is not set, the other bits indicate WRAP condition. All bits off indicate a ì ring downî condition. The following summarizes possible ring conditions which can be signalled by these LEDs. Ring states are defined in section 9.7.6.2 of the SMT Rev. 6.2 specifications.

Table D-1. Ring State LEDs (LED3 - LED5)

Ring State	PRI LED3	THRU LED4	SEC LED5
Isolated	Off	Off	Off
Wrap_A	On	Off	Off
Wrap_B	Off	Off	On
Wrap_AB	On	Off	On
THRU_A	On	On	Off
THRU_B	Off	On	On
THRU_AB	On	On	On

LED6, LED7, LED8 and LED9 indicate the status of the four DMA channels on the 4211. LED6 and LED7 signal transmit activity when the ring is up. LED8 and LED9 signal when the channel is programmed and the board is ready to receive a new frame. These LEDs are summarized in Table D-2.

Table D-2. DMA Status LEDs (LED6 - LED9)

Channel	LED	Function
Tx (Synchronous)	LED6	On = transmitting; Off = not active
Tx (Asynchronous)	LED7	On = transmitting; Off = not active
Rx Channel A	LED8	On = ready to receive; Off = not ready
Rx Channel B	LED9	On = ready to receive; Off = not ready

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Note:

LEDs 3 through 9 are only supported on controllers with hardware revision level HO4211-xxx, REVD and later. LED1 and LED2 are supported on all versions of the controller.

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Software E

4211SN Software Distribution

This section describes the contents of the 4211SN distribution tape or CD-ROM.

Files in the 4211SN Software Distribution

This file is an example of the contents of the perm.sun4.data file. (This list is correct as of this printing but is subject to change.)

```
# @(#)$Id: perm.sun4.data,v 1.26 1992/12/31 18:58:54 jdonahue Exp $
#
# field 1: is the pathname in the distribution area.
# field 2: is the pathname from the installation root.
# field 3: are permissions.
# field 4: are ownerships.
# field 5: is an action word to the install program.
#
./usr                                ./usr                                2755    root.wheel  directory
./usr/etc                            ./usr/etc                            2755    root.staff  directory
./usr/etc/PG                         ./usr/etc/PG                         2755    root.staff  directory
./usr/etc/fddimon                    ./usr/etc/fddimon                    0500    root.staff  private
./usr/etc/install                    ./usr/etc/install                    2755    root.staff  directory
./usr/etc/install/PG                 ./usr/etc/install/PG                 2755    root.staff  directory
./usr/etc/install/PG/PG              ./usr/etc/install/PG/PG              2755    root.staff  directory
./usr/etc/install/PG/install_unbundled./usr/etc/install/PG/install_unbundled 0755    root.staff  private
./usr/etc/install/PG/install         ./usr/etc/install/PG/install         0755    root.staff  private
./usr/etc/install/PG/cdinstall       ./usr/etc/install/PG/cdinstall       0755    root.staff  private
./usr/etc/install/PG/deinstall       ./usr/etc/install/PG/deinstall       0755    root.staff  private
./usr/etc/install/PG/reinstall       ./usr/etc/install/PG/reinstall       0755    root.staff  private
./usr/etc/install/PG/verify          ./usr/etc/install/PG/verify          0755    root.staff  private
./usr/etc/install/PG/fddi_cfg        ./usr/etc/install/PG/fddi_cfg        0755    root.staff  private
./usr/etc/install/PG/cfg_sw_tbl      ./usr/etc/install/PG/cfg_sw_tbl      0755    root.staff  private
./usr/etc/install/PG/gen_script      ./usr/etc/install/PG/gen_script      0755    root.staff  private
./usr/etc/install/PG/dh              ./usr/etc/install/PG/dh              0755    root.staff  private
./usr/etc/install/PG/pg.conf_c       ./usr/etc/install/PG/pg.conf_c       0755    root.staff  private
./usr/etc/install/PG/pg.config       ./usr/etc/install/PG/pg.config       0755    root.staff  private
./usr/etc/install/PG/pg.config.npgc  ./usr/etc/install/PG/pg.config.npgc  0755    root.staff  private
./usr/etc/install/PG/COPYRIGHT_NOTICE./usr/etc/install/PG/COPYRIGHT_NOTICE 0755    root.staff  private
./usr/etc/install/PG/READ_ME         ./usr/etc/install/PG/READ_ME         0755    root.staff  private
./usr/etc/install/PG/PG/perm.sun4.data./usr/etc/install/PG/PG/perm.sun4.data 0644    root.staff  private
./usr/etc/install/PG/PG/what.sun4.data./usr/etc/install/PG/PG/what.sun4.data 0644    root.staff  private
./usr/etc/install/PG/man             ./usr/etc/install/PG/man             2755    root.staff  directory
./usr/etc/install/PG/man/pg.4        ./usr/etc/install/PG/man/pg.4        0644    root.staff  new
./sys                                ./sys                                2775    root.staff  directory
./sys/sun4                           ./sys/sun4                           2775    root.staff  directory
./sys/sun4/OBJ                       ./sys/sun4/OBJ                       2775    root.staff  directory
./sys/sun4/OBJ/PG                    ./sys/sun4/OBJ/PG                    2775    root.staff  directory
./sys/sun4/OBJ/if_pg.o               ./sys/sun4/OBJ/if_pg.o               0444    root.staff  new
./sys/sun4/conf                      ./sys/sun4/conf                      2775    root.staff  directory
./sys/sun4/conf/PG                   ./sys/sun4/conf/PG                   2775    root.staff  directory
./sys/sun4/conf/PG/config.add.pg.1   ./sys/sun4/conf/PG/config.add.pg.1   0644    root.staff  private
./sys/sun4/conf/PG/config.add.pg.2   ./sys/sun4/conf/PG/config.add.pg.2   0644    root.staff  private
./sys/sun4/conf/PG/files.add.pg.1    ./sys/sun4/conf/PG/files.add.pg.1    0644    root.staff  private
./sys/sunif                          ./sys/sunif                          2775    root.staff  directory
./sys/sunif/PG                       ./sys/sunif/PG                       2775    root.staff  directory
./sys/sunif/pg_conf.c                ./sys/sunif/pg_conf.c                0444    root.staff  new
./sys/sunif/if_pgreg.h               ./sys/sunif/if_pgreg.h               0444    root.staff  new
./sys/sun                            ./sys/sun                            2775    root.staff  directory
./sys/sun/PG                         ./sys/sun/PG                         2775    root.staff  directory
./sys/sun/PG/pg_cdevsw_entry         ./sys/sun/PG/pg_cdevsw_entry         0644    root.staff  private
./sys/sun/PG/pg_ifdef_entry          ./sys/sun/PG/pg_ifdef_entry          0644    root.staff  private
```


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Cabling F

Cabling Connections

The following table lists sample part numbers of components which can be used to set up various types of FDDI stations.

Table F-1. Sample Parts for Cabling the 4211.

Type of Part	Sample Part Number	Purpose
ST-to-MIC Cable	AMP 502175-7 [a]	Routes Tx and Rx signals from the ST connectors of one 6U 4211 PHY. The FSD connector on the cable plugs into the MIC receptacle of a concentrator or a 9U 4211SN.
MIC-to-MIC Cable	AMP 502122 [b]	Routes Tx and Rx signals from the MIC connector of one 9U 4211 PHY to another. This cable also connects the optical bypass switch to the data link.
Optical Bypass Switch	Interphase Part # [c] SA0000070	Provides the optical bypassing mechanism described in FDDI specifications.

a. This part number is for a 15-meter dual-fiber cable with two 2.5mm bayonet ST connectors on one end and an FDDI connector on the other. Cable size is 62.5/125 µm.

b. This part number is for a 15-meter light-duty dual-fiber cable with two FDDI connectors at each end. Cable size is 62.5/125 µm.

c. This part is an AMP 502443-3 optical bypass switch. The switch has two pairs of ST connectors that mate with the Tx/Rx connectors on a dual-PHY 4211. It also has a 6-pin mini DIN plug on its optical bypass control cable that mates with the 4211ís J7 connector.

FDDI Connectors

Before cabling the 4211SN, it is necessary to key certain FDDI-standard connectors on the cables. For example, the ST-to-MIC cable specified in Table F-1 is an AMP ìuniversalî FDDI cable. The FDDI end of the cable will mate with any MIC receptacle as delivered.

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Important

It is essential that all FDDI connectors be properly keyed. Otherwise, it is likely that signals will get crossed during installation or when network cables are later detached/ reconnected.

Identifying and Installing Connector Keys. To determine the keying of an FDDI connector, examine it for some kind of identifying mark or aperture for the key. For example, if you are looking at an AMP FDDI cable connector, remove the protective cover and locate the key aperture. This aperture is approximately 1/4 inch from the end of the connector.

If the aperture is empty, the connector is unkeyed (ì universalî). If installed, the key can be identified by the key type or by color. See Table F-2.

Table F-2. Keying Scheme on AMP FDDI Connectors

Key Color	Key Type	Function
Red	A	Connect to PHY A
Blue	B	Connect to PHY B
Green	M	Connect to concentrator or single-attachment station

To key an unkeyed AMP FDDI cable connector:

a. Get the desired key. Keys for an AMP FDDI connector are stored in connectorís protective cover. To remove a key from the protective cover, pry it out carefully with a pin knife.

b. Press the key into the key aperture. Orient the key so that the T-shaped end fits into the rectangular groove on the connector. The other end of the key will be flush with the smooth side of the connector.

To remove a key from an AMP FDDI cable connector, turn the smooth side of the connector face up, place the tip of a small, flat-headed screwdriver on the key and press firmly.

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Fiber Distributed Data Interface (FDDI) - A Tutorial

G

by Mark S. Wolter, National Semiconductor Corporation

Introduction

Some of the basic characteristics of the FDDI specification include fiber optic transmission media, ring topology, token access protocol and an architecture with a distributed management approach. The network parameters achieved by these characteristics include a 100Mbps data rate, 2-3 km distance between connections, up to 1000 connections on a network and a total distance of 200 km. The specification for FDDI is compliant with the Open Systems Interconnection.

Demand for FDDI

Mainframe computers were originally developed to support multiple users. As computers became more plentiful, the need arose to transfer data between computer systems, and proprietary computer networks were developed. The advent of mini, micro and personal computers led to the need to share expensive resources between several autonomous systems, each having their own operating environment. From this need, standardized *Local Area Networks* (LANs) evolved that supported shared printers, modems, and disk drives. With the availability of this standard network, new applications not suited to the available bandwidth of existing technology LANs were developed. The need for a high speed network, FDDI, was established. Shared data intensive resources such as file systems are now used as an integral part of a node's operating system and require fast access across a network. Plotters and graphic printers, and fast interactive support of high resolution graphic workstations require the solution offered by FDDI. Different networks, each with their own characteristics, were attached to each other, creating a nightmare for a network administrator responsible for network loading and fault isolation. Better management and greater bandwidth are needed for interconnection of existing departmental LANs onto a high speed FDDI backbone.

Fiber Optic Media

One of the characteristics of FDDI is the use of fiber optic cable as a communication media which has several advantages over alternative copper media. The bandwidth of coaxial cable or twisted pair wires limits the transmission speed and the distance between active connections as compared to fiber optic cables.

Fiber optic cable also has several advantages security over most alternatives. Fiber optic cable is immune to *Electromagnetic Interference* (EMI) so that it cannot be jammed by high power transmissions such as radio transmitters. Fiber optics do not emit *Electromagnetic Radiation* (EMR), avoiding the capability of eavesdropping. Splicing into a fiber optic cable for the purpose of eavesdropping is extremely difficult and can be easily detected as the receiving station as an increase in signal losses at the fiber optic receiver.

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As technology improves, the cost of converting from one generation standard to the next can be expensive. Installation of a new transmission medium can be particularly expensive in the conversion costs. An investment into fiber optic cable can be used for FDDI now, as well as future networks using a gigabit per second technology.

Ring Topology

The topology of an FDDI network incorporates several features that allow for greater reliability and fault tolerance of a damaged network. The *dual counter-rotating ring* allows the network to be reconfigured around hardware failures that occur. Any single failure that occurs within a dual ring connection can be isolated from the ring and the integrity of the rest of the ring is still maintained. Multiple hardware failures on the dual ring will result in dividing the ring into separate rings that still function but are isolated from each other.

FDDI provides facilities which allow an FDDI network to be configured into a star topology. The support of a star topology in an office environment has several advantages to the ring topology. A typical office environment for a network consists of independent connections between each office workstation and a wiring closet, constituting a star topology. A wiring closet may be connected in a hierarchical manner to additional closets. This approach allows the flexibility to isolate stations from the network during installation and reinstallation of office equipment which occurs on a regular basis.

Other Topologies

An FDDI network allows for the support of several of these features available in a star topology. A station connected to the dual ring is knows as a *Dual Attach Station* (DAS) and supports the flexible reconfiguration mentioned previously. In a star topology, a station may be connected to a single ring and is known as a *Single Attach Station* (SAS). This SAS connection alone would not allow for the reliability available to a DAS, but with the constraint that it is used to attach to a *Dual Attach Concentrator* (DAC) the reliability of the dual ring may be maintained. This means that faulty SAS connections may be isolated by a concentrator, causing no damage to the remainder of the ring. *Single Attach Concentrators* (SAC) may be connected to DACs and other SACs to form a tree-structured hierarchical topology. This tree structure is connected to the trunk dual ring. (Figure G-1.)

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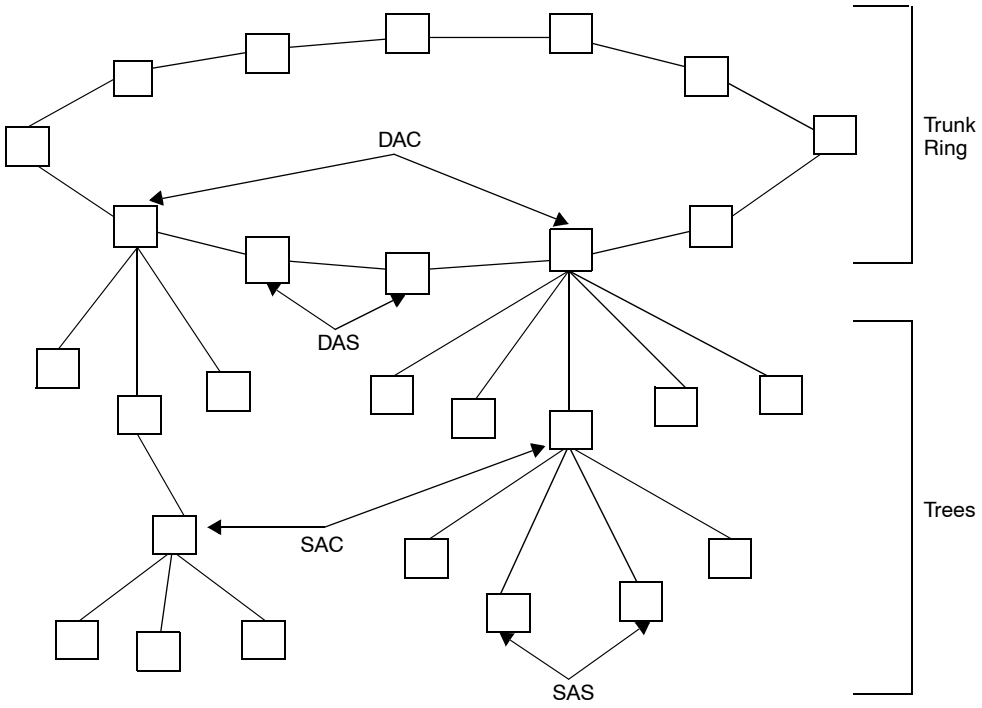


Figure G-1. FDDI Topology

In the case of a catastrophic failure of a station on the ring trunk such as a power outage, the use of an optional *optical bypass switch* adds to the reliability of an FDDI network. Since this is a passive connection, it results in additional attenuation of the signal with the combined attenuation of the attached fiber segments. Care must be taken in the placement and use of this switch so as not to exceed the attenuation budget between FDDI stations.

Token Protocol

The two basic entities transmitted in an FDDI ring are called *frames* and *tokens*. Access to begin transmission on the ring is gained by capturing a special frame called a token. There is only *one* token allowed on the ring, and therefore only one station may transmit new data onto the ring at a time. A station transmits data by receiving a token, transmitting multiple frames until a timer expires, and retransmitting the token onto the ring. While frames circulate around the ring, they are copied by the receiving station. When the frame returns to the originating station, it is stripped by that station by not being re-transmitted.

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The circulating token protocol provides an efficient access method to the ring, particularly at high network loads. It provides deterministic access to the network, guaranteeing eventual access to the network. The overall performance does not degrade as the number of stations added to the network increases.

Distributed Approach

A distributed approach was used in developing the FDDI network. The primary advantage of the distribution of network functions is that the loss of any single station does not inhibit the use of the network by the remaining stations. The design incorporates distributed clocking, fault recovery, and monitoring functions to add to the reliability and management capability of the network.

The use of independent clocks on each station adds to the reliability of the network. Since each station acts as a repeater, clock signals can be recovered from the upstream neighbor's signal transmission and re-transmitted by the station's local clock. Each station requires its own clock recovery circuit, but since there is local buffering and re-transmission there is no further need for the accommodation of accumulated jitter. If a clock were to fail at a given station, only that station would be affected and would be isolated by the neighboring stations on the ring.

The initialization process of an FDDI ring is done as a shared responsibility in which all stations take part. Prior to a ring becoming operational, all of the active stations participate in the parameter and token initialization. Timer expiration parameters must be set so that each station will be able to identify the failure of the ring due to the loss of a token. While the timer parameters are being set, the stations are also determining who will transmit the initial token frame. Since this approach allows any selected active station to recognize ring failure and to transmit the first token upon initialization or recovery, no single faulty station can cause the failure of the entire network.

A distributed approach is also used in the development of network management support. At the network interface level, all stations are peers and possess the same capabilities. Each station can transmit information about itself and its neighbors to a requesting station or as a broadcast message to all stations on the network. Each station can also request information and network reconfiguration. This flexibility allows for extensive diagnosis, isolation and reporting of problems on the network by any designated node at a given installation. The problems that can be identified include both physical failures and loading inefficiencies.

OSI Compliance

The FDDI standard is compliant with the lower layer of the OSI protocol stack. FDDI provides services specified by the Data Link and Physical layers. The FDDI specification includes the sublayers of the Physical layer called the *Physical* (PHY) and *Physical Media Dependent* (PMD) sublayers in FDDI terminology. The Data Link layer is subdivided into the *Link Layer Control* (LLC) and the *Media Access Control* (MAC) sublayers, of which FDDI specifies the MAC sublayer. The LLC sublayer is specified as an IEEE 802.2 standard, which interfaces directly to the MAC sublayer of FDDI as well as the other IEEE 802.x MAC sublayers of other network specifications.

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PMD Layer

The PMD layer includes the specification for all of the transmission media hardware. The station-to-station attenuation budget of the fiber optic cables and connections are specified, as are the fiber optic transceivers. The optional optical bypass switch is also included. The fiber optic transmitter transforms an electrical signal into a signal suitable for driving a *Light Emitting Diode* (LED). The fiber optic receiver amplifies and filters the electrical output signal of a PIN (*p*-intrinsic-*n*) photodiode receiving light impulses.

MIC

The cable connector receptacle defined by the FDDI standard is called a *Media Interface Connector* (MIC). The specification provides for the alignment of optical fibers. The fiber optic plug is not directly specified, but is an implied specification as a mate to the MIC. The receptacle can be mounted on a printed circuit board. The plug and receptacle are keyed to insure the interconnectability between conforming FDDI stations. MIC A (transmit on primary, receive on secondary) and MIC B (transmit on secondary, receive on primary) provide for attachment of DASs and DACs to the primary and secondary fibers of the dual ring. MIC M (*Master connection*) is used in a concentrator to provide an attachment for the MIC S (*Slave connection*) of a SAS. Optical losses are supplied by the fiber and receptacle vendors and must be considered in the installation plans.

The cable plant interface specifications include fiber types and attenuation. A 62.5µm core diameter fiber with 125µm cladding is the most commonly referenced fiber size, although 50µ/125µ and 100µm/140µ sizes are also referenced. The attenuation specification allows a -11.0dB loss between stations, including cable, splices, connectors, and fiber optic switches. Typically a 1300nm wavelength multimode cable is specified as less than 2.5dB/km attenuation. The maximum cable length is defined as the maximum distance possible without violation of the -11.0dB attenuation budget which includes connector loss. For 1300nm cable, this distance is around 2 km.

The PMD includes the specification for an optional optical bypass switch, which includes attenuation, interchannel isolation, switching time and media interruption time. When the station is powered off, the switch will go into bypass mode. Care must be taken to insure that the attenuation budget is not exceeded by too many optical bypass switches in bypass mode in series during a likely power down scenario.

PHY Layer

The *Physical* (PHY) layer handles all of the symbol based functions. A *symbol* is the basic sequence of bits which represents data and control information. The PHY layer encodes and decodes the data and control symbols. It provides serial-to-parallel and parallel-to-serial conversions. It recovers the clock signal from the upstream neighbor, and includes an elasticity buffer for synchronizing to the local station clock.

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NRZI Coding

The PHY layer provides the 4B/5B symbol coding function and the NRZI bit coding function. The 4B/5B (four bit to five bit) coding maps data in four bit symbols to a corresponding five bit symbol that guarantees a logic 1 bit at least every five data bits in sequence to be transmitted. Since this five bit symbol is then transmitted using NRZI (non-return to zero, invert on ones) code, a signal transition occurs every time there is a logic one and is guaranteed at least every five data bits. This guaranteed transition is required by the clock recovery circuitry, a *Phase Locked Loop* (PLL), of the downstream neighbor to remain locked to the transmission frequency and recover the clock signal. The signal transitions are also required to maintain DC balance on the receive circuitry to minimize data noise.

The 4B/5B symbol coding and NRZI bit coding provide an efficient clock encoding scheme. The 4B/5B code uses one extra bit for every four bits of data to be transmitted, or 20% bandwidth overhead for clock encoding. This is why FDDI can transmit 100Mbps with a 125MHz clock frequency. A less efficient alternative encoding scheme might use Manchester encoding which guarantees at least one signal transition for every data bit to be transmitted, or 50% bandwidth overhead for clock encoding. The use of NRZI coding makes the highest frequency pattern or required bandwidth equal half the encoded frequency, or 62.5MHz for FDDI.

Since only about half of the possible 5B codes are mapped to corresponding 4B data patterns, several of the non-data codes are used for control symbols, under the constraint that they are also combinations that guarantee a logic 1 every five bits, with the exception of the Quiet symbol. These additional symbols are divided into four groups, being line state symbols, starting/ending delimiter symbols, control indicator symbols and violation symbols. Line state symbols include *Quiet* (Q), *Halt* (H) and *Idle* (I) symbols. Q indicates the absence of any transitions and loss of clock recovery ability. H indicates a forced logical break in activity while maintaining DC balance and clock recovery. I indicates normal condition between token and frame transmissions while providing the best case conditions for clock recovery. The starting delimiter consists of a unique *J* and *K* symbol pair and is used to designate the beginning of a frame. A pair of ending delimiters *Terminate* (T) symbols is used to terminate a token frame, while a single T followed by control indicator symbols terminates all other frames. Control indicator symbols consist of *Reset* (R) or *Set* (S) symbols and are defined by the MAC layer as well as implementation dependent extensions. Finally, all remaining symbol codes are designated as *Violation* (V) symbols, some of which may be recognized as an off-alignment H symbol.

The PHY layer also has to provide an elasticity buffer to allow for variation in clock frequency from one station to its upstream neighbor. If the upstream neighbor's clock frequency is higher, I's between frames will be dropped when repeating, and if the frequency is lower, I's will be added to the transmission stream.

Line States

The PHY layer generates control symbols and detects sequences of control and data symbols by entering into a designated line state. *Quiet Line State* (QLS) is entered after a stream of 16 or 17 Q's. *Master Line State* (MLS) is entered after a stream of 8 consecutive

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HQ symbol pairs. *Halt Line State* (HLS) is entered after a stream of 16 or 17 H's. *Idle Line State* (ILS) is entered after as many I's. *Active Line State* (ALS) is entered after a JK symbol pair frame starting delimiter. *Noise Line State* (NLS) is entered after 16 or 17 potential noise events have occurred without entering into another line state. Normal operating conditions of a network would toggle between ALS and ILS because frames and tokens will cause entry into ALS and the I's surrounding them will cause entry into ILS. Other line states are forced during the initialization process, the reconfiguration process or to signify a fault condition during the operation process.

In order to prevent the propagation of bit stream errors and to simplify fault isolation, each PHY must provide a *repeat filter* that will not repeat V's or other NLS conditions to its transmitter. Although this would not be required in the PHY when a MAC is included in the repeat path because the MAC performs this function automatically, some configurations of a DAS or Concentrator provide paths that do not include a MAC.

MAC Layer

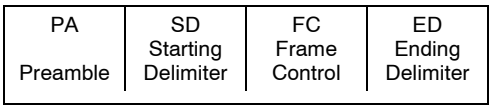
The *Media Access Control* (MAC) layer handles all of the frame based functions and controls access to the transmission media. It handles the framing of data including the starting delimiter, frame class and ending delimiter. The MAC layer generates and recognizes source and destination addresses. It also generates and verifies a CRC frame check sequence.

Tokens

The token is a unique ì frameî that allows a given node to gain access to the ring for transmission of data. It consists of a preamble of 16 or more I's, a starting delimiter of a JK, a data field called the *frame control field* consisting of 2 symbols denoting that this frame is a token of a given class, and an ending delimiter of 2 T's. Two classes of tokens, *restricted* and *nonrestricted*, are defined. A nonrestricted token is used for normal operation, and a restricted token restricts all of the asynchronous (unreserved and unused) bandwidth of the network to be used by a specified set of two nodes for the remainder of their reserved connection. The MAC layer is responsible for capturing and re-transmitting the token. (Figure G-2.).

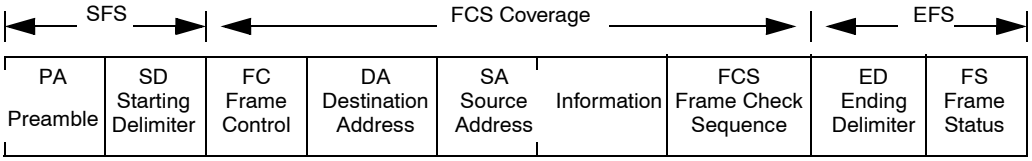
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Token Format



PA = Preamble (16 or more I symbols)
SD = Starting Delimiter (1 JK symbol pair)
FC = Frame Control (2 symbols)
ED = Ending Delimiter (2 T symbols)

Frame Format



SFS = Start of Frame Sequence
PA = Preamble (16 or more I symbols)
SD = Starting Delimiter (1 JK symbol pair)
FC = Frame Control (2 symbols)
DA = Destination Address (4 or 12 symbols)
SA = Source Address (4 or 12 symbols)
INFO = Information (0 or more symbols)
FCS = Frame Check Sequence (8 symbols)
EFS = End of Frame Sequence
ED = Ending Delimiter (1 T symbol)
FS = Frame Status (3 or more R or S symbols)

Figure G-2. Token and Frame Formats

Frames

Frames consist of the same preamble and starting delimiter sequence, a sequence of MAC control and data information, and an end of frame delimiter that consists of a single T symbol and a series of R and S symbols noting the status of the E, A, and C control indicator symbols as well as other implementation defined R/S indicators. The setting and resetting of the EAC indicators is administered by the MAC layer and designate whether a MAC layer condition has occurred indicating *frame check Error detected* (E), *destination Address recognized* (A) and *frame Copied* (C). The data sequence includes the frame control field, the destination and source address fields, the information field containing 0 or more symbols, and 8 symbols of the frame check sequence field. (Figure G-2.)

The frame control field denotes the type of frame. A void frame is a frame whose content is ignored while it is stripped by the transmitting station, its use is explained later. MAC frames, SMT frames, and LLC frames are used to transmit information between matching layer entities between stations. A reserved frame exists for use for the dependent implementation of a network.

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MAC frames are used to initialize several MAC parameters including those explained below. Special MAC frames include the *Beacon Frame* used to localize the fault of a serious ring failure and the *Claim Frame* used to determine which station will transmit the first token and initialize the ring.

Station Management (SMT) functions implement network management facilities and use their own class of frames. A special SMT frame exists that addresses the next station, and is used by SMT for ring mapping and recovery functions. LLC frames are used for the transmission of data between the upper layers of the OSI stack and serve as the main data stream for network connectivity. LLC frames can be sent as synchronous or asynchronous frames. Synchronous frames are frames that are sent as part of a station's predetermined guaranteed bandwidth and are top priority frames. Asynchronous frames use the unreserved or unused bandwidth of the network and allocation of this bandwidth is provided to the stations in a round robin fashion.

Addressing

The destination and source address fields can be either 16 or 48 bit addresses. All stations are required to fully support the 16-bit address frames, repeat all 48-bit address frames and support the 48-bit Claim, Beacon and Broadcast address frames. Broadcast addresses consist of all ones. Null addresses of all zeros are not recognized by any station as its address. The first bit of the destination address field denotes whether a frame is an individual or group address, while the second bit of the 48 bit address denotes whether the address is a universally or locally administered address. The first bit of the source address always denotes an individual address.

The information field consists of 0 or more eight bit octets of data transmitted as symbol pairs. The frame check sequence field consists of a 32 bit CRC polynomial commonly used for communication protocols that encapsulates the entire data sequence, including the frame control, addressing and information fields, and the frame check sequence field itself.

Timers

Three timers and a counter are used by the MAC layer to regulate the operation of the ring. The *Token Holding Timer* (THT) controls how long the station may transmit asynchronous frames. The *Valid-Transmission Timer* (TVX) is used to recover from transient ring error situations. It times the delay since the last valid transmission, and a void frame may be used to reset the TVX in the absence of a normal data frame. The *Token Rotation Timer* (TRT) controls ring scheduling during normal operation and to detect and recover from serious ring error situations. The *Late Counter (Late_Ct)* counts the number of TRT expirations since the MAC was reset or a token was received.

Three additional counters are used to aid in problem determination and fault location. The *Frame_Ct* is a count of all complete (non-fragment) frames received. The *Error_Ct* is a count of frames received with a frame check error and without the E indicator already set. The *Lost_Ct* is a count of all instances that while receiving a frame or token an error occurred that threatened the integrity of the frame itself, such as the reception of a V symbol.

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Claim Process

A station with data to transmit gains access to the ring by capturing a token. It continues to transmit multiple frames until it is finished or its available time expires, and then re-transmits the token onto the ring. While frames circulate around the ring, they are recognized by the receiving station which sets the A indicator.

If the station can, frames are copied to that station's available buffer space after which the station also sets the C indicator of the frame during re-transmission. When the frame returns to the originating station, it is stripped by that station by transmitting I's immediately following its recognition, i.e., the source address field.

During the Claim process, all stations in a ring agree upon a common *Target Token Rotation Time* (TTRT), the station with the lowest bid TTRT winning. Some stations are also assigned a synchronous allocation time that guarantees that station an allotted transmission bandwidth. A station's synchronous allocation time is based on that ring's implementation and set by an SMT-to-SMT communication. Each time a token is received, *Late_Ct* is reset to zero and TRT is reset to TTRT and begins to count down. If another token is received before TRT expires, both asynchronous and synchronous transmission may take place. At this time, THT is set to TRT and TRT is reset to TTRT to begin timing the next rotation time. THT is then the unreserved and unused bandwidth that is available for asynchronous transmission, and asynchronous frames may be transmitted until THT expires. An asynchronous priority scheme also exists that requires THT to be of greater value than a threshold value *T_Pri(n)* before a frame of priority level (n) may be transmitted.

If instead TRT expires before the arrival of another token, *Late_Ct* is incremented to one and only Synchronous transmission can take place for its allocated time upon reception of the token. If TRT expires a second time before receiving a token, *Late_Ct* is incremented to two, the token is considered lost, and a new Claim process will begin. This protocol guarantees an average TRT (or average synchronous response time) not greater than TTRT, and a maximum TRT (or maximum synchronous response time) not greater than twice TTRT. This protocol also guarantees that the asynchronous bandwidth is not entirely taken by one station, but that every other station has a chance to use this bandwidth in a round-robin fashion before a given station gets another chance.

SMT Specification

The FDDI standard also includes a *Station Management* (SMT) specification which allows for the necessary network management functions for performance monitoring, fault detection, and error recovery. SMT is subdivided into three areas: *Frame-Based Management*, *Connection Management* (CMT) and *Ring Management* (RMT). SMT provides frame-based functions that gather information about and exercise control over the FDDI network. CMT manages the PHY components and their interconnections, and uses MAC and PHY entities within a station to achieve logical attachment of the station to the ring. MAC layer components and the rings to which they are logically attached are managed by RMT. (Figure G-3.)

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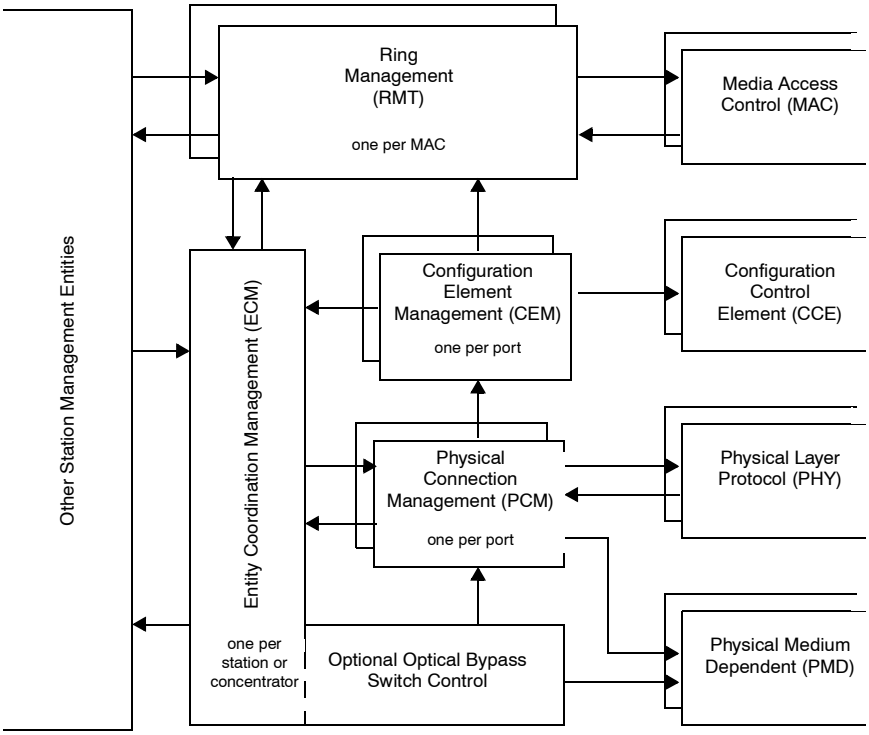


Figure G-3. Station Management Interfaces

Management Frames

SMT frame-based management services include the use of several types of SMT frames for performing various functions. *Neighborhood Notification* (NN) uses *Neighborhood Information Frames* (NIFs) to determine its *Upstream and Downstream Neighbor Addresses* (UNA and DNA), to provide supplemental duplicate address detection, and to verify the operation of local MAC receive and transmit paths in the absence of any other traffic. NIFs provide information for resolving network faults and constructing logical ring maps. *Status Report Frames* (SRFs) provide optional information by reporting network parameter conditions and connection events.

Optional *Parameter Management Frames* (PMFs) are used by a protocol to operate on all SMT *Management Information Base* (MIB) attributes to allow remote management of station attributes, such as the synchronous bandwidth allocation of each station. *Station Information Frames* (SIFs) provide station status obtained remotely by polling stations for connection and configuration parameters, and statistical operation information. *Echo Frames* provide for SMT-to-SMT loopback testing on a ring. *Root Concentrator Polling* allows a node in a concentrator tree to determine where it is within a tree of concentrators and where it resides in terms of global connectivity by using any of the SMT request/response protocols. *Extended Service Frames* (ESFs) are defined for extending new

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SMT frame based protocols and require a unique identification parameter. *Request Denied Frames* (RDFs) are defined to allow backward compatibility by allowing new protocols to easily identify incompatible stations in a mixed environment.

Connection Management

Connection Management (CMT) operates the insertion and removal of PHY and PMD entities called *Ports* to the ring, and the connection of ports to the MAC entities. CMT is further subdivided into three areas, including ECM, PCM, and CFM. *Entity Coordination Management* (ECM) is responsible for the media interface to the FDDI network, including the coordination of the activity of all the Ports and the optional optical bypass switch associated with that station or concentrator. After completing optical bypass switching, ECM signals *Physical Connection Management* (PCM) when the media is ready to begin initialization of the PHY. ECM also coordinates the *Trace and Path Test* functions, which are used to localize a *Stuck Beacon* condition and test the path to the nearest upstream MAC, respectively.

PCM initializes the physical connection between the Port being managed and another Port, such as in an adjacent station or concentrator on the FDDI ring, by signaling between these Ports upon a request from the ECM. Signaling is done by transmitting a continuous stream of symbols until a neighbor responds, which transitions to a new line state and the station begins to transmit a different stream of symbols awaiting the next response. PCM sequences through a number of bit signals to communicate such connection information as the port type (A,B,M,S), the compatibility of this connection, the duration of a *Link Confidence Test* (LCT), the availability of a MAC for LET, the failure of a LET, the assignment of a MAC for Local Loop testing, and the assignment of a MAC to this port for ring operations as a tree or peer MAC. Once the connection has been verified completely by this procedure, a response is issued to *Configuration Management* (CFM). Through the use of this signaling feature, CMT on one station can force its neighboring CMT to a known state by transmitting a series of symbols, aiding in the isolation of faults in a ring.

Configuration Management

Each Port in a station or concentrator has a PCM entity associated with it. Each PCM has a *Configuration Element Management* (CEM) entity associated with it. Each CEM controls an associated *Configuration Control Element* (CCE), sometimes referred to as the configuration switch, which physically connects the MAC and Port entities. *Configuration Management* (CFM) collectively refers to all of the CEMs in a station or concentrator and manages the configuration of the MAC and Port entities therein. CFM supports the configuration of all types of stations and concentrators including DAS, SAS, DAC, and SAC through the use of four different CEMs supporting A and B connections to a dual attach ring and the S and M connections for all single attachments. There is also a single CEM specifically used for coordinating the connection of all MACs within a node called *MAC Placement Management*. Each CCE is required to provide a primary path connection to its associated Port, and may optionally include the capability for connecting the secondary path. The allowance of a local path that may be used for connecting a dedicated MAC to the Port also exists. CFM is also responsible for ensuring that a reconfiguration of the ring does not create any undesirable frames on the ring. This includes *ring scrubbing*,

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or the removal of frames from MACs that are no longer of the token path, non-concatenation of frames, or sourcing at least 16 I's before connecting a new path into the ring, and the avoidance of concurrently processing A and B Port CEMs which may result in the entrance into undesirable states.

Ring Management

Ring Management (RMT) is responsible for receiving status from the MAC and CMT and reporting the status of the MAC to SMT. RMT identifies a Stuck Beacon by the expiration of a timer, and then *Directed Beacons* are sent to see if the problem still remains unresolved. If it does, RMT initiates the Trace function which uses PHY signalling to identify the fault domain, which results in a Path Test in all nodes in the fault domain. A number of conditions can be used by RMT to detect duplicate addresses during the Claim and Beacon processes which could result in the processes never being resolved. Resolution of duplicate address problems that prevent *Ring_Op* is done so that MACs with duplicate addresses will not prevent communication by the entire FDDI ring. This can be done by changing the MAC address, configuring the MAC to lose the Claim process and disabling the LLC services, or removing the MAC with the duplicate address from the ring.

Summary of Benefits

FDDI is a fast reliable network protocol which provides many unique network management functions. Its fiber optic transmission media allows longer, more secure connections between stations. Its efficient use of the available bandwidth insures maximum throughput. Its token method provides deterministic access services which will not degrade as the number of connections increase. It provides advanced capabilities with provisions made for extension to the protocol.

References

[1] American National Standards Institute (ANSI), ì FDDI Token Ring Media Access Control (MAC),î American National Standard, ASC X3T9.5, 1986

[2] ANSI, ì FDDI Physical Layer Protocol (PHY),î Draft Proposed American National Standard, ASC X3T9.5, Rev. 13, 1986

[3] ANSI, ì FDDI Physical Layer Medium Dependent (PMD),î Draft Proposed American National Standard, ASC X3T9.5, Rev. 7.3, 1988

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