Sun™ HIPPI/P 1.1 Installation and User Guide

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Preface

The *Sun HIPPI/P 1.1 Installation and User Guide* provides instructions for the Sun™ HIPPI/P adapter supported by the Sun HIPPI/P software. This manual also describes how to install and configure the Sun HIPPI/P software.

Before You Read This Book

This guide is intended for the Sun HIPPI/P 1.1 system administrator who has a working knowledge of UNIX® systems, particularly those based on the Solaris™ operating environment. If you do not have such knowledge, first read all of the books in the Solaris System Administration collection in AnswerBook2™ format provided with your server and consider UNIX system administration training.

How This Book Is Organized

The *Sun HIPPI/P 1.1 Installation and User Guide* is organized as follows:

Chapter <$elemparanumonly describes the Sun HIPPI/P implementation of the HIPPI protocols and includes a list of the specifications to which it conforms.

Chapter <$elemparanumonly provides detailed instructions on how to install your Sun HIPPI/P PCI card in your machine and describes how to connect the HIPPI cable.

Chapter <$elemparanumonly describes how to install the Sun HIPPI/P device driver and utilities on machines running the Solaris 8 environment.

Chapter <$elemparanumonly describes the configurable network parameters and provides general advice on how to obtain the best performance from your network.

Chapter <$elemparanumonly tells you how to detect and resolve problems with your HIPPI network.

Chapter <$elemparanumonly provides an overview of the HIPPI network model and describes how HIPPI networks operate.

Chapter <$elemparanumonly describes the network utilities delivered with Sun HIPPI/P and tells you how to use them to recover network statistics.

Appendix <$elemparanumonly contains a list of common questions and their responses.

Appendix <$elemparanumonly describes how to create applications that run over Sun HIPPI/P, using the DLPI interface for a Solaris environment.

Using UNIX Commands

This document does not contain information on basic UNIX® commands and procedures such as shutting down the system, booting the system, and configuring devices. See one or more of the following for this information:

- *Solaris Handbook for Sun Peripherals*
- AnswerBook online documentation for the Solaris software environment
- Other software documentation that you received with your system

Typographic Conventions

TABLE P-1   Typographic Conventions

Typeface	Meaning	Examples
AaBbCc123	The names of commands, files, and directories; on-screen computer output	Edit your `.login` file. Use `ls -a` to list all files. `% You have mail.`
AaBbCc123	What you type, when contrasted with on-screen computer output	`% `**`su`** `Password:`
AaBbCc123	Book titles, new words or terms, words to be emphasized	Read Chapter 6 in the *User Guide*. These are called *class* options. You *must* be superuser to do this.
	Command-line variable; replace with a real name or value	To delete a file, type `rm` *filename*.

Shell Prompts

TABLE P-2   Shell Prompts

Shell	Prompt
C shell	*machine_name*%
C shell superuser	*machine_name*#
Bourne shell and Korn shell	$
Bourne shell and Korn shell superuser	#

Related Documentation

Application	Title	Part Number
Reference	*Sun HIPPI/P 1.1 Reference Manual*	806-3674
	Sun HIPPI/P 1.1 Release Notes	806-3677

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Sun HIPPI/P Overview

This chapter describes the Sun HIPPI/P (High Performance Parallel Interface) implementation of the HIPPI/P protocols, including a list of the ANSI/HIPPI standards to which it conforms. See Chapter <$elemparanumonly<$elemtext for more information on HIPPI/P architecture.

Feature Summary

The Sun HIPPI/P PCI Adapter 1.1 is a combination of hardware and software that adds HIPPI/P networking support to your system.

Sun HIPPI/P is a high-speed networking product that provides significantly greater bandwidth (up to 80 times) compared to 10-megabit Ethernet networks. It is designed for SPARC™ system architectures running the Solaris 2.6, Solaris 7, or Solaris 8 operating environment.

Sun HIPPI/P does the following:

- Provides connection to multimode fiber networks
- Supports data transfer rates of up to 100 MBps or 800 Mbps
- Provides full support for existing SunOS™ 5.*x* operating system network services and utilities
- Provides power-up self test and system diagnostic tests
- Supports up to four Sun HIPPI/P PCI cards installed in one machine

HIPPI/P Conformance

Sun HIPPI/P conforms to the following standards and specifications:

- ANSI X3.183-1991 - Physical sublayer
- ANSI X3.222-1993 - Framing protocol
- ANSI X3.218-1993 - Link encapsulation
- PCI specification, revision 2.1, part number 802-2387
- RFC 2067 - IP over HIPPI

Installing the Sun HIPPI/P Adapter

This chapter tells you where to find step-by-step procedures for installing PCI cards. It describes the convention used to assign device names to Sun HIPPI/P PCI cards, and tells you how to connect fiber-optic cables.

Caution – For your personal safety and to protect your machine, observe the following precautions when you install a PCI card in a SPARC workstation or server.

Before opening your machine, always ensure that the power switch is off (0 position). When the power is off, the green light on the front of the machine is unlit and the fan in the power supply is not running. Always take care to protect your equipment from the effects of static electricity.

Be sure to wear a wrist strap when performing any of these procedures.

Device Instances and Device Names

You can install a Sun HIPPI/P PCI card in any available PCI slot. Sun HIPPI/P supports up to four Sun HIPPI/P PCI cards installed in one machine.

Sun HIPPI/P PCI cards are assigned device names of the form `hipip`*inst*, where the instance number *inst* is determined by the number and relative positions of the cards installed. When you install a Sun HIPPI/P card in your machine for the first time, it has instance number 0 and a device name `hipip0`. If multiple cards are installed, the device name `hipip0` is associated with the card in the lowest numbered slot, the device name `hipip1` is associated with the card in the next higher numbered slot, and so on.

Refer to the hardware installation manual that came with your system for detailed instructions on how to identify the PCI slots in your machine.

Note – For a machine running the Solaris environment, if a Sun HIPPI/P PCI card is moved from its initial slot to a different one, the operating system will find the device in the new slot and assume that it is a new instance of the device. As a result, the operating system will assign the next instance number to it and there will appear to be two devices installed in the machine.

Inventory Items

Before proceeding with the installation, make sure you have received the following items:

- One Sun HIPPI/P PCI adapter
- Disposable grounding wrist strap
- CD-ROM containing Sun HIPPI/P software
- 15-meter cable
- *Sun HIPPI/P 1.1 Installation and User Guide*

Contact your sales representative if any of these items are missing.

Installing Sun HIPPI/P PCI Cards

Caution – The Sun HIPPI/P PCI card is sensitive to static electricity. Always use the wrist strap supplied with Sun HIPPI/P when handling the card and ensure that the wrist strap is properly grounded. Handle the Sun HIPPI/P PCI card by the edges, and avoid touching any of the components.

▼ To Install the Sun HIPPI/P PCI Card

1. **Confirm that your system supports 33-MHz PCI operation, which is required for this HIPPI/P PCI card.**

2. **Attach a properly grounded antistatic strap to your wrist.**

3. **Remove the PCI card from the antistatic bag.**

> **Caution –** Handle circuit cards only while wearing a properly grounded wrist strap. This prevents potential damage to the card from static electricity.

4. **Remove covers and boards as required to access the PCI slots in your system.**

   Refer to the hardware installation manual that came with your system for detailed instructions on how to access the PCI slots in your machine.

5. **Select a PCI slot and remove the lock-down screw securing the PCI cover plate.**

6. **Remove the cover plate.**

7. **If used, confirm that the riser card in your system is 5 volts.**

   Riser cards have etches noting the voltages. Also, riser cards are keyed to prevent damage.

8. **Install the PCI card into the selected slot.**

   Refer to the hardware installation manual that came with your system for detailed instructions on how to install a PCI card in your machine.

9. **Confirm that the card is firmly installed into the PCI connector then secure the card with the lock-down screw.**

10. **Replace all covers and boards as required.**

> **Note –** There are no user-configurable jumpers or switches on the Sun HIPPI/P PCI card. Altering any of the components on the card can affect its operation adversely and will render any product warranty void.
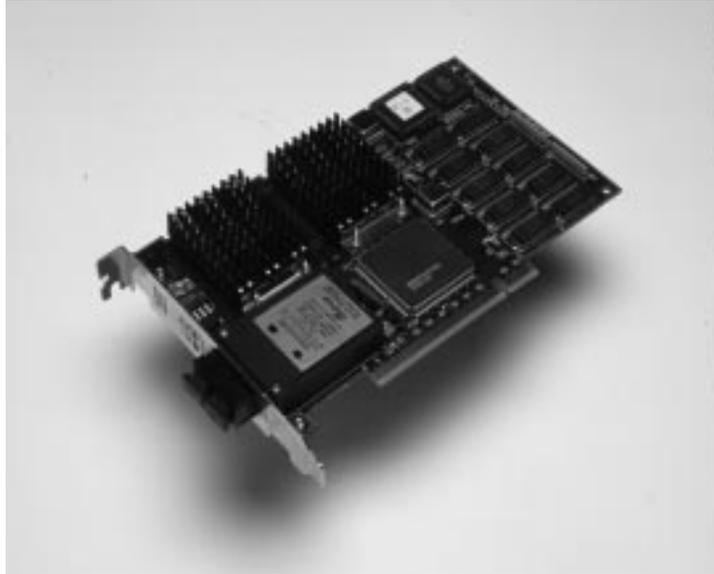
FIGURE 2-1   HIPPI/P PCI Card

Connecting Fiber-Optic Cables

Fiber-optic cable is fragile and should not be subjected to mechanical stress or impact. Always observe the following precautions when handling fiber-optic cable and connectors:

- Fiber-optic cable connectors consist of a ceramic or steel ferrule through which the optical fiber passes. Do not touch the tip of the ferrule, as marring or depositing oil or dirt on its delicate surface will destroy its ability to transmit light.
- Use the protective caps provided on the fiber-optic cable connectors and optic data links whenever the cable is not connected.
- Fiber-optic cable has a limited turn radius. Do not bend it in a way that could damage the fiber or cause signal loss.

▼ To Connect the Fiber-Optic Cables

1. **Unpack the cable, remove the plastic protective caps from each end, and remove the cap from the transceiver unit on the card.**

2. **Make sure the fiber-optic cable is properly oriented with its connector on the Sun HIPPI/P card.**

   Most fiber-optic cables have raised keys on one side of the connectors. There are also keyway notches on the inside of the connector on the card; the fiber-optic cable should be oriented so that the keys on the cable connectors line up with the keyway notches on the card (FIGURE 2-2).

Caution – Some cables do not possess raised keys to help you properly orient the connection. When installing the cables, verify the *source* on one end of the cable connects to the *destination* on the other end of the cable.

Keys
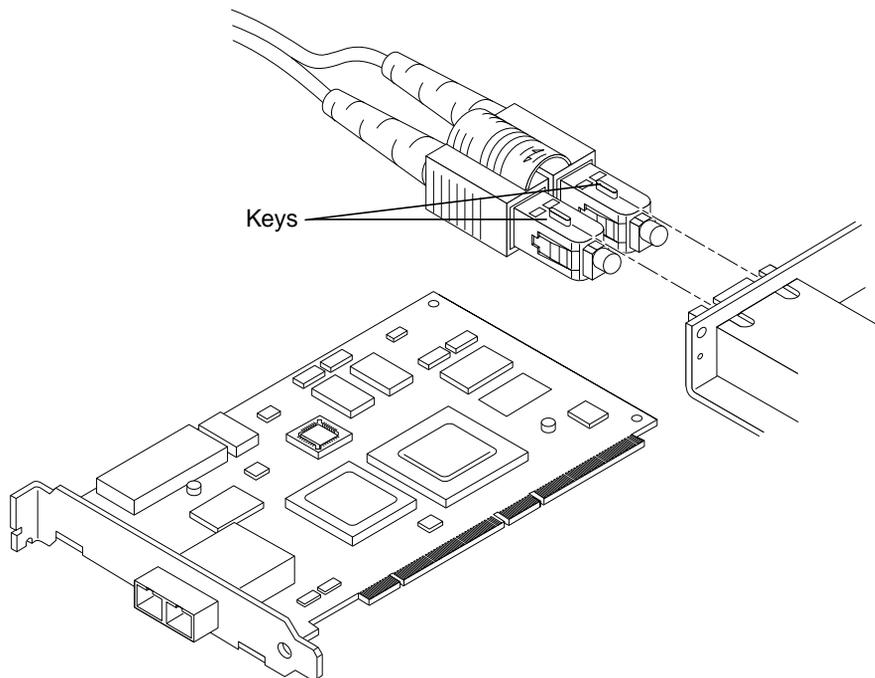
FIGURE 2-2 Aligning SC Type Fiber-Optic Cable Connectors

3. **After you have verified that the fiber-optic cable and the connector on the Sun HIPPI/P card are properly oriented (see caution statement), insert the cable into the card connector.**

   You should hear a distinctive click sound, indicating that the cable is properly mated with the card connector.

Cleaning the Fiber-Optic Cable

Fiber-optic cable connectors can be cleaned if they become contaminated with dirt, dust, or oil, which can cause signal noise on the network.

▼ To Clean the Fiber-Optic Cable

1. Gently wipe the end of the ferrule with an alcohol-moistened cotton swab.
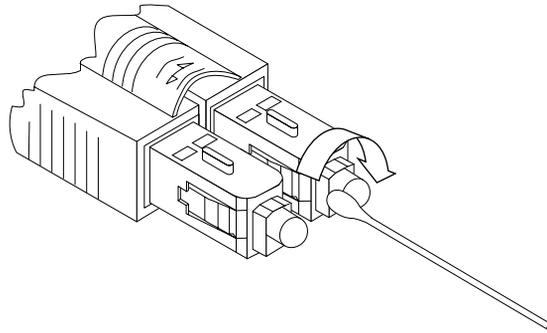
FIGURE 2-3 Cleaning the End of a Fiber-Optic Cable

2. Blow clean, dry compressed air around the end of the connector and around the ferrule to dislodge loose dust and grit.

3. Clean the adapter by moistening the end of a pipe cleaner in alcohol and running the pipe cleaner though the adapter.

Repeat with a dry pipe cleaner.

4. Blow the adapter with clean, dry compressed air again to finish drying the clean adapter.

Installing the Sun HIPPI/P Software

This chapter tells you how to install the Sun HIPPI/P device drivers and utilities in a Solaris 2.6, Solaris 7, or Solaris 8 operating environment. It includes instructions on how to check your installation and how to remove the Sun HIPPI/P software, if necessary.

TABLE 3-1   Installation Requirements

Requirements	Description
Hardware and Software Platforms	SPARC system architectures (32 Mbytes RAM minimum) running a Solaris 2.6, Solaris 7, or Solaris 8 operating environment.
Disk Space	2300 Kbytes of disk space to install Sun HIPPI/P in a Solaris environment.
Host names and IP Addresses	A unique host name and IP address for each Sun HIPPI/P device installed in your machine. If you are installing more than one interface in a single machine, each interface must be connected to a different subnet of a network.

Declaring IP Addresses for Sun HIPPI/P

The files on your NIS/NIS+ server must be updated *before* you install the Sun HIPPI/P software.

▼ To Declare IP Addesses for Sun HIPPI/P

● **Update the files on your NIS/NIS+ server to assign IP addresses and host names for the Sun HIPPI/P interfaces that you are going to configure.**

If you are not using an NIS/NIS+ name service, update the `/etc/inet/hosts` file on each machine in the network to add the IP addresses and host names of the hosts attached to the HIPPI/P network. See the `hosts`(4M) man page for additional information.

Removing Conflicting Packages

If you have existing Essential HIPPI/P packages installed, they must be removed prior to installing Sun HIPPI/P packages.

▼ To Remove Conflicting Packages

1. **Determine if conflicting packages are present by, as superuser, typing:**

```
# pkginfo | grep ESShip
```

2. **If present, save all configuration files.**

3. **Remove the conflicting packages by typing:**

```
# /usr/sbin/pkgrm package_name
```

You need to remove all of the packages that were returned by the `grep`(1) command in Step 1.

Installing and Configuring Sun HIPPI/P

Use `pkgadd(1M)` to install unbundled software on machines running a Solaris environment. Refer to the Solaris operating environment installation documents for detailed information on installing software products using `pkgadd`.

The SUNWhipmn package contains the Sun HIPPI/P man pages. By default, the base directory for this package is /opt. You can change the base directory when you start pkgadd(1M) with the -R option. This package can be installed on a server and shared among multiple machines, if required.

The SUNWhipc package contains the Sun HIPPI/P developer utilities. By default, the base directory *basedir* for this package is /opt. You can change the default base directory when you start pkgadd(1M) with the -R option.

▼ To Load and Mount the CD-ROM

1. **Log in as superuser.**

2. **Place the CD-ROM into the CD-ROM drive.**

3. **If not mounted automatically, mount the CD-ROM on a local directory.**

   - If the Volume Manager (vold) is running on your machine, then the CD-ROM is mounted automatically under /cdrom/sun_hippi_1_1.

   - If the Volume Manager (vold) is *not* running on your machine, create a directory called /cdrom/sun_hippi_1_1 and mount the CD-ROM manually.

   ```
   # mkdir -p /cdrom/sun_hippi_1_1
   # /usr/sbin/mount -o ro -F hsfs /dev/dsk/c0t6d0s0 \
   /cdrom/sun_hippi_1_1
   ```

   - If you are installing the HIPPI/P 1.1 software on a Sun Enterprise™ 10000 server, you need to share the CD-ROM with the domain by using the following command.

   ```
   ssp# share -F nfs -o ro,anon=0 /cdrom/cdrom0
   ```

   After mounting the CD-ROM, you will see the /cdrom/sun_hippi_1_1/Product directory. This directory contains the HIPPI/P software packages and the examples directory.

▼ To Install Sun HIPPI/P By Using pkgadd(1M)

The following instructions are for Sun HIPPI/P on a Solaris 8 operating environment.

1. **Log in as superuser.**

2. **Start** `pkgadd` **by typing:**

```
# /usr/sbin/pkgadd –d /cdrom/sun_hippi_1_1/Product
```

3. **Press Return to install all of the packages and respond to any prompts that appear on the command line.**

There are four packages associated with Sun HIPPI/P. They contain the device drivers, developer utilities, and man pages used to manage your Sun HIPPI/P hardware. If you are installing only a subset of the packages, enter the number that corresponds to the package you want to install and press Return.

```
The following packages are available:
  1  SUNWhipab    Sun HIPPI 1.1 AnswerBook
                  (all) 44.2
  2  SUNWhip      SunHIPPI PCI Drivers
                  (sparc) 1.1,REV=XXXX.XX.XX
  3  SUNWhipmn    SunHIPPI Online Documentation
                  (sparc) 1.1,REV=XXXX.XX.XX

Select package(s) you wish to process (or 'all' to process
all packages). (default: all) [?,??,q]:
```

▼ To Install the Device Driver

The `SUNWhip` package contains the Sun HIPPI/P device driver, utility commands, and start-up scripts. By default, the base directory for this package is `/`. You can change the default base directory for this package when you start `pkgadd`(1M) with the `-R` option. This package must be installed on every machine that runs Sun HIPPI/P.

1. **After installing the packages, as superuser, type:**

```
# /etc/opt/SUNWconn/bin/hipadmin
/etc/opt/SUNWconn/bin/hipadmin - Sun HIPPI Administration Tool
```

■ If hardware is present, type answers similar to the responses in the following example:

```
Detected 1 HiPPI NIC(s) present

Enter the IP {hostname} or address for hipip0 [?] 192.215.165.2

Enter the netmask for hipip0 [?] 0xffffff00

Enter the HIPPI logical address for hipip0 in hex notation [?] 0x7

saving configuration to /etc/opt/SUNWconn/hippi/hip0.conf
setting tuning parameters into hip0 EEPROM
downloading firmware into hip0 EEPROM

Do you wish to patch the global network tunables for increased network
throughput? [y]  [y,n,?] y

You will need to update the HiPPI ARP configuration file:
  /etc/opt/SUNWconn/hippi/hippiarp.conf
in order to be able to communicate with other HiPPI hosts on
your network using the IP protocol.

#
```

Note – If a HIPPI/P switch is not present, enter an unused arbitrary switch address between 0 and 0xf8f. The unused arbitrary switch address must be unique for each system.

After the questions have been answered, Go to Step 2.

- If no hardware is present, you will be asked to enter a number in the range 1 to 4 to indicate the number of NICs that you would like to configure. Press Return to accept the default or type answers similar to the responses in the following example.

```
No HiPPI NIC present

How many HiPPI interfaces do you want to configure [1-4,?,q] 1

Enter the IP {hostname} or address for hipip0 [?] 192.215.165.2

Enter the netmask for hipip0 [?] 0xffffff00

Enter the HIPPI logical address for hipip0 in hex notation [?] 0x7

saving configuration to /etc/opt/SUNWconn/hippi/hip0.conf

   NOTE: After installing the HiPPI NIC(s) in your system,
   run /etc/opt/SUNWconn/bin/hipadmin -u to update the NIC(s) EEPROM contents.

Do you wish to patch the global network tunables for increased network
throughput? [y]  [y,n,?] y

You will need to update the HiPPI ARP configuration file:
  /etc/opt/SUNWconn/hippi/hippiarp.conf
in order to be able to communicate with other HiPPI hosts on
your network using the IP protocol.

#
```

Refer to the hipadmin(1M) and hippiarp(1M) man pages for more information.

a. **Bring the system down.**

b. **Install the hardware.**

   Install the HIPPI/P hardware, and at the OBP prompt, boot the system by typing:

```
ok boot diskname -r
```

   For more details about installing HIPPI/P hardware, see Chapter <$elemparanumonly<$elemtext and the service manual for your platform.

2. **Update the** hippiarp.conf **file.**

a. **Obtain and retain the MAC address of the NIC card.**

   The machine_ULA, represented by 0:a0:88:1:2:59, is the MAC address of the NIC card. After the HIPPI/P hardware is installed, you can find the machine ULA by typing:

```
# /etc/opt/SUNWconn/hippi/bin/hippiarp -h
hip0: DOWN NOT_RUNNING
hip0: ULA 0:a0:88:1:2:59 Logical Address <Not Known>
```

Note – Use the form hip*n* to specify the HIPPI/P adapter on the local system. For more information about this syntax, refer to the hippiarp(1M) man page.

b. **Update the hippiarp.conf file with all the machine names in the HIPPI/P network as shown in the following example:**

```
# vi /etc/opt/SUNWconn/hippi/hippiarp.conf
#!/bin/sh
PATH="`pkginfo -r SUNWhip`/etc/opt/SUNWconn/hippi/bin:${PATH}"
#
# Add the entries for all machines in the hippi network.
# The format is hippiarp -s hostname machine_ULA
 machine_switch_address local_HIPPI_interface
# Example:
#        hippiarp -s hipserv -h 0:0:82:90:1a:c 0x104 hip0
#
# Run this file after updating it.
#

hippiarp -s hostname machine_ULA machine_switch_address local_HIPPI_interface
```

Note – An entry must exist for all systems on the network. For additional information, refer to the hippiarp(1M) man page.

   If the ULA of the remote host is unknown, *machine_ULA* for this host must be given as 0:0:0:0:0:0.

c. **Verify that the hostname and IP address are in either your local /etc/hosts file or in the NIS hosts database.**

3. **Bring the HIPPI/P interfaces online by typing:**

```
# /etc/init.d/hippi start
```

▼ To Finish the Installation

1. **Type q to stop pkgadd when the list of available packages is displayed again.**

```
The following packages are available:
  1  SUNWhipab    Sun HIPPI 1.1 AnswerBook
                  (all) 44.2
  2  SUNWhip      SunHIPPI PCI Drivers
                  (sparc) 1.1,REV= xxxx.xx.xx
  3  SUNWhipmn    SunHIPPI Online Documentation
                  (sparc) 1.1,REV= xxxx.xx.xx

Select package(s) you wish to process (or 'all' to process
all packages). (default: all) [?,??,q]:
```

2. **Eject the CD-ROM from the CD-ROM drive.**
   - If Volume Manager (`vold`) is running on your machine, type:

```
# eject cdrom
```

   The CD-ROM is unmounted automatically and the directory removed when the CD-ROM is ejected

   - If Volume Manager (`vold`) is not running on your machine, unmount the CD-ROM before you eject and remove the directory that you created by typing:

```
# /usr/sbin/umount /cdrom/sun_hippi_1_1
# eject cdrom
# rmdir /cdrom/sun_hippi_1_1
```

3. **Reboot your machine to ensure correct system operation.**

4. **Verify that all of the latest HIPPI/P patches have been installed.**

   Refer to the SunSolve database for the latest released patches and instructions for installing them.

▼ To Verify the Installation

1. Use `netstat`**(1M) to check for Sun HIPPI/P interfaces.**

```
% /usr/bin/netstat -i
Name    Mtu    Net/Dest  Address    Ipkts Ierrs Opkts Oerrs Collis Queue
lo0     8232   loopback  localhost  21    0     21    0     0      0
le0     1500   our-lan   hanna      2146  0     950   1     13     0
hipip0  57344  our-hip   hanna-h    1086  0     907   0     0      0
```

2. Use `ifconfig`**(1M) to check the current state of the Sun HIPPI/P interfaces.**

```
% /usr/sbin/ifconfig hipip0
hipip0: flags=843<UP,BROADCAST,RUNNING,MULTICAST> mtu 57344
     inet host_address netmask netmask broadcast ip_address
     ether mac_address
```

3. If the Sun HIPPI/P host is attached to an active HIPPI/P network, use `ping`**(1M) to verify that you can send and receive data across the HIPPI/P connection.**

```
% /usr/sbin/ping remote_host_name
remote_host_name is alive
```

Your Sun HIPPI/P interface should now be active, and you should be able to send and receive data across a HIPPI/P connection.

For optimum performance from your HIPPI/P network, you may need to tune the configurable network parameters. See Chapter <$elemparanumonly<$elemtext for detailed instructions.

If you have problems configuring or using your Sun HIPPI/P host, see Chapter <$elemparanumonly<$elemtext for help.

Testing the Installation and Operation of the NIC

The installation and operation of the NIC can be tested by placing the NIC in internal loopback mode and passing some HIPPI/P packets. Internal loopback mode uses the entire NIC except the optical interface module. Sent packets are electronically looped back to the receive electronics. You must have superuser access to run these utilities.

▼ To Test the Installation and Operation of the NIC

1. **Log into the host as superuser.**

2. **Turn HIPPI/P off.**

   ```
   # /etc/opt/SUNWconn/hippi/bin/hippi off
   ```

   This step turns off RunCode.

   > **Note –** The command in the example above is not the same as the `hippi start/stop` script that exists in the `/etc/init.d` directory.

3. **Unplumb the HIPPI/P interface.**

   ```
   # ifconfig hipip0 down
   ```

   This step is needed only if you have configured the NIC for network use. If you are unsure if the interface is configured, you can use the `ifconfig hipip0` command to check the current state of the interface.

4. **Place the NIC into the internal loopback mode.**

   ```
   # hippi on loopback
   ```

5. **Set up the NIC to receive packets.**

```
# sink -n 10 &
```

The sink(1M) command sets up the NIC to receive ten default packets (4 kilobytes in length) in the background.

6. **Send the packets.**

```
# blast -n 10
```

The blast(1M) command sends the ten packets.

7. **Check the status of the jobs.**

```
# hippi status
```

The status argument should report that ten packets have been sent from the source and received by the destination. You should not encounter any errors.

If the above test fails, either the installation failed or the NIC is defective. In either case, contact your Sun Service representative for assistance.

Deinstalling the Sun HIPPI/P Packages

If you remove the Sun HIPPI/P hardware interfaces from the machine, you should also remove the Sun HIPPI/P software to prevent the device driver from starting each time you reboot the machine.

Use pkgrm(1M) to remove unbundled software from machines running a Solaris environment. Refer to *Installing Solaris Software* for detailed information on removing software packages by using pkgrm(1M).

If you prefer to keep any of the configuration files, save these files prior to performing the package removal.

▼ To Deinstall the Sun HIPPI/P Packages

1. **Log in as superuser.**

2. **Stop the HIPPI/P driver.**

```
# /etc/init.d/hippi stop
```

3. **Unload the HIPPI/P drivers.**

```
# modinfo | grep hip
# modunload -i module ID for hipip driver
# modunload -i module ID for hip driver
```

4. **Use** `pkgrm`**(1M) to remove the Sun HIPPI/P packages.**

The post-remove script removes the modifications made to the system files and updates the package information on your machine. If you prefer to keep any of the configuration files, save these files prior to performing the package removal by typing:

```
# /usr/sbin/pkgrm SUNWhip
# /usr/sbin/pkgrm SUNWhipmn
# /usr/sbin/pkgrm SUNWhipab
```

5. **Reboot the machine to ensure correct system operation.**

Configuring the Sun HIPPI/P Interface

This chapter tells you how to obtain the best performance from your HIPPI/P network. It assumes that you are familiar with HIPPI/P network architecture and related terminology. See Chapter <$elemparanumonly<$elemtext for a detailed description of the HIPPI/P protocols.

Caution – There are a number of ways to improve network performance, some of which are discussed in this chapter; however, these should be undertaken only by experienced system administrators. Tuning your network incorrectly can adversely affect network performance.

High Performance HIPPI/P Networks

Think of a HIPPI/P network as having the potential to carry *more* information with increased throughput, rather than as being a faster connection. If the applications running over the network do not use the available bandwidth efficiently, you will not see much improvement in the performance of your network by using HIPPI/P.

Data Throughput Improvement

The most significant improvements in throughput are achieved by maximizing the rate at which data is transferred to and from the HIPPI/P network. If you are running TCP/IP or UDP/IP applications, you can improve throughput by

modifying the parameters that control the rate at which these protocols transfer data to and from the Sun HIPPI/P device driver—that is, between user space and kernel space.

The send and receive buffers control the maximum rate at which data is transferred between user space and kernel space by applications that use sockets. The size of these buffers defines the amount of data that can be transferred at one time.

To optimize performance, assign consistent values for the send and receive buffers. The default value (4 Kbytes) assigned to these parameters is optimized for transmission across Ethernet connections. For applications running over HIPPI/P, the send and receive buffers must be set to 512 Kbytes at a minimum.

Improving Performance

The following sections describe how to modify the user-configurable network parameters. To obtain optimum network performance, you may need to tune some, or all, of these parameters, depending on your network configuration and the type of network traffic.

Note – The following performance changes are optionally installed as part of the `hipadmin`(1M) portion of the Sun HIPPI/P installation process and are executed during a system boot as part of the `/etc/init.d/inetinit` startup script.

The variables used for tuning network performance are global and any changes made by these variables will also affect other network connections. It is up to the individual to determine the proper balance of changes.

▼ To Tune the High-Water Marks

The maximum rate at which data is transferred between user space and kernel space by applications that use STREAMS is controlled by the *high-water marks*. These parameters define the maximum amount of data that can be queued for transmission to the TCP or UDP STREAMS modules. There are independent send and receive high-water marks for TCP and UDP applications.

When the number of bytes queued exceeds the high-water mark, transmission is halted temporarily to enable the backlog to be cleared. The *low-water mark* specifies the level to which the queue must drop before transmission is restarted.

For optimum performance, assign consistent values for the transmit and receive high-water marks. The default value (8192) assigned to these parameters is optimized for transmitting across Ethernet connections. For applications running over HIPPI/P, the high-water marks must be set to 1024 Kbytes.

1. **Log in as superuser.**

2. **Use** ndd**(1M) to check the current value of the TCP high-water marks (**tcp_xmit_hiwat **and** tcp_recv_hiwat**).**

```
# ndd -get /dev/tcp tcp_xmit_hiwat
8192
# ndd -get /dev/tcp tcp_recv_hiwat
8192
```

3. **Use** ndd**(1M) to modify the current value of the TCP high-water marks (**tcp_xmit_hiwat **and** tcp_recv_hiwat**).**

   For optimum performance over HIPPI/P connections, set the TCP high-water marks to 1024 Kbytes.

```
# ndd —set /dev/tcp tcp_xmit_hiwat 1045876
# ndd —set /dev/tcp tcp_recv_hiwat 1045876
```

4. **Use** ndd**(1M) to check the current value of the UDP high-water marks (**udp_xmit_hiwat **and** udp_recv_hiwat**).**

```
# ndd —get /dev/udp udp_xmit_hiwat
8192
# ndd —get /dev/udp udp_recv_hiwat
8192
```

5. **Use** ndd**(1M) to modify the current value of the UDP high-water marks (**udp_xmit_hiwat **and** udp_recv_hiwat**).**

   For optimum performance over HIPPI/P connections, set the UDP high-water marks to 1024 Kbytes.

```
# ndd —set /dev/udp udp_xmit_hiwat 1045876
# ndd —set /dev/udp udp_recv_hiwat 1045876
```

▼ To Tune the Window Scaling Flag

The Solaris environment supports TCP window scaling as defined by RFC 1323. To ensure that this feature is always used, set the `tcp_wscale_always` global flag to 1.

1. **Log in as superuser.**

2. **Use** `ndd`**(1M) to modify the current value of the TCP window scaling flag (**`tcp_wscale_always`**).**

   For optimum performance over HIPPI/P connections, set the window scaling flag to 1.

   ```
   # ndd –set /dev/tcp tcp_wscale_always 1
   ```

▼ To Tune the Congestion Window Maximum

1. **Log in as superuser.**

2. **Use** `ndd`**(1M) to modify the current value of the TCP maximum congestion window (**`tcp_cwnd_max`**).**

   For optimum performance over HIPPI/P connections, set the maximum congestion window to 1024 Kbytes.

   ```
   # ndd –set /dev/tcp tcp_cwnd_max 1048576
   ```

Tuning the High- and Low-Water Marks at Boot Time

Each time you reboot your machine, the network variables used for tuning performance are reset to their default values. The `hipadmin`(1M) portion of the Sun HIPPI/P installation software optionally modifies boot scripts on your system so that the high-water marks, window scaling, and congestion window are modified automatically each time you reboot the machine.

The effect of these scripts should be verified after system reboot. It is possible for other boot scripts to set these global variables to conflicting values.

Tuning the Socket Options

For applications that use sockets, the application developer can make more efficient use of the increased bandwidth provided by a HIPPI/P connection by increasing the size of the send and receive buffers used by a specific application. This manipulation is restricted to applications and does not affect the other socket connections.

The Solaris environment supports program calls to `getsockopt`(3N) and `setsockopt`(3N). The options `SO_SNDBUF` and `SO_RCVBUF` are used to set the size of the TCP send and receive buffers for a specified socket. Refer to the `getsockopt`(3N) man page for more detailed information.

To optimize performance, assign consistent values for the transmit and receive buffers. The default value (4 Kbytes) assigned to these parameters is optimized for transmitting across Ethernet connections. For applications running over HIPPI/P, the send and receive buffers must be set to 512 Kbytes at a minimum.

Troubleshooting and Diagnostics

This chapter describes how to detect and resolve common problems with your HIPPI/P network. It includes instructions on how to load and configure the Sun HIPPI/P device driver manually, if required. Note that Sun HIPPI/P supports almost all of the standard SunOS network diagnostic utilities, including `snoop`(1M), `netstat`(1M), and `ping`(1M).

For a Solaris environment, the default base directory is:

```
/etc/opt/SUNWconn/bin
```

Troubleshooting Checklist

Use the following sections to verify the major components of your Sun HIPPI/P host, and to check that it is installed, configured, and attached to the network correctly.

▼ To Check the Sun HIPPI/P Driver

A sudden increase in the number of errors could indicate a noisy connection caused by a dirty cable.

● **Use** netstat**(1M) to check that the Sun HIPPI/P (**hipip**) driver is installed correctly, and to check for an excessive number of errors and collisions.**

```
# netstat -i
Name Mtu    Net/Dest Address   Ipkts Ierrs Opkts Oerrs Collis Queue
lo0  8232  loopback localhost  21    0     21    0     0      0
le0  1500  our-lan  hanna      2146  0     950   1     13     0
hipip0 57344  our-hip hanna-h  1086  0     907   0     0      0
```

▼ To Check the IP Addresses

You must assign a unique IP address to each Sun HIPPI/P interface. If you have more than one IP interface installed in your machine—either multiple Sun HIPPI/P interfaces, or some other LAN interface (for example, an Ethernet interface)—each interface must be attached to a different subnetwork.

● **Use** ifconfig**(1M) to check the IP addresses assigned to the two Sun HIPPI/P interfaces.**

```
# ifconfig -a
hipip0: flags=843(UP,BROADCAST,RUNNING,MULTICAST) mtu 57344
     inet 123:123:201:71 netmask ffffff00 broadcast
123:123:201:255
hipip1: flags=843(UP,BROADCAST,RUNNING,MULTICAST) mtu 57344
     inet 123:123:201:75 netmask ffffff00 broadcast
123:123:201:255
```

If the interfaces have the same subnetwork number, as shown in this example, you must change the IP address assigned to one of the interfaces.

Ensure that the IP addresses and host names for each Sun HIPPI/P interface are entered in the NIS map, or in /etc/inet/hosts on the local machine if you are not using NIS/NIS+.

▼ To Check the IP Routing

1. **Check the IP routing table using the** netstat**(1M) command.**

```
# netstat -nr
```

2. **Check that the HIPPI/P subnetwork is featured in the routing table.**

   If the routing table is empty, check that the routing daemon (`in.routed`) is running on your machine.

▼ To Check the Protocol Statistics

1. **Use `netstat`(1M) to check the per-protocol (for example, IP, TCP, UDP) statistics for errors.**

```
# netstat -s
UDP
    udpInDatagrams        =  1423udpInErrors             =      0
    udpOutDatagrams       =   540

TCP tcpRtoAlgorithm       =      4    tcpRtoMin            =    200
    tcpRtoMax             = 60000    tcpMaxConn           =     -1
    tcpActiveOpens        =     38    tcpPassiveOpens      =      1
    tcpAttemptFails       =      0    tcpEstabResets       =     33
    tcpCurrEstab          =      2    tcpOutSegs           =    427
    tcpOutDataSegs        =    264    tcpOutDataBytes      = 15917
    tcpRetransSegs        =     38    tcpRetransBytes      =      0
    tcpOutAck             =    143    tcpOutAckDelayed     =     56
    tcpOutUrg             =      1    tcpOutWinUpdate      =      0
    tcpOutWinProbe        =      0    tcpOutControl        =    111
    tcpOutRsts            =     36    tcpOutFastRetrans    =      0
    tcpInSegs             =    606
    tcpInAckSegs          =    292    tcpInAckBytes        = 15949
    tcpInDupAck           =     62    tcpInAckUnsent       =      0
    tcpInInorderSegs      =    311    tcpInInorderBytes    = 99169
    tcpInUnorderSegs      =      0    tcpInUnorderBytes    =      0
    .
    .
    .
```

2. **Use `netstat`(1M) to check the driver statistics.**

```
# netstat -k
hipip0
    ipackets = A, ierrors = B, opackets = C, oerrors = D, opackets = E
    defer = F, framming = G, crc = H, oflo = I, uflo = J, missed = K, \
    late_collisons = L
    retry_error = M, nocarrier = N, inits = O, nocanput = P, allocbfail = Q
    .
```

▼ To Check the HIPPI/P Components

● **Use SunVTS™ to verify the operation of the HIPPI/P components.**

Refer to the following table for release information:

TABLE 5-1   Release Support

Operating Environment	SunVTS Version	Support Release Date	Release Mechanism
Solaris 2.6	2.1.3	12/04/98	Patch[1]
Solaris 7	3.0	12/11/98	Patch
Solaris 7 3/99	3.1	GA	Integrated
Solaris 8	4.0	GA	Integrated

1. Refer to the SunSolve database for the latest released patches and instructions for installing them.

Checking the MAC Address

By default, the Sun HIPPI/P interface takes the card-resident MAC address stored in its EEPROM.

Solving Common Problems

Use the following information to diagnose and resolve some of the common problems that can occur when installing, configuring, or running Sun HIPPI/P.

TABLE 5-2   Problems Installing Sun HIPPI/P

Problem	Action
The Sun HIPPI/P software package (SUNWhip) cannot be found. The Sun HIPPI/P developer utilities package (SUNWhipc) cannot be found. The Sun HIPPI/P man pages/utilities package (SUNWhipmn) cannot be found.	Check that you have inserted the CD-ROM in the CD-ROM drive and that the CD-ROM is mounted on a local directory. If the Volume Manager (vold) is running on your machine, the Sun HIPPI/P software is located in the following directory: /cdrom/sun_hippi_1_1/Sol_2.*x*. If the Volume Manager (vold) is not running on your machine, you must create a directory and mount the CD-ROM as described in Chapter <$elemparanumonly<$elemtext.
The configuration script cannot configure the IP address. "Enter the IP {hostname} or address for hipipx[?] Illegal ip address. . . . Try again"	Check that you have entered a valid IP address or hostname. The script will keep prompting you until you enter a valid address.
The configuration script cannot find the hardware devices installed in the machine.	Check that the Sun HIPPI/P PCI card is installed correctly and is seated firmly in the PCI slot. Use the prtconf command to see if the hipip card exists.
The configuration script cannot load the device driver.	Check whether the driver is already installed on the system. Confirm that all previous versions of the package have been removed.
The configuration script cannot configure the device driver. The procedure fails with the message, "Duplicate MAC address."	Two or more interfaces have been assigned the same MAC address. The most likely conflict lies between the first Sun HIPPI/P 1.1 interface (hipip0) and other interfaces installed in the same machine.

TABLE 5-3   Problems Running Sun HIPPI/P

Problem	Action
The Sun HIPPI/P interface (`hipip`) is not displayed by `netstat`.	Check that the Sun HIPPI/P device driver is loaded, using `modinfo`(1M) to display information about loaded kernel modules. If the device driver is not loaded, see Section "Loading the Device Driver Manually" on page 32 for detailed instructions.
The Sun HIPPI/P interface (`hipip`) is not displayed by `ifconfig`.	Check that the Sun HIPPI/P device driver is loaded, using `modinfo`(1M) to display information about loaded kernel modules. If the device driver is not loaded, see Section "Loading the Device Driver Manually" on page 32 for detailed instructions.
The local host can reach HIPPI/P hosts located on the same subnetwork, but these hosts cannot reach the local host.	Check that the IP address and host name of the local host is entered in the NIS map or NIS+ tables (or in `/etc/inet/hosts` on each remote host if you are not running NIS or NIS+).
The local host cannot reach other HIPPI/P hosts located on the same subnetwork.	Use `ifconfig`(1M) to verify that the Sun HIPPI/P interface (`hipip`) is up.
	Check that the IP address and host name of the remote host is entered in the NIS map or NIS+ tables (or in `/etc/inet/hosts` on the local host if you are not running NIS or NIS+).
	Use `hippiarp` to verify that ARP entries are defined for all of the remote hosts.

Loading the Device Driver Manually

Normally, the Sun HIPPI/P device driver is loaded and configured by the post-installation script, which is launched automatically when the software is installed. If you encounter problems when running this script, or if you want to customize the installation, you may need to load the device driver manually.

▼ To Manually Load the Device Driver

1. Log in as superuser.

2. **Stop the driver.**

```
# /etc/init.d/hippi stop
```

3. **Check that there are no partially installed drivers for Sun HIPPI/P.**

   a. **Check for existing Sun HIPPI/P devices in the** /dev **directory.**

```
# ls /dev | grep hip
hip
hipip
```

   b. **Unload the Sun HIPPI/P drivers.**

```
# modinfo | grep hip
# modunload -i module ID for hip driver
# modunload -i module ID for hipip driver
```

   c. **Use** rem_drv**(1M) to remove any installed Sun HIPPI/P devices and remove the device directories.**

```
# /usr/sbin/rem_drv hipip
# /usr/sbin/rem_drv hip
# /bin/rm —f /dev/hipip
# /bin/rm —f /dev/hip
```

   d. **Check the** /etc/name_to_major **file for entries of the form** hipip num **and** hip num **and remove these entries if they exist.**

4. **Use** add_drv**(1M) to inform the system about the new drivers.**

```
# /usr/sbin/add_drv hip
# /usr/sbin/add_drv hipip
```

5. **Check that the device drivers have been added to the system correctly.**

   a. Look in the `/devices/pseudo` directory for entries of the form.

   ```
   ls -l /devices/pseudo | grep hipip
   crw------- 1 root sys 11,119 date clone@0:hipip
   ```

   b. Look in the `/dev` directory for links to these entries.

   ```
   ls -l /dev | grep hipip
   lrwxrwxrwx 1 root other date hipip -> ../devices/pseudo/clone@0:hipip
   ls -l /dev | grep hip
   lrwxrwxrwx 1 root other date hip x -> ../devices/pci@49, 2000/ethernet@2:hip x/
   clone@0:hip
   ```

6. **Create a file called** `/etc/opt/SUNWconn/hipip/hipinst.conf` **for each Sun HIPPI/P IP interface that you configure.**

   Each file must contain the host name assigned to the IP interface, netmask, and switch address. Refer to `hipadmin`(1M). These files are used to configure the interfaces when the system is rebooted. You should not assign the primary host name to one of the HIPPI/P interfaces. The primary host name is that interface that has its name entered in the `/etc/nodename` file.

7. **Use** `ifconfig`**(1M) to configure the Sun HIPPI/P IP interfaces (**hipip*inst***).**

   The host name assigned to the IP interface must be entered in the NIS map, NIS+ tables, or in `/etc/inet/hosts` on the local machine. Configure the interface using an `ifconfig`(1M) command of the form:

   ```
   # /usr/sbin/ifconfig hipipinst plumb hostname netmask + up
   ```

   Note that the modifier `netmask +` takes the netmask defined in the `/etc/inet/netmasks` file. If this entry is missing, you must specify the netmask explicitly using dot notation.

   Provided the installation and configuration was successful, your Sun HIPPI/P host is now active and you can send and receive data transparently across a HIPPI/P connection.

HIPPI Network Architecture

This chapter provides a brief introduction to the High-Performance Parallel Interface (HIPPI).

Introduction to HIPPI Networking

HIPPI (High-Performance Parallel Interface) was developed in the late 1980s to provide high-speed I/O connectivity between supercomputers and other devices. HIPPI/P has evolved beyond this original purpose to encompass high-speed local-area networking.

The basis of HIPPI is a simplex, 100-megabyte per second (Mbytes per second), or 800-megabit per second (Mbits per second), channel. Typically, two HIPPI channels are combined to create a duplex connection.

Initially, the only link medium for HIPPI was parallel copper cables that can be up to 25 meters long. It is now possible to establish multimode and single-mode fiber connections that can be up to 10 kilometers long.

Network Architecture

HIPPI consists of several protocol layers, each of which is defined by a standards document.

ANSI X3.183-1991 defines the HIPPI physical layer, referred to as HIPPI-PH. This document defines the basic copper or fiber-optic cables, the interconnect mechanisms, and the low-level movement of data. (Data is broken up into packets and further subdivided into bursts of up to 256 four-byte words.)

There are three layers on top of the physical medium to enable the basic HIPPI channel to be used in a very efficient, low-latency network. These are HIPPI-SC (switch control, ANSI X3.222-1993), HIPPI-FP (framing protocol, ANSI X3.210-1992), and HIPPI-LE (link encapsulation, ANSI X3.218-1993). The ANSI Serial-HIPPI Specification defines fiber-optic implementations.

These ANSI standards documents, along with RFC 2067, define how a TCP/IP network can operate on top of a physical network of HIPPI channels and switches. This mode of operation enables other protocols and proprietary applications to access the HIPPI network.

Switched Network Topology

The HIPPI network itself consists of a number of systems that have full-duplex HIPPI connections and are interconnected with a set of high-speed switches. The HIPPI connections in these systems are either provided by add-on boards or are intrinsic parts of the system. Host software enables you to set up the HIPPI channel in a network orientation.

The switches used in HIPPI networks are nonblocking with very low latency. The total throughput of a HIPPI switch is the total of the HIPPI connections on the switch multiplied by two. For example, a 16 x 16 switch has 32 connections, for a total throughput of 32 interfaces at 100 Mbytes per second, for a combined bandwidth of 3200 Mbytes per second.

To move data through the switch network to a specific destination, a special header called an *I-field* is used. I-field format is defined in the HIPPI-PH document.

I-Field

The I-field defines destination routing for a data packet. The I-field is four bytes long and carries two sequences of information: a control byte and a network/switch route. The control byte tells the switch how to interpret the network/switch route portion of the I-field.
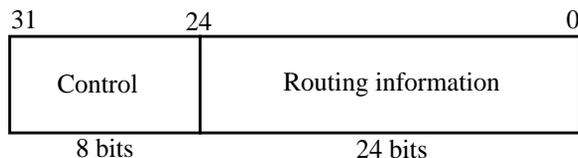

FIGURE 6-1   I-Field

The following table contains definitions of the information fields within the routing control bytes.

TABLE 6-1 Control Byte Information Fields

Bit(s)	Designation	Description
29-31	Reserved	
28	Double-wide mode	Distinguishes between 32- or 64-bit connections when using a 64-bit port.
27	Direction	Identifies which end of the I-field routing information to use (0 for right, 1 for left).
25-26	Path selection	The two bits for path selection are defined as follows: 1,1 Logical address with automation and random selection of one port from a list. 1,0 Reserved for future use. 0,1 Logical address with automatic selection of the first available port to reach destination. 0,0 Source routing.
24	CAMP_ON	If CAMP_ON is set to 1, the connection waits for the destination to be available. If set to 0, the connection is rejected if the requested destination is not available.

There are two basic forms of HIPPI switch addresses: source route addresses and logical addresses. The source route address uses the three routing bytes to guide the packet through the switch network. The n least-significant bits indicate onto which switch ports the data should be switched (where 2^n is the number of the ports on the switch. For example, on an eight port switch, n equals three. The switch then rotates the routing field n bits to the right so that the next switch, if there is one, sees the next bits as the port it should use. The switch also places the incoming port in the n most-significant bits. This enables the final end point to create a "reverse route" from the I-field that it receives. Refer to the HIPPI-SC document for additional information.

The logical address is a more elegant method of routing data. This mechanism takes advantage of the switch internal routing tables. You can think of the logical address in the same way as you think of an IP address, and the switch routing table as the routing table found in an IP router. When the switch sees a packet with the logical address flag set, it looks in its routing table and determines which port should send the packet out. This is repeated in all the switches until the packet arrives at its final and proper destination.

> **Note –** Sun HIPPI/P uses logical addressing to send IP packets to remote hosts.

Another important I-field control bit is the camp-on field. This field enables the switch to keep a packet waiting while other data is passing through a final or intermediate destination that the waiting packet wishes to use. This enables a guaranteed arrival when the end destination is active.

> **Note –** The camp-on bit is always set for IP packets sent by the Sun HIPPI/P driver.

Framing Protocol

Because the HIPPI network can carry different types of traffic, a framing protocol was developed. This protocol enables the destination to determine what type of traffic it is receiving. The most common framing protocol used is ISO 802.2. This protocol is typically used to carry TCP/IP traffic. Other protocols used are IPI3 (for disk device traffic) and proprietary protocols.

The value in the ULP (upper-layer protocol) field of the framing protocol determines the protocol being carried. Values include those for a number of well-known protocols (for example, 802.2 is 4 and IPI3 is 6, 7, and 8) and a "local-use" bit that enables you to specify that the protocol is a local one.

HIPPI/P Network Model

The High-Performance Parallel Interface (HIPPI) provides high-performance, multistation networking at data transfer rates of up to 100 Mbytes per second or 800 Mbits per second.

The ANSI/HIPPI specifications define a network model that consists of the following components:

- Physical Media Dependent (PMD) Layer
- Physical (PHY) Layer
- Switched Control Layer
- Framing Protocol Layer
- Link Encapsulation Layer

FIGURE 6-2 shows the organization of these components, and their relationship with other network protocols that use them.
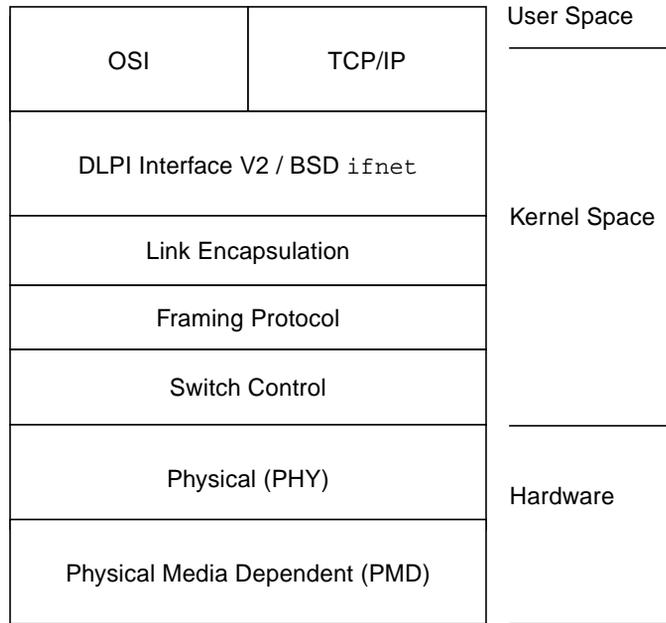
FIGURE 6-2 HIPPI Architectural Model

HIPPI Network Configuration

A typical HIPPI network can either be a point-to-point configuration (FIGURE 6-3) or a more complex topology requiring the purchase and installation of a HIPPI switch (FIGURE 6-4).
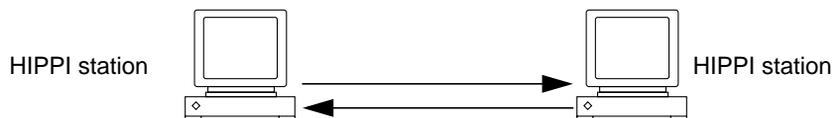

FIGURE 6-3 Basic HIPPI Point-to-Point Configuration
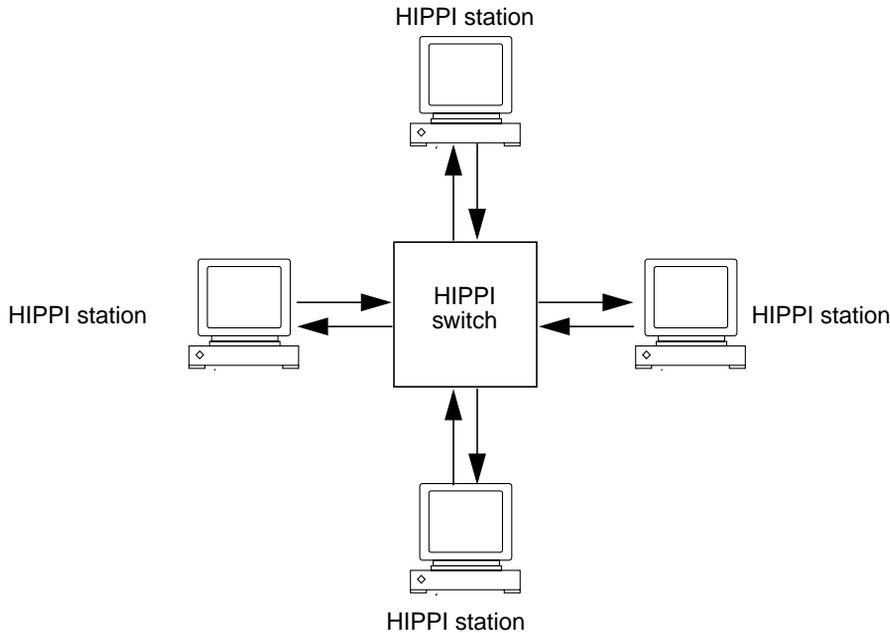
FIGURE 6-4   HIPPI Network Configuration Using a Switch

HIPPI Performance

Although the HIPPI standards define a medium that supports data transfer rates of up to 100 Mbytes per second or 800 Mbits per second, this does not translate directly to an increase in overall system performance. If fact, it frequently transfers the bottleneck elsewhere, so that the HIPPI connection is not used to full capacity.

A HIPPI network has the *potential* to carry more information rather than to be a faster connection. If the applications running over the network do not use the available bandwidth efficiently, you will not see much improvement in the performance of your network above that of traditional Ethernet connections.

Among the factors that affect HIPPI network performance are:

- Network topology
- Network load
- Network efficiency
- Processor speed (on the HIPPI stations)
- Bus architecture

There are a number of ways of improving the overall performance of the network, some of which are discussed in Chapter <$elemparanumonly<$elemtext. However, the majority of these suggestions should only be undertaken by experienced system administrators. Any improvement made by modifying the actions of the HIPPI network is negligible compared to what is gained by making more efficient use of the available bandwidth.

Using the Sun HIPPI/P Network Utilities

This chapter describes the network utilities delivered with **Sun HIPPI/P**.

Throughout this chapter, it is assumed that you have installed the Sun HIPPI/P software under the default base directory for your operating system.

For a Solaris environment, the default base directory is:

```
/etc/opt/SUNWconn/bin
```

Changing the Default MAC Address

Each attachment to a HIPPI/P network is identified by a unique 48-bit MAC address. By default, each Sun HIPPI/P PCI card adopts the card-resident MAC address stored in its own EEPROM.

In general, this convention is sufficient to ensure that each Sun HIPPI/P PCI card installed in the machine has a unique MAC address. However, if you need to change the default MAC address assigned to a Sun HIPPI/P PCI card installed in the system, use the following method.

▼ To Change the Default MAC Address

1. **Log in as superuser.**

2. **Modify the startup file on your machine so that the MAC address is assigned correctly when the system is rebooted.**

Edit the `/etc/init.d/hippi` file to add the following `if` statement immediately *after* the `ifconfig` command that initializes the interface `hipip`*inst*. If you are changing the MAC address of more than one interface, add one `if` statement for each interface.

```
ifconfig $hipipname plumb 2>&1 >/dev/null
    if [ $hipipname = "hipipinst" ]; then
        ifconfig hipipinst ether mac_address
    fi
```

3. **Reboot your machine to assign the new MAC address to the Sun HIPPI/P interface.**

Once a station starts sending packets on the network, the Address Resolution Protocol (ARP) updates the ARP tables on other systems to include the MAC address of its interface. If you swap Sun HIPPI/P PCI cards that use the card-resident MAC address, you must wait until the ARP entries timeout, or remove the ARP entries from every active station manually before packets can be routed correctly.

Using the Sun HIPPI/P Device Driver Utilities

The Sun HIPPI/P device driver software includes user-level utilities and diagnostics. TABLE 7-1 provides a brief description for these commands. Refer to the HIPPI/P man pages for a more complete description of the commands, required permissions, and command-line options.

TABLE 7-1   Device Driver Utilities

Utility	Function	Description
hipadmin	Network configuration program	Sets the IP address, netmask, and HIPPI/P switch address in the /etc/opt/SUNWconn/hippi/hip*inst*.conf file.
hippiarp	Controls HIPPI/P address resolution	Controls and displays the HIPPI/P address resolution table. It also adds, deletes, or verifies the contents of the HIPPI/P address resolution tables.
hippid	Provides user context with the system support daemon	Provides a user context for the ARP and IP agent to broadcast ARP and IP requests to known hosts. It also provides a user context for self-discovery activity as well as a watchdog mechanism to ensure the NIC is operating correctly.
hippidb	Displays and controls device driver trace levels	Displays and controls the debug trace levels of the Sun HIPPI/P device driver.
hippidisp	Displays internal states	Displays information retrieved directly from an NIC or information previously extracted from an NIC using the dump daemon hippidmpd(1M). Much of the information that is displayed contains internal state information of the driver. This tool does not describe this information.
hippidmpd	Dumps device state	Generates device state dumps to enable offline device problem analysis. Dumping of the device state occurs automatically when the device watchdog detects anomalous behavior on the NIC, and can occur manually when requested.
hippidnld	Downloads RunCode	Manages the on-board embedded code on the Sun HIPPI/P NIC. It also updates the on-board firmware.
hippi	Controls and queries status	Controls the state of the Sun HIPPI/P device driver and associated hardware, or to query the current status or version information.
hippistat	Displays Sun HIPPI/P statistics	Retrieves NIC statistics (configuration, number of resets, number of packets reassembled, and so forth).

TABLE 7-1   Device Driver Utilities *(Continued)*

Utility	Function	Description
hippitb	Displays debug traces	Displays a formatted version of the driver firmware and trace buffers.
hippitune	Provides tuning performance	Dynamically changes or updates Sun HIPPI/P registers to tune performance. It also sets the values in the Sun HIPPI/P EEPROM so that the tuning values persist across system reboots.
blast	Diagnostic utility	Used to perform diagnostics on a HIPPI/P adaptor. It can also be used with sink(1M) to analyze system performance.
sink	Diagnostic utility	Used with blast(1M) to analyze system performance.

Displaying Sun HIPPI/P Statistics (`hippistat`)

The hippistat(1M) utility displays current hardware statistics for a HIPPI/P Network Interface Card.

```
# basedir/hippistat [-D] unit
```

Where *unit* is hip0, hip1, and so forth. The output from this command will be similar to the following text:

```
# ./hippistat -D hip0
hip0 NIC STATISTICS:
    Time when stats last updated          408098467 0x185316a3
    Rings created                                 1       0x1
    Stats updates by timer                       20      0x14
    Stats updates by command                     22      0x16
    Number of Watchdog commands                  75      0x4b
    HIPPI Link ready established                   1       0x1
    Connections established                     263     0x107
    Packets sent                                263     0x107
    Bytes sent                                33608    0x8348
    Connections accepted                        262     0x106
    Packets received                            262     0x106
    Bytes received                            32488    0x7ee8
#
```

Frequently Asked Questions About Sun HIPPI/P

This appendix contains the responses to some of the most frequently asked questions about Sun HIPPI/P. It also contains references to more detailed information.

1. The network performance is much lower than I expected. Why can I not transfer data at 100 Mbytes per second over my HIPPI connection?

   If the applications running over HIPPI do not use the available bandwidth efficiently you will see much lower performance than expected. See Chapter <$elemparanumonly<$elemtext for advice on how to get the best performance from your Sun HIPPI/P station.

2. What is the MTBF for Sun HIPPI/P?

   The mean time before fail (MTBF) for each of the Sun HIPPI/P interface cards is 424,953 hours. This was obtained using the standard method for calculating MTBF.

3. Why is performance poor when I use the NFS™ file system over HIPPI?

   For a single file transfer, the maximum data transfer rate is limited to 0.5 Mbytes/second when writing to an NFS mounted file system and 1.5 Mbytes/second when reading from an NFS mounted file system. This performance limitation, which affects Ethernet, HIPPI, and any other fast network, is due to the NFS version 2 protocol. It will be removed by NFS version 3.

   Note that when several NFS operations are performed in parallel (several reads and writes in parallel), the aggregate throughput is much higher with HIPPI than it is with Ethernet.

4. How do I disable the Sun HIPPI/P interface?

Use ifconfig(1M) to disable the Sun HIPPI/P interface temporarily. It will be reconfigured when you reboot your machine.

```
# ifconfig hipipinst down
```

To disable the Sun HIPPI/P interface so that it is not reconfigured when you reboot the machine, change the name of the hipinst.conf file.

```
# mv /etc/opt/SUNNconn/hippi/hipinst.conf /etc/opt/SUNWconn/hippi/ \
oldhipinst.conf
```

5. How do I disable the Ethernet interface?

Use ifconfig(1M) to disable the Ethernet interface temporarily. It will be reconfigured when you reboot your machine.

```
# ifconfig leinst down
```

To disable the Ethernet interface so that it is not reconfigured when you reboot the machine, change the name of the /etc/hostname.leinst file.

```
# mv /etc/hostname.leinst /etc/oldhostname.leinst
```

6. How do I use the host name assigned to the Sun HIPPI/P interface as the primary host name for my machine?

In a Solaris environment, the primary host name is defined in the /etc/nodename file. Usually, this file contains the host name assigned to the Ethernet interface built in to your machine. It is not possible to assign the primary network interface to the Sun HIPPI/P interface.

7. Can I associate several IP addresses with a single Sun HIPPI/P interface?

Yes. To associate multiple IP addresses with a single interface, type:

```
# ifconfig hipip0     ip_address_1 netmask mask up
# ifconfig hipip0:1  ip_address_2 netmask mask up
# ifconfig hipip0:2  ip_address_3 netmask mask up
.
.
.
```

8. How many Sun HIPPI/P PCI cards can I install in one machine?

You can install up to four Sun HIPPI/P PCI cards in one machine.

Developing Applications for Sun HIPPI/P Networks

This chapter describes how to develop your own applications running over Sun HIPPI/P networks. It assumes that you are an experienced programmer, who is already familiar with the DLPI Version 2 interface for use with Solaris 2.6, Solaris 7, or Solaris 8 operating environment.

This chapter provides a brief overview of each of the programming environments and concentrates on network addressing and other issues that are specific to the Sun HIPPI/P implementation of these interfaces. It does not provide a detailed specification of the interfaces.
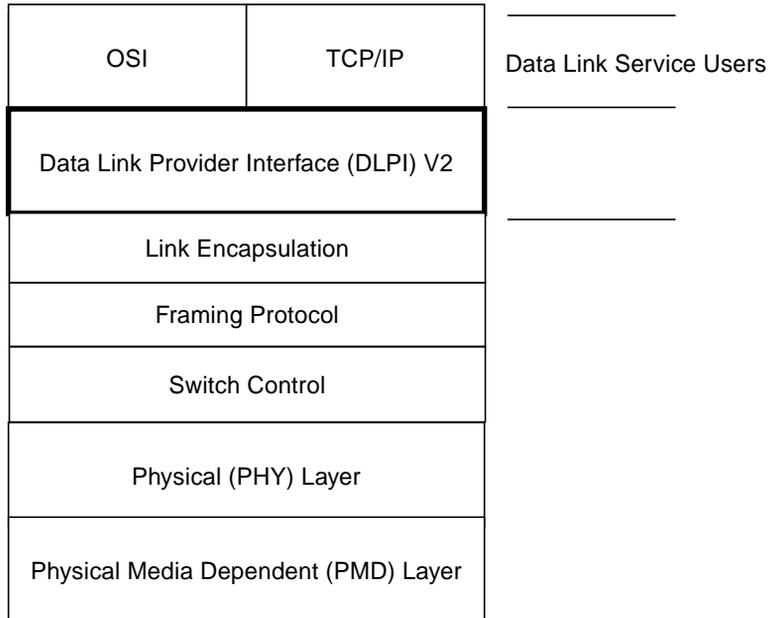
Developing Applications with DLPI

The Data Link Provider Interface (DLPI) Version 2 enables any data link user to access the services of a data link provider without any special knowledge about the underlying protocols. In addition to HIPPI/P services, DLPI supports access to X.25, LAPB, LAPD, ISDN, Ethernet, Token Ring, Token Bus, SDLC, BISYNC, and other data link protocols.

DLPI is used to access the services of the Sun HIPPI/P link layer of the Sun HIPPI/P device driver in a Solaris environment without the need for specialized knowledge of the underlying protocol. You can obtain a copy of the *STREAMS DLPI Specification* from Sun Microsystems, Inc.

The DLPI header file provided in the Solaris 2.6, Solaris 7, or Solaris 8 operating environment is `sys/dlpi.h`. A detailed description of the functions contained in the header is available in the *STREAMS DLPI Specification*.

DLPI defines a STREAMS message set, state table, and conventions that support interaction between a data link service user (for example, IP or ARP) and a data link service provider (for example, the `hipip` HIPPI/P driver). The folowing figure illustrates the relationship between DLPI and the layers of the HIPPI/P protocol.

```
┌─────────────────┬─────────────────┐          ──────────────
│                 │                 │
│      OSI        │     TCP/IP      │          Data Link Service Users
│                 │                 │
├─────────────────┴─────────────────┤          ──────────────
│                                   │
│  Data Link Provider Interface (DLPI) V2  │
│                                   │
├───────────────────────────────────┤          ──────────────
│         Link Encapsulation        │
├───────────────────────────────────┤
│          Framing Protocol         │
├───────────────────────────────────┤
│           Switch Control          │
├───────────────────────────────────┤
│                                   │
│        Physical (PHY) Layer       │
│                                   │
├───────────────────────────────────┤
│                                   │
│  Physical Media Dependent (PMD) Layer │
│                                   │
└───────────────────────────────────┘
```

FIGURE B-1   DLPI Access to HIPPI/P

DLPI primitives are defined in terms of STREAMS messages. All DLPI messages are either type M_PROTO or type M_PCPROTO and contain the appropriate DLPI message structure. DPLI primitives are exchanged by *confirmed* negotiation—request primitives are issued by the user, which then waits to receive an acknowledge (or error) response primitive from the provider.

DLPI Connectionless Service Primitives

Applications developed to run over HIPPI/P use the DLPI connectionless service primitives, which support the following set of operations:

■ Attaching a STREAM to a given addressable device
■ Getting and setting the physical address of the attached device
■ Binding a data link service access point (SAP) to the STREAM

- Transmitting and receiving data link frames
- Transmitting and receiving multicast addresses
- Enabling physical and data link promiscuous mode

DLPI Addressing

DLPI addressing is implemented as a DLSAP (data link service access point) address.

Information returned by the DL_INFO_ACK primitive (in response to a DL_INFO_REQ) is used to specify the encoding and decoding rules to insert and extract the DLSAP for a given data link provider. The information returned by the Sun HIPPI/P device driver is shown in the following table.

TABLE B-1 DL_INFO_REQ Frame

Element	Value	Description
dl_max_sdu	65280 bytes	Maximum MTU
dl_min_sdu	0 bytes	Minimum MTU
dl_addr_length	8 bytes	Length of DLSAP
dl_mac_type	DL_ETHER	HIPPI/P MAC layer
dl_reserved	0	Unused
dl_current_state	—	Current state of data link provider
dl_sap_length	-2 bytes	Length of DLSAP
dl_service_mode	DL_CLDLS	Connectionless service
dl_qos_length	0	Not supported
dl_qos_offset	0	Not supported
dl_range_length	0	Not supported
dl_range_offset	0	Not supported
dl_provider_style	DL_STYLE2	Can be cloned
dl_addr_offset	76	Offset to address location
dl_version	2	DLPI Version 2
dl_brdcst_addr_length	6	Broadcast address length
dl_brdcst_addr_offset	84	Offset to broadcast address location

Note that the value `dl_sap_length` is set to minus 2, which indicates that the SAP is 2 bytes beyond the physical address.

Glossary

This glossary contains definitions of the acronyms, abbreviations, and terms used in this guide.

A

ARP   (Address Resolution Protocol) a protocol used within local networks that supports broadcast (such as Ethernet or HIPPI/P) and binds IP addresses to MAC addresses. View the current contents of a Sun machine ARP table with the Solaris command, `arp -a`; specified in RFC 826.

B

baud   a measure of the rate of data transfer, based on the number of times per second the signal can change states on the transmission line. The transmission line ordinarily uses just two signal states to indicate data transfer, making the baud rate equal the number of bits per second that can be transferred.

D

dotted decimal notation a way of representing the 32-bit Internet address: four decimal integers separated by decimal points, where each integer is the decimal value of one octet of the Internet address. For example, the 32-bit Internet address (binary) `11000000 00001001 11001001 00000111` is represented as `192.9.201.7` (decimal).

G

gateway a dedicated computer that connects to two or more networks and routes packets from one network "community" to the other. Gateways route packets to other gateways until the packets can be delivered directly to their specified destination across one physical network. In general usage, the term identifies any computer that transfers information between networks.

K

Kpbs (kilobits per second) a measure of the rate of data transmission.

M

MAC (Media Access Control) Local area network protocol functions corresponding to the OSI data link layer (layer 2), but providing the following: 1) on transmission, assembles data into a frame with address and error-detection fields; 2) on reception, disassembles frame, performs address recognition and error detection; 3) links communications management.

N

NRZI-4B/5B (nonreturn to zero inverted) a differential encoding technique that encodes four-bit data groups as five bits (data plus a signal element); satisfies the minimum signal transition requirements to transmit synchronization (clock) within the data stream.

NIC Network Interface Card

O

OSI (Open System Interconnection) the OSI model is a standard for computer-communications protocols and the implementation of these protocols. The model is a product of the International Standards Organization (ISO), and specifies a seven-layer architecture with one or more protocol standards at each layer.

P

PHY (Physical Layer Protocol) a protocol that performs the clock recovery and serial-to-parallel (on receive) or parallel-to-serial (on transmit) of data between the transmission medium and the MAC entity.

R

RARP (Reverse Address Resolution Protocol) a protocol used by diskless machines and their servers within local networks such as Ethernet or HIPPI/P. In a RARP exchange, a diskless machine broadcasts its MAC address. A boot server responds to that client with the client IP address, enabling the client to begin the boot process.

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