



Sun StorEdge™ SAN Foundation Software 4.3 Installation Guide

Sun Microsystems, Inc.
www.sun.com

Part No. 817-3671-10
November 2003, Revision A

Submit comments about this document at: <http://www.sun.com/hwdocs/feedback>

Copyright 2003 Sun Microsystems, Inc., 4150 Network Circle, Santa Clara, California 95054, U.S.A. All rights reserved.

Sun Microsystems, Inc. has intellectual property rights relating to technology that is described in this document. In particular, and without limitation, these intellectual property rights may include one or more of the U.S. patents listed at <http://www.sun.com/patents> and one or more additional patents or pending patent applications in the U.S. and in other countries.

This document and the product to which it pertains are distributed under licenses restricting their use, copying, distribution, and decompilation. No part of the product or of this document may be reproduced in any form by any means without prior written authorization of Sun and its licensors, if any.

Third-party software, including font technology, is copyrighted and licensed from Sun suppliers.

Parts of the product may be derived from Berkeley BSD systems, licensed from the University of California. UNIX is a registered trademark in the U.S. and in other countries, exclusively licensed through X/Open Company, Ltd.

Sun, Sun Microsystems, the Sun logo, AnswerBook2, docs.sun.com, Sun StorEdge, and Solaris are trademarks or registered trademarks of Sun Microsystems, Inc. in the U.S. and in other countries.

All SPARC trademarks are used under license and are trademarks or registered trademarks of SPARC International, Inc. in the U.S. and in other countries. Products bearing SPARC trademarks are based upon an architecture developed by Sun Microsystems, Inc.

The OPEN LOOK and Sun™ Graphical User Interface was developed by Sun Microsystems, Inc. for its users and licensees. Sun acknowledges the pioneering efforts of Xerox in researching and developing the concept of visual or graphical user interfaces for the computer industry. Sun holds a non-exclusive license from Xerox to the Xerox Graphical User Interface, which license also covers Sun's licensees who implement OPEN LOOK GUIs and otherwise comply with Sun's written license agreements.

Netscape Navigator is a trademark or registered trademark of Netscape Communications Corporation in the United States and other countries.

U.S. Government Rights—Commercial use. Government users are subject to the Sun Microsystems, Inc. standard license agreement and applicable provisions of the FAR and its supplements.

DOCUMENTATION IS PROVIDED "AS IS" AND ALL EXPRESS OR IMPLIED CONDITIONS, REPRESENTATIONS AND WARRANTIES, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT, ARE DISCLAIMED, EXCEPT TO THE EXTENT THAT SUCH DISCLAIMERS ARE HELD TO BE LEGALLY INVALID.

Copyright 2003 Sun Microsystems, Inc., 4150 Network Circle, Santa Clara, Californie 95054, Etats-Unis. Tous droits réservés.

Sun Microsystems, Inc. a les droits de propriété intellectuelle relatants à la technologie qui est décrit dans ce document. En particulier, et sans la limitation, ces droits de propriété intellectuelle peuvent inclure un ou plus des brevets américains énumérés à <http://www.sun.com/patents> et un ou les brevets plus supplémentaires ou les applications de brevet en attente dans les Etats-Unis et dans les autres pays.

Ce produit ou document est protégé par un copyright et distribué avec des licences qui en restreignent l'utilisation, la copie, la distribution, et la décompilation. Aucune partie de ce produit ou document ne peut être reproduite sous aucune forme, par quelque moyen que ce soit, sans l'autorisation préalable et écrite de Sun et de ses bailleurs de licence, s'il y ena.

Le logiciel détenu par des tiers, et qui comprend la technologie relative aux polices de caractères, est protégé par un copyright et licencié par des fournisseurs de Sun.

Des parties de ce produit pourront être dérivées des systèmes Berkeley BSD licenciés par l'Université de Californie. UNIX est une marque déposée aux Etats-Unis et dans d'autres pays et licenciée exclusivement par X/Open Company, Ltd.

Sun, Sun Microsystems, le logo Sun, AnswerBook2, docs.sun.com, Sun StorEdge, et Solaris sont des marques de fabrique ou des marques déposées de Sun Microsystems, Inc. aux Etats-Unis et dans d'autres pays.

Toutes les marques SPARC sont utilisées sous licence et sont des marques de fabrique ou des marques déposées de SPARC International, Inc. aux Etats-Unis et dans d'autres pays. Les produits protant les marques SPARC sont basés sur une architecture développée par Sun Microsystems, Inc.

L'interface d'utilisation graphique OPEN LOOK et Sun™ a été développée par Sun Microsystems, Inc. pour ses utilisateurs et licenciés. Sun reconnaît les efforts de pionniers de Xerox pour la recherche et le développement du concept des interfaces d'utilisation visuelle ou graphique pour l'industrie de l'informatique. Sun détient une licence non exclusive de Xerox sur l'interface d'utilisation graphique Xerox, cette licence couvrant également les licenciées de Sun qui mettent en place l'interface d'utilisation graphique OPEN LOOK et qui en outre se conforment aux licences écrites de Sun.

Netscape Navigator est une marque de Netscape Communications Corporation aux Etats-Unis et dans d'autres pays.

LA DOCUMENTATION EST FOURNIE "EN L'ÉTAT" ET TOUTES AUTRES CONDITIONS, DECLARATIONS ET GARANTIES EXPRESSES OU TACITES SONT FORMELLEMENT EXCLUES, DANS LA MESURE AUTORISEE PAR LA LOI APPLICABLE, Y COMPRIS NOTAMMENT TOUTE GARANTIE IMPLICITE RELATIVE A LA QUALITE MARCHANDE, A L'APTITUDE A UNE UTILISATION PARTICULIERE OU A L'ABSENCE DE CONTREFAÇON.



Adobe PostScript

Contents

Preface v

1. Overview of the Sun StorEdge SAN Foundation Software 1

SAN Versus Direct-Attached Storage 2

Storage Area Network Configuration 2

Direct-Attached Storage Configuration 4

SFS Overview 5

Software Architecture 5

Software Component Functionality 7

Installation Task Summary 8

2. Installing or Upgrading the Software 19

Preparing to Upgrade to the SFS 4.3 Release from an Earlier Version 20

Back Up All Data 20

▼ To Unconfigure Devices 21

▼ To Prepare to Upgrade from Previous Versions, Solaris 8 Operating Environment 23

▼ To Prepare to Upgrade from Previous Versions, Solaris 9 Operating Environment 23

Installing the Software With the `install_it` Script 25

▼ To Download the Sun StorEdge SAN Foundation Software and `install_it` Script 26

- ▼ To Install the Sun StorEdge SAN Foundation Software Using the install_it Script 27
- ▼ To Install Switch Packages 33
- Reconfiguring the System After Upgrading to Version 4.3 34
 - ▼ To Reconfigure the `scsi_vhci.conf` file 34
 - ▼ To Reconfigure Devices 35
- Configuring Your SAN 36
- A. Manually Installing SAN Foundation Software Packages and Patches 37**
 - ▼ To Download the Packages 40
 - ▼ To Download the Patches 40
 - ▼ To Manually Install the SFS Packages and Patches 44
- Glossary 45**
- Index 47**

Preface

The *Sun StorEdge SAN Foundation Software 4.3 Installation Guide* describes how to install the Sun StorEdge™ SAN Foundation software (SFS). The book is intended for system administrators who have experience with storage systems.

Note – While the emphasis of this manual is on using the software in a storage area network (SAN), you can use the SFS in direct-attached storage systems consisting of one host and storage unit.

Using UNIX Commands

This document may 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*
- AnswerBook2™ online documentation for the Solaris™ operating environment
- Other software documentation that you received with your system

How This Book Is Organized

Chapter 1 provides an overview of the SFS and its role in a storage area network (SAN) environment.

Chapter 2 explains how to upgrade your software from an earlier release or how to install the software for the first time.

Appendix A describes how to install the software manually (without using the `install_it` automatic installation script).

Glossary is a list of words and phrases and their definitions.

Typographic Conventions

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

Shell Prompts

Shell	Prompt
C shell	<i>machine_name%</i>
C shell superuser	<i>machine_name#</i>
Bourne shell and Korn shell	\$
Bourne shell and Korn shell superuser	#

Related Documentation

Product	Application	Title	Part Number
Sun StorEdge SAN Foundation Software 4.3	Documentation information	<i>Sun StorEdge SAN Foundation Software 4.3 Guide to Documentation</i>	817-3670

Accessing Sun Documentation

You can view, print, or purchase a broad selection of Sun documentation, including localized versions, at:

<http://www.sun.com/documentation>

Contacting Sun Technical Support

If you have technical questions about this product that are not answered in this document, go to:

<http://www.sun.com/service/contacting>

Sun Welcomes Your Comments

Sun is interested in improving its documentation and welcomes your comments and suggestions. You can submit your comments by going to:

<http://www.sun.com/hwdocs/feedback>

Please include the title and part number of your document with your feedback:

Sun StorEdge SAN Foundation Software 4.3 Installation Guide, part number 817-3671-10

Overview of the Sun StorEdge SAN Foundation Software

This chapter provides overview information about the Sun StorEdge™ SAN Foundation software (SFS). The SFS incorporates kernel drivers and utilities that enable a host to connect, monitor, and transfer data on a storage area network (SAN).

Note – You can also use the SFS in simple direct-attached storage systems consisting of a host and storage device.

For full fabric support for your SAN, the minimum operating system software installed on systems in your SAN must be Solaris™ 8 4/01 Operating Environment (OE). For information about how to upgrade your systems, see the documentation for the Solaris OE at <http://docs.sun.com>.

This chapter describes the following topics:

- “SAN Versus Direct-Attached Storage” on page 2
- “SFS Overview” on page 5
- “Installation Task Summary” on page 8

SAN Versus Direct-Attached Storage

Although you can use the SFS in direct-attached storage systems consisting of a host connected to a storage device, you will likely be using it in a more complex environment such as a SAN.

This section contains the following topics:

- “Storage Area Network Configuration” on page 2
- “Direct-Attached Storage Configuration” on page 4

Storage Area Network Configuration

A SAN is a complete network that contains a variety of switch, storage, and host devices and software applications.

Before installing or configuring any SAN components, you need to plan how your site will use the SAN and identify your goals in implementing the SAN. There are numerous options at various steps in the installation and configuration process, and understanding the purpose of the SAN clarifies appropriate decisions for your site.

Hardware components can include:

- Fibre Channel switches
- Fibre Channel host adapters
- Storage devices
- Enclosures

FIGURE 1-1 shows a simple SAN configuration containing a single host with two host bus adapters (HBAs), two switches, and one storage device (a Sun StorEdge T3+ partner pair).

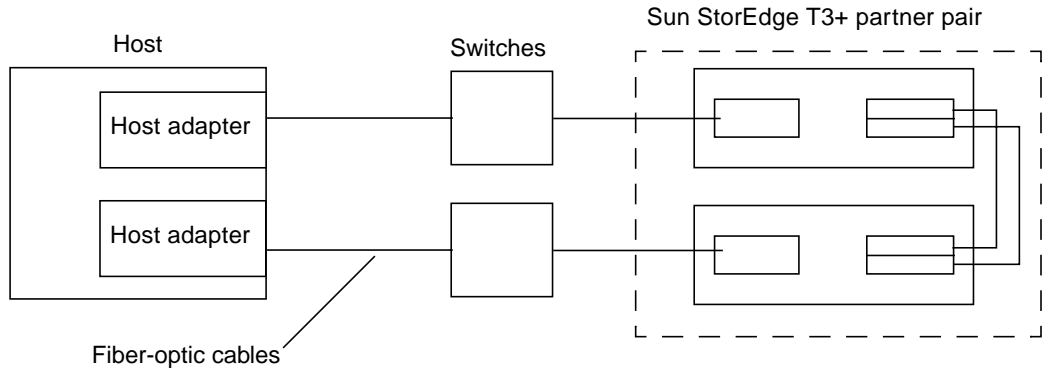


FIGURE 1-1 SAN Hardware Configuration

In addition to the SFS, there are several other software applications you can include on a SAN. The following list provides a sample of the applications that would reside on the hosts:

- Java™ SDK/JDK
- Sun StorEdge Instant Image software
- Sun StorEdge Network Data Replicator software
- Flash Proms for servers
- Sun StorEdge Enterprise Storage Manager software
- Storage Automated Diagnostic Environment software
- HBA FCODE and FPGA
- Solstice DiskSuite™ or Solaris™ Volume Manager software
- VERITAS Volume Manager software

Direct-Attached Storage Configuration

FIGURE 1-2 shows a direct-attached configuration consisting of a host and a storage device. You would install the SFS on the host and use it to enable the host to recognize the storage device.

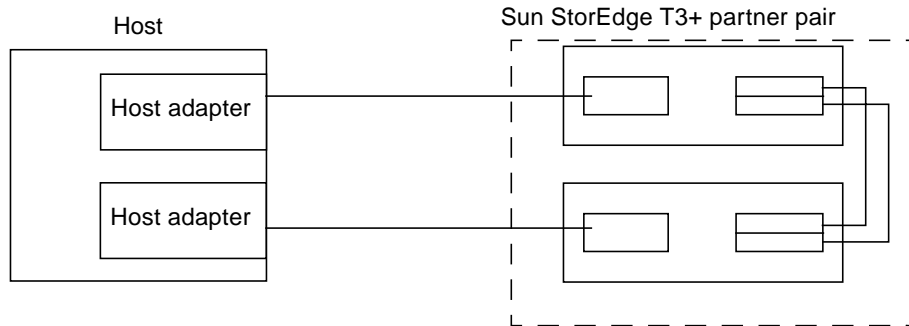


FIGURE 1-2 Direct-attached Hardware Configuration

SFS Overview

The SFS includes several driver and utility packages and patches, including the `cfgadm` packages for fabric on-demand node creation. It is used to discover SAN-attached devices and to create and delete nodes for those devices.

This section contains the following topics:

- “Software Architecture” on page 5
- “Software Component Functionality” on page 7

Software Architecture

FIGURE 1-3 shows the architecture of the software in the SAN. The SFS drivers and utilities reside on the server and identify the storage and switch devices on the SAN.

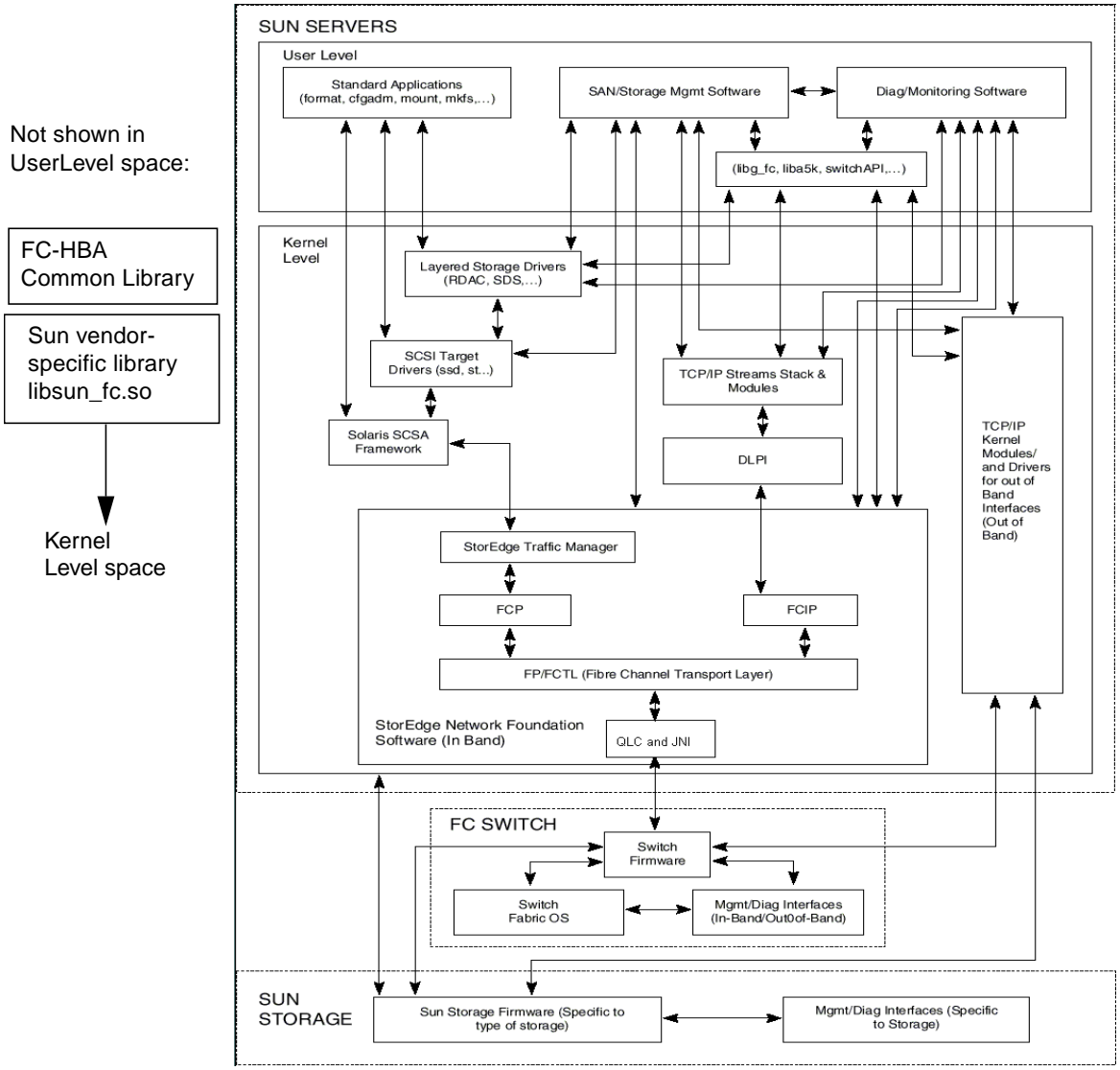


FIGURE 1-3 SAN Software Architecture

Software Component Functionality

TABLE A-3 in Appendix A shows a brief description of SFS packages and patches. SNIA (now known as FC-HBA) and Fibre Channel Switch Management (FCSM) packages are included among the SFS components to enable open, standards based support of fibre channel switches and associated storage devices.

The Sun StorEdge Traffic Manager software (STMS) is the multipathing, load-balancing, and failover application that is bundled with the SFS. You can install STMS as part of the SFS packages and patches. If you are using a multipathing application from another vendor, you might not need STMS. See also the *Sun StorEdge Traffic Manager Software Installation and Configuration Guide*.

Device discovery features are implemented through the `cfgadm` framework. See the `cfgadm_fp(1M)` man page for additional information about how to use this utility.

Note – SNIA (for example, “SNIA common library”) is also known as FC-HBA.

Installation Task Summary

Tasks	See This Documentation or Web Site
<p>1. Prepare your system.</p> <p>Save your current settings for your SAN, Sun StorEdge Traffic Manager, and HBA configuration (from various system <code>/etc/*.conf</code> and other files).</p>	<ul style="list-style-type: none">• Install the OE if necessary. The minimum version supported in this release is Solaris 8 4/01 or Solaris 9 OE.• Install the Recommended and Security Patch Cluster on the host.• Install the HBAs, connect the hosts, switches, and storage devices.• Connect the switches, hosts and storage devices on the SAN.
<p>2. Download and install the SFS software and patches.</p>	<p>See your Solaris operating environment installation and user documentation for details. Also see the specific HBA and Sun StorEdge Traffic Manager documentation.</p> <p>The Recommended and Security Patch Cluster is available at http://sunsolve.sun.com.</p> <p>See the documentation that came with your HBAs, hosts, switches and storage devices for instructions about installing the particular hardware. You can find a table of supported hardware components and required firmware levels in the <i>Sun StorEdge SAN Foundation Software 4.3 Release Notes</i>.</p> <p>See the installation documentation that came with your hardware for details.</p>
<p>3. Configure your SAN.</p>	<p>Chapter 2</p> <p>“Installing or Upgrading the Software” on page 19</p> <p><i>Sun StorEdge SAN Foundation Software 4.3 Configuration Guide</i></p> <p>See TABLE 2-2 on page 36 and TABLE 2-3 on page 36 for configurable features.</p>

Installing or Upgrading the Software

This chapter describes how to upgrade or install the Sun StorEdge SAN Foundation software. TABLE 2-1 shows the sections to read depending on your installation type.

Note – You must install this software on each host in your SAN or direct-attached storage environment.

TABLE 2-1 Upgrade or Installation Sections to Read

Task	See This Section
Upgrading the software from an earlier release	“Preparing to Upgrade to the SFS 4.3 Release from an Earlier Version” on page 20
	“Installing the Software With the <code>install_it</code> Script” on page 25
	“Reconfiguring the System After Upgrading to Version 4.3” on page 34
	“Configuring Your SAN” on page 36
Installing the software for the first time	“Installing the Software With the <code>install_it</code> Script” on page 25
	“Configuring Your SAN” on page 36

Preparing to Upgrade to the SFS 4.3 Release from an Earlier Version

If you have multiple hosts on your SAN, you can upgrade them simultaneously or one at a time without affecting your SAN environment. Hosts that are not being upgraded will not be affected during the upgrade. Systems being upgraded will be unavailable to users and the SAN *during* each upgrade procedure, however.

Note – Before upgrading or installing the software, save copies of your system configuration files, typically found in your `/etc` directory (for example, `hba.conf`).

Consider the following:

- **When upgrading from version 3.x**, you must install both the most recent packages and the most recent patches.
- **When upgrading from versions prior to version 4.3**, first check patch revision levels and then install the most recent packages as described in “To Prepare to Upgrade from Previous Versions, Solaris 8 Operating Environment” on page 23.
- After upgrading the Sun StorEdge SAN Foundation software from previous versions, you must also reset certain values in the `scsi_vhci.conf` file. See “Reconfiguring the System After Upgrading to Version 4.3” on page 34.

This section contains the following topics:

- “Back Up All Data” on page 20
- “To Unconfigure Devices” on page 21
- “To Prepare to Upgrade from Previous Versions, Solaris 8 Operating Environment” on page 23

Back Up All Data

Before attempting to install the Sun StorEdge SAN Foundation software, ensure that you have current backup copies of your data.

▼ To Unconfigure Devices

This section contains the steps necessary to unmount file systems and unconfigure fabric-attached devices before performing the actual upgrade.

1. Display your current file systems.

For example:

```
# df -k
Filesystem            kbytes    used    avail capacity  Mounted on
/dev/dsk/c0t0d0s0    12100380 1744206 10235171   15%      /
/proc                 0          0         0         0%      /proc
fd                   0          0         0         0%      /dev/fd
mnttab                0          0         0         0%      /etc/mnttab
swap                 3683560   16 3683544   1%      /var/run
swap                 3683584   40 3683544   1%      /tmp
/dev/dsk/c0t0d0s6     96975     9  87269    1%      /reserve
/dev/dsk/c0t0d0s4    3122055   10 3059604   1%      /var/tmp
nssr-mgt:/install-packages
                    13105131 9426803 3547277   73%     /install-packages
nssr-mgt:/demo        13105131 9426803 3547277   73%     /demo
sharedFS              10485760 1465344 9020416   14%     /sharedFS
```

2. Display all devices.

For example:

```
# cfgadm -al
Ap_Id                Type            Receptacle    Occupant      Condition
c0                   scsi-bus        connected     configured    unknown
c0::dsk/c0t0d0       disk            connected     configured    unknown
c0::dsk/c0t6d0       CD-ROM          connected     configured    unknown
c1                   scsi-bus        connected     unconfigured  unknown
c2                   fc-fabric       connected     configured    unknown
c2::50020f230000576c disk            connected     configured    unknown
c3                   fc-fabric       connected     configured    unknown
c3::50020f230000591d disk            connected     configured    unknown
c4                   fc              connected     unconfigured  unknown
c5                   fc              connected     unconfigured  unknown
```

3. Unmount all file systems.

```
# umount /mount/point
```

Where */mount/point* represents the directory structure where the file system is mounted.

4. (Optional) Edit the */etc/vfstab* file using a text editor and comment out any entry relating to a device in your SAN environment.

5. Unconfigure fabric-attached devices by using the *cfgadm(1M)* command.

```
# cfgadm -c unconfigure Ap_id Ap_id ...
```

The *Ap_id* argument specifies the attachment point ID of the configured Fibre Channel devices. This ID can be the controller number and WorldWide Name of a device (for example, *c3::50020f230000591d*). See the *cfgadm* output example in Step 2. See also the *cfgadm(1M)* manual page for an explanation of attachment points.

Note – Any *Ap_id* with type *fc-private* cannot be unconfigured. Only type *fc-fabric* can be configured and unconfigured.

▼ To Prepare to Upgrade from Previous Versions, Solaris 8 Operating Environment

For hosts running the Solaris 8 operating environment

- As superuser, check for patch 108982-10, and, if found, remove it.

Note – A previous version of this patch 108982-09 may remain loaded.

```
# patchadd -p | nawk '{print $2}' | grep 108982
# patchrm 108982-10
```

▼ To Prepare to Upgrade from Previous Versions, Solaris 9 Operating Environment

1. If you are upgrading your Sun StorEdge SAN Foundation software and using Solaris 9 4/03 or later, as superuser, check for the following patches:

- 113040-04 and all previous revisions

```
# patchadd -p | nawk '{print $2}' | grep 113040
```

- 113043-03 and all previous revisions

```
patchadd -p | nawk '{print $2}' | grep 113043
```

2. Perform one of the following:

- If you find these patch revision levels, remove these patches and others as described in Step 3.
- If you find the correct patch revision levels, skip Step 3 and follow the procedures described in “Installing the Software With the `install_it` Script” on page 25.

3. If either patch revision level is less than specified (113040-04 and 113043-03), remove the following patches in the order listed.



Caution – Perform Step 3 only if you find the patch revision levels from Step 1.

```
# patchrm 114478-01
# patchrm 114477-01
# patchrm 114476-01
# patchrm 113044-03
# patchrm 113043-03
# patchrm 113042-04
# patchrm 113041-03
# patchrm 113040-04
# patchrm 113039-03
# patchrm 113044-02
# patchrm 113043-02
# patchrm 113042-03
# patchrm 113041-02
# patchrm 113040-03
# patchrm 113039-02
# patchrm 113044-01
# patchrm 113043-01
# patchrm 113042-02
# patchrm 113042-01
# patchrm 113041-01
# patchrm 113040-02
# patchrm 113040-01
# patchrm 113039-01
```

Note – An error message is displayed if a particular patch is not installed (that is, you try to remove a patch that is not installed). Continue removing the patches until all patches listed here are removed.

4. Follow the procedures described in “Installing the Software With the `install_it` Script” on page 25.
5. After installing the software, following the procedures in “Reconfiguring the System After Upgrading to Version 4.3” on page 34.

Installing the Software With the `install_it` Script

Note – You can manually install the software instead of using the `install_it` script. See “Manually Installing SAN Foundation Software Packages and Patches” on page 37.

Advantages to using the `install_it` script are that the script installs the PatchPro software, installs the packages and patches in the correct order, and can roll back changes if the script somehow fails. This script helps reduce user errors possibly caused by a manual installation.

The preferred method of installing or upgrading the software is to use the `install_it` script. You can obtain the Sun StorEdge `install_it` script and README file by navigating to the following URL:

<http://www.sun.com/storage/san>

The installation script is a wrapper script to help install the packages and required patches. The script behaves as follows:

- It installs PatchPro to help manage patch administration. For more information about PatchPro, follow the links at:
<http://www.sun.com/bigadmin/patches/>
- **The script will override your current SVR4 for Solaris install policies** with its own `admin` file.
- If the script detects that a previous version of a package is installed, the script removes the package and installs the most current one. If the script detects that current version of the package is installed, the script does not reinstall it.
- If the SAN software somehow fails to completely install (that is, the script fails), the script prompts you to choose whether to roll back any installation changes that have been completed. If you choose to roll back changes, the script removes any patches and packages loaded in reverse order. This behavior helps to prevent the user from getting a less than full set of the product and perhaps create system stability issues. (Patchpro and any non-SAN patches are not affected by this rollback.)

This section contains the following procedures:

- “To Download the Sun StorEdge SAN Foundation Software and install_it Script” on page 26
- “To Install the Sun StorEdge SAN Foundation Software Using the install_it Script” on page 27
- “To Install Switch Packages” on page 33

▼ To Download the Sun StorEdge SAN Foundation Software and install_it Script

Note – You must register a user name and password to download software from the web page described in this procedure. Also, the example messages shown in this section are from a new installation; when you upgrade from a previous version, you might see fewer messages.

1. In a web browser such as Netscape Navigator™, navigate to:

`http://www.sun.com/storage/san/`

2. Navigate to the bottom of the page and click the Sun StorEdge SAN 4.3 release Software/Firmware Upgrades and Documentation link.
3. Enter your Username and Password and click Login.
If you have not already registered, click the Register Now before proceeding.
4. Accept the License Agreement and click Continue.
5. Download the required packages for your operating system (Solaris 8 or 9).
One compressed file contains the packages for the Solaris 8 operating environment, another compressed file contains the packages for the Solaris 9 operation environment.
6. Uncompress the compressed files and follow the instructions in the README file.

▼ To Install the Sun StorEdge SAN Foundation Software Using the `install_it` Script

1. Log in as superuser and change to the directory where you uncompressed the files.
2. Run the installation script.

```
# ./Install_it/install_it
```

The script checks for adequate installation space and makes sure appropriate tools are in place. It then installs or upgrades the required software packages. The following message displays:

```
This routine installs the packages and patches that
make up Sun StorEdge SAN.

PatchPro will be installed for use with downloading the
most up to date versions of the patches.

Would you like to continue with the installation? [y,n,?,q]
```

3. Type `y`.

The script then prompts you to install PatchPro.

```
Patchpro not installed. Starting installation of Patchpro.
.
.
.
This installation will preserve critical data files by
executing a shell script with root permission.

Would you like to continue with the installation? [y,n,?,q]
```

4. Type `y`.

The installation begins and the packages and patches are listed as they are installed.

```
Beginning installation ...
Now installing supporting packages...
  SUNWjhrt
  == installed successfully
  SUNWjsse
  == installed successfully
  SUNWsdb
  == installed successfully
  SUNWapcy
  == installed successfully
  SUNWppmn
  == installed successfully
  SUNWcert
  == installed successfully
Now installing required patches...
  108940-07
  == already applied
  SUNWppro
  == installed successfully

Installation is complete and verified. Be sure to:

  o Add "/opt/SUNWppro/bin" to your PATH. Set this in
    your .cshrc or .profile to make it permanent.
  o If you have not installed the PatchPro patch
    certificates, see "/opt/SUNWppro/README" for
    instructions.
  o If you have not installed the Sun certificates,
    see  "/etc/certs/SUNW/README" for instructions.
  o Run the "/opt/SUNWppro/bin/uninstallpatchpro"
    script to uninstall PatchPro.

Ready to configure PatchPro Security Certificates.
```

5. Confirm that the following security certificates are valid.

You must confirm each certificate to complete the installation of PatchPro. The default answer to the Trust this certificate? prompt is **no**.

You can find information on security certificates at:

<http://www.sun.com/pki/ca/>

The following code example shows a sample .log output for the PatchPro certificates.

```
Importing certificate smicacert
Owner: O=Sun Microsystems Inc, CN=Sun Microsystems Inc CA (Class B)
Issuer: CN=Sun Microsystems Inc Root CA, O=Sun Microsystems Inc, C=US
Serial number: 1000006
Valid from: Mon Nov 13 12:23:10 MST 2000 until: Fri Nov 13 12:23:10 MST 2002
Certificate fingerprints:
    MD5:  B4:1F:E1:0D:80:7D:B1:AB:15:5C:78:CB:C8:8F:CE:37
    SHA1: 1E:38:11:02:F0:5D:A3:27:5C:F9:6E:B1:1F:C4:79:95:E9:6E:
Trust this certificate? [no]:  yes
Certificate was added to keystore

Importing certificate smirootcert
Owner: CN=Sun Microsystems Inc Root CA, O=Sun Microsystems Inc, C=US
Issuer: CN=GTE CyberTrust Root, O=GTE Corporation, C=US
Serial number: 200014a
Valid from: Tue Nov 07 15:39:00 MST 2000 until: Thu Nov 07 16:59:00 MST 2002
Certificate fingerprints:
    MD5:  D8:B6:68:D4:6B:04:B9:5A:EB:34:23:54:B8:F3:97:8C
    SHA1: BD:D9:0B:DA:AE:91:5F:33:C4:3D:10:E3:77:F0:45:09:4A:E8:
Trust this certificate? [no]:  yes
Certificate was added to keystore

Importing certificate patchsigning
Owner: CN=Enterprise Services Patch Management, O=Sun Microsystems In
Issuer: O=Sun Microsystems Inc, CN=Sun Microsystems Inc CA (Class B)
Serial number: 1400007b
Valid from: Mon Sep 24 14:38:53 MDT 2001 until: Sun Sep 24 14:38:53 MST 2002
Certificate fingerprints:
    MD5:  6F:63:51:C4:3D:92:C5:B9:A7:90:2F:FB:C0:68:66:16
    SHA1: D0:8D:7B:2D:06:AF:1F:37:5C:0D:1B:A0:B3:CB:A0:2E:90:D6:
Trust this certificate? [no]:  yes
Certificate was added to keystore.
```

6. After confirming the security certificates, the script prompts you to specify a proxy server (or no server, if applicable) to enable Internet access to retrieve the latest patch set.

```
Enter name of your systems proxy server.  
(Type "local" if you would prefer to not access the remote server.)  
(Type "clear" if you would prefer to set the Proxy server to  
nothing)
```

7. Perform one of the following:

- If you are using a proxy server to access the internet and want to obtain the latest patch set, type the name and port number of your proxy server.
- If you are **not** using a proxy server to access the internet and want to obtain the latest patch set, type **clear**.
- If you do not want to obtain the latest patch set, type **local**. In this case, the `install_it` script can provide Sun StorEdge SAN Foundation software version 4.3 but no subsequent updates

CODE EXAMPLE 2-1 shows example output if you are using a proxy server.

8. Shut down and restart your system now by using the `shutdown(1M)` command.

Note – If you are upgrading from an earlier release, first complete the procedures in “Reconfiguring the System After Upgrading to Version 4.3” on page 34 and then shut down and restart your system.

```
# shutdown -g0 -y -i6
```

CODE EXAMPLE 2-1 Sample Internet Access Output for Retrieving Patches

```
Proxy server name : webcache1.central
Enter port number of your proxy server
Proxy port number : 8080

Proxy setting is correct.

Proxy set.
PatchPro Configuration Completed.
Checking PatchPro for patchadd patches
Assessing patches needed for your system...
.....
Retrieved patch list...
Downloading patches to /var/spool/pkg/patchpro...
.....
/var/spool/pkg/patchpro/112396-02.jar has been validated.

/var/spool/pkg/patchpro/108987-09.jar has been validated.
.
Download of patches completed.

Installing patchadd patches -

        patch 112396-02 : Installed Successfully
        patch 108987-09 : Installed Successfully

patchadd patch installation completed.
Installing StorEdge SAN packages -

        Package SUNWsan      : Installed Successfully
        Package SUNWcfpl     : Installed Successfully
        Package SUNWcfplx    : Installed Successfully
.
.
.
        Package SUNWmdiu     : Installed Successfully

StorEdge SAN packages installation completed.

Checking PatchPro for StorEdge SAN patches.
Assessing patches needed for your system...
.....
Retrieved patch list...
Downloading patches to /var/spool/pkg/patchpro...
.....
/var/spool/pkg/patchpro/111412-12.jar has been validated.
```

CODE EXAMPLE 2-1 Sample Internet Access Output for Retrieving Patches (*Continued*)

```
Proxy server name : webcache1.central
.
/var/spool/pkg/patchpro/111095-14.jar has been validated.

/var/spool/pkg/patchpro/111096-07.jar has been validated.

/var/spool/pkg/patchpro/111097-13.jar has been validated.
.
/var/spool/pkg/patchpro/111413-11.jar has been validated.

/var/spool/pkg/patchpro/111846-07.jar has been validated.

/var/spool/pkg/patchpro/111847-07.jar has been validated.
.
Download of patches completed.

Installing StorEdge SAN patches -

    patch 111412-12 : Installed Successfully
    patch 111095-14 : Installed Successfully
    patch 111096-07 : Installed Successfully
    patch 111097-13 : Installed Successfully
    patch 111413-11 : Installed Successfully
    patch 111846-07 : Installed Successfully
    patch 111847-07 : Installed Successfully

StorEdge SAN patch installation completed.

Installation of Sun StorEdge SAN completed Successfully
```

▼ To Install Switch Packages

Note – These switch packages are required if your SAN environment includes the Sun StorEdge Network 2 Gbit FC Switches. These packages are not intended for McDATA Corp. or Brocade Communications Systems switches.

1. **Log in as superuser.**
2. **If you have not already done so, download any switch packages from**
<http://www.sun.com/storage/san>.
See “To Download the Sun StorEdge SAN Foundation Software and install_it Script” on page 26 for information about downloading packages.
3. **If you have an older version of the switch patch and package installed on your system, remove them.**

```
# patchrm 112429-xx
# pkgrm SUNWsmgr2
```

4. **Uncompress and extract the files.**

```
# uncompress SUNWsmgr-version.tar.Z
# tar xvf SUNWsmgr-version.tar
```

Where *-version* is the required software version for the Sun StorEdge SAN Foundation software.

5. **Install the packages according to the instructions in the README file.**

Reconfiguring the System After Upgrading to Version 4.3

After upgrading the Sun StorEdge SAN Foundation software from previous versions, complete the following procedures to get your SAN up and running as soon as possible.

- “To Reconfigure the `scsi_vhci.conf` file” on page 34
- “To Reconfigure Devices” on page 35

▼ To Reconfigure the `scsi_vhci.conf` file

1. **Using a text editor, edit the `/kernel/drv/scsi_vhci.conf` file to ensure the following entries exist and also modify it to reflect your appropriate system environment:**

```
mpxio-disable="no";
load-balance="round-robin";
auto-failback="enable";
```

2. **Save and exit the file.**
3. **If any Fibre Channel HBA patches or packages you have installed included FCODE updates for the HBA, install the update by using the `luxadm(1M)` command.**

See the README file included with the package or patch. For example, to download the FCODE into all Sun StorEdge Single or Dual Channel Fibre Channel PCI HBAs, type:

```
# /usr/sbin/luxadm qlgc_s_download -f FCODE-filename
```

Note – Type the command without the `-f FCODE-filename` option to see currently-installed FCODE version.

4. **Continue to “To Reconfigure Devices” on page 35.**

▼ To Reconfigure Devices

This section contains information about restoring configuration settings as they were before upgrading the SAN.

1. Verify devices by using the `cfgadm(1M)` command.

```
# cfgadm -al
Ap_Id                Type          Receptacle  Occupant    Condition
c0                   scsi-bus      connected   configured  unknown
c0::dsk/c0t0d0       disk          connected   configured  unknown
c0::dsk/c0t6d0       CD-ROM        connected   configured  unknown
c1                   scsi-bus      connected   unconfigured unknown
c2                   fc-fabric     connected   unconfigured unknown
c2::50020f230000576c disk          connected   configured  unknown
c3                   fc-fabric     connected   unconfigured unknown
c3::50020f230000591d disk          connected   configured  unknown
c4                   fc            connected   configured  unknown
c5                   fc            connected   configured  unknown
```

2. Upgrade the components to the revision levels outlined in *Sun StorEdge SAN Foundation Software 4.3 Release Notes*.

3. Configure devices.

```
# cfgadm -c configure Ap_id Ap_id ...
```

4. Re-enable any entries in the `/etc/vfstab` file that you commented out as described in “To Unconfigure Devices” on page 21 and mount these devices by using the `mount(1M)` command.

5. Shut down and restart your system now by using the `shutdown(1M)` command.

```
# shutdown -g0 -y -i6
```

Configuring Your SAN

To configure one or more Sun StorEdge SAN Foundation software features, see TABLE 2-2 and TABLE 2-3

TABLE 2-2 *Sun StorEdge SAN Foundation Software 4.3 Configuration Guide*

To Configure:	Read
Sun StorEdge FC switch ethernet ports	Chapter 2
Booting from Fibre channel storage devices	Chapter 3
Adding or removing SAN devices	Chapter 4
Fabric device Node Recognition	Chapter 5
IPFC Management	Chapter 6
Dynamic Reconfiguration	Chapter 7

TABLE 2-3 *Sun StorEdge Traffic Manager Software For the Solaris Operating System and the Sun StorEdge SAN Foundation Software 4.3*

To Configure:	Read
Multipathing	Chapter 3
Booting from multipathed devices	Chapter 3

Manually Installing SAN Foundation Software Packages and Patches

Note – SNIA (for example, “SNIA common library”) is also known as FC-HBA.

This appendix explains how to install the Sun StorEdge SAN Foundation software (SFS) manually. Solaris 8 04/01 (also known as Solaris 8 update 4) is the minimum supported operating environment.

You can download the required patches and packages for SFS and STMS from the web sites listed in TABLE A-3. Follow the installation order defined in TABLE A-3.

This chapter describes the following topics:

- “Task Summary to Install the Software” on page 38
- “Downloading the Packages and Patches” on page 39
- “Installing the Packages and Patches” on page 41

Task Summary to Install the Software

TABLE A-1 Task Summary to Manually Install the Software

Step	See This Section
• Upgrading from an earlier version of the software.	“Preparing to Upgrade to the SFS 4.3 Release from an Earlier Version” on page 20
	“Downloading the Packages and Patches” on page 39
	“Installing the Packages and Patches” on page 41
	“Reconfiguring the System After Upgrading to Version 4.3” on page 34
	“Configuring Your SAN” on page 36
• Installing the software for the first time.	“Downloading the Packages and Patches” on page 39
	“Installing the Packages and Patches” on page 41
	“Configuring Your SAN” on page 36

Downloading the Packages and Patches

The compressed Sun StorEdge SAN Foundation 4.3 software package files are available at the <http://www.sun.com/storage/san> web site. One compressed file contains the packages for the Solaris 8 operating environment, another compressed file contains the packages for the Solaris 9 operation environment.

Finding and Downloading Packages and Patches

TABLE A-2 lists where to find the software.

TABLE A-2 Packages and Patches Download Web Sites

Software	Downloading Web Site
Packages	http://www.sun.com/storage/san
Patches	http://sunsolve.sun.com

Note the following:

- Install the packages before you install the patches.
- If any version 4.3 packages are already on the system from a previous installation, you do not need to install them again.
- Check the <http://www.sun.com/download/> or <http://www.sun.com/storage/san> web sites for updates.

Check <http://sunsolve.sun.com> for updates.

▼ To Download the Packages

Note – You must register a user name and password to download software from the web page described in this procedure.

1. In a web browser such as Netscape Navigator™, navigate to:

`http://www.sun.com/storage/san/`

2. Navigate to the bottom of the page and click the **Sun StorEdge SAN 4.3 release Software/Firmware Upgrades and Documentation** link.
3. Enter your Username and Password and click **Login**.
If you have not already registered, click the Register Now before proceeding.
4. Accept the License Agreement and click **Continue**.
5. Download the required packages for your operating system (Solaris 8 or 9).
6. Click on the links of any optional packages to download them.

▼ To Download the Patches

1. Go to `http://sunsolve.sun.com`.
2. Click **Patches**.
3. Click **PatchPro**.
4. Under **PatchPro Interactive**, click **Network Storage Products**.
5. Select the appropriate versions for **OS Release, Platform, and SAN Products**.
 - Specify 4.3 in the SAN Products field.Optionally, you can also select Disk Arrays Libraries, Disk Drives, Software, Tape Drives, and Switches and HBAs.
6. Click **Generate Patch List** to generate a list of patches.
7. Click **Download selected patches**.
8. Move the patches to the machine on which you intend to install the software.
9. As superuser, unzip the patches into the `/tmp` directory.

Installing the Packages and Patches

This section covers:

- “Software Installation Order” on page 41
- “To Manually Install the SFS Packages and Patches” on page 44

Software Installation Order

The software components listed in TABLE A-3 are required for SFS and STMS support on your SAN. You must install them in the order shown. After adding all of the packages and patches to your system, you must shut down and restart it.

Note – The patches listed in TABLE A-3 are the minimum patch level. Also, SNIA (for example, “SNIA common library”) is also known as FC-HBA. “(SAN)” indicates an unbundled patch file. That is, some updated versions of the Solaris 8 and 9 operating environments might already include a bundled version of the patch which is installed on your system.

TABLE A-3 Software Packages and Patches Installation Order

Solaris 8 OE Package or Patch	Solaris 9 OE Package or Patch	Software Component
SUNWsan	SUNWsan	Sun StorEdge SAN Foundation Software package.
SUNWcfpl	SUNWcfpl	cfgadm fp port driver specific library.
SUNWcfplx	SUNWcfplx	cfgadm fp port driver specific library (64-bit) package.
SUNWfchba	SUNWfchba	Sun Fibre Channel Host Bus Adapter Library package. Provides Sun’s implementation of the T11 FC-HBA specification API. It provides a subset of the Common Fibre Channel HBA API Library (USR) package and is supported by the other SFS drivers. This package is installed in the /usr directory.
SUNWcfclr	SUNWcfclr	Common Fibre Channel HBA API Library (root) package. This SNIA (FC-HBA) common library dynamically loads Sun and non-Sun vendor implementations of the T11 FC-HBA specification API. This package is installed in the root directory and installs the /etc/hba.conf configuration file. This file specifies the non-Sun vendor implementation to load.

TABLE A-3 Software Packages and Patches Installation Order (*Continued*)

Solaris 8 OE Package or Patch	Solaris 9 OE Package or Patch	Software Component
SUNWfchbr	SUNWfchbr	Sun Fibre Channel Host Bus Adapter Library (<code>root</code>) package. Provides Sun's implementation of the T11 FC-HBA specification API. It provides a subset of the Common Fibre Channel HBA API Library (<code>Root</code>) package and is supported by the other SFS drivers. This package is installed in the <code>root</code> directory.
SUNWfchbx	SUNWfchbx	Sun Fibre Channel Host Bus Adapter Library (<code>usr</code>) (64-bit) package. Provides Sun's implementation of the T11 FC-HBA specification API. It provides a subset of the Common Fibre Channel HBA API Library (<code>Usr</code>) package and is supported by the other SFS drivers. This 64-bit version of the package is installed in the <code>/usr</code> directory.
SUNWfcsm	SUNWfcsm	FCSM driver package. This FCSM kernel driver package supports the Sun Fibre Channel Host Bus Adapter Library packages for in-band Fibre Channel switch communication.
SUNWfcsmx	SUNWfcsmx	FCSM driver (64-bit) package. This 64-bit version of the FCSM kernel driver package supports the Sun Fibre Channel Host Bus Adapter Library packages for in-band Fibre Channel switch communication
SUNWfccl	SUNWfccl	Common Fibre Channel HBA API Library (<code>usr</code>) package. Provides Sun's implementation of the T11 FC-HBA specification API. It provides a subset of the Common Fibre Channel HBA API Library (<code>Usr</code>) package and is supported by the other SFS drivers. This package is installed in the <code>/usr</code> directory.
SUNWfcclx	SUNWfcclx	Common Fibre Channel HBA API Library (<code>usr</code>) (64-bit) package. This 64-bit version of the SNIA (FC-HBA) common library dynamically loads Sun and non-Sun vendor implementations of the T11 FC-HBA specification API. This package is installed in the <code>usr</code> directory.
SUNWmdi	SUNWmdi	Sun StorEdge Traffic Manager software. Provides support for Sun StorEdge Traffic Manager boot device support functionality. Provides a multipathing, load balancing, and failover application.
SUNWjfc	SUNWjfc	SG-XPCI1FC-JF2 and SG-XPCI2FC-JF2 Fibre Channel HBA driver packages.
SUNWjfcax	SUNWjfcax	
SUNWjfcaw	SUNWjfcaw	
SUNWjfcawx	SUNWjfcawx	
111847-08	111847-08	SAN Foundation patch. Provides enhancements to the Sun StorEdge Network Foundation package and contains man pages.
	113046-01	<code>fc</code> patch.

TABLE A-3 Software Packages and Patches Installation Order *(Continued)*

Solaris 8 OE Package or Patch	Solaris 9 OE Package or Patch	Software Component
N/A	113049-01	luxadm and liba5k.so.2 patch.
111412-12	113039-04	(SAN) Sun StorEdge Traffic Manager patch
111095-14	113040-06	(SAN) fcp/fp/ctl drivers patch. Provides the Fibre Channel drivers to enable the host to communicate with Fibre Channel devices.
111096-07	113041-04	(SAN) fcip driver patch. Enables IP traffic to run over Fibre Channel (also known as IPFC).
111097-13	113042-05	(SAN) qlc driver patch. Supports Sun X6799A, X6727A, X6767A, or X6768 HBAs.
111413-11	113043-05	(SAN) luxadm and libg_fc/liba5k patch. Contains utilities to control Fibre Channel devices. You can use the commands to take disks offline or put them online, load firmware, and display volumes.
111846-07	113044-04	(SAN) cfgadm fp plug-in library patch. Provides updates to the cfgadm fp package.
110614-02	N/A	ses driver patch. Provides an interface to SCSI enclosure services devices. These devices sense and monitor the physical conditions within an enclosure. The devices also allow access to the status reporting and configuration features of the enclosure, such as indicator LEDs on the enclosure.
114475-02	114476-02	(SAN) FCSM driver patch.
113766-02	114477-01	(SAN) Common Fibre Channel HBA API Library patch
113767-03	114478-02	(SAN) SNIA Sun Fibre Channel HBA Library patch
112244-03	112244-03	SBus Dual Fibre Channel Network Adapter Firmware patch*
114877-02	114878-02	Fibre Channel HBA patch
111853-02	111853-02	1Gb PCI Single/Dual FC Network Adapter FCODE
114874-02	114873-02	2Gb PCI Single/Dual HBA Network Adapter FCODE

* Install the optional patch 112244-02 if the HBA FCode revision is 1.13.06 or lower. See the patch README file for details.

▼ To Manually Install the SFS Packages and Patches

Follow the package and patch order listed in TABLE A-3.

Note – If you are upgrading from an earlier release, complete the steps described in “Preparing to Upgrade to the SFS 4.3 Release from an Earlier Version” on page 20. These steps include removing certain patches according to revision level.

1. Log in as superuser.
2. Install the packages for the SFS software by using the `pkgadd(1M)` command.

```
# pkgadd -d pkg-location pkg-names
```

Where *pkg-location* is where you uncompressed and extracted the packages and *pkg-names* are the packages listed in TABLE A-3.

3. Install the SFS patches by using the `patchadd(1M)` command.

Note – Ensure that the package relating to a particular patch is already installed. Do not install patches for packages that you have not installed. Use the correct patch for your Solaris 8 or Solaris 9 OE. See TABLE A-3.

```
# patchadd -M patch-location patch-name
```

Where *patch-location* is where you uncompressed and extracted the patches and *patch-names* are the patches listed in TABLE A-3.

4. If applicable, perform the procedures in “To Install Switch Packages” on page 33.
5. If you are upgrading from an earlier release, see “Reconfiguring the System After Upgrading to Version 4.3” on page 34.
6. Shut down and restart your system now by using the `shutdown(1M)` command.

```
# shutdown -g0 -y -i6
```

For each storage device, upgrade the software, firmware, or configuration. See the *Sun StorEdge SAN Foundation Software 4.3 Release Notes* for additional information about firmware requirements.

Glossary

This glossary defines SAN terminology used in this book.

A

- AL_PA** Arbitrated Loop Physical Address. An AL_PA is an eight-bit value used to identify a device attached to a Fibre Channel arbitrated loop.
- Ap_Id** Attachment Point Identifier. The port identifier for either a host or a storage device connected to a switch. For example, `c0` identifies the host port and `c0::50020f23000063a9` identifies an array.

C

- Cascade** Connection of two or more switches together to increase the number of available ports or to allow for increased distances between components of the SAN.

F

- Fabric ports (F port)** Fabric port on a Fibre Channel switch. Switch ports used to connect to the fabric capable storage devices, such as the Sun StorEdge T3+ array or Sun StorEdge 39x0, 69x0 and 99x0 series, tape drives and host bus adapters.

Fabric One or more switches in a Fibre Channel network. It is also common to refer to something as a "fabric device" or being in "fabric mode."

Fabric Loop ports (FL port) A port that is able to transmit under fabric protocol and also has arbitrated loop capabilities.

I

Initiator Each host bus adapter port connection that provides a path to a storage device.

Interswitch Link (ISL) A segment or cable connecting two cascaded switches. Does not include cables from host to the switch or from storage devices to the switch.

P

Private Loop Fibre Channel Arbitrated Loop (FC-AL) with 8-bit addressing that supports up to 126 device connections with no fabric attachment (F and FL ports). Private loops are closed systems incapable of seeing outside the loop.

Index

C

cfgadm, 5
cfgadm updates, 43
Common Fibre Channel HBA API Library, 41, 42

D

DAS, 1
devices, 8
direct-attach system illustration, 4
direct-attach systems, 1
download web sites, 39
downloading software, 39

F

Fabric node creation, 5
Fabric support, 1
failover, 7
FC-AL, 46
FCSM, 7, 42
Fibre Channel
 Fibre Channel Arbitrated Loop, 46
Fibre Channel device control utilities, 43

H

hardware, 8

hardware for SANs, 2

I

initiator, 46
 active, 46
 inactive, 46
installation, 41
inter-switch link, 46
IP over Fibre Channel, 43
ISL, 46

K

kernel drivers, 1

L

load-balancing, 7

M

multipathing, 7

O

on-demand node creation, 5
operating environment, 1, 8

P

packages, 39
patches, 39
PatchPro Interactive, 40
private loop, 46

R

Recommended and Security Patch Cluster, 8

S

SAN, 1, 2
SAN diagnostic software, 3
SAN hardware, 2
SAN illustration, 3
SAN management software, 3
SCSI enclosure services, 43
SFK, 37
SFS, 1
SFS architecture illustration, 6
SNIA, 7
software architecture, 6
software for SANs, 3
Solaris operating environment, 8
Solstice DiskSuite software, 3
STMS, 7, 37
storage area network, 1
Storage Automated Diagnostic Environment
software, 3
Sun StorEdge Enterprise Storage Manager
Topology Reporter software, 3
Sun StorEdge Instant Image software, 3
Sun StorEdge Network Data Replicator software, 3
Sun StorEdge Traffic Manager software, 7, 37
sunsolve, 8, 39
support contact, viii

T

T11 FC-HBA specification API, 41, 42

U

utilities, 1, 43

V

volume manager software, 3