Solaris Express SAN Configuration and Multipathing Guide
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Preface

The Solaris Express SAN Configuration and Multipathing Guide provides an overview of the Sun StorageTek Traffic Manager software as an integrated part of the Sun Solaris Express Developer’s Edition Operating System (OS). This guide includes instructions about how to install and configure the software and devices.

This guide is intended for system, storage and network administrators who create and maintain Fibre Channel (FC) storage area networks (SANs) and serial attached SCSI (SAS) Domains. A high level of expertise in the management and maintenance of SANs and SAS Domains is assumed.

Before You Read This Document


How This Document Is Organized

Chapter 1, “Product Overview,” provides an overview of the Sun StorageTek Traffic Manager software.

Chapter 2, “Fibre Channel Configuration Overview,” provides an overview of configuring the Sun StorageTek Traffic Manager software.

Chapter 3, “Administering Multipathing Devices Through mpathadm Commands,” explains how to use the mpathadm command to enable multipathing administration through the ANSI standard Multipath Management API.

Chapter 4, “Configuring Multipathing Software” explains how to configure the multipathing feature for FC devices provided in the Solaris Express Developer’s Edition OS.

Chapter 5, “Configuring SAN Devices,” provides high level overviews of the steps used to configure SAN devices.

Chapter 6, “Configuring Virtual Fibre Channel Ports,” provides the steps used to configure N Port ID Virtualization (NPIV) ports, also known as virtual Fibre Channel ports.
Chapter 7, "Configuring FCoE Ports," provides the steps used to configure FCoE ports hosted on normal Ethernet interfaces.

Chapter 8, "Configuring SAS Domains," provides high-level overviews of the steps used to configure SAS domains.

Chapter 9, "Configuring IPFC SAN Devices," explains considerations when configuring IPFC SAN Devices.

Chapter 10, “Sun Solaris Express Developer’s Edition OS x86/x64 Fibre Channel Operating System Booting Procedure” describes how to manually install the Solaris Express Developer’s Edition OS, x86/x64 FC Operating System.

Chapter 11, "Persistent Binding for Tape Devices" describes how you can specify tape binding in the Solaris Express Developer’s Edition OS while retaining the benefits of automatic discovery for disk-based devices.


Appendix B, “Supported FC-HBA API” provides details on Supported FC-HBA API.

Appendix C, "Multipathing Troubleshooting" provides trouble shooting information for potential problems that might occur while you run the Sun StorageTek Traffic Manager software.

Using UNIX Commands

This document might not contain information about basic UNIX® commands and procedures such as shutting down the system, booting the system, and configuring devices. Refer to the following for this information:

- Software documentation that you received with your system
- Solaris Operating System documentation at http://docs.sun.com

Related Third-Party Web Site References

Third-party URLs are referenced in this document and provide additional, related information.
Note – Sun is not responsible for the availability of third-party web sites mentioned in this document. Sun does not endorse and is not responsible or liable for any content, advertising, products, or other materials that are available on or through such sites or resources. Sun will not be responsible or liable for any actual or alleged damage or loss caused or alleged to be caused by or in connection with use of or reliance on any such content, goods, or services that are available on or through such sites or resources.

Documentation, Support, and Training

The Sun web site provides information about the following additional resources:

- Documentation (http://www.sun.com/documentation/)
- Support (http://www.sun.com/support/)
- Training (http://www.sun.com/training/)

Sun Welcomes Your Comments

Sun is interested in improving its documentation and welcomes your comments and suggestions. To share your comments, go to http://docs.sun.com and click Feedback.

Typographic Conventions

The following table describes the typographic conventions that are used in this book.

<table>
<thead>
<tr>
<th>Typeface</th>
<th>Meaning</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>AaBbCc123</td>
<td>The names of commands, files, and directories, and onscreen computer output</td>
<td>Edit your .login file. Use ls -a to list all files. machine_name% you have mail.</td>
</tr>
<tr>
<td>AaBbCc123</td>
<td>What you type, contrasted with onscreen computer output</td>
<td>machine_name% su Password:</td>
</tr>
<tr>
<td>aabbcc123</td>
<td>Placeholder: replace with a real name or value</td>
<td>The command to remove a file is rm filename.</td>
</tr>
</tbody>
</table>
### Shell Prompts in Command Examples

The following table shows the default UNIX system prompt and superuser prompt for the C shell, Bourne shell, and Korn shell.

**TABLE P-2  Shell Prompts**

<table>
<thead>
<tr>
<th>Shell</th>
<th>Prompt</th>
</tr>
</thead>
<tbody>
<tr>
<td>C shell</td>
<td>machine_name%</td>
</tr>
<tr>
<td>C shell for superuser</td>
<td>machine_name#</td>
</tr>
<tr>
<td>Bourne shell and Korn shell</td>
<td>$</td>
</tr>
<tr>
<td>Bourne shell and Korn shell for superuser</td>
<td>#</td>
</tr>
</tbody>
</table>
This chapter provides an overview of the Sun StorageTek Traffic Manager software, and covers the following topics:

- “About Sun StorageTek Traffic Manager” on page 11
- “What’s New?” on page 12
- “Software Features” on page 12
- “Supported Standards” on page 15

## About Sun StorageTek Traffic Manager

The Sun StorageTek Traffic Manager software enables multipathing connections for Sun Solaris Express Developer’s Edition OS hosts. Multipathing provides higher availability for storage devices through the use of multiple access paths. Fibre Channel (FC), Serial Attached SCSI (SAS), and Internet Small Computer Storage Interface (iSCSI) protocols are supported.

The Sun StorageTek Traffic Manager software resides on the host and identifies the storage devices on your SAN or SAS Domain. The software enables you to attach Fibre Channel storage in either loop, fabric, or point-to-point mode. The software provides a common interface for managing both Fibre Channel and SAS storage.

For information on how to configure targets and initiators in preparation for multipathing, see the following:

- Chapter 14 of the Solaris 10 *System Administration: Devices and File Systems Guide*, to configure Solaris iSCSI targets and initiators
What’s New?

- Support for NPIV is included in the Solaris Express Community Edition (SXCE) Build 92, and all subsequent builds.

  NPIV is a Fibre Channel facility that enables one Fibre Channel adapter to have many N Port IDs. Each N Port has a unique identity (port WWN and node WWN) on the SAN and can be used for zoning and LUN masking. Soft zoning, which you can use to group ports together by port WWN, is the preferred method of zoning. For more information, see Chapter 6, “Configuring Virtual Fibre Channel Ports.”

- Support for Fibre Channel over Ethernet (FCoE) is included in the SXCE Build 122, and all subsequent builds.

  Fibre Channel over Ethernet (FCoE) is a proposed standard that is being developed by INCITS T11. The FCoE protocol specification maps Fibre Channel natively over Ethernet and is independent of the Ethernet forwarding scheme. The protocol provides I/O consolidation by preserving all Fibre Channel constructs, maintaining the same latency, security, and traffic management attributes of FC, while preserving investments in FC tools, training, and SANs. For more information, see Chapter 7, “Configuring FCoE Ports.”

Software Features

The Sun StorageTek Traffic Manager software enables multipathing connections for the Sun Solaris Express Developer’s Edition OS hosts, with the following software features:

- “Fibre Channel Software Features” on page 12
- “SAS Software Features” on page 13
- “Multipathing Software Features” on page 14

Fibre Channel Software Features

The Sun StorageTek Traffic Manager software provides the following key features:

- Dynamic Storage Discovery – The software automatically recognizes devices and any modifications made to device configurations. This feature makes devices available to the system without requiring you to reboot or manually change information in configuration files.

- Persistent Device Naming – Devices that are configured within the software maintain their device naming through reboots or reconfiguration. The only exception to this policy are tape devices found in /dev/rmt that will not change unless they are removed, and then regenerated at a later date.

- Fibre Channel Arbitrated Loop (FCAL) Support – OpenBoot™ PROM (OBP) commands that are used on servers can access FCAL attached storage for scanning the FC loop.
Fabric Booting – The Solaris OS supports booting from fabric devices as well as non-fabric Fibre Channel devices. Fabric topologies with Fibre Channel switches provide higher speed, more connections, and port isolation.

FC-HBA Library – What was previously known as the Storage Networking Industry Association Fibre Channel host bus adapter (SNIA FC-HBA) library is now known as the FC-HBA library. The FC-HBA library application programming interface (API) enables management of FC HBAs and provides a standards-based interface for other applications (such as Sun StorEdge™ Enterprise Storage Manager) that can be used to gather information about FC HBAs.

Man pages for common FC-HBA APIs are included in the Solaris Express Developer’s Edition OS in libhbaapi (3LIB). For additional information about FC specifications, refer to http://www.t11.org.

Fibre Channel Virtualization – N Port ID Virtualization (NPIV) is an extension to the Fibre Channel standard, which enables one Fibre Channel port to simulate many ports on the SAN. This is useful for virtualization environments such as xVM.

Fibre Channel over Ethernet (FCoE) – A new T11 standard to transport encapsulated Fibre Channel frames over Enhanced Ethernet is now available. Solaris FCoE is a software implementation that is designed to work with normal Ethernet controllers.

SAS Software Features

Dynamic Storage Discovery – The Solaris OS Storage Multipathing software automatically recognizes devices and any modifications made to device configurations. This makes devices available to the system without requiring you to reboot or manually change information in configuration files.

Persistent Device Naming – Dynamic Storage Discovery Devices that are configured within the Solaris OS Storage Multipathing software maintain their device naming through reboots or reconfiguration.
Multipathing Software Features

The Solaris Express Developer’s Edition OS contains the Sun StorageTek Traffic Manager software. The software is enabled by default for x86-based platforms and optional for SPARC-based platforms. The software contains the following features:

■ **Path management** – The Sun StorageTek Traffic Manager software dynamically manages the paths to any storage devices it supports. The addition or removal of paths to a device is done automatically when a path is brought online or removed from a service. This feature enables hosts configured with the software to begin with a single path to a device and add more host controllers, increasing bandwidth and RAS, without changing device names or modifying applications. Sun storage does not require configuration files to manage or databases to keep current. For storage other than Sun, contact your storage vendor for methods to enable support and to ensure it is qualified with the Sun StorageTek Traffic Manager software.

■ **Single Device Instances** – Unlike other multipathing solutions, the Sun StorageTek Traffic Manager software is fully integrated with the Solaris Express Developer’s Edition OS. The software displays multipath devices as single device instances instead of as one device, or device link, per path. This feature reduces the cost of managing complex storage architectures utilities such as `format(1M)` or Sun Solaris OS Volume Manager, to “see” one representation of a storage device instead of a separate device for each path.

■ **Failover support** – Implementing higher levels of RAS requires redundant host connectivity to storage devices. The Sun StorageTek Traffic Manager software manages the failure of storage paths while maintaining host I/O connectivity through available secondary paths.

■ **Symmetrical/Asymmetrical device support** – The Sun StorageTek Traffic Manager software supports the following disk storage devices:
  - All Sun disk storage, both symmetric and asymmetric
  - All T10/T11 standards-compliant non-Sun symmetrical disk devices
  - Many non-Sun asymmetrical disk arrays

  **Note** – T10 ALUA support has been added for asymmetrical devices that support this T10 standard. Contact your storage vendor to see whether your device is supported.

■ **I/O load balancing** – In addition to providing simple failover support, the Sun StorageTek Traffic Manager software can use any active paths to a storage device to send and receive I/O. With I/O routed through multiple host connections, bandwidth can be increased by the addition of host controllers. The software uses a round-robin load-balancing algorithm by which individual I/O requests are routed to active host controllers in a series one after the other.
Queue depth – SCSI storage arrays present storage to a host in the form of a logical unit number (LUN). LUNs have a finite set of resources available, such as the amount of data that can be stored, as well as the number of active commands that a device or LUN can process at one time. The number of active commands that can be issued before a device blocks further I/O is known as queue depth. When the Sun StorageTek Traffic Manager software is enabled, a single queue is created for each LUN regardless of the number of distinct or separate paths it may have to the host. This feature enables the disk driver to maintain and balance one queue to the LUN, effectively managing queue depth. No other multipathing software available for the Solaris Express Developer’s Edition OS has this ability.

stmsboot command – The Solaris Express Developer’s Edition OS includes the stmsboot (1M) command, which allows you to enable or disable the Solaris OS Multipathing software on your boot device after the OS installation has been completed. This command is available for both SPARC and x86/x64 systems, and provides support for SAS multipathing with the Solaris Express Developer’s Edition OS. SAS multipathing is not enabled by default in the Solaris Express Developer’s Edition OS for either SPARC or x86/x64 hosts, so use of the stmsboot command is required as a post-installation step if you wish to enable Multipathing.

SPARC hosts do not enable multipathing for Fibre Channel devices by default, so use of the stmsboot command is required as a post-installation step.

X86/x64 hosts do enable multipathing of Fibre Channel devices by default, so the use of the stmsboot command is not mandatory as a post-installation step.

Dynamic reconfiguration – The Sun StorageTek Traffic Manager software supports the Solaris Express Developer’s Edition OS dynamic reconfiguration (DR).

Supported Standards

The Sun StorageTek Traffic Manager software is based on open standards for communicating with devices and device management, ensuring interoperability with other standards-based devices and software. The following standards are supported by the Sun StorageTek Traffic Manager software:

- T10 standards, including SCSI-3, SAM, FCP, SPC, and SBC
- T11.3 FC standards, including FC-PH, FC-AL, FC-LS, and FC-GS
- T11.5 storage management standards, including FC-HBA
- IETF standards, including RFC 2625
- Serial Attached SCSI-2 (SAS2)
This chapter provides information about configuring the Solaris OS Fibre Channel (FC) and Storage Multipathing software. The following topics are discussed:

- “Configuration Task Overview” on page 17
- “Configuration Considerations” on page 18

Configuration Task Overview

This section provides a high level overview of the tasks that you should perform to configure the Sun StorageTek Traffic Manager software.

The following table lists the configuration tasks, description about each task and the reference information where you can find the procedures to perform each task.

<table>
<thead>
<tr>
<th>Configuration Task</th>
<th>Task Description</th>
<th>Reference Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enable Multipathing</td>
<td>Multipathing capability is provided by the Sun StorageTek Traffic Manager software in the Solaris Express Developer Edition OS. This software enables multipathing:</td>
<td>The steps for enabling multipathing are outlined in Chapter 4, “Configuring Multipathing Software.”</td>
</tr>
<tr>
<td></td>
<td>■ By default, for Fibre Channel-attached devices on x86/x64 platforms</td>
<td></td>
</tr>
<tr>
<td></td>
<td>■ By manual configuration on SPARC platforms</td>
<td></td>
</tr>
<tr>
<td></td>
<td>■ By manual configuration for SAS devices</td>
<td></td>
</tr>
</tbody>
</table>
### Configuration Considerations

Before you configure the Sun StorageTek Traffic Manager software, consider the following:

- Configure ports and zones according to the vendor-specific documentation for storage and switches.
- LUN masking enables specific LUNs to be seen by specific hosts. See your vendor-specific storage documentation that describes masking.
- Power management needs to be disabled for hosts and devices on a SAN. See `power.conf` (4) for details about power management.
- The STMS Boot utility is included with the Sun StorageTek Traffic Manager software that manages the enable and disable process needed for SAN booting. Issuing the `stmsboot` command allows the automatic update of `/etc/vfstab` and the dump configuration to reflect device name changes when enabling or disabling the Sun StorageTek Traffic Manager software. Note that the software is disabled by default with SPARC devices and enabled by default with x86 devices.

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### TABLE 2–1 Tasks to Configure Solaris OS FC and Sun StorageTek Traffic Manager Software (Continued)

<table>
<thead>
<tr>
<th>Configuration Task</th>
<th>Task Description</th>
<th>Reference Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Configure Fibre Channel Devices</td>
<td>In the Solaris Express Developer Edition OS, FCAL, fabric, and point-to-point connected devices are made available to the host. This feature differs from previous versions of the Sun StorageTek Traffic Manager software running on the Solaris 8 or 9 OS. In those versions, manual configuration steps were required to achieve fabric-connected device availability on the Solaris host.</td>
<td>Chapter 5, &quot;Configuring SAN Devices&quot;</td>
</tr>
<tr>
<td>Configure Virtual Fibre Channel Ports</td>
<td>You can configure N Port ID Virtualization (NPIV) ports, which is especially useful for virtualization environments such as xVM.</td>
<td>Chapter 6, &quot;Configuring Virtual Fibre Channel Ports&quot;</td>
</tr>
<tr>
<td>Set up FC Boot Device</td>
<td>The Sun StorageTek Traffic Manager software enables a Solaris server to boot from a fabric device.</td>
<td>&quot;SAN Device Considerations&quot; on page 49</td>
</tr>
<tr>
<td>Configure IPFC SAN devices</td>
<td>You can configure host recognition of IPFC devices and implementation of IP over FC in a SAN. Configuration of IPFC depends on the instance of the Fabric Port (FP) driver for the FC adapter ports.</td>
<td>Chapter 9, &quot;Configuring IPFC SAN Devices&quot;</td>
</tr>
<tr>
<td>Configure SAS Devices</td>
<td>In the Solaris Express Developer Edition OS, multipathing of SAS devices is supported.</td>
<td></td>
</tr>
</tbody>
</table>
For Sun Solaris Express Developer's Edition OS, fabric-connected devices are configured and made available to the host automatically during install and boot time.

**Note** – If you are performing an upgrade and want to make any Fibre Channel (FC) devices unavailable after upgrade, those devices have to be manually unconfigured using `cfgadm -c unconfigure` commands. However, to make those devices permanently unavailable to the system, you may want to consider using switch zoning or LUN masking. The changes made by `cfgadm -c unconfigure` do not persist after a reboot unless manual configuration for fabric-connected devices has been turned on. To find out how to disable the fabric devices discovery during boot or install, please refer to Appendix A, “Manual Configuration for Fabric-Connected Devices”
Administering Multipathing Devices Through mpathadm Commands

You determine and configure Solaris OS multipathing support by using mpathadm commands. In the Solaris Express Developer Edition OS, the mpathadm command enables multipathing administration through the ANSI standard Multipath Management API. The terms used in this chapter to denote a path, initiator port, target port, and logical unit are consistent with the T10 specification.

Administering Multipathing Devices

Perform the following tasks to administer any multipathing devices.

▼ To Get a List of Multipathing Support That Can Be Administered by the mpathadm Command

The multipathing support is identified with the Multipath Management API plug-in library name.

- List the multipathing support by typing the mpathadm list mpath-support command.
  
  # mpathadm list mpath-support
  mpath-support: libmpcsii_vhci.so

  (Only one result is shown in the preceding example.)

▼ To Get the Multipathing Support Properties

The multipathing support properties are associated with Multipath Management API plug-in properties.
1 List the multipathing support by typing the `mpathadm list mpath-support` command.

```
# mpathadm list mpath-support
mpath-support: libmpscsi_vhci.so
```

(Only one `mpath` support name result is shown in the preceding output list example.)

2 Choose the `mpath` support name from the output list.

3 List the multipathing support properties for a specified `mpath` support name by typing the `mpathadm show mpath-support mpath-support-name` command.

```
# mpathadm show mpath-support libmpscsi_vhci.so
mpath-support: libmpscsi_vhci.so
Vendor: Sun Microsystems
Driver Name: scsi_vhci
Default Load Balance: round-robin
Supported Load Balance Types:
  round-robin
  logical-block
Allows To Activate Target Port Group Access: yes
Allows path Override: no
Supported Auto Failback Config: yes
Auto Failback: on
Failback Polling Rate (current/max): 0/0
Supported Auto Probing config: no
Auto Probing: NA
probing Polling Rate (current/max): NA/NA
Supported Devices:
  Vendor: SUN
  Product: T300
  Revision:
  Supported Load Balance Types:
    round-robin
  Vendor: SUN
  Product: T4
  Revision:
  Supported Load Balance Types:
    round-robin
```

The command output also shows a list of device products that is supported by the multipathing support software. The multipathing support `libmpscsi_vhci.so` supports T10 target port group compliant devices by default.
To Get a List of Initiator Ports Discovered on the System

An initiator port is part of a path that consists of an initiator port, target port, and a logical unit.

- Run the `mpathadm list initiator-port` command.
  
  ```bash
  # mpathadm list initiator-port
  Initiator-Port: iqn.1986-03.com.sun:01:080020b7ac2b.437a3b3e,4000002affff
  Initiator-Port: 2000000173018713
  ```

To Get the Properties of a Particular Initiator Port

Display the properties of an initiator port by typing the `show` command.

1. Run the `mpathadm list initiator-port` command.
   
   ```bash
   # mpathadm list initiator-port
   Initiator-Port: iqn.1986-03.com.sun:01:080020b7ac2b.437a3b3e,4000002affff
   Initiator-Port: 2000000173018713
   ```

2. Select an initiator port to use from the output.

3. Run the `mpathadm show initiator-port initiator-port-name` command.
   
   ```bash
   # mpathadm show initiator-port 2000000173018713
   initiator-port: 2000000173018713
   Transport Type: Fibre Channel
   OS Device File: /devices/pci@1f,2000/SUNW,glc@4/fp@0,0
   ```

To Get a List of Logical Units Discovered on the System

The `mpathadm list lu` command displays the list of logical units attached to the initiator. This list displays the number of paths and the operational path count to each logical unit listed.

- Run the `mpathadm list lu` command.
  
  ```bash
  # mpathadm list lu
  /dev/rdsk/c4t60020F20000035AF4267CCCB0002CEE2d0s2
  Total Path Count: 2
  Operational Path Count: 2
  /dev/rdsk/c4t600003BA27D2120004204AC2B0000DAB00d0s2
  Total Path Count: 2
  ```
To Get the Properties and Associated Path Information of a Particular Logical Unit by Name

Display the list of logical units, along with the properties for each logical unit through the `mpathadm` command. The list of logical units contains logical unit names that in turn can be used to display the properties of a particular logical unit.

1. **Run the `mpathadm list lu` command.**

   ```
   # mpathadm list lu
   /dev/rdsk/c4t60003BA27D2120004204AC1A000F1D6Cd0s2
   Total Path Count: 2
   Operational Path Count: 2
   /dev/rdsk/c4t60003BA27D2120004204AC2B000DAB00d0s2
   Total Path Count: 2
   Operational Path Count: 2
   /dev/rdsk/c4t60003BA27D2120004204AC1A000F1D6Cd0s2
   Total Path Count: 2
   Operational Path Count: 2
   ```

2. **Select a logical unit name from the output.**

3. **Run the `mpathadm show lu logical-unit-name` command.**

   ```
   # mpathadm show lu /dev/rdsk/c4t60003BA27D2120004204AC2B000DAB00d0s2
   logical unit: /dev/rdsk/c4t60003BA27D2120004204AC2B000DAB00d0s2
   mpath-support libmpscsi_vhci.so
   Vendor: SUN
   Product: T4
   Revision: 0301
   Name Type: SCSI Inquiry VPD page 83 type 3
   Name: 60003ba27d2120004204ac2b000dab00
   Asymmetric: yes
   Current Load Balance: round-robin
   Logical Unit Group ID: NA
   Auto Failback: on
   Auto Probing: NA
   ```

   ```
   Paths:
   Initiator Port Name: 2000000173818713
   ```
To list all logical units associated with a particular target port:

To list paths through a target port use the show command of a logical unit. First, retrieve the list of target ports associated with a logical unit. Then, use the target port to list all logical units associated with this target port.

1. Run the `mpathadm list lu` command.

```
# mpathadm list lu
/dev/rdsks/c4t60020F20000035AF4267CCCB0002CEE2d0s2
  Total Path Count: 2
  Operational Path Count: 2
/dev/rdsks/c4t6003BA27D2120004204AC2B0000DAB00d0s2
  Total Path Count: 2
  Operational Path Count: 2
/dev/rdsks/c4t6003BA27D2120004204AC1A000F1D6Cd0s2
  Total Path Count: 2
  Operational Path Count: 2
```
2 Select a logical unit name from the output.

3 Run the `mpathadm show lu` command.

```bash
# mpathadm show lu /dev/rdsk/c4t60003BA27D2120004204AC2B000DAB00d0s2
logical unit: /dev/rdsk/c4t60003BA27D2120004204AC2B000DAB00d0s2
 mpath-support libmpscsi_vhci.so
   Vendor: SUN
   Product: T4
   Revision: 0301
   Name Type: SCSI Inquiry VPD page 83 type 3
   Name: 60003ba27d2120004204ac2b000dab00
   Asymmetric: yes
   Current Load Balance: round-robin
   Logical Unit Group ID: NA
   Auto Failback: on
   Auto Probing: NA

Paths:
  Initiator Port Name: 2000000173818713
  Target Port Name: 20030003ba27d212
  Override Path: NA
  Path State: OK
  Disabled: no

  Initiator Port Name: 2000000173018713
  Target Port Name: 20030003ba27d095
  Override path: NA
  Path State: OK
  Disabled: no

Target Port Groups:
  ID: 2
  Explicit Failover: yes
  Access State: standby
  Target Ports:
    Name: 20030003ba27d212
    Relative ID: 0

  ID: 5
  Explicit Failover: yes
  Access State: active
  Target Ports:
    Name: 20030003ba27d095
    Relative ID: 0
```

4 Select a target port from the output list.
5 Run the `mpathadm list lu -t` command.

```
# mpathadm list lu -t 20030003ba27d212
/dev/rdsk/c4t60003BA27D2120004204AC2B0000DAB00d0s2
  Total Path Count: 2
  Operational Path Count: 2
/dev/rdsk/c4t60003BA27D2120004204AC1A00F1D6Cd0s2
  Total Path Count: 2
  Operational Path Count: 2
```

▼ To List a Logical Unit With a Particular Name Derived From the Hardware Used by the System

1 Run the `mpathadm list lu` command.

```
# mpathadm list lu
/dev/rdsk/c4t60003BA27D2120004204AC2B0000DAB00d0s2
  Total Path Count: 2
  Operational Path Count: 2
/dev/rdsk/c4t60003BA27D2120004204AC2B0000DAB00d0s2
  Total Path Count: 2
  Operational Path Count: 2
/dev/rdsk/c4t60003BA27D2120004204AC1A00F1D6Cd0s2
  Total Path Count: 2
  Operational Path Count: 2
```

2 Select a logical unit name from the output.

3 Run the `mpathadm show lu logical-unit-name` command.

```
# mpathadm show lu /dev/rdsk/c4t60003BA27D2120004204AC2B0000DAB00d0s2
logical unit: /dev/rdsk/c4t60003BA27D2120004204AC2B0000DAB00d0s2
  mpath-support libmpscsi_vhci.so
  Vendor: SUN
  Product: T4
  Revision: 0301
  Name Type: SCSI Inquiry VPD page 83 type 3
  Name: 60003ba27d2120004204ac2b0000dab00
  Asymmetric: yes
  Current Load Balance: round-robin
  Logical Unit Group ID: NA
  Auto Failback: on
  Auto Probing: NA
Paths:
```
Select an inquiry-string-name from the output.

Run the mpathadm list Lu -n inquiry-string-name command.

# mpathadm list lu -n 60003ba27d2120004204ac2b0000dab00
mpath-support: libmpscsi_vhci.so
/dev/rsk/c4t60003BA27D2120004204AC2B0000DAB00d0s2
Total Path Count: 2
Operational Path Count: 2

To Configure Auto-Failback for a Particular Multipathing Support

Symmetrical devices allow for automatic failback to a possible optimal path. If a failover occurs on the initial path, the standby path becomes the new online path. Usually the standby path is a suboptimal path. When auto-failback is enabled, the initial path comes back online, failover to the initial path automatically occurs.
1 Run the `mpathadm list mpath-support` command.
   
   ```bash
   # mpathadm list mpath-support
   mpath-support: libmpscsi vhci.so
   ```

2 Select an mpath support name from the output list.

3 Run the `mpathadm modify mpath-support -a [on | off] mpath-support-name` command.
   
   ```bash
   # mpathadm modify mpath-support -a off libmpscsi vhci.so
   ```

4 Run the `mpathadm show mpath-support mpath-support-name` command to check the change.
   
   ```bash
   # mpathadm show mpath-support libmpscsi vhci.so
   mpath-support: libmpscsi vhci.so
       Vendor: Sun Microsystems
       Driver Name: scsi vhci
       Default Load Balance: round-robin
       Supported Load Balance Types:
           round-robin
           logical-block
       Allows To Activate Target Port Group Access: yes
       Allows path Override: no
       Supported Auto Failback Config: yes
       Auto Failback: on
       Failback Polling Rate (current/max): 0/0
       Supported Auto Probing config: no
       Auto Probing: NA
       probing Polling Rate (current/max): NA/NA
   Supported Devices:
       Vendor: SUN
       Product: T300
       Revision:
       Supported Load Balance Types:
           round-robin
   Vendor: SUN
       Product: T4
       Revision:
       Supported Load Balance Types:
           round-robin
   ```

**Note** – The auto-failback display initiated by the `mpathadm modify` command setting is effective while the system is running. However, to keep the changed setting persistent, you must update the `/kernel/drv/scsi vhci.conf` file. Refer to “Configuring Automatic Failback” on page 47.
To Fail Over a Logical Unit

This operation is applicable only to devices in the following two categories:

- Asymmetric devices with a proprietary failover mechanism recognized and supported by multipathing support
- Devices conforming to the T10 Standard Target Port Group Support libmpscsi_vhci.so and providing *explicit* mode asymmetric logical unit access

1. **Run the** `mpathadm list lu` **command.**
   
   ```bash
   # mpathadm list lu
   /dev/rdsk/c4t60020F20000035AF4267CCB0002CEE2d0s2
   Total Path Count: 2
   Operational Path Count: 2
   /dev/rdsk/c4t60003BA27D2120004204AC2B0000AB00d0s2
   Total Path Count: 2
   Operational Path Count: 2
   /dev/rdsk/c4t60003BA27D2120004204AC1A000F1D6D0s2
   Total Path Count: 2
   Operational Path Count: 2
   ```

2. **Select a logical unit name from the output.**

3. **Run the** `mpathadm show lu logical-unit-name` **command.**
   
   ```bash
   # mpathadm show lu /dev/rdsk/c4t60003BA27D2120004204AC2B0000AB00d0s2
   logical unit: /dev/rdsk/c4t60003BA27D2120004204AC2B0000AB00d0s2
   mpath-support libmpscsi_vhci.so
   Vendor: SUN
   Product: T4
   Revision: 0301
   Name Type: SCSI Inquiry VPD page 83 type 3
   Name: 60003ba27d2120004204ac2b0000ab00
   Asymmetric: yes
   Current Load Balance: round-robin
   Logical Unit Group ID: NA
   Auto Failback: on
   Auto Probing: NA
   Paths:
   Initiator Port Name: 2000000173818713
   Target Port Name: 20030003ba27d212
   Override Path: NA
   Path State: OK
   Disabled: no
   Initiator Port Name: 2000000173018713
   ```
Target Port Name: 20030003ba27d095
Override path: NA
Path State: OK
Disabled: no

Target Port Groups:
  ID: 2
  Explicit Failover: yes
  Access State: standby
  Target Ports:
    Name: 20030003ba27d212
    Relative ID: 0

  ID: 5
  Explicit Failover: yes
  Access State: active
  Target Ports:
    Name: 20030003ba27d095
    Relative ID: 0

4 Run the `mpathadm failover lu logical-unit-name` command.

```bash
# mpathadm failover lu /dev/rdsk/c4t60003BA27D2120004204AC2B000DAB00d0s2
```

If this operation is successful, the access state of the devices' target port groups changes as a result of the logical unit failover.

5 Run the `mpathadm show lu logical-unit-name` command to verify the access state change.

```bash
# mpathadm show lu /dev/rdsk/c4t60003BA27D2120004204AC2B000DAB00d0s2
logical unit: /dev/rdsk/c4t60003BA27D2120004204AC2B000DAB00d0s2
mpath-support libmpscsi_vhci.so
  Vendor: SUN
  Product: T4
  Revision: 0301
  Name Type: SCSI Inquiry VPD page 83 type 3
  Name: 60003ba27d2120004204ac2b000dab00
  Asymmetric: yes
  Current Load Balance: round-robin
  Logical Unit Group ID: NA
  Auto Failback: on
  Auto Probing: NA

Paths:
  Initiator Port Name: 20000000173818713
  Target Port Name: 20030003ba27d212
  Override Path: NA
  Path State: OK
  Disabled: no
Initiator Port Name: 2000000173018713
Target Port Name: 20030003ba27d095
Override path: NA
Path State: OK
Disabled: no

Target Port Groups:
  ID: 2
  Explicit Failover: yes
  Access State: active
  Target Ports:
    Name: 20030003ba27d212
    Relative ID: 0

  ID: 5
  Explicit Failover: yes
  Access State: standby
  Target Ports:
    Name: 20030003ba27d095
    Relative ID: 0

▼ To Enable a Path

If the path to a logical unit is disabled, the enable command changes the path back to enabled. The full path must be specified using the initiator port name, target port name, and the logical unit. To verify the change, run the show command for the logical unit.

1 Run the mpathadm list lu command.

   # mpathadm list lu
   /dev/rdsk/c4t60003BA27D212004204AC1A000F1D6Cd0s2
   Total Path Count: 2
   Operational Path Count: 2

2 Select a logical unit name from the output.

3 Run the mpathadm show lu logical-unit-name command.

   # mpathadm show lu /dev/rdsk/c4t60003BA27D212004204AC1A000F1D6Cd0s2
   logical unit: /dev/rdsk/c4t60003BA27D212004204AC1A000F1D6Cd0s2
mpath-support libmpscsi_vhci.so
Vendor: SUN
Product: T4
Revision: 0301
Name Type: SCSI Inquiry VPD page 83 type 3
Name: 60003ba27d212004204ac2b000dab00
Asymmetric: yes
Current Load Balance: round-robin
Logical Unit Group ID: NA
Auto Failback: on
Auto Probing: NA

Paths:
   Initiator Port Name: 2000000173018713
   Target Port Name: 20030003ba27d212
   Override Path: NA
   Path State: OK
   Disabled: no

   Initiator Port Name: 2000000173018713
   Target Port Name: 20030003ba27d095
   Override path: NA
   Path State: OK
   Disabled: no

Target Port Groups:
   ID: 2
   Explicit Failover: yes
   Access State: standby
   Target Ports:
      Name: 20030003ba27d212
      Relative ID: 0

   ID: 5
   Explicit Failover: yes
   Access State: active
   Target Ports:
      Name: 20030003ba27d095
      Relative ID: 0

4 Select an initiator port and a target port name.

5 Run the `mpathadm enable path -i initiator-port-name -t target-port-name -l logical-unit-name command`.

   # mpathadm enable path -i 20000000173018713 -t 20030003ba27d095 \
      -l /dev/rdsk/c4t60003BA27D212004204AC2B000DAB00d0s2
# To Disable a Path

This operation makes the path unavailable for the logical unit, regardless of its operational state.

**Note** – The disabled state is not persistent across rebooting. If the path is operational before the next boot sequence, it is enabled by default. This operation is not allowed when the given path is the last operational path remaining.

1. **Run the** `mpathadm list lu` **command.**
   ```bash
   # mpathadm list lu
   /dev/rdsk/c4t600020F20000035AF4267CCB0002CEE2d0s2
   Total Path Count: 2
   Operational Path Count: 2
   /dev/rdsk/c4t60003BA27D2120004204AC2B0000DAB00d0s2
   Total Path Count: 2
   Operational Path Count: 2
   /dev/rdsk/c4t60003BA27D2120004204AC1A0001D6Cd0s2
   Total Path Count: 2
   Operational Path Count: 2
   ```

2. **Select a logical unit name from the output.**

3. **Run the** `mpathadm show lu logical-unit-name` **command.**
   ```bash
   # mpathadm show lu /dev/rdsk/c4t60003BA27D2120004204AC2B000DAB00d0s2
   logical unit: /dev/rdsk/c4t60003BA27D2120004204AC2B000DAB00d0s2
   mpath-support libmpscsi_vhci.so
   Vendor: SUN
   Product: T4
   Revision: 0301
   Name Type: SCSI Inquiry VPD page 83 type 3
   Name: 60003ba27d2120004204ac2b000dab0
   Asymmetric: yes
   Current Load Balance: round-robin
   Logical Unit Group ID: NA
   Auto Failback: on
   Auto Probing: NA

   Paths:
   Initiator Port Name: 2000000173818713
   Target Port Name: 20030003ba27d212
   Override Path: NA
   Path State: OK
   Disabled: no

   Initiator Port Name: 2000000173018713
   ```
Select an initiator port and a target port name.

4 Run the `mpathadm disable path -i initiator-port-name -t target-port-name -l logical-unit-name` command.

```
# mpathadm disable path -i 2000000173018713 -t 20030003ba27d095 -l /dev/rdsk/c4t60003BA27D72120004204AC2B0000AB000d0s2
```
Configuring Multipathing Software

This chapter explains how to configure the Sun StorageTek Traffic Manager software that is provided in the Solaris Express Developer Edition OS for Fibre Channel (FC) devices. It also provides the considerations while enabling or disabling the multipathing feature on SPARC based systems, x86 based systems, per-port basis and third-party storage devices.

The following topics are discussed:
- “Configuring Multipathing” on page 37
- “Multipathing Considerations” on page 38
- “Enabling and Disabling Multipathing” on page 38
- “Enabling or Disabling Multipathing on a Per-Port Basis” on page 41
- “Configuring Third-Party Storage Devices” on page 43
- “Configuring Automatic Failback” on page 47

Configuring Multipathing

The multipathing feature for FC devices can be configured to control all Sun supported FC HBAs. Multipathing is disabled by default for FC devices on SPARC based systems, but is enabled by default on x86 based systems. Configuration of the multipathing software depends on how you intend to use your system.

Note – The multipathing feature is not available for parallel SCSI devices but is available for FC disk devices. Multipathing is not supported on tape drives or libraries, or on IP over FC.

Before you configure third-party devices for multipathing, be aware of the following:
Multipathing Considerations

Before you change multipathing configuration note the following considerations. Then follow the instructions for your machine architecture (SPARC or x86) described in the subsequent sections. Some devices need to be properly configured to work with the multipathing software. Refer to your storage array documentation for details on the device specific configuration for your device.

- Device Specific Considerations
- Device Name Change Considerations

In the /dev and /devices trees, multipath-enabled devices receive new names that indicate that they are under multipath control. A device therefore will have a different name from its original name when it is under multipath control.

Device name with multipath disabled:

/dev/dsk/c1t1d0s0

Device name with multipath enabled:

/dev/dsk/c0t6003BA2705170003E502A7A0007F302d0s0

Therefore, applications that use device names directly must be configured to use the new names whenever you change multipath configuration from disabled to enabled or vice-versa.

The system's /etc/vfstab file and the dump configuration also contain references to device names. On both SPARC and x86/x64-based systems the stmsboot(1m) command described in the following sections automatically updates the /etc/vfstab file dump configuration with the new device names. If you have application-dependent file systems which are not listed in the file /etc/vfstab, you can use the stmsboot command to determine the mapping between the old and new device paths.

Caution – if you have run devfsadm -C or performed a reconfiguration reboot then the old device paths will not exist and the stmsboot -L command will fail to provide this information.

Enabling and Disabling Multipathing

With the release of the Solaris Express Developer Edition OS, the stmsboot(1m) command is now available for use on SPARC, x86, and x64 based systems to enable or disable multipathing for Fibre Channel (FC) and SAS devices. The stmsboot command updates the /etc/vfstab file and dump configuration to reflect device name changes during the next reboot. You do not need to manually edit the /kernel/drv/fp.conf or /kernel/drv/mpt.conf files.
The following considerations apply to the `stmsboot -e`, `-d`, and `-u` options:

- You should reboot immediately after running the `stmsboot` command.
- Ensure that `eprom(1m)` boot device is set to boot from your current boot device. This is required since the `stmsboot` command reboots the machine to complete the operation.
- The `stmsboot` command saves a copy of your original `/kernel/drv/fp.conf`, `/kernel/drv/mpt.conf` and `/etc/vfstab` files before modifying them. See Appendix C, "Multipathing Troubleshooting," if you encounter unexpected problems while using `stmsboot`.

Note – The behavior of the `stmsboot` command in the Solaris Express Developer Edition OS differs from the `stmsboot` command provided by Sun StorEdge SAN Foundation software in the Solaris 8 and Solaris 9 OS. In the Solaris 8 and Solaris 9 OS, the `stmsboot` command is used to enable or disable multipathing on the boot device only for SPARC based hosts only. In the Solaris Express Developer Edition OS, the command is used to enable or disable multipathing on all capable devices.

The `stmsboot` command is available on both SPARC and x86/x64-based systems from the Solaris Express Developer Edition OS onwards. In the Solaris Express Developer Edition OS the `stmsboot` command is used to enable, disable or update multipathing for Serial-Attached SCSI devices as well as FC devices.

To Enable Multipathing

Perform the following steps to enable multipathing on all multipath-capable devices on SPARC or x86/x64 based systems. If you want to enable multipathing only on specific FC or SAS HBA ports, refer to "Enabling or Disabling Multipathing on a Per-Port Basis" on page 41.

The multipathing software automatically recognizes Sun supported devices. If you want to enable multipathing on third-party devices, add entries to the `/kernel/drv/scsi_vhci.conf` file as described by Device Name Change Considerations in "Multipathing Considerations" on page 38.

1 Run the `stmsboot -e` command:

   `# stmsboot -e`

   WARNING: `stmsboot` operates on each supported multipath-capable controller detected in a host. In your system, these controllers are

```
/devices/pci@780/pci@0/pci@8/SUNW,qlc@0/fp@0,0
/devices/pci@780/pci@0/pci@8/SUNW,qlc@0,1/fp@0,0
/devices/pci@7c0/pci@0/pci@1/pci@0,2/LSILogic,sas@1
/devices/pci@7c0/pci@0/pci@1/pci@0,2/LSILogic,sas@1
/devices/pci@7c0/pci@0/pci@1/pci@0,2/LSILogic,sas@2
```
Enabling and Disabling Multipathing

If you do NOT wish to operate on these controllers, please quit stmsboot and re-invoke with -D { fp | mpt } to specify which controllers you wish to modify your multipathing configuration for.

Do you wish to continue? [y/n] (default: y) y
Checking mpxio status for driver fp
Checking mpxio status for driver mpt
WARNING: This operation will require a reboot.
Do you want to continue? [y/n] (default: y) y
The changes will come into effect after rebooting the system.
Reboot the system now? [y/n] (default: y) y

Note – During the reboot, /etc/vfstab and the dump configuration are updated to reflect the device name changes.

2 (Optional) After the reboot, if necessary, configure your applications to use new device names as described by Device Name Change Considerations in “Multipathing Considerations” on page 38.

To Disable Multipathing

Perform the following steps to disable multipathing on all multipath-capable devices on SPARC or x86/x64 based systems. If you want to disable multipathing only on specific FC or SAS HBA ports, refer to “Enabling or Disabling Multipathing on a Per-Port Basis” on page 41.

1 Run the stmsboot -d command.

# stmsboot -d
WARNING: stmsboot operates on each supported multipath-capable controller detected in a host. In your system, these controllers are

/devices/pci@7c0/pci@0/pci@9/LSILogic,sas@0
/devices/pci@7c0/pci@0/pci@9/LSILogic,sas@0

If you do NOT wish to operate on these controllers, please quit stmsboot and re-invoke with -D { fp | mpt } to specify which controllers you wish to modify your multipathing configuration for.
Enabling or Disabling Multipathing on a Per-Port Basis

Multipathing can be enabled or disabled on specific Fibre Channel Host Bus Adapter (HBA) controller ports. If you enable multipathing on a specific HBA port controller port, all supported devices connected to that controller port will be enabled for multipath operation.

The following procedure applies to both SPARC and x86 based machines.

Port Configuration Considerations

Before you start configuring the software by port, consider the following:

- FC global and per-port multipath settings are specified in the file `/kernel/drv/fp.conf`. Per-port multipath settings have priority over the global setting. This means that if global multipathing is enabled by a specific port has been disabled for multipathing, the port will not be available in the multipathing configuration. Conversely, even if global multipathing has been disabled, specific ports may be enabled for multipathing if they are listed in the appropriate `driver.conf` file.

- Load balancing is controlled by the global load-balance property in `/kernel/drv/scsi_vhci.conf` file and is not controlled on a per-port basis.

- If a device has more than one path to the host, all paths to the device must be configured with multipathing enabled or disabled.

- Configuring multipathing by port enables the multipathing software to coexist with other multipathing solutions like Symantec (VERITAS) Dynamic Multipathing (DMP), or EMC PowerPath. However, devices and paths should not be shared between the multipathing software and other multipathing solutions.
To Configure Multipathing by Port

Depending on how many ports you want the multipathing software to control, you can enable or disable multipathing globally or for specified ports.

1 Log in as root (su - root).

2 Determine the HBA controller ports that you want the multipathing software to control.
   For example, to select the desired device, perform an ls -l command on /dev/cfg directory. The following example shows the ls -l command output.
   
   ```
   lrwxrwxrwx 1 root root 50 Jan 29 21:33 c0 -> ../../devices/pci@7c0/pci@0/pci@0/pci@0/ide@8:scsi
   lrwxrwxrwx 1 root root 61 Jan 29 21:33 c1 -> ../../devices/pci@7c0/pci@0/pci@0/pci@0,2/LSILogic,sas@1:scsi
   lrwxrwxrwx 1 root root 61 Jan 29 21:33 c2 -> ../../devices/pci@7c0/pci@0/pci@0,2/LSILogic,sas@2:scsi
   lrwxrwxrwx 1 root root 53 Jan 29 21:33 c3 -> ../../devices/pci@7c0/pci@0/pci@9/LSILogic,sas@0:scsi
   lrwxrwxrwx 1 root root 54 Apr 16 20:28 c5 -> ../../devices/pci@780/pci@0/pci@0,0/SUNW,qlc@0,1/fp@0,0:fc
   lrwxrwxrwx 1 root root 56 Apr 16 20:28 c6 -> ../../devices/pci@780/pci@0/pci@0,0/SUNW,qlc@0,1/fp@0,0:fc
   ```

   Note – Controllers c5 and c6 are ports A and B on a dual-port FC HBA. Controllers c1 and c3 are single port SAS HBA ports. Controller c2 is the internal SAS controller in a Sun Fire™ T2000 server.

   Once you have determined the port, or ports, you want to explicitly enable or disable multipathing for, go to the next step.

3 Enable or disable specific ports as follows:
   
   - FC HBA ports
     
     a. Edit file /kernel/drv/fp.conf

     b. Add the following line for each FC HBA port that is to be enabled:
        
        ```
        name="fp" parent="parent name" port=port-number mpxio-disable="no";
        ```

        where `parent name` is the port device name, and `port-number` is the FC HBA port number.
For example, the following entries disable multipathing on all FC HBA controller ports except for the two specified ports:

```bash
mpxio-disable="yes";
name="fp" parent="/pci@6,2000/SUNW,qlc@2" port=0 mpxio-disable="no";
name="fp" parent="/pci@13,2000/pci@2/SUNW,qlc@5" port=0 mpxio-disable="no";
```

c. Add the following line for each FC HBA port that is to be disabled:
```
name="fp" parent="parent name" port=port-number mpxio-disable="yes";
```

For example:
```
name="fp" parent="/pci@6,2000/SUNW,qlc@2" port=0 mpxio-disable="yes";
```

4 Type `stmsboot -u` to start the reboot and configuration process.
You are prompted to reboot. During the reboot, the `/etc/vfstab` file and your dump device configuration are updated to reflect any device name changes.

5 (Optional) After the reboot, if necessary, configure your applications to use new device names as described in “Multipathing Considerations” on page 38.

### Configuring Third-Party Storage Devices

**Note** – Before configuring any third-party device, ensure that they are supported. Refer to your third-party user documentation, or third-party vendor for information on proper vendor and product IDs, modes and various settings required for the device to work with multipathing software.

### Third-Party Device Configuration Considerations

Before you configure third-party devices for multipathing, be aware of the following:

- The device must support the `REPORT_LUNS` SCSI command, and `SCSI-3 INQUIRY` command VPD Device Identification Page (0x83).
- You will need the vendor ID (VID) and product ID (PID) of the device. You can obtain them by using the `format` command followed by the inquiry option on your system. See the `format(1M)` man page.

When multipathing is enabled, the multipath access still depends on a device specific `scsi_vhci` failover implementation accepting the device. The default way this occurs, automatically, is for the `scsi_vhci` code to call a `probe` function in each failover implementation, looking for the first `probe` result that indicates the device is supported.
A probe implementation determines support based on some combination of scsi_inquiry(9S) data. A device with INQUIRY data indicating T10 Target-Port-Group-Support (TPGS) compliance will use the standards-based TPGS failover implementation. For noncompliant devices, a failover implementation’s probe will typically determine support based on VID/PID match against a private compiled-in table.

To override the probe process, the scsi_vhci.conf file supports a scsi_vhci-failover-override property. The value of scsi_vhci-failover-override can be used to establish support for a device not currently accepted by probe, override probe support, or disable multipath support for a device.

### Configuring Third-Party Storage Devices: New Devices

Multipathing can be configured on third-party symmetric storage devices. A symmetric storage device is defined as a storage device in which all paths to the storage device are active and I/O commands can be issued through any path.

#### To Configure New Third-Party Devices

Perform the following steps to configure third-party devices if your system already has multipathing enabled. If your system has multipathing disabled, you can configure third-party devices while enabling multipathing as described earlier in this chapter.

1. **Add the vendor ID and product ID entries to the /kernel/drv/scsi_vhci.conf file.**
   
The vendor ID and product ID are the vendor and product identification strings that the device returns in SCSI INQUIRY data. The vendor ID must be eight characters long. You must specify all eight characters even if the trailing characters are spaces.

   The product ID can be up to 16 characters long.

   ```
   scsi_vhci-failover-override =
   "VendorID1ProductID1", "f_sym",
   "VendorID2ProductID2", "f_sym",
   ...
   "VendorIDnProductIDn", "f_sym";
   
   Note that the entries are separated by the ';' character and the last vendor/product entry is terminated by the ';' character.
   
   For example, to add a device from a "ACME" vendor with a product ID of "MSU", and to add a device from vendor "XYZ" vendor with a product ID of "ABC", you would add the following lines to file /kernel/drv/scsi_vhci.conf:
   
   ```
   To add a device from a "XYZ" vendor with a product ID of "ABC", you would add:

   ```
   scsi_vhci-failover-override =
   "ACME MSU", "f_sym",
   "XYZ ABC", "f_sym";
   ```
2 Save and exit the `scsi_vhci.conf` file.

3 Type `stmsboot -u` to start the reboot and configuration process.
   You are prompted to reboot. During the reboot, the `/etc/vfstab` file and the dump configuration are updated to reflect the device name changes.

4 If necessary, perform device name updates as described in “Enabling and Disabling Multipathing” on page 38.

Configuring Third-Party Storage Devices: Disabling Devices

Multipathing can be disabled for all devices of a certain Vendor ID/Product ID combination from Inquiry data. This exclusion is specified in the `scsi_vhci.conf` file.

▼ To Disable Third-Party Devices

1 Add the vendor ID and product ID entries to the `/kernel/drv/scsi_vhci.conf` file.
   The vendor ID and product ID are the vendor and product identification strings that the device returns in SCSI INQUIRY data. The vendor ID must be eight characters long. You must specify all eight characters even if the trailing characters are spaces. The product ID can be up to 16 characters long.

   ```
   scsi-vhci-failover-override =
   "VendorID1ProductID1", "NONE",
   "VendorID2ProductID2", "NONE",
   ...
   "VendorIDnProductIDn", "NONE";
   ```

   The entries in the preceding example are separated by the `,` character and the last vendor/product entry is terminated by the `;` character. For example, to add a device from vendor “ACME” with a product ID of “MSU,” and a vendor device from vendor “XYZ” with product ID “ABC,” you would add the following lines to the file `/kernel/drv/scsi_vhci.conf`:

   ```
   scsi-vhci-failover-override =
   "ACME MSU", "NONE",
   "XYZ ABC", "NONE";
   ```

2 Save and exit the `scsi_vhci.conf` file.

3 Type `stmsboot -u` to start the reboot and configuration process.
   You are prompted to reboot. During the reboot, the `/etc/vfstab` file and the dump configuration are updated to reflect the device name changes.
If necessary, perform the device name updates as described in "Enabling and Disabling Multipathing" on page 38.

Displaying Device Name Changes

The `stmsboot(1M)` command, available on Solaris Express Developer’s Edition OS SPARC, x86 and x64 platforms, can be used to display the mapping between non-multipathed and multipathed device names, after the changes made to the multipath configuration by invoking `stmsboot` with the `-e`, `-d`, or `-u` option. Both the non-multipathed and the multipathed device names must exist in order to show the mapping.

The `-L` option displays the mapping of devices on all controllers.

```
# stmsboot -L
```

### non-STMS device name | STMS device name
--- | ---
/dev/rdsck/c2t8d0 | /dev/rdsck/c10t500000E01046DEE0d0
/dev/rdsck/c2t0d0 | /dev/rdsck/c10t500000E01046B070d0
/dev/rdsck/c2t3d0 | /dev/rdsck/c10t20000020372A40AFd0
/dev/rdsck/c2t12d0 | /dev/rdsck/c10t500000E01046DEF0d0
/dev/rdsck/c2t11d0 | /dev/rdsck/c10t500000E01046E390d0
/dev/rdsck/c3t8d0 | /dev/rdsck/c10t500000E01046DEE0d0
/dev/rdsck/c3t0d0 | /dev/rdsck/c10t500000E01046B070d0
/dev/rdsck/c3t3d0 | /dev/rdsck/c10t20000020372A40AFd0
/dev/rdsck/c3t12d0 | /dev/rdsck/c10t500000E01046DEF0d0
/dev/rdsck/c3t11d0 | /dev/rdsck/c10t500000E01046E390d0
```

The `-l` option displays the mapping of devices on only the specified controller. The following example displays the mapping of controller 3.

```
# stmsboot -l3
```

### non-STMS device name | STMS device name
--- | ---
/dev/rdsck/c3t8d0 | /dev/rdsck/c10t500000E01046DEE0d0
/dev/rdsck/c3t0d0 | /dev/rdsck/c10t500000E01046B070d0
/dev/rdsck/c3t3d0 | /dev/rdsck/c10t20000020372A40AFd0
/dev/rdsck/c3t12d0 | /dev/rdsck/c10t500000E01046DEF0d0
/dev/rdsck/c3t11d0 | /dev/rdsck/c10t500000E01046E390d0
Configuring Automatic Failback

Some storage devices have controllers configured as PRIMARY and SECONDARY as part of the array configuration. The secondary paths may operate at a lower performance level than the primary paths. The multipathing software uses the primary path to talk to the storage device and keeps the secondary path on standby. In the event of a primary path failure, the multipathing software automatically directs all I/O traffic over the secondary path, with the primary path taken offline. This process is called a “failover” operation. When the failure associated with the primary path has been repaired, the multipathing software automatically directs all I/O traffic over the primary path and keeps the secondary path standby as before. This process is called a “failback” operation.

You can disable the automatic failback operation so the multipathing software does not automatically failback to the primary path. Later, after the failure associated with the primary path has been repaired, you can do a manual failback operation using the `luxadm(1M)` command.

▼ To Configure Automatic Failback

1. Open the `/kernel/drv/scsi_vhci.conf` file in a text editor.

2. To disable automatic failback capability, change the auto-failback entry to:
   ```
   auto-failback="disable";
   ```
   To enable automatic failback capability (if you disabled it before), change the auto-failback entry to:
   ```
   auto-failback="enable";
   ```

3. Save and exit the file.

4. Reboot the system.
   ```
   # shutdown -g@ -y -i6
   ```
This chapter provides the high level overview of the steps used to configure SAN devices. In the Solaris Express Developer Edition OS, FCAL, fabric, and point-to-point connected devices are made available to the host automatically. This feature differs from previous versions of the SAN Foundation software running on the Solaris 8 or the Solaris 9 OS. In those versions, manual configuration steps were required to achieve fabric-connected device availability on the host. To find out how to manually configure fabric-connected devices, refer to Appendix A, “Manual Configuration for Fabric-Connected Devices.”

The following topics are discussed:

- “SAN Device Considerations” on page 49
- “Adding SAN Devices” on page 50
- “Configuring Fabric Boot Devices on SPARC” on page 51

**SAN Device Considerations**

Be aware of the following considerations before configuring the Sun StorageTek Traffic Manager software.

- Configure ports and zones according to the vendor-specific documentation for storage and switches.
- With the Solaris Express Developer Edition OS you no longer have to manually configure devices unless you enable manual device configuration.
- LUN masking enables specific LUNs to be seen by specific hosts. See your vendor-specific storage documentation that describes masking.
- Turn off power management on servers connected to the SAN to prevent unexpected results as one server attempts to power down a device while another attempts to gain access. See `power.conf(1M)` man page for details about power management.
Adding SAN Devices

Adding and removing SAN devices requires knowledge of the following commands:

- `luxadm(1M)`
- `format(1M)`
- `fsck(1M)`
- `newfs(1M)`
- `cfgadm(1M)` and `cfgadm_fp(1M)`

**Note** – If you use the `format` command when the Sun StorageTek Traffic Manager software multipathing feature is enabled, you will see only one instance of a device identifier for each LUN. Without the Sun StorageTek Traffic Manager software enabled, you will see one identifier for each path.

The `cfgadm` and `cfgadm_fp` commands are used most frequently to configure storage devices on a SAN. Refer to the appropriate man page for detailed instructions about how to use each command.

**To Add a SAN Device**

1. Create the LUNs desired on the SAN device.
2. If necessary, apply LUN masking for HBA control on the SAN device.
3. Connect the storage device to the system.
4. If necessary, create port-based or WWN zones on the switch on the SAN device.
5. Run the `fsck` or `newfs` commands on the device, if used for file systems.
Mount any existing file systems available on the storage device’s LUNs or disk groups.

Note – You might need to run the fsck command to repair any errors in the LUNs listed in the /etc/vfstab file.

Configuring Fabric Boot Devices on SPARC

The Sun StorageTek Traffic Manager software allows a Solaris Express Developer Edition OS SPARC server to be booted from a fabric disk device.

Boot Considerations

Fabric boot devices can be added through the Solaris Express Developer Edition OS interactive installation GUI or text installer just as internal boot devices have been added in the previous Solaris OS releases. Refer to the Solaris Express Developer Edition OS installation guide for details. You should consider the following points while enabling a fabric boot device.

- Minimize interference to boot devices through the following actions:
  - Ensuring the boot device is not an overly subscribed target or LUN
  - Avoiding installation of applications and software on target or LUN
  - Reducing physical distance between host and fabric device, as well as the number of hops
  - Remove the boot disk from volume manager control prior to beginning the fabric boot procedure.
  - Ensure that the latest HBA Fcode and drivers are loaded for the install HBAs on the system.
  - If multipathing is desired on the boot device, use the stmsboot command as described in Chapter 4, "Configuring Multipathing Software."
This chapter provides the steps used to configure N Port ID Virtualization (NPIV) ports, also known as virtual Fibre Channel ports.

- "What is NPIV?" on page 53
- "Limitations of NPIV" on page 53
- "Creating NPIV Ports" on page 54

**What is NPIV?**

NPIV is a Fibre Channel facility that enables one Fibre Channel adapter to have many N Port IDs. Each N Port has a unique identity (port WWN and node WWN) on the SAN and can be used for zoning and LUN masking. Soft zoning, which you can use to group ports together by port WWN, is the preferred method of zoning.

**Limitations of NPIV**

Here is the list of NPIV limitations when used to virtualize Fibre Channel ports:

- NPIV ports may not be used for booting.
- NPIV ports are best used in SANs with a relatively small number of ports, either virtual or physical. Also, some targets may not have enough resources to process the large number of ports that NPIV can create. This limitation exists because processing state change notifications (SCN) on the SAN takes significant time if there are a large number of ports on the SAN. You can workaround this limitation on a large SAN by using zoning, which can limit the number of visible ports.
- MPxIO can be used with NPIV, although you should ensure that different paths are physically redundant.
- NPIV is supported only in a Fabric topology. It is not supported in an FC-AL or point-to-point topology.
Not all hardware supports NPIV. Both switches and HBAs (although not targets) must support NPIV in a SAN. By specification, HBAs should support up to 255 virtual ports, although this is defined by the resources on the switch. Switches may have to be updated to the latest firmware levels for NPIV support.

Creating NPIV Ports

The `fcadm(1M)` command is available to configure NPIV for non-virtualized environments. For xVM, see the `virsh(1M)` command documented in the Virtualization System Administration Guide.

The `fcinfo(1M)` and `fcadm(1M)` status commands are available to determine the status of NPIV ports, whether the ports are created from `fcadm(1M)` or by virtualization specific commands, such as `xm(1M)`. The commands also report the relationship between the physical port and the virtual ports hosted on that port.

Other Fibre Channel commands, such as `luxadm(1M)` and `cfgadm(1M)`, report NPIV information, although there is no distinction made between virtual and physical ports.

▼ To Create an NPIV Port

Before You Begin

Each virtual port must have a port and node name. The port name must be unique on the SAN. You can assign names manually or use the built-in random WWN generator. If you attempt to register duplicate names, most switches will report an error status on the newly registered WWN, and the switch will not register the new WWN.

For more information on acceptable name formats, refer to the T11 standard: Fibre Channel Framing and Signaling (FC-FS 2).

If you try to create an NPIV port on an HBA that does not support NPIV, an error will occur. If you try to create an NPIV port on an HBA that supports NPIV, but it is attached to a switch which does not support NPIV, the port will be created with an offline status. The status will be reported in the `fcinfo(1M)` output.

1 Become superuser.

2 Create an NPIV port:

```
# fadm create-npiv-port -p Virtual_Port_WWN -n Virtual_Node_WWN PhysicalPort_port_WWN
```

Without the `-p` and `-n` options, a random WWN will be assigned for the virtual port and virtual node, respectively.
Creating an NPIV Port

The following example creates an NPIV port on a physical HBA port with a WWN of 210000e08b170f1c, a virtual port WWN set to 2000000000000001, and a virtual node WWN set to 2100000000000001.

```bash
# fcadm create-npiv-port -p 2000000000000001 -n 2100000000000001 210000e08b170f1c
```

To Delete an NPIV Port

**Before You Begin**

You can use the `fcinfo hba-port` command to display the current WWN values for the NPIV ports.

1. Become superuser.

2. Delete an NPIV port:

```bash
# fcadm delete-npiv-port -p Virtual_Port_WWN -n Virtual_Node_WWN PhysicalPort_port_WWN
```

Deleting an NPIV Port

The following example deletes an NPIV port on a physical HPA port with a WWN of 210000e08b170f1c.

```bash
# fcadm delete-npiv-port -p 2000000000000001 -n 2100000000000001 210000e08b170f1c
```

To Report Status on NPIV Ports

1. Become superuser.

2. Report status on the currently configured NPIV ports:

```bash
# fcinfo hba-port
```

The NPIV Port List shows the lists of currently configured NPIV ports.

Example 6–3 Reporting Status on NPIV Ports

The following example shows that HBA port 210000e08b84f7eb has one virtual port.

```bash
# fcinfo hba-port
HBA Port WWN: 210000e08b84f7eb
    Port Mode: Initiator
    Port ID: 10100
```
Creating NPIV Ports

- OS Device Name: /dev/cfg/c7
- Manufacturer: QLogic Corp.
- Model: 375-3294-01
- Firmware Version: 04.04.00
- FCode/BIOS Version: BIOS: 1.4; fcode: 1.11; EFI: 1.0;
- Serial Number: 0402F00-0549112895
- Driver Name: qlc
- Driver Version: 20080430-0.00
- Type: N-port
- State: online
- Supported Speeds: 1Gb 2Gb 4Gb
- Current Speed: 4Gb
- Node WWN: 200000e08b84f7eb
- Max NPIV Ports: 63
- NPIV port list:
  - Virtual Port1:
    - Node WWN: 111000000000000
    - Port WWN: 121000000000000
Configuring FCoE Ports

This chapter provides the steps used to configure FCoE ports hosted on normal Ethernet interfaces. This chapter does not apply to hardware FCoE ports on Converged Network Adapters (CNA).

The following topics are discussed:

- “What is FCoE?” on page 57
- “Limitations of FCoE” on page 57
- “Configuring FCoE Ports” on page 58

What is FCoE?

FCoE is a new T11 standard that transports encapsulated Fibre Channel frames over Enhanced Ethernet. FCoE is designed to enable network convergence and cost-effective SAN expansion in data centers.

Limitations of FCoE

The Solaris FCoE initiator is a pure software implementation that is designed to work with normal Ethernet controllers. However, you must comply with the following limitations of Solaris FCoE implementations:

- FCoE ports cannot be used for booting.
- FCoE ports cannot be configured in xVM or LDom guest operating systems.
- FCoE is supported in fabric and point-to-point topologies.

FCoE is not supported on all hardware. FCoE works with Ethernet controllers that support 802.3x PAUSE and jumbo frames, and have a GLDv3 driver.
Configuring FCoE Ports

The `fcadm(1M)` command is available to configure FCoE ports. The `fcinfo(1M)` and `fcadm(1M)` status commands are available to determine the status of FCoE ports. The commands also report the relationship between the Ethernet interface and the FCoE port hosted on that interface.

Other Fibre Channel commands, such as `luxadm(1M)` and `cfgadm(1M)`, report FCoE information, although there is no distinction made between FCoE and native FC ports.

▼ To Create an FCoE Port

Before You Begin

Before you begin this procedure, you must perform the following tasks:

- Enable the 802.3x (also called PAUSE) setting on the Ethernet interface. This setting ensures a lossless Ethernet transport.

- Enable jumbo frames (greater than 2.5 Kbytes) on the Ethernet interface. A Fibre Channel data frame can be as large as 2136 bytes.

These settings can vary for different Ethernet hardware and drivers. In most cases, you must modify the `driver.conf` file of the Ethernet interface and then reboot. See the `driver.conf` file for your Ethernet interface for details on how to enable these features.

Each virtual port must have a port and node name. The port name must be unique on the SAN. You can assign names manually or use the built-in WWN generator. If you attempt to register duplicate names, the switch will report an error status on the newly registered WWN, and the switch will not register the new WWN. For more information on acceptable name formats, refer to the T11 standard: Fibre Channel Framing and Signaling (FC-FS 2).

If you try to create an FCoE port on a network interface that does not support FCoE (for example, xnf in xVM or VNET in LDom), an error occurs and the FCoE port is not created.

1 Become superuser.

2 Create an FCoE port.
   
   ```bash
   # fcadm create-fcoe-port -p Port_WWN -n Node_WWN Ethernet_Interface
   ```

   If the selected Ethernet interface does not support Multiple Unicast Address, you are prompted to explicitly enable promiscuous mode on that interface.

   ```bash
   # fcadm create-fcoe-port -f Ethernet_Interface
   ```
Creating an FCoE Port

The following example creates an FCoE port on Ethernet interface nxge0 with port WWN and node WWN generated automatically.

```
# fcadm create-fcoe-port nxge0
```

To Delete an FCoE Port

Before You Begin
You can use the `fcadm list-fcoe-ports` command to display the Ethernet interfaces hosting the FCoE ports.

1. Become superuser.

2. Delete an FCoE port.
   ```
   # fcadm delete-fcoe-port network_interface
   ```

Deleting an FCoE Port

The following example deletes an FCoE port on Ethernet interface nxge0.

```
# fcadm delete-fcoe-port nxge0
```

To Report Status on FCoE Ports

1. Become superuser.

2. Report the status on the currently configured FCoE ports.
   ```
   # fcinfo hba-port -e
   ```
   This command retrieves a list of FC specific information for all FCoE ports in the system.

   ```
   # fcadm list-fcoe-ports
   ```
   This command retrieves a list of FCoE specific information for all FCoE ports in the system.

Reporting Status on FCoE Ports

The following example reports FC and FCoE specific information for all FCoE ports.

```
# fcinfo hba-port -e
HBA Port WWN: 200000144fc1f5c8
   Port Mode: Initiator
```
Port ID: 9a0042
OS Device Name: /dev/cfg/c6
Manufacturer: Sun Microsystems, Inc.
Model: FCoE Virtual FC HBA
Firmware Version: N/A
FCode/BIOS Version: N/A
Serial Number: N/A
Driver Name: SunFC FCoEI v20090422-1.00
Driver Version: v20090422-1.00
Type: N-port
State: online
Supported Speeds: 1Gb 10Gb
Current Speed: 10 Gb
Node WWN: 10000144fc1f5c8

# fcadm list-fcoe-ports
HBA Port WWN: 200000144fc1f5c8
   Port Type: Initiator
   MAC Name: nxge0
   MTU Size: 9194
   Primary MAC Address: 00144fc1f5c8
   Current MAC Address: 0efc009a0042
   Promiscuous Mode: Off
This chapter provides overviews of SAS Domain considerations, SAS device discovery, and SAS boot device configuration.

**SAS Multipathing Considerations**

- SAS multipathing is supported with the Solaris Express Developer Edition OS release when using the bundled `mpt(7d)` driver.
- SAS expanders are not supported with the Solaris Express Developer Edition OS release.
- LUN masking is not supported with SAS-attached devices in the Solaris Express Developer Edition OS release.
- Turn off power management on hosts connected to the SAS Domain in order to prevent unexpected results as one server attempts to power down a device while another attempts to gain access. See `pmconfig(1m)` and `power.conf(4)` for details about power management.

**Dynamic Discovery of SAS Devices**

Adding and removing SAS devices is performed dynamically when using the `mpt(7d)` driver. You are no longer required to edit the `sd.conf` file to enable your system to detect specific targets and LUNs attached with the `mpt` driver. See `mpt(7d)` for more information.

You are no longer required to edit the `sd.conf` file to enable your system to detect specific targets and LUNs attached with the `mpt` driver.

If you add or remove a device in your SAS domain, messages will be written to the `/var/adm/messages` file indicating presence or removal. If a device has been added, it is visible to and available by the `format(1m)` command.
Configuring SAS Boot Devices

The Solaris Multipathed IO software allows Solaris Express Developer Edition OS hosts to boot from a multipathed SAS device, or from a SATA device connected to a SAS controller. Only the bundled mpt driver is supported for SAS multipathing in the Solaris Express Developer Edition OS release.

Some SAS and SATA devices might not support multipathing but will still function as non-multipathed devices. See http://sunsolve.sun.com for more information.
Configuring IPFC SAN Devices

Configuring Internet Protocol over Fibre Channel (IPFC) on the host system describes host recognition of IPFC devices and implementation of IP over FC in a SAN. The IPFC driver is based on RFC 2625 and allows IP traffic to run over FC.

This chapter contains the following topics:
- “IPFC Considerations” on page 63
- “Invoking and Configuring IPFC” on page 66

IPFC Considerations

The following table shows the supported features available for IPFC.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Supported</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cascading</td>
<td>Yes, with fabric zones only</td>
</tr>
<tr>
<td>Zone type</td>
<td>Fabric zone with the HBA configured as an F-port point-to-point connection</td>
</tr>
<tr>
<td>Maximum number of device ports per zone</td>
<td>253</td>
</tr>
</tbody>
</table>

The following restrictions apply:
- IPFC is not supported on 1 Gbit Sun switches.
- Promiscuous mode is not supported. The snoop(1M) utility cannot be used.
- Multicasting is supported through broadcasting only.
- Network cards using IPFC cannot be used as routers. The /etc/not_router file must be present on the host.
Any standard network commands can be used after IPFC is attached. These commands (telnet, ping, or ftp) are used in this environment in the same way as in an Ethernet setup.

Determining Fibre Channel Adapter Port Instances

This section explains how to configure the desired host system for IPFC. It includes the procedures to determine the port instance and to plumb an IPFC instance.

To Determine Port Instances

1. Determine the HBA PCI adapter slot and the I/O board PCI slot.
   You need this information to perform the calculation in “Determining Fibre Channel Adapter Port Instances” on page 64.

   For example, assume you have an array with an HBA card located in PCI adapter slot 5, and the PCI adapter is in slot 1 of the I/O board.

2. Determine the instance number.

   a. Search for the fp driver binding name in the /etc/path_to_inst file.

      Note – Determine the correct entry by finding the hardware path described in your server hardware manual or Sun System Handbook. The Sun System Handbook is available at http://sunsolve.sun.com/handbook_pub/.

   b. Narrow the search by using the I/O board and slot information from Step 1.

      Note – The following method of deriving the Solaris Express Developer Edition OS device path of an HBA from its physical location in server might not work for all Sun server hardware.

      i. Multiply the PCI adapter slot number by the number of adapter ports.

         For example, if the HBA has two ports, multiply by 2. Using the array with an HBA in the PCI adapter slot 5, multiply 5 by 2 to get 10.

      ii. Add the PCI adapter I/O board slot number to the number derived in Step i.

         Using an HBA in PCI adapter slot 5 and PCI slot 1 of the I/O board, add 1 to 10 for a sum of 11.

      iii. Convert the number derived in Step ii to hexadecimal.

         The number 11 converts to “b” in hexadecimal.
iv. Search for the fp entry with \texttt{pci@} \texttt{hex} where \texttt{hex} is the number you derived in Step iii.

The following table shows the elements of the device path for a PCI single FC network adapter device that has the following path:

"/pci@b,2000/SUNW,qlc@2/fp@0,0" 7 "fp"

<table>
<thead>
<tr>
<th>Entry Item</th>
<th>Entry Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Name</td>
<td>/pci@b,2000/SUNW,qlc@2/fp@0,0</td>
</tr>
<tr>
<td>Instance Number</td>
<td>7</td>
</tr>
<tr>
<td>Driver Binding Name</td>
<td>fp</td>
</tr>
</tbody>
</table>

c. Manually plumb each FP instance.

Use the \texttt{ifconfig interface-number plumb} command. In this example, the value of \texttt{interface-number} is fcip7.

\texttt{# ifconfig fcip7 plumb}

When the command is successful, a message appears on both the console and in the messages file. For example:

```
Sep 13 15:52:30 bytownite ip: ip: joining multicasts failed (7) on fcip0 -
will use link layer brocasts for multicast
```

\section*{To Plumb an IPFC Instance}

Each FP instance on the system has an entry in \texttt{/dev/fc}. If HBAs have been removed, some stale links might exist. Use this procedure to load and plumb IPFC.

1. For each entry in \texttt{/dev/fc}, issue a \texttt{luxadm -e dump_map} command to view all the devices that are visible through that HBA port:

\texttt{# luxadm -e dump_map /dev/fc/fp0}

<table>
<thead>
<tr>
<th>Pos</th>
<th>Port_ID</th>
<th>Hard_Addr</th>
<th>Port WWN</th>
<th>Node WWN</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>610100</td>
<td>0</td>
<td>210000e08b049f53 200000e08b049f53</td>
<td>0x1f (Unknown Type)</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>620d02</td>
<td>0</td>
<td>210000e08b02c32a 200000e08b02c32a</td>
<td>0x1f (Unknown Type)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>620f00</td>
<td>0</td>
<td>210000e08b03eb4b 200000e08b03eb4b</td>
<td>0x1f (Unknown Type)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>620e00</td>
<td>0</td>
<td>210000e08b220713 200100e08b220713</td>
<td>0x1f (Unknown Type,Host Bus Adapter)</td>
<td></td>
</tr>
</tbody>
</table>

\texttt{# luxadm -e dump_map /dev/fc/fp1}

No FC devices found. - /dev/fc/fp1

2. Based on the list of devices, determine which destination HBAs are visible to the remote host with which you want to establish IPFC communications.

In the example for this procedure, the destination HBAs have port IDs 610100 and 620d02. The originating HBAs port ID is 620e00.
3 List the physical path of the originating HBA port from which you can see the destination HBA port, where `originating-hba-link` is a variable for the link determined in Step 2.

```bash
# ls -l /dev/fc/fp originating-hba-link
```

In the following example, 0 is the number for the `originating-hba-link`:

```bash
# ls -l /dev/fc/fp 0
lrwxrwxrwx 1 root root 51 Sep 4 08:23 /dev/fc/fp0 ->../../devices/pci@8,600000/SUNW,qlc@1/fp@0,0:devctl
```

4 Search the physical path identified in Step 3.

You must remove the leading `../../devices` from the path name output. For example

```bash
# grep pci@8,600000/SUNW,qlc@1/fp@0,0 /etc/path_to_inst
"/pci@8,600000/SUNW,qlc@1/fp@0,0" 0 "fp"
```

5 Determine the `fp` instance for the originating HBA port from the output of the command in Step 4.

The instance number precedes “fp” in the output. In the following example output, the instance number is 0.

"/pci@8,600000/SUNW,qlc@1/fp@0,0" 0 "fp"

6 Use the instance number from Step 5 to load IPFC and plumb the IPFC interface.

In this example, the instance is 0.

```bash
# ifconfig fcip 0 plumb
```

## Invoking and Configuring IPFC

Immediately upon installation, start IPFC manually with the `ifconfig` command. You can configure the host so that on subsequent reboot, the IPFC network interface starts automatically. This section describes the procedures to start a network interface manually and to configure the host for automatic plumbing upon reboot.

### To Start a Network Interface Manually

Use this procedure when you want to plumb IPFC with specific netmask values and get the IPFC interface up and running.
1 Use the `ifconfig` command with the appropriate interface.

Ask your network administrator for an appropriate IP address and netmask information. For example, to enable an IPFC interface associated with fp instance 0 and an IP address of 192.9.201.10, type:

```bash
# touch /etc/notrouter
# ifconfig fcip0 inet 192.9.201.10 netmask 255.255.255.0 up
```

The `ifconfig` command is described in more detail in the `ifconfig(1M)` man page.

2 Use the command `ifconfig -a` to verify that the network is functioning.

The output of `ifconfig -a` should look like this:

```
lo0: flags=1000849<UP,LOOPBACK,RUNNING,MULTICAST,IPv4> mtu 8232 index 1
inet 127.0.0.1 netmask ff000000
fcip0: flags=1001843<UP,BROADCAST,RUNNING,MULTICAST,MULTI_BCAST,IPv4> mtu 1500 index 2
inet 192.9.201.10 netmask ffffff00 broadcast 192.9.201.255 ether 0:e0:8b:1:3c:f7
hme0: flags=1000843<UP,BROADCAST,RUNNING,MULTICAST,IPv4> mtu 1500 index 3
inet 192.9.200.70 netmask ffffff00 broadcast 192.9.200.255
ether 8:0:20:fc:e9:49
```

To Configure the Host for Automatic Plumbing Upon Reboot

Each network interface must have an `/etc/hostname.interface` file defining the name of the IP address associated with it. For example, IPFC network interface `fcip0` has a file named `/etc/hostname.fcip0`.

1 Manually create a `/etc/hostname.interface` file that contains a single line that identifies the host name or interface IP address.

2 Make any additional entries to the `/etc/inet/hosts` file.

The Solaris Express Developer Edition OS installation program creates the `/etc/inet/hosts` file with minimum entries. You must manually make additional entries with a text editor. See the `hosts(4)` man page for additional information.

The `/etc/inet/hosts` file contains the hosts database. This file contains the host names and the primary network interface IP addresses, as well as the IP addresses of other network interfaces attached to the system and of any other network interfaces that the machine must know about.

The following example shows an `/etc/inet/host` file.

```
127.0.0.1   localhost   loghost
192.9.200.70  sun1   #This is the local host name
192.9.201.10  fcip0  #Interface to network 192.9.201.10
```
3 Edit the /etc/nsswitch.conf file so that all uncommented entries have the word files before any other name service.

The /etc/nsswitch.conf specifies which name service to use for a particular machine. The following code shows an example of an /etc/nsswitch.conf file.

hosts: files nis
CHAPTER 10

Sun Solaris Express Developer's Edition OS
x86/x64 Fibre Channel Operating System
Booting Procedure

In the Solaris Express Developer's Edition, x86/x64 Operating System (OS), Fibre Channel (FC) devices now appear in the disk selection portion of Solaris SunInstall. An interactive Solaris Express Developer's Edition installation is now required due to the potentially large number of devices that might appear in the disk selection portion of Solaris SunInstall.

This chapter describes how to manually install the Solaris Express Developer’s Edition. This OS includes Sun StorageTek SAN Foundation software with the Sun 2-Gbit and 4-Gbit Fibre Channel (FC) HBA drivers, and the Sun StorageTek Traffic Manager software.

Note –

Sun 1 Gb HBAs do not support booting over a SAN on x86 machines. Sun 4 Gb HBAs do support booting over a SAN on x86 machines. Most Sun 2 Gb HBAs do support booting over a SAN on x86 machines, except for the following:

- Sun StorageTek 2 Gb Enterprise Class Dual-Port Fibre HBA, SG-XPCI2FC-QF2-Z
- Sun StorageTek 2 Gb PCI Dual-Port Fibre HBA, SG-XPCI2FC-QF2
- Sun StorageTek 2 Gb FC PCI Single-Channel Network Adapter, X6767A
- Sun StorageTek 2 Gb FC PCI Dual-Channel Network Adapter, X6768A
- Sun StorageTek 2 Gb FC PCI–X Enterprise Single-Port HBA, SG-XPCI1FC-QL2
- Sun StorageTek 2 Gb FC PCI Single-Port Host Adapter, SG-XPCI1FC-QF2

The Sun Solaris Express Developer’s Edition x64/x86 OS can be installed from a CD-ROM, DVD-ROM, or network.

This chapter contains the following topics:

- "Setup Requirements" on page 70
- "Installation Overview" on page 70
- "Installation Procedure" on page 71
- "Post-Installation Patches for the Sun Solaris Express Developer’s Edition OS" on page 78
**Setup Requirements**

You must have the following items for installation.

- Solaris Express Developer’s Edition
- 10/100/1000 Mbit/sec Ethernet network for network-based OS installation
- One of the following for installation support
  - Jump-start server for a network-based OS installation
  - CD-ROM or DVD-ROM drive for a CD-ROM or DVD-ROM based OS installation

**Installation Overview**

In order to successfully complete the installation, use an FC-based device during the disk selection portion of the installation. At the end of the interactive installation, you must select Manual Reboot.

After OS installation and before rebooting, gather the configuration information by issuing the `luxadm` command on the newly installed logical unit number (LUN). The `luxadm` command output provides a map from `c#t#d#` to the array WWN and LUN number. Record the HBA World Wide Name (WWN) and array WWN port information.

During rebooting, use the WWN and LUN number to set the HBA BIOS for each HBA to be used to boot from each LUN on the same array. Change the system BIOS to perform booting from CD-ROM or Network to disk.

---

**Note** – Console access is required for HBA and system BIOS changes.

In addition, note the following during the Sun Solaris OS installation.

- If using a custom disk layout, do not remove the overlap (s2) partition. The x86 boot installer has a dependency on this partition.
- By default, the Sun StorageTek Traffic Manager software manages the FC boot devices with multiple paths to a single boot device.
Installation Procedure

▼ To Summarize the Procedure

1 Install the HBA hardware.
   Follow the instructions in the appropriate Sun HBA installation guide found at http://docs.sun.com/app/docs?q=StorageTek+Host+Bus+Adapter.

2 Install the Sun Solaris OS as described in the next section, “Installation Procedure” on page 71

▼ To Perform a CD-ROM, DVD ROM, or Network-Based OS Installation

After installing the HBA, perform the following steps for an interactive network-based installation of the Sun Solaris Express Developer’s Edition x86/x64 OS.

For more information, refer to Solaris Express Installation Guide: Basic Installations, 819-2393 at http://docs.sun.com/.

1 If you are installing from a CD-ROM or DVD-ROM rather than over a network, insert the Sun Solaris Software into the CD-ROM or DVD-ROM drive.

2 Upon initial power up, provide the system BIOS and configure it to boot from either the network or CD-ROM (DVD-ROM) as applicable.
   See Figure 10–1 for an example of one of several BIOS setup screens.

Note – The system BIOS setup screens are different for each system BIOS vendor.
Install the Sun Solaris OS using the Solaris Interactive Installation (SunInstall). See Figure 10–2 for an example of one of several SunInstall screens.
During installation, select a desired array and its associated LUN. Select Manual Reboot at the end of the SunInstall utility screens and then verify your selections to start the Sun Solaris OS installation.

Before rebooting after the installation completes, issue the luxadm display command on the boot LUN. See Figure 10–3.

# luxadm display /dev/rdsk/c0t600015d0002028000000000000001142d0s2
DEVICE PROPERTIES for disk: /dev/rdsk/c0t600015d0002028000000000000001142d0s2
Vendor:    SUN
Product ID:  SE6920
Revision:   0202
Serial Num:  00500057
Unformatted capacity:  10240.000 MBytes
Read Cache:   Enabled
   Minimum prefetch:   0x0
   Maximum prefetch:   0xffff
Device Type: Disk device
Path(s):
   /dev/rdsk/c0t600015d0002028000000000000001142d0s2
   /devices/scsi_vhci/diskg600015d0002028000000000000001142d0s2::c, raw
Controller /dev/cfg/c4
Device Address  213600015d207200, 0

FIGURE 10-2 Selecting an FC-based Boot Disk During Disk Selection

4  During installation, select a desired array and its associated LUN.

5  Select Manual Reboot at the end of the SunInstall utility screens and then verify your selections to start the Sun Solaris OS installation.

6  Before rebooting after the installation completes, issue the luxadm display command on the boot LUN.

See Figure 10–3.
Host controller port WWN 210100e08b206812
Class primary
State ONLINE
Controller /dev/cfg/c11
Device Address 213600015d207200,0
Host controller port WWN 210100e08b30a2f2
Class primary
State ONLINE

The following luxadm command output from the example in the figure can be used to map the MPxIO based c#t#d# to the HBA WWN and array WWN:

- MPxIO c#t#d# = c0t600015d0002028000000000000001142d
- Array WWN = 213600015d207200, LUN 0
- HBA WWNs = 210100e08b206812 and 210100e08b30a2f2
During the reboot process, watch the monitor so you can enter the HBA #1 BIOS screen and specify the boot device to be the FC LUN onto which you just installed the Sun Solaris OS. Follow this step for each HBA to be used for multipathing, and specify the boot device to be the FC LUN on which you installed the Sun Solaris OS. See Figure 10–4 and Figure 10–5.

- For the QLogic HBA BIOS, perform the following steps.
  a. During host rebooting, press Control-Q to display the HBA BIOS screen.
  b. Select the HBA that you want to enable as the boot device and enable boot.
  c. Configure the boot device:
     i. Select Configuration Settings.
     ii. Select Selectable Boot Settings.
     iii. Make sure that Selectable Boot is set to enable.
        In this menu, you can select the boot device/LUN by the array WWPN.
     iv. Save and then exit the HBA BIOS screen.

- For the Emulex HBA BIOS, perform the following steps.
  a. During host rebooting, press Alt-E to display the HBA BIOS screen.
  b. Select the HBA that you want to enable as the boot device and enable boot.
  c. Select Configure Boot Devices.
  d. Select a boot entry.
  e. Select the WWPN of the desired boot device.
  f. Type the LUN number.
  g. Select the boot LUN.
  h. Select Boot Device with the Array WWPN.
  i. Save and exit the HBA BIOS screen.
### Installation Procedure

#### FIGURE 10-4  HBA BIOS Screen for an HBA WWN

<table>
<thead>
<tr>
<th>Adapter Type</th>
<th>I/O Address</th>
<th>Slot</th>
<th>Bus</th>
<th>Device</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>QLA2462</td>
<td>3400</td>
<td>02</td>
<td>03</td>
<td>01</td>
<td>1</td>
</tr>
</tbody>
</table>

Use <Arrow keys> and <Enter> to change settings, <Esc> to exit
Note –

The figure shows the following modifications:

- Selectable boot = Enabled
- ARRAY WWN = 213600015d207200
- ARRAY LUN = 0
- HBA WWN = 210100e08b206812

8 Repeat the appropriate modifications for all HBAs and all LUNs.

9 Type the system BIOS per the vendor’s access method and specify the boot device to be the FC LUN on which you installed the Solaris Express Developer’s Edition OS. The following figure shows an example of one screen in a vendor’s system BIOS.
Reboot to the newly installed Solaris Express Developer's Edition OS using the FC LUN specified in the system BIOS.

### Post-Installation Patches for the Sun Solaris Express Developer's Edition OS

The following patches are recommended for the OS:

- 120223-xx Emulex-Sun LightPulse FC adapter driver
- 119131-xx FC device drivers
- 119716-xx MPxI0
- 119471-xx luxadm

These patches can be found on the SunSolve™ web site at http://sunsolve.sun.com.
To simplify management of servers in SAN-based data-centers, the Sun StorageTek™ SAN Foundation software stack in the Solaris OS dynamically detects devices in a SAN and builds associated /dev tree entries without requiring you to edit configuration files.

In most cases, this process greatly simplifies SAN management. However, for tape devices, you might like the ability to explicitly specify how that /dev entries are created and to ensure the /dev entries are identical across multiple servers on a SAN. This chapter describes how you can specify this tape binding in the Solaris OS while retaining the benefits of automatic discovery for disk-based devices.

**Persistent Binding Overview**

The /dev/rmt directory contains links to physical devices under /devices for tape devices. Each tape LUN seen by the system is represented by 24 minor nodes in the form of /dev/rmt/N, /dev/rmt/Nb, and /dev/rmt/Nbn, where N is an integer counter starting from 0. This number is picked by devfsadm during enumeration of new devices. Every new tape logical unit number (LUN) found by devfsadm gets the next available number in /dev/rmt.

Because the /dev/rmt name depends on the order in which devices appear in the device tree, it changes from host to host. For a given tape drive that is seen by two or more different hosts, the /dev/rmt link can be different on each of these hosts. This difference can cause problems for the most common usage of Symantec (VERITAS) NetBackup (SSO option). Also, if the drive is replaced, the links change unless the vendor provides a way to retain the port World-Wide Name (PWWN) of the drive.
Creating Tape Links

The `/etc/devlink.tab` file is called the default device table file. It specifies rules that `devfsadm` uses to create links in the `/dev` directory. Type `man devlinks` on the command-line interface (CLI) for more information. This file does not contain any entries for tapes because `devfsadm` is already able to create links for tape drives, but rules can be added that will modify the default behavior for creating tape links.

For any tape drive visible to the Sun Solaris OS but not specified in the `devlink` file, `devfsadm` automatically assigns a minor node number starting from 0. These minor node numbers will conflict with any lower numbers assigned manually in `/etc/devlink.tab`, so be sure to assign numbers there that are high enough to avoid conflicts.

This approach can easily lead to duplicate links in `/dev/rmt`. Any tapes discovered before entries were specified in `/etc/devlink.tab` have automatically created links. When entries are added and `devfsadm` is run, the original links remain in `/dev/rmt`, resulting in duplicate links. To remove the original links in `/dev/rmt`, run the `rm /dev/rmt/*` command before running `devfsadm`.

This approach cannot be used with multiple-port tape drives that are attached to multiple HBA ports. If multiple HBA ports are attached to the same tape LUN, the system detects two tape drives instead of one. The one that appears last in the `prtconf` output gets the link generated by the `/etc/devlink.tab`.

The following example shows a sample entry for tape in the `devlink` file.

```
type=ddi_byte:tape;addr=PNWN,LUN-number; rmt/rmt-number\M0
```

Change the `rmt #` to whatever `/dev/rmt/N` is required. Then change the PNWN and LUN to match the desired tape device. You can obtain this value by running the `ls -l` command on the existing `/dev/rmt/` link as shown below.

```
# ls -l /dev/rmt/4
lrwxrwxrwx 1 root root 69 Oct 6 14:57 /dev/rmt/4 ->
../devices/pci@1f,700000/SUMW,qlc@2/fp@0,0/st@w5005076300617717,0:
```

If, for example, you wanted the `/dev/rmt/` number to be 40, you would create an entry in `/etc/devlink.tab` like the following example:

```
# type=ddi_byte:tape;addr=w5005076300617717,0; rmt/40\M0
```

You can then add this line to the `devlink` file on every Solaris server on the SAN that uses this drive so that it always appears as minor node 40.
Configuration Steps

1. Create the entries in `/etc/devlink.tab` as described in “Creating Tape Links” on page 80.
   If `devfsadm` has previously discovered the devices, you must determine the device address by running the `ls -l` command on the existing link.

   Note – Be sure to assign `/dev/rmt/N` numbers to avoid conflicts with any automatically configured devices, as described above.

2. Remove existing links from `/dev/rmt` by running the `rm /dev/rmt/*` command.

3. Run `devfsadm`.
   This command creates new links as per the entries in `/etc/devlink.tab` in addition to automatically creating links for any unspecified devices.
Manual Configuration for Fabric-Connected Devices

This appendix explains about configuring and unconfiguring the fabric devices in the Solaris Express Developer’s Edition OS. It explains how the visible fabric devices on a host are detected and configured with and without enabling the Sun StorageTek Traffic Manager software.

This appendix contains the following sections:

- “Manual Configuration” on page 83
- “Fabric Device Node Configuration” on page 84
- “Configuring Device Nodes Without Multipathing Enabled” on page 86
- “Configuring Device Nodes With Solaris Multipathing Software Enabled” on page 89
- “Unconfiguring Fabric Devices” on page 93

Manual Configuration

In the Solaris Express Developer’s Edition OS, fabric-connected devices are made available to the Solaris host. This differs from previous versions of the Sun StorageTek Traffic Manager software running on the Solaris 8 or the Solaris 9 OS. In those versions, manual configuration steps were required to achieve fabric-connected device availability.

If you want to manually configure the fabric-connected devices, use the following steps to change the default behavior on the Solaris Express Developer’s Edition OS.

Note – Changing the default behavior makes all of your fabric-connected devices unavailable, which can cause problems for fabric-connected devices that are required to be available at boot time.
**To Configure Manually**

1. **To enable manual configuration**, make sure that the following line in the `/kernel/drv/fp.conf` file does not start with an initial # character:

   ```
   manual_configuration_only=1;
   ```

   Refer to the `fp(7D)` man page and the `cfgadm_fp(1M)` man page for further information on this setting.

2. **Reboot the host.**

3. **For each fabric-connected device that will need to be made available**, follow the steps in “Configuring Device Nodes Without Multipathing Enabled” on page 86 or “Configuring Device Nodes With Solaris Multipathing Software Enabled” on page 89, depending on whether you are using the Sun StorageTek Traffic Manager software for multipathing.

   If the original default behavior for fabric-connected devices is desired, use the following steps:

4. **To disable manual configuration**, make sure that the following line in the `/kernel/drv/fp.conf` file starts with an initial # character:

   ```
   # manual_configuration_only=1;
   ```

   Refer to the `fp(7D)` man page and the `cfgadm_fp(1M)` man page for further information on this setting.

5. **Reboot the host.**

---

**Fabric Device Node Configuration**

After you configure the hardware in your direct-attach system or SAN, you must ensure that the hosts recognize the devices. This section explains host recognition of fabric devices, also known as 24-bit FC addressing devices on the SAN. After configuring the devices, ports, and zones in your SAN, make sure that the host is aware of the devices. You can have up to 16 million fabric devices connected together on a SAN with FC support.

This section is limited to the operations required from the perspective of the Solaris Express Developer’s Edition OS. It does not cover other aspects, such as device availability and device-specific management. If devices are managed by other software, such as a volume manager, refer to the volume manager product documentation for additional instructions.
Ensuring That LUN Level Information Is Visible

To Ensure LUN Level Information is Visible

1. Use the `cfgadm` command to identify LUN level information. If you issue the `cfgadm -a1 -o show_SCSI_LUN controller-ID` command immediately after a system boots up, the output might not show the Fibre Channel Protocol (FCP) SCSI LUN level information. The information does not appear because the storage device drivers, such as the `ssd` and `st` driver, are not loaded on the running system.

2. Use the `modinfo` command to check whether the drivers are loaded. After the drivers are loaded, the LUN level information is visible in the `cfgadm` output.

To Detect Fabric Devices Visible on a Host

This section provides an example of the procedure for detecting fabric devices using FC host ports c0 and c1. This procedure also shows the device configuration information that is displayed with the `cfgadm(1M)` command.

Note – In the following examples, only failover path attachment point IDs (Ap_Ids) are listed. The Ap_Ids displayed on your system depend on your system configuration.

1. Log in as root (su - root).

2. Display the information about the attachment points on the system.

   ```
   # cfgadm -l
   Ap_Id     Type     Receptacle  Occupant  Condition
   c0        fc-fabric connected  unconfigured  unknown
   c1        fc-private  connected  configured  unknown
   
   In this example, c0 represents a fabric-connected host port, and c1 represents a private, loop-connected host port. Use the `cfgadm(1H)` command to manage the device configuration on fabric-connected host ports.
   
   By default, the device configuration on private, loop-connected host ports is managed by a host using the Solaris Express Developer’s Edition OS.
   
   3. Display information about the host ports and their attached devices.

   ```

<table>
<thead>
<tr>
<th>Ap_Id</th>
<th>Type</th>
<th>Receptacle</th>
<th>Occupant</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>c0</td>
<td>fc-fabric</td>
<td>connected</td>
<td>unconfigured</td>
<td>unknown</td>
</tr>
<tr>
<td>c0::50020f230000006077 disk</td>
<td>connected</td>
<td>unconfigured</td>
<td>unknown</td>
<td></td>
</tr>
<tr>
<td>c0::50020f2300000063a9 disk</td>
<td>connected</td>
<td>unconfigured</td>
<td>unknown</td>
<td></td>
</tr>
<tr>
<td>c0::50020f230000005f24 disk</td>
<td>connected</td>
<td>unconfigured</td>
<td>unknown</td>
<td></td>
</tr>
</tbody>
</table>
configuring device nodes without multipathing enabled

this section describes fabric device configuration tasks on a host that does not have multipathing enabled.

the procedures in this section show how to detect fabric devices that are visible on a host and to configure and make them available to a host using the solaris express developer's edition os. the procedures in this section use specific devices as examples to illustrate how to use the cfgadm(1m) command to detect and configure fabric devices.

the device information that you supply and that is displayed by the cfgadm(1m) command depends on your system configuration.

▼ to configure an individual device without multipathing

this sample procedure describes how to configure a fabric device that is attached to the fabric-connected host port c0.

1 log in as root (su - root).

2 identify the device to be configured.

```
# cfgadm -al
Ap_Id     Type       Receptacle Occupant Condition
---------- --------            --------
c0:50020f2300006107 disk    connected unconfigured unknown
```

note – the cfgadm -l command displays information about fc host ports. you can also use the cfgadm -al command to display information about fc devices. the lines that include a port world wide name (wwn) in the ap_id field associated with c0 represent a fabric device. use the cfgadm configure and unconfigure commands to manage those devices and make them available to hosts using the solaris express developer's edition os. the ap_id devices with port wwns under c1 represent private-loop devices that are configured through the c1 host port.
3  Configure the fabric device.
    # cfgadm -c configure c0::50020f2300006077

4  Verify that the selected fabric device is configured.
    # cfgadm -al

<table>
<thead>
<tr>
<th>Ap_Id</th>
<th>Type</th>
<th>Receptacle</th>
<th>Occupant</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>c0</td>
<td>fc-fabric</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c0::50020f2300006077</td>
<td>disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c0::50020f23000063a9</td>
<td>disk</td>
<td>connected</td>
<td>unconfigured</td>
<td>unknown</td>
</tr>
<tr>
<td>c0::50020f2300005f24</td>
<td>disk</td>
<td>connected</td>
<td>unconfigured</td>
<td>unknown</td>
</tr>
<tr>
<td>c0::50020f2300006107</td>
<td>disk</td>
<td>connected</td>
<td>unconfigured</td>
<td>unknown</td>
</tr>
<tr>
<td>c1</td>
<td>fc-private</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c1::22020370bb69c32b</td>
<td>disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c1::22020370ba7d032</td>
<td>disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c1::22020370bb45f2</td>
<td>disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c1::22020370bb2b2</td>
<td>disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
</tbody>
</table>

Notice that the Occupant column for both c0 and c0::50020f2300006077 displays as configured, indicating that the c0 port has a configured occupant and that the c0::50020f2300006077 device is configured.

5  Use the show_SCSI_LUN option to display FCP SCSI LUN information for multi-LUN SCSI devices.

    # cfgadm -al -o show_SCSI_LUN c0

<table>
<thead>
<tr>
<th>Ap_Id</th>
<th>Type</th>
<th>Receptacle</th>
<th>Occupant</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>c0</td>
<td>fc-fabric</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c0::50020f2300006077,0</td>
<td>disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c0::50020f2300006077,1</td>
<td>disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c0::50020f2300006077,2</td>
<td>disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c0::50020f2300006077,3</td>
<td>disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
</tbody>
</table>

The device is now available on the host using the Solaris Express Developer’s Edition OS. The paths represent each SCSI LUN in the physical device represented by c0::50020f2300006077.
To Configure Multiple Devices Without Multipathing

Make sure you first identify the devices visible to the host with the procedure “Ensuring That LUN Level Information Is Visible” on page 85. This procedure describes how to configure all unconfigured fabric devices that are attached to a fabric-connected host port. The port used as an example is c0.

1  Log in as root (su - root).

2  Identify the devices to be configured.

   # cfgadm -al

<table>
<thead>
<tr>
<th>Ap_Id</th>
<th>Type</th>
<th>Receptacle</th>
<th>Occupant</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>c0</td>
<td>fc-fabric</td>
<td>connected</td>
<td>unconfigured</td>
<td>unknown</td>
</tr>
<tr>
<td>c0::50020f2300006077</td>
<td>disk</td>
<td>connected</td>
<td>unconfigured</td>
<td>unknown</td>
</tr>
<tr>
<td>c0::50020f23000063a9</td>
<td>disk</td>
<td>connected</td>
<td>unconfigured</td>
<td>unknown</td>
</tr>
<tr>
<td>c0::50020f2300005f24</td>
<td>disk</td>
<td>connected</td>
<td>unconfigured</td>
<td>unknown</td>
</tr>
<tr>
<td>c0::50020f2300006107</td>
<td>disk</td>
<td>connected</td>
<td>unconfigured</td>
<td>unknown</td>
</tr>
<tr>
<td>c1</td>
<td>fc-private</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c1::220203700b69c32b</td>
<td>disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c1::220203700ba7d832</td>
<td>disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c1::220203700b0d45f2</td>
<td>disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c1::220203700b9e20b2</td>
<td>disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
</tbody>
</table>

3  Configure all of the unconfigured devices on the selected port.

   # cfgadm -c configure c0

   Note – This operation repeats the configure operation of an individual device for all the devices on c0. This can be time consuming if the number of devices on c0 is large.

4  Verify that all devices on c0 are configured.

   # cfgadm -al

<table>
<thead>
<tr>
<th>Ap_Id</th>
<th>Type</th>
<th>Receptacle</th>
<th>Occupant</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>c0</td>
<td>fc-fabric</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c0::50020f2300006077</td>
<td>disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c0::50020f23000063a9</td>
<td>disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c0::50020f2300005f24</td>
<td>disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c0::50020f2300006107</td>
<td>disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c1</td>
<td>fc-private</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c1::220203700b69c32b</td>
<td>disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c1::220203700ba7d832</td>
<td>disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c1::220203700b0d45f2</td>
<td>disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c1::220203700b9e20b2</td>
<td>disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
</tbody>
</table>
Use the `show_SCSI_LUN` command to display FCP SCSI LUN information for multi-LUN SCSI devices.

The following code example shows that the physical devices represented by `c0::50020f230006077` and `c0::50020f230006107` each have four LUNS configured. The physical devices represented by `c0::50020f2300063a9` and `c0::50020f230005f24` each have two LUNS configured.

```
# cfgadm -al -o show_SCSI_LUN c0
```

<table>
<thead>
<tr>
<th>Ap_Id</th>
<th>Type</th>
<th>Receptacle</th>
<th>Occupant</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>fc-fabric</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
<td></td>
</tr>
<tr>
<td>c0::50020f230006077,0</td>
<td>disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c0::50020f230006077,1</td>
<td>disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c0::50020f230006077,2</td>
<td>disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c0::50020f230006077,3</td>
<td>disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c0::50020f2300063a9,0</td>
<td>disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c0::50020f2300063a9,1</td>
<td>disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c0::50020f230005f24,0</td>
<td>disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c0::50020f230005f24,1</td>
<td>disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c0::50020f230006107,0</td>
<td>disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c0::50020f230006107,1</td>
<td>disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c0::50020f230006107,2</td>
<td>disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c0::50020f230006107,3</td>
<td>disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
</tbody>
</table>

Configuring Device Nodes With Solaris Multipathing Software Enabled

This section describes how to perform fabric device configuration steps on a host that has the multipathing software enabled.

The devices attached to the fabric-connected host port are not configured by default and so are not available to the host using the Solaris Express Developer’s Edition OS. Use the `cfgadm configure` and `cfgadm unconfigure` commands to manage device node creation for fabric devices. See the `cfgadm(1M)` man page for additional information. The procedures in this section illustrate steps to detect fabric devices that are visible on a host and to configure them as multipathing devices to make them available to the host using the Solaris Express Developer’s Edition OS.

The device information that you supply, and that is displayed by the `cfgadm(1M)` command, depends on your system configuration. For more information on the `cfgadm` command, see the `cfgadm_fp(1M)` and `cfgadm(1M)` man pages.
To Configure Individual Devices With Sun StorageTek Traffic Manager Software

This sample procedure uses fabric-connected host ports c0 and c2 to configure fabric devices as multipath devices on a host that has the Sun StorageTek Traffic Manager software enabled.

The `cfgadm -c configure` command for fabric devices is the same regardless of whether multipathing is enabled.

1. **Log in as root** *(su - root)*.

2. **Identify the port WWN of the device to be configured as the Sun StorageTek Traffic Manager software device.**

   Look for devices on a fabric-connected host port marked as `fc-fabric`. These devices are the devices you can configure with the `cfgadm -c configure` command.

   ```
   # cfgadm -al
   Ap_Id  Type      Receptacle     Occupant     Condition
   c0     fc-fabric connected unconfigured unknown
   c0::50020f2300006077 disk connected unconfigured unknown
   c0::50020f23000063a9 disk connected unconfigured unknown
   c1     fc-private connected configured unknown
   c1::220203708b69c32b disk connected configured unknown
   c1::220203708ba7d832 disk connected configured unknown
   c1::220203708b8d45f2 disk connected configured unknown
   c1::220203708b9b20b2 disk connected configured unknown
   c2     fc-fabric connected unconfigured unknown
   c2::50020f2300006107 disk connected unconfigured unknown
   c2::50020f2300006107 disk connected unconfigured unknown
   #
   ``

   In the above example, the `c0::50020f2300006077` and `c2::50020f2300006107` `Ap_Id`s represent the same storage device with different port WWNs for the storage device controllers. The `c0` and `c2` host ports are enabled for use by the Sun StorageTek Traffic Manager software.

3. **Configure the fabric device and make the devices available to the host.**

   ```
   # cfgadm -c configure c0::50020f2300006077 c2::50020f2300006107
   ``

4. **Verify that the selected devices are configured.**

   ```
   # cfgadm -al
   Ap_Id  Type      Receptacle     Occupant     Condition
   c0     fc-fabric connected configured unknown
   c0::50020f2300006077 disk connected configured unknown
   c0::50020f23000063a9 disk connected unconfigured unknown
   c1     fc-private connected configured unknown
   c1::220203708b69c32b disk connected configured unknown
   c1::220203708b9b20b2 disk connected configured unknown
   ```
Notice that the Occupant column of c0 and c0::50020f2300006077 specifies configured, which indicates that the c0 port has at least one configured occupant and that the c0::50020f2300006077 device is configured. The same change has been made in c2 and c2::50020f2300006107.

When the configure operation has been completed without an error, multipathing-enabled devices are created on the host. If the physical device represented by c0::50020f2300006077 and c2::50020f2300006107 has multiple SCSI LUNs configured, each LUN is configured as a Sun StorageTek Traffic Manager software device. The example below shows that two LUNs are configured through c0::50020f2300006077 and c2::50020f2300006107. Each Ap_Id is associated with a path to those Sun StorageTek Traffic Manager software devices.

```
# cfgadm -a -o show_SCSI_LUN c0::50020f2300006077\ c2::50020f2300006107
```

The example above shows that the following two multipathing-enabled devices are created for the device represented by c0::50020f2300006077 and c2::50020f2300006107:

<table>
<thead>
<tr>
<th>Ap_Id</th>
<th>Type</th>
<th>Receptacle</th>
<th>Occupant</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>c0::50020f2300006077,0 disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
<td></td>
</tr>
<tr>
<td>c0::50020f2300006077,1 disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
<td></td>
</tr>
<tr>
<td>c2::50020f2300006107,0 disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
<td></td>
</tr>
<tr>
<td>c2::50020f2300006107,1 disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
<td></td>
</tr>
</tbody>
</table>

To Configure Multiple Devices With Multipathing

Before you configure or remove device nodes, be sure to first identify the fabric devices by using the procedure “Ensuring That LUN Level Information Is Visible” on page 85.

In this example, an Ap_Id on a fabric-connected host port is a path to the Sun StorageTek Traffic Manager software device. For example, all devices with a path through c2 are to be configured, but none through c0 are to be configured. c2 is an attachment point from the host to the fabric, whereas c2::50020f2300006107 is an attachment point from the storage to the fabric. A host detects all the storage devices in a fabric for which it is configured.

Configuring an Ap_Id on the device that has already been configured through another Ap_Id results in an additional path to the previously configured device. A new device node is not created in this case. The device node is created only the first time an Ap_Id to the corresponding device is configured.

1 Log in as root (su - root)..
Identify the fabric-connected host port to be configured.

```bash
# cfgadm -al
```

<table>
<thead>
<tr>
<th>Ap_Id</th>
<th>Type</th>
<th>Receptacle</th>
<th>Occupant</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>c0</td>
<td>fc-fabric</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c0::50020f2300006077 disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
<td></td>
</tr>
<tr>
<td>c0::50020f23000063a9 disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
<td></td>
</tr>
<tr>
<td>c1</td>
<td>fc-private</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c1::22020370b60c32b disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
<td></td>
</tr>
<tr>
<td>c1::22020370ba7d832 disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
<td></td>
</tr>
<tr>
<td>c1::22020370b8d45f2 disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
<td></td>
</tr>
<tr>
<td>c1::22020370b9b20b2 disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
<td></td>
</tr>
<tr>
<td>c2</td>
<td>fc-fabric</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c2::50020f2300006107 disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
<td></td>
</tr>
</tbody>
</table>
| Devices represented by Ap_Ids c0::50020f2300006077 and c2::50020f2300006107 are two paths to the same physical device, with c0::50020f2300006077 already configured. Configure the unconfigured devices on the selected port. This operation repeats the configure command of an individual device for all the devices on c2. This can be time-consuming if the number of devices on c2 is large.

```bash
# cfgadm -c configure c2
```

Verify that all devices on c2 are configured.

```bash
# cfgadm -al
```

<table>
<thead>
<tr>
<th>Ap_Id</th>
<th>Type</th>
<th>Receptacle</th>
<th>Occupant</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>c0</td>
<td>fc-fabric</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c0::50020f2300006077 disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
<td></td>
</tr>
<tr>
<td>c0::50020f23000063a9 disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
<td></td>
</tr>
<tr>
<td>c1</td>
<td>fc-private</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c1::22020370b60c32b disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
<td></td>
</tr>
<tr>
<td>c1::22020370ba7d832 disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
<td></td>
</tr>
<tr>
<td>c1::22020370b8d45f2 disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
<td></td>
</tr>
<tr>
<td>c1::22020370b9b20b2 disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
<td></td>
</tr>
<tr>
<td>c2</td>
<td>fc-fabric</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c2::50020f2300006107 disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
<td></td>
</tr>
</tbody>
</table>

Notice that the Occupant column of c2 and all of the devices under c2 is marked as configured.

The show_SCSI_LUN command displays FCP SCSI LUN information for multiple LUN SCSI devices. The following code example shows that the physical devices connected through by c2::50020f2300006107 and c2::50020f2300006077 each have two LUNs configured.

```bash
# cfgadm -al -o show_SCSI_LUN c2
```

<table>
<thead>
<tr>
<th>Ap_Id</th>
<th>Type</th>
<th>Receptacle</th>
<th>Occupant</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>c2</td>
<td>fc-fabric</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c2::50020f2300006107 disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
<td></td>
</tr>
</tbody>
</table>
Unconfiguring Fabric Devices

This section provides information about unconfiguring the Sun StorageTek Traffic Manager software.

Unconfiguring a Fabric Device

Before you unconfigure a fabric device, stop all activity to the device and unmount any file systems on the fabric device. See the administration documentation for the Solaris Express Developer’s Edition OS for unmounting instructions. If the device is under any volume manager’s control, see the documentation for your volume manager before unconfiguring the device.

To Unconfigure a Fabric Device

This procedure describes how to unconfigure a fabric device that is attached to the fabric-connected host port c0.

1 Log in as root (su - root).. 
2 Identify the device to be unconfigured.
   Only devices on a fabric-connected host port can be unconfigured.
   
   # cfgadm -al
<table>
<thead>
<tr>
<th>Ap_Id</th>
<th>Type</th>
<th>Receptacle</th>
<th>Occupant</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>c0</td>
<td>fc-fabric</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c0::50020f23000006077</td>
<td>disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c0::50020f230000063a9</td>
<td>disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c1</td>
<td>fc-private</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c1::22020370b669c32b</td>
<td>disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c1::22020370ba7d832</td>
<td>disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
</tbody>
</table>

3 Unconfigure the fabric device.
   
   # cfgadm -c unconfigure c0::50020f23000006077

4 Verify that the selected fabric device is unconfigured.
   
   # cfgadm -al
<table>
<thead>
<tr>
<th>Ap_Id</th>
<th>Type</th>
<th>Receptacle</th>
<th>Occupant</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>c0</td>
<td>fc-fabric</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
</tbody>
</table>
Unconfiguring Fabric Devices

To Unconfigure All Fabric Devices on a Fabric-Connected Host Port

This procedure describes how to unconfigure all configured fabric devices that are attached to a fabric-connected host port.

1 Log in as root (su - root).

2 Identify the fabric devices to be unconfigured.

Only devices on a fabric-connected host port can be unconfigured.

```
# cfgadm -al
```

<table>
<thead>
<tr>
<th>Ap_Id</th>
<th>Type</th>
<th>Receptacle</th>
<th>Occupant</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>c0</td>
<td>fc-fabric</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c0::50020f2300006077 disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
<td></td>
</tr>
<tr>
<td>c0::50020f23000063a9 disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
<td></td>
</tr>
<tr>
<td>c1</td>
<td>fc-private</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c1::220203708b69c32b disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
<td></td>
</tr>
<tr>
<td>c1::220203708ba7d832 disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
<td></td>
</tr>
</tbody>
</table>

3 Stop all activity to each fabric device on the selected port and unmount any file systems on each fabric device.

If the device is under any volume manager's control, see the documentation for your volume manager before unconfiguring the device.

```
# cfgadm -c unconfigure c0
```

4 Unconfigure all of the configured fabric devices on a selected port.

```
# cfgadm -al
```

<table>
<thead>
<tr>
<th>Ap_Id</th>
<th>Type</th>
<th>Receptacle</th>
<th>Occupant</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>c0</td>
<td>fc-fabric</td>
<td>connected</td>
<td>unconfigured</td>
<td>unknown</td>
</tr>
<tr>
<td>c0::50020f2300006077 disk</td>
<td>connected</td>
<td>unconfigured</td>
<td>unknown</td>
<td></td>
</tr>
<tr>
<td>c0::50020f23000063a9 disk</td>
<td>connected</td>
<td>unconfigured</td>
<td>unknown</td>
<td></td>
</tr>
<tr>
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</tr>
<tr>
<td>c1::220203708b69c32b disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
<td></td>
</tr>
<tr>
<td>c1::220203708ba7d832 disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
<td></td>
</tr>
</tbody>
</table>

Note – This operation repeats the unconfigure operation of an individual device for all the devices on c0. This process can be time-consuming if the number of devices on c0 is large.

5 Verify that all the devices on c0 are unconfigured.

```
# cfgadm -al
```

<table>
<thead>
<tr>
<th>Ap_Id</th>
<th>Type</th>
<th>Receptacle</th>
<th>Occupant</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>c0</td>
<td>fc-fabric</td>
<td>connected</td>
<td>unconfigured</td>
<td>unknown</td>
</tr>
<tr>
<td>c0::50020f2300006077 disk</td>
<td>connected</td>
<td>unconfigured</td>
<td>unknown</td>
<td></td>
</tr>
<tr>
<td>c0::50020f23000063a9 disk</td>
<td>connected</td>
<td>unconfigured</td>
<td>unknown</td>
<td></td>
</tr>
<tr>
<td>c1</td>
<td>fc-private</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c1::220203708b69c32b disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
<td></td>
</tr>
<tr>
<td>c1::220203708ba7d832 disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
<td></td>
</tr>
</tbody>
</table>
Notice that the Occupant column of c0 and all the fabric devices attached to it are displayed as unconfigured.

▼ To Unconfigure a Fabric Device Associated With Sun StorageTek Traffic Manager Multipathing-Enabled Devices

This procedure shows fabric-connected host ports c0 and c2 to illustrate how to unconfigure fabric devices associated with Sun StorageTek Traffic Manager software devices.

1 Log in as root (su - root)

2 Identify the port WWN of the fabric device to be unconfigured.

```
# cfgadm -al
```

<table>
<thead>
<tr>
<th>Ap_Id</th>
<th>Type</th>
<th>Receptacle</th>
<th>Occupant</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>c0</td>
<td>fc-fabric</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c0:50020f2300006077</td>
<td>disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c0:50020f23000063a9</td>
<td>disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c1</td>
<td>fc-private</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c1:220203708b69c32b</td>
<td>disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c1:220203708ba7d832</td>
<td>disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c2</td>
<td>fc-fabric</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c2:50020f2300006107</td>
<td>disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
</tbody>
</table>

In this example, the c0:50020f2300006077 and c2:50020f2300006107 Ap_Ids represent different port WWNs for the same device associated with a Sun StorageTek Traffic Manager software device. The c0 and c2 host ports are enabled for use by the Sun StorageTek Traffic Manager software.

3 Stop all device activity to each fabric device on the selected port and unmount any file systems on each fabric device.

If the device is under any volume manager’s control, see the documentation for your volume manager for maintaining the fabric device.

4 Unconfigure fabric devices associated with the device.

Only devices on a fabric-connected host port can be unconfigured through the `cfgadm -c unconfigure` command.

```
# cfgadm -c unconfigure c0:50020f2300006077 c2:50020f2300006107
```

Note – You can remove a device from up to eight paths individually, as in the example command `cfgadm -c unconfigure c0::1111, c1::2222, c3::3333, and so on. As an alternative, you can remove an entire set of paths from the host, as in the example `cfgadm -c unconfigure c0`. 

Appendix A • Manual Configuration for Fabric-Connected Devices 95
5  Verify that the selected devices are unconfigured.

```
# cfgadm -al
```

<table>
<thead>
<tr>
<th>Ap_Id</th>
<th>Type</th>
<th>Receptacle</th>
<th>Occupant</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>c0</td>
<td>fc-fabric</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c0::50020f2300006077 disk</td>
<td>connected</td>
<td>unconfigured</td>
<td>unknown</td>
<td></td>
</tr>
<tr>
<td>c0::50020f23000063a9 disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
<td></td>
</tr>
<tr>
<td>c1</td>
<td>fc-private</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c1::220203708b69c32b disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
<td></td>
</tr>
<tr>
<td>c1::220203708ba7d832 disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
<td></td>
</tr>
<tr>
<td>c2</td>
<td>fc-fabric</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c2::50020f2300006107 disk</td>
<td>connected</td>
<td>unconfigured</td>
<td>unknown</td>
<td></td>
</tr>
</tbody>
</table>

Notice that the Ap_Ids c0::50020f2300006077 and c2::50020f2300006107 are unconfigured. The Occupant column of c0 and c2 still displays those ports as configured because they have other configured occupants.

The Sun StorageTek Traffic Manager software devices associated with the Ap_Ids c0::50020f2300006077 and c2::50020f2300006107 are no longer available to the host using the Solaris Express Developer's Edition OS. The following two devices are removed from the host:

```
/dev/rdsk/c6t60020F20000061073ACB52D000B74A3d0s2
/dev/rdsk/c6t60020F20000061073ACB84C50004ED3Ad0s2
```

▼  To Unconfigure One Path to a Multipathing Device

In contrast to the procedure in the preceding section, this procedure shows how to unconfigure one device associated with c2::50020f2300006107 and leave the other device, 50020f2300006077, configured. Only devices on a fabric-connected host port can be unconfigured through the `cfgadm unconfigure` command.

1  Log in as root (su - root).

2  Identify the Ap_Id of the Sun StorageTek Traffic Manager software device to be unconfigured.

```
# cfgadm -al
```

<table>
<thead>
<tr>
<th>Ap_Id</th>
<th>Type</th>
<th>Receptacle</th>
<th>Occupant</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>c0</td>
<td>fc-fabric</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c0::50020f2300006077 disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
<td></td>
</tr>
<tr>
<td>c0::50020f23000063a9 disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
<td></td>
</tr>
<tr>
<td>c1</td>
<td>fc-private</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c1::220203708b69c32b disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
<td></td>
</tr>
<tr>
<td>c1::220203708ba7d832 disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
<td></td>
</tr>
<tr>
<td>c2</td>
<td>fc-fabric</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c2::50020f2300006107 disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
<td></td>
</tr>
<tr>
<td>c2::50020f2300006077 disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
<td></td>
</tr>
</tbody>
</table>
In this example, c0::50020f2300006077 and c2::50020f2300006107 Ap_Ids represent different port WWNs for the same device.

3 Unconfigure the Ap_Id associated with the device.

Note – If the Ap_Id represents the last configured path to the device, stop all activity to the path and unmount any file systems on it. If the multipathing device is under any volume manager’s control, see the documentation for your volume manager for maintaining the fabric device.

In the example that follows, the path represented as c2::50020f2300006107 is unconfigured, and c0::50020f2300006077 remains configured to show how you can unconfigure just one of multiple paths for a multipathing device.

```sh
# cfgadm -c unconfigure c2::50020f2300006107
```

4 Verify that the selected path c2::50020f2300006107 is unconfigured.

```sh
# cfgadm -al
```

<table>
<thead>
<tr>
<th>Ap_Id</th>
<th>Type</th>
<th>Receptacle</th>
<th>Occupant</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>c0</td>
<td>fc-fabric</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c0::50020f2300006077</td>
<td>disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c0::50020f23000063a9</td>
<td>disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c1</td>
<td>fc-private</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c1::22020370b69c32b</td>
<td>disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c1::22020370ba7d832</td>
<td>disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c2</td>
<td>fc-fabric</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c2::50020f2300006107</td>
<td>disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c2::50020f2300005f24</td>
<td>disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c2::50020f2300006107</td>
<td>disk</td>
<td>connected</td>
<td>unconfigured</td>
<td>unknown</td>
</tr>
</tbody>
</table>

The devices associated with that Ap_Id are still available to a host using the Solaris Express Developer’s Edition OS through the other path, represented by c0::50020f2300006077. A device can be connected to multiple Ap_Ids and an Ap_Id can be connected to multiple devices.

```
> /dev/rdsk/c6t60020f20000061073AC8B52000874A3Ad0s2
```

To Unconfigure All Fabric-Connected Devices With Multipathing Enabled

An Ap_Id on a fabric-connected host port is a path to the Sun StorageTek Traffic Manager software device.

When a Sun StorageTek Traffic Manager software device has multiple Ap_Ids connected to it, the device is still available to the host using the Solaris Express Developer’s Edition OS after you unconfigure an Ap_Id. After you unconfigure the last Ap_Id, no additional paths remain and...
the device is unavailable to the host using the Solaris Express Developer’s Edition OS. Only devices on a fabric-connected host port can be unconfigured.

1 Log in as root (su - root).

2 Identify the devices to be unconfigured.

```
# cfgadm -al
```

<table>
<thead>
<tr>
<th>Ap_Id</th>
<th>Type</th>
<th>Receptacle</th>
<th>Occupant</th>
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</thead>
<tbody>
<tr>
<td>c0</td>
<td>fc-fabric</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c0::50020f2300006077 disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
<td></td>
</tr>
<tr>
<td>c0::50020f23000063a9 disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
<td></td>
</tr>
<tr>
<td>c1</td>
<td>fc-private</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c1::220203700b69c32b disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
<td></td>
</tr>
<tr>
<td>c1::220203700b9b20b2 disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
<td></td>
</tr>
<tr>
<td>c2</td>
<td>fc-fabric</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c2::50020f2300005f24 disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
<td></td>
</tr>
</tbody>
</table>

3 Unconfigure all of the configured devices on the selected port.

```
# cfgadm -c unconfigure c2
```

Note – This operation repeats the unconfigure command of an individual device for all devices on c2. This process can be time-consuming if the number of devices on c2 is large.

4 Verify that all devices on c2 are unconfigured.

```
# cfgadm -al
```

<table>
<thead>
<tr>
<th>Ap_Id</th>
<th>Type</th>
<th>Receptacle</th>
<th>Occupant</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>c0</td>
<td>fc-fabric</td>
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</tr>
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<td>connected</td>
<td>configured</td>
<td>unknown</td>
<td></td>
</tr>
<tr>
<td>c1</td>
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<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c1::220203700b69c32b disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
<td></td>
</tr>
<tr>
<td>c1::220203700ba7d832 disk</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
<td></td>
</tr>
<tr>
<td>c2</td>
<td>fc-fabric</td>
<td>connected</td>
<td>configured</td>
<td>unknown</td>
</tr>
<tr>
<td>c2::50020f2300005f24 disk</td>
<td>connected</td>
<td>unconfigured</td>
<td>unknown</td>
<td></td>
</tr>
<tr>
<td>c2::50020f2300006107 disk</td>
<td>connected</td>
<td>unconfigured</td>
<td>unknown</td>
<td></td>
</tr>
</tbody>
</table>

Notice that the Occupant column lists c2 and all the devices attached to c2 as unconfigured.
Supported FC-HBA API

This appendix contains the list of supported and unsupported FC-HBA Interfaces. For further information regarding the API, refer to the Sun StorageTek Traffic Manager multipathing “Software Features” on page 12.

Supported Fibre Channel HBA API

<table>
<thead>
<tr>
<th>FC-HBA Interfaces</th>
<th>Supported or Not Supported by Sun StorageTek Traffic Manager Software</th>
</tr>
</thead>
<tbody>
<tr>
<td>HBA_GetVersion</td>
<td>Supported</td>
</tr>
<tr>
<td>HBA_LoadLibrary</td>
<td>Supported</td>
</tr>
<tr>
<td>HBA_FreeLibrary</td>
<td>Supported</td>
</tr>
<tr>
<td>HBA_GetNumberOfAdapters</td>
<td>Supported</td>
</tr>
<tr>
<td>HBA_GetAdapterName</td>
<td>Supported</td>
</tr>
<tr>
<td>HBA_OpenAdapter</td>
<td>Supported</td>
</tr>
<tr>
<td>HBA_CloseAdapter</td>
<td>Supported</td>
</tr>
<tr>
<td>HBA_GetAdapterAttributes</td>
<td>Supported</td>
</tr>
<tr>
<td>HBA_GetAdapterPortAttributes</td>
<td>Supported</td>
</tr>
<tr>
<td>HBA_GetDiscoveredPortAttributes</td>
<td>Supported</td>
</tr>
<tr>
<td>HBA_GetPortAttributesbyWWN</td>
<td>Supported</td>
</tr>
<tr>
<td>HBA_SendCTPassThru</td>
<td>Supported</td>
</tr>
<tr>
<td>FC-HBA Interfaces</td>
<td>Supported or Not Supported by Sun StorageTek Traffic Manager Software</td>
</tr>
<tr>
<td>---------------------------</td>
<td>---------------------------------------------------------------------</td>
</tr>
<tr>
<td>HBA_SendCTPassThruV2</td>
<td>Supported</td>
</tr>
<tr>
<td>HBA_RefreshInformation</td>
<td>Supported</td>
</tr>
<tr>
<td>HBA_GetFcpTargetMapping</td>
<td>Supported</td>
</tr>
<tr>
<td>HBA_SendScsiInquiry</td>
<td>Supported</td>
</tr>
<tr>
<td>HBA_SendReportLuns</td>
<td>Supported</td>
</tr>
<tr>
<td>HBA_SendReadCapacity</td>
<td>Supported</td>
</tr>
<tr>
<td>HBA_GetPortStatistics</td>
<td>Supported</td>
</tr>
<tr>
<td>HBA_ResetStatistics</td>
<td>Not supported</td>
</tr>
<tr>
<td>HBA_GetFcpPersistentBinding</td>
<td>Not supported</td>
</tr>
<tr>
<td>HBA_GetEventBuffer</td>
<td>Not supported</td>
</tr>
<tr>
<td>HBA_SetRNIDMgmtInfo</td>
<td>Supported</td>
</tr>
<tr>
<td>HBA_GetRNIDMgmtInfo</td>
<td>Supported</td>
</tr>
<tr>
<td>HBA_SendRNID</td>
<td>Supported</td>
</tr>
<tr>
<td>HBA_SendRNIDV2</td>
<td>Supported</td>
</tr>
<tr>
<td>HBA_ScsiInquiryV2</td>
<td>Supported</td>
</tr>
<tr>
<td>HBA_ScsiReportLUNsV2</td>
<td>Supported</td>
</tr>
<tr>
<td>HBA_ScsiReadCapacityV2</td>
<td>Supported</td>
</tr>
<tr>
<td>HBA_OpenAdapterByWNN</td>
<td>Supported</td>
</tr>
<tr>
<td>HBA_RefreshAdapterConfiguration</td>
<td>Supported</td>
</tr>
<tr>
<td>HBA_GetVendorLibraryAttributes</td>
<td>Supported</td>
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<tr>
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This appendix provides solutions to potential problems that might occur while running the Sun StorageTek Traffic Manager software.

This appendix contains the following sections:
- “System Fails to Boot During stmsboot” on page 103
- “System Crashes During stmsboot” on page 104

**System Fails to Boot During stmsboot**

During the reboot following stmsboot enable (-e), disable (-d), or update (-u) operations if the system fails to boot but lets you enter single user mode, perform the following to recover.

▼ To Recover From Single User Mode

1. Type the root password and enter single user mode.

2. **Restart the mpxio-upgrade service.**
   ```
   # svcadm restart svc:/system/device/mpxio-upgrade:default
   ```

If this command is not successful, follow the instructions in the next section to recover your original configuration.

---

**Note** – In prior versions of the Solaris Express Developer’s Edition OS, this service was known as `svc:/platform/sun4u/mpxio-upgrade:default`. 
System Crashes During stmsboot

During the reboot following stmsboot enable (-e), disable (-d), or update (-u) operations, if your system hangs, panics, or fails to boot, follow the instructions below to recover your original configuration.

▼ To Recover from a System Crash

1. Boot the system from another disk, CD, DVD, or over the network.
2. Run the fsck your-root-device command where your-root-device is your original root device.
   ```
   # fsck your-root-device
   ```
3. Mount your original root device.
   ```
   # mount your-root-device /mnt
   ```
4. Restore your original fp.conf file (for FC multipathing) or mpt.conf (for SAS multipathing) as follows.
   ▪ If you ran the stmsboot -e command or stmsboot -d command:
     - For SAS multipathing, type the command cp /mnt/etc/mpxio/mpt.conf /mnt/kernel/drv/mpt.conf
     - For FC multipathing, type the command cp /mnt/etc/mpxio/fp.conf /mnt/kernel/drv/fp.conf
   ▪ If you ran the stmsboot -u command, and you modified either the fp.conf file or the mpt.conf undo the changes you made to this file by editing either the /mnt/kernel/drv/fp.conf or the /mnt/kernel/drv/mpt.conf files.
5. Undo any other changes you made to the multipathing configuration prior to running the stmsboot command.
   For example, if you modified the scsi_vhci.conf file, undo the changes you made to this file by editing the /mnt/kernel/drv/scsi_vhci.conf file.
   If you modified the device settings of your storage arrays, restore their original settings.
6. Restore your original /etc/vfstab file:
   ```
   # cp /mnt/etc/mpxio/vfstab /mnt/etc/vfstab
   ```
   The /mnt/etc/mpxio/vfstab file is a copy your original /etc/vfstab file that the stmsboot command saved prior to updating your vfstab file. A /mnt/etc/mpxio/vfstab file will not exist if the stmsboot command has not modified your vfstab file.
If the system is running on a Solaris Express Developer’s Edition OS x86 based system, perform the following steps:

a. **Restore your original** `/boot/solaris/bootenv.rc` **file.**
   
   ```bash
   # cp /mnt/etc/mpxio/bootenv.rc /mnt/boot/solaris/bootenv.rc
   ```
   
   The `/mnt/etc/mpxio/bootenv.rc` file is a copy your original `/boot/solaris/bootenv.rc` file that the stmsboot command saved prior to updating your bootenv.rc file. A `/mnt/etc/mpxio/bootenv.rc` file will not exist if the stmsboot command has not modified your bootenv.rc file.

b. **Update the boot archive.**
   
   ```bash
   # bootadm update-archive -R /mnt
   ```

8 **Disable the mpxio-upgrade service:**
   
   ```bash
   # /usr/sbin/svccfg -f /mnt/etc/mpxio/svccfg_recover
   ```

9 **Type** `sync` **to synchronize the file systems.**

10 **Unmount the device.**
    
    ```bash
    # umount /mnt
    ```

11 **Reboot the system.**
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