SANpath User's Guide

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Changes

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Contents

Preface

This manual provides instructions for installing, configuring, operating, and troubleshooting SANpath®.

How This Book Is Organized

This book contains the following topics:

Chapter 1 introduces SANpath and provides an overview.

Chapter 2 describes the SANpath hardware.

Chapter 3 describes SANpath commands and general configuration options.

Chapter 4 describes how install and configure SANpath on the Solaris operating system.

Chapter 5 provides Solaris troubleshooting suggestions.

Chapter 6 describes how to install and configure SANpath on the Linux operating system.

Chapter 7 provides Linux troubleshooting suggestions.

Chapter 8 describes how to install and configure SANpath on the Windows operating system.

Chapter 9 provides Windows troubleshooting suggestions.

Chapter 10 describes how to set up and install SANpath on the IBM AIX operating system.

Chapter 11 provides IBM AIX troubleshooting suggestions.

Appendix A provides a list of error codes and error and status messages.

Typographic Conventions

Typeface[1]	Meaning	Examples
`AaBbCc123`	The names of commands, files, and directories; onscreen user input	Edit your `.login` file. Use `ls -a` to list all files. `sccli> about`
AaBbCc123	Book titles, new words or terms, words to be emphasized, command-line variables.	Read Chapter 6 in the *User's Guide*. These are called *class* options. You *must* be a superuser to do this. To delete a file, type `rm` *filename*.

1 The settings on your browser might differ from these settings.

Related Documentation

Title	Part Number
SANpath Release Notes	83-00002723
SANscape® User's Guide	83-00003197
SANscape 3.0 Release Notes	83-00003225
SANscape Alert User's Guide	83-00003198
SANscape CLI User's Guide	83-00003199

Technical Support

For late-breaking *Release Notes* and all manuals for this product, go to the SANpath section at:

http://www.dothill.com/manuals

The following information may be required when contacting Technical Support: Dot Hill serial number and part number of hardware; version of Dot Hill supplied software; host computer platform and operating system version; description of the problem and any related error messages.

Please also supply the following information to facilitate our tracking system and improve our response time: customer name, company name; state and country; telephone number with area code; Internet mail address; maintenance contract number, if applicable.

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CHAPTER 1

Overview

This chapter introduces SANpath. Topics covered in this chapter include:

What is SANpath?

SANpath is a host-based SAN (Storage Area Network) management software product that manages virtual storage and SAN data paths. Its primary purpose is to allow for the easy configuration of multiple hosts in a SAN network configuration and to provide an instantaneous failover capability.

SANpath offers a new level of data accessibility and improved performance for storage systems, including Dot Hill's SANnet® I and SANnet II FC and SCSI arrays. It eliminates the point of failure represented by a single input/output (I/O) path between servers and storage systems and permits I/O to be distributed across multiple paths.

SANpath is available on Solaris, Windows NT 4, Windows 2000, IBM AIX, and Linux.

Failover/Failback Data Paths

By providing alternate I/O paths from the server to the storage system, SANpath provides uninterrupted access to mission-critical data. This substantially insulates server applications from I/O path failures.

In the event of a failed HBA, interface cable, or channel I/O card within the storage system, SANpath automatically reroutes I/O traffic to an alternate data path. Failover is essentially transparent, ensuring continuous access to data stored on the storage system. When configured in the recommended failback mode, SANpath automatically restores the primary data path and system redundancy once the defective component is replaced.

I/O Load Balancing

SANpath supports up to 32 data paths per LUN. Multiple data paths can be used to improve performance in one of three ways:

1. by allowing SANpath to uniformly distribute primary paths among all available I/O paths.This is the default behavior of SANpath.
2. by manually assigning I/O traffic for a logical drive to a particular path. The administrator with an understanding of the I/O load patterns of his or her applications can optimize performance through an intelligent choice of paths.
3. by enabling automatic load balancing. In this mode of operation SANpath monitors the load on each path and sends I/O requests through the path with the lightest load. This is the default behavior when you use SANpath with a Network Appliance storage device.

Dynamic LUN Masking

In SAN configurations with multiple servers attached to the same storage device, SANpath allows the system administrator to assign a logical drive to one server and prevent the other servers in the SAN from accessing that same logical drive.

How SANpath Works

SANpath's filter driver resides between the file system drivers and the SCSI disk device drivers. I/O requests are passed from the file system through SANpath, SANpath then the SCSI disk driver and ultimately to the hardware.

SANpath monitors the execution of I/O requests through the layered driver architecture. When it detects a failure along an I/O path, it automatically reroutes the request to an alternate path. Failover to the redundant I/O path is transparent to server applications and permits continuous access to the information stored on the disk array(s). To applications, there is only a slight delay in normal I/O operations during path failover. Existing drive numbers and device access functions continue to work as expected.

Supported SANpath Configurations

SANpath supports single and multiple-server configurations. See Table 1-1 for specific software/hardware requirements for SANpath.

User documentation for products used with SANpath is referenced throughout this manual. Have your hardware and operating system manuals available for quick reference.

Table 1-1. Minimum System Requirements

Operating System Requirements				
	Solaris	**Windows**	**IBM AIX**	**Linux**
Host Hardware	Ultra SPARC platform	Intel Pentium-based computer	All RS/6000 series computers	Intel Pentium-based computer
Host Software	Solaris 8 and 9, with Sun recommended patches	Windows NT 4.0 (Server or Workstation), with Service Pack 6A; Windows 2000 with Service Pack 3	AIX 5.1 32– and 64–bit	Red Hat Linux 7.3 with kernel 2.4.18-3
Host Disk Space	5 MB in **`$TEMP`** and 1 MB in the **`root`** directory	2 MB in the installation drive	5 MB in the **`root`** filesystem	5 MB in the **`root`** filesystem

Table 1-2. Firmware Requirements

Firmware Requirements (Applicable to All Operating Systems)		
	SANnet II	**SANnet I**
SCSI array	3.25O or later	3.15F or later
FC array	3.27K or later	3.15F or later

Summary of SANpath Benefits

- Increases throughput by directing I/O requests through multiple HBAs and storage system channels. Logical drives can be assigned to HBAs, manually balancing the I/O load across paths.
- Provides continuous access to mission-critical data by insulating server applications from I/O path failures.
- Installs easily and is transparent to server applications.
- Allows you to limit access to devices in a multi-initiator (SAN) environment using LUN (logical unit number) exclusion.

CHAPTER 2

Hardware Preparation

This chapter describes the SANpath hardware. Topics covered in this chapter include:

Hardware Overview

Multiple I/O Paths

Although SANpath can claim and manage qualified devices accessible from the host by only a single I/O path (see "Devices with Only One Path to the Host" on page 43), one of its primary purposes is the management of multiple I/O paths to storage system devices. This eliminates the data path as a potential single point of failure in the storage system.

To be properly configured for this purpose, every I/O-path element in the system must be redundant. A given host must be equipped with at least two HBAs (with a maximum of four HBAs), connected, in turn, by at least two cables to the storage system.

Host Computer and Storage Devices

SANpath supports all of Dot Hill's SANnet I and SANnet II FC and SCSI arrays. In order to take advantage of failover data paths and load balancing, these must be equipped with redundant interfaces.

- The SANnet II FC array are dual-controller, fibre channel RAID systems. Full I/O path redundancy requires them to be used with multiple hubs (see Figure 2-1.). SANnet II firmware 3.27K or later is required for operation with SANpath software.
- The SANnet II SCSI array are dual-controller, SCSI RAID systems. Full I/O path redundancy is achieved through independent host connections to the dual controllers. SANnet II firmware 3.25O or later is required for operation with SANpath software.
- The SANnet I FC array are dual-controller, fibre channel RAID systems. Full I/O path redundancy requires them to be used with multiple hubs. SANnet I firmware 3.15F or later is required for operation with SANpath software.

- The SANnet I SCSI array are dual-controller, SCSI RAID systems. Full I/O path redundancy is achieved through independent host connections to the dual controllers. SANnet I firmware 3.15F or later is required for operation with SANpath software.

All hardware elements in the system should be installed according to the directions in their respective user documentation.

Example Configurations

Figure 2-1. shows a dual-path configuration of SANpath with the SANnet II 200 FC array.

One of the host computer's two host bus adapters (HBA 1) is connected to the SANnet II through the first of the two fibre channel hubs (Hub 1), and the other (HBA 2) is connected through a second hub (Hub 2). Each hub is then connected to both of the SANnet II controllers.

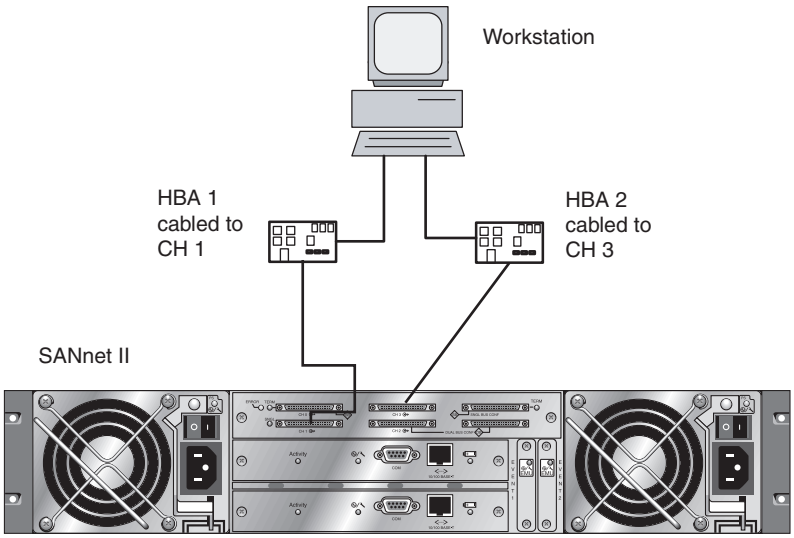

Figure 2-1. Dual-path SANpath System with the SANnet II 200 FC array

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Note – The cabling for the SANpath unit depends on the channels that you designate for host or drive usage. The example above uses CH 0, 1, 4 and CH 5 as host channels. Refer to Figure 2-3. for more details.

The host computer has two completely independent data paths to the storage system. If any element in either path fails, SANpath redirects all I/O to the functioning path.

Refer to the *SANnet II 200 FC Array Installation, Operation, and Service Manual* for detailed directions on cabling the SANnet II 200 FC array.

Figure 2-2. shows a single-path configuration of SANpath with the SANnet II 200 SCSI array with detailed cabling.

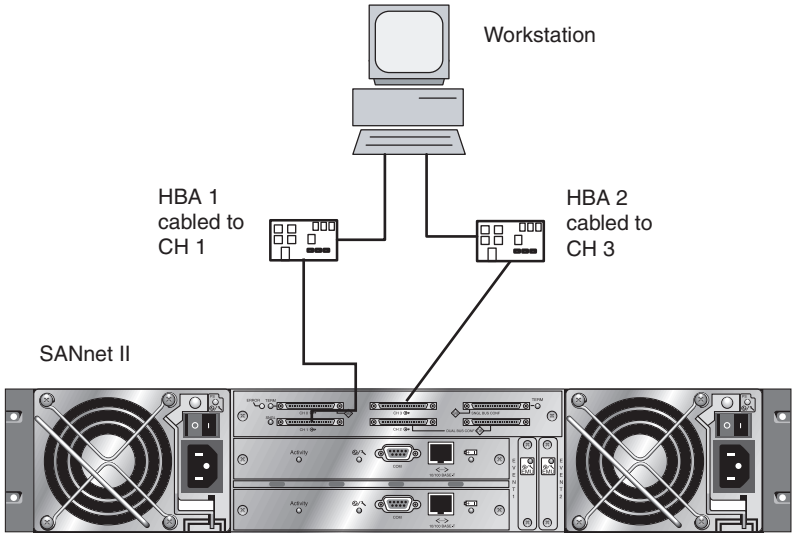

Figure 2-2. Single-path SANpath System with the SANnet II 200 SCSI array

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Note – The cabling for the SANpath unit depends on the channels that you designate for host or drive usage. The example above uses CH 1 and CH 3 as host channels.

Refer to the *SANnet II 200 SCSI Array Installation, Operation, and Service Manual* for detailed directions on cabling the SANnet II 200 SCSI array.

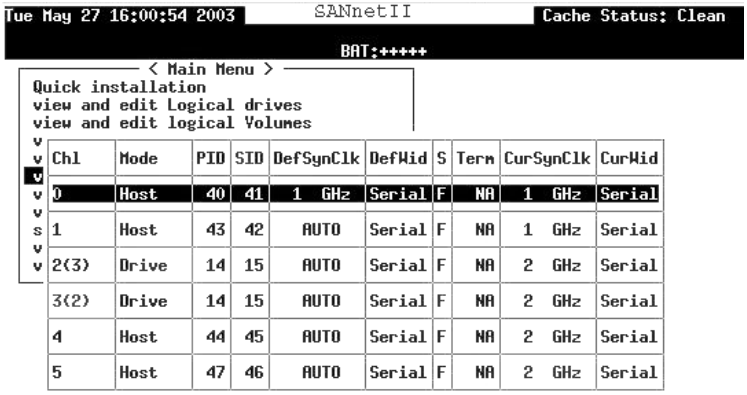
Host LUN Mapping

For both the SANnet II 200 FC and SCSI arrays, you must assign host channel target IDs. This can be done using the Hyperterm program, **`Kermit`** or other terminal emulation software or with a VT–100 compatible terminal.

Connect the RS–232 cable to the COM1 connector on the internal bus jumper I/O card in the back of the SANnet II.

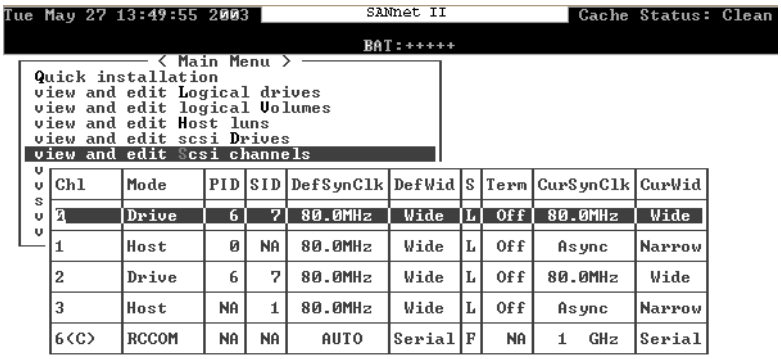
Refer to the *SANscape User's Guide* for detailed directions on establishing a serial interface connection.

From the main menu, choose **view and edit SCSI Channels**. Set the primary (PID) and secondary (SID) SCSI IDs for the host channels. For SANnet I, the host channels should be set to Channels 6 and 7. For SANnet II, the host channels should be set to Channels 0 and 1 for the FC array and to Channels 1 and 3 for the SCSI array, as shown in Figure 2-3. and Figure 2-4..



Chl	Mode	PID	SID	DefSynClk	DefWid	S	Term	CurSynClk	CurWid
0	Host	40	41	1 GHz	Serial	F	NA	1 GHz	Serial
1	Host	43	42	AUTO	Serial	F	NA	1 GHz	Serial
2(3)	Drive	14	15	AUTO	Serial	F	NA	2 GHz	Serial
3(2)	Drive	14	15	AUTO	Serial	F	NA	2 GHz	Serial
4	Host	44	45	AUTO	Serial	F	NA	2 GHz	Serial
5	Host	47	46	AUTO	Serial	F	NA	2 GHz	Serial

Figure 2-3. Host Assignments for a SANnet II 200 FC array



Chl	Mode	PID	SID	DefSynClk	DefWid	S	Term	CurSynClk	CurWid
2	Drive	6	7	80.0MHz	Wide	L	Off	80.0MHz	Wide
1	Host	0	NA	80.0MHz	Wide	L	Off	Async	Narrow
2	Drive	6	7	80.0MHz	Wide	L	Off	80.0MHz	Wide
3	Host	NA	1	80.0MHz	Wide	L	Off	Async	Narrow
6(C)	RCCOM	NA	NA	AUTO	Serial	F	NA	1 GHz	Serial

Figure 2-4. Host Assignments for a SANnet II 200 SCSI array

The following figure shows multiple hosts with consolidated storage.

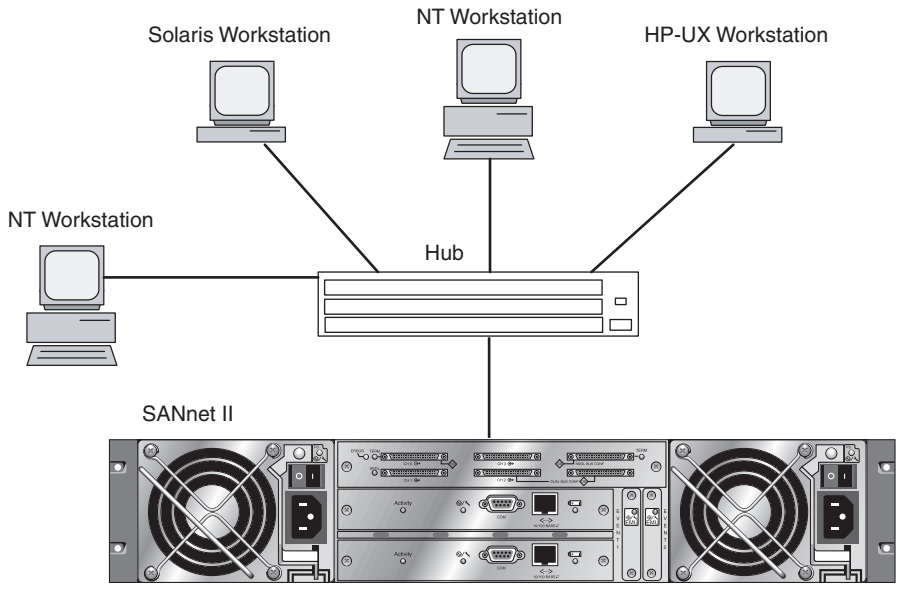


Figure 2-5. Multiple Hosts with Consolidated Storage

CHAPTER 3

SANpath Operation

This chapter describes SANpath commands and general configuration options. Topics covered in this chapter include:

Overview

There are three commands in SANpath:

- **`setsp`** is used to examine and configure the system's operating parameters and is the command most often invoked by the user.
- **`sppath`** identifies devices to be placed under SANpath's control.
- **`spmon`** monitors path states.

Note – For Microsoft Windows, Solaris, and IBM AIX: **`spmon`** should not be used when SANpath is used with SANscape.

The setsp Command

The **`setsp`** command is used for most configuration tasks.

Table 3-1. gives a brief explanation of **`setsp`** command options. Those used to configure SANpath device parameters are covered in detail in "Changing the Configuration" on page 18.

The output of **`setsp`** is also used in conjunction with OS level events to determine the nature and physical location of failures. This is covered in detail in the Troubleshooting chapters of this manual.

Command options that take arguments (shown in braces after the command) require an argument and should not be run without one.

Table 3-1. setsp Command Options

Option	Effect
–a	Show current device configuration and state.
–b{0|1|2}	Set load balancing for a logical device. Must be used with the -l command option: –b0 disables load balancing for the device. –b1 enables load balancing for the device. –b2 enables load-balancing for HACMP only.
–d<n>	Set a retry delay of *n* for a logical drive, where *n* is the interval between retries in milliseconds within the range of 0–100000. Must be used with the -l command option.
–e{0|1}	Set exclusion for a logical drive. Must be used with the -l command option: –e0 includes the device. –e1 excludes it; excluded devices are not accessible by user applications.
–f{0|1}	Set failback for a logical drive. Must be used with the -l command option: –f0 disables failback for the device. –f1 enables it.
–g	Generate kernel configuration files after an sppath command is issued.
–i	Show contents of driver configuration files.
–l{<n>|all}	Specify a logical drive for the command, where *n* is the drive's SPD number. When all is specified, the command applies to every SANpath device.
–L <parameter>	Show current device configuration according to condition(s) defined by setsp command option parameter(s) (e.g., setsp –L –e1 lists all excluded devices; setsp –L –b0 –f1 lists all devices that have load balancing disabled and failback enabled). Acceptable parameters are: –l, –e, –p, –b, –r, –d, and –f.
–n<n>	Allocate *n* buffer pointers for a logical drive. The range is 1–4000. Must be used with the -l command option.
–N	Change the configuration files without affecting the running system (changes take effect at the next boot).
–p<n>	Select the primary path *n* for an SPD device. Must be used with the -l command option.

Table 3-1. setsp Command Options *(Continued)*

–r<n>	Set a retry count of *n* for a logical drive, where *n* is the number of times a command will be retried. The number must be between 0 and 8192. Must be used with the -l command option.
–S	Start the SPD driver. Must be used with the -l command option. If this option does not include an argument, it starts all SPD devices.
–T	Terminate the SPD driver. Must be used with the -l command option.If this option does not include an argument, it terminates all SPD devices.
–u{0|1|2}	Show devices by their configuration status: –u0 shows all available devices. –u1 shows configured disks. –u2 shows unconfigured disks.
–U	Unmount a drive letter (Windows 2000 only): –U *G* removes the drive assigned to the letter *G*
–v	Runs the –a command in verbose mode.
–V	Display the SANpath version.
–x	Removes an SPD device from the config file. It suppresses the named (with –l) SPD device(s). If the device is started, it won't take effect until the device is stopped or the host rebooted. The end result is “similar” to a device ignored on sppath (sppath –I). That is, the paths to that LUN are not mapped through a single pseudo device. “setsp –g –l<n>” must be used to cancel.

The sppath Command

The **sppath** command is run automatically at boot after SANpath is installed. The main function of **sppath** is to create the configuration file that identifies devices to be put under SANpath’s control. Its command options are used to display or modify this device set.

sppath examines disk devices attached to the system to determine whether any physical devices are accessible via redundant paths and whether those devices should be put under the control of the SANpath driver. Qualifying devices are written to the **sppath.conf** file. This file should not be modified directly by the user.

To qualify, devices must *not* be boot devices, and must be a SANnet I or SANnet II storage device.

The following table provides a synopsis of **sppath** options.

Table 3-2. sppath Command Options

Option	Effect
–a	Sets up the SANpath serial number and authorization code.
–b	Enable or disable the paths of boot devices. –b0 ignores the boot devices. The default value is 0. –b1 includes the boot devices. This command prevents the ignored devices from being put under SANpath control.
–d	Display inquiry information in raw format (for debugging).
–D	Clear the list of ignored devices (should be followed by **setsp -g**; see NOTE below).
–I<devices>	Ignore the device or group of devices specified. AIX devices are specified in the form hdiskX where *X* is the number assigned by AIX for each disk. Alternate form for all host environments: –I using SAN ID. Example: –I “DotHill SANnet RAID x300 0001–0043BF50–04” All devices that match are ignored. This command should be followed by **setsp -g** to take effect: see the note below.
–v	Display the contents of **sppath.conf** after writing the file.
–V	Display the SANpath version.

Note – After running either reconfiguration **sppath** option (**-I** or **-D**), you must run **setsp -g** in order for the changes to be reflected in SANpath’s other configuration files, **spd.conf** and **/kernel/drv/spn.conf** for Solaris.

Table 3-3. sppath Command Options

Option	Effect
–a	Sets up the SANpath serial number and authorization code.
–b	Enable or disable the paths of boot devices. –b0 ignores the boot devices. The default value is 0. –b1 includes the boot devices. This command prevents the ignored devices from being put under SANpath control.
–d	Display inquiry information in raw format (for debugging)
–D	Clear the list of ignored devices (should be followed by setsp –g: see NOTE below)
–I<devices>	Ignore the device or group of devices specified. Solaris devices are specified in the form cX, cXtY, or cXtYdZ. AIX devices are specified in the form hdiskX where *X* is the number assigned by AIX for each disk. Microsoft Windows devices are specified in the form cX, cWbX, cWbXtY, or cWbXtYdZ. Linux devices are specified in the form cW, cWbX, cWbXtY, or cWbXtYdZ Example: –I cWbXtYdZ Alternate form for all host environments: –I using SAN ID Example: –I “DotHill SANnet RAID x300 0001–0043BF50–04” All devices that match will be ignored. This command should be followed by setsp –g to take effect: see NOTE below.
–v	Display the contents of *sppath.conf* after writing the file

Note – After running either reconfiguration **`sppath`** option (**`-I`** or **`-D`**), you must run **`setsp -g`** in order for the changes to be reflected in SANpath’s other configuration files, **`spd.conf`** and **`/kernel/drv/spn.conf`** for Solaris.

Note – **`sppath -I`** and **`setsp -e`** are not the same. **`sppath -I`** ignores the device and SANpath does not manage the ignored devices. **`setsp -e`** masks the LUN and SANpath does manage the devices.

Display Options for sppath

The **-v** option causes **sppath** to display the contents of the **sppath.conf** file.

```
# sppath -v
LUN=0  c7t0d0 dev=32,528 type=1
SANID="DotHill SANnetII 0002-31E88DA7-00"
LUN=0  c8t0d0 dev=32,704 type=1
SANID="DotHill SANnetII 0002-31E88DA7-00"
LUN=1  c7t0d1 dev=32,536 type=1
SANID="DotHill SANnetII 0002-31E88DA7-01"
LUN=1  c8t0d1 dev=32,712 type=1
SANID="DotHill SANnetII 0002-31E88DA7-01"
LUN=2  c7t0d2 dev=32,544 type=1
SANID="DotHill SANnetII 0002-31E88DA7-02"
LUN=2  c8t0d2 dev=32,720 type=1
```

Figure 3-1. Using **sppath** in Verbose Mode

The **-d** option displays inquiry data in raw format and is generally used only for debugging.

Ignore and Reclaim Devices with sppath

The **-I** option accepts symbolic device names corresponding to controllers or specific disks (see “spd field” on page 16 for examples of acceptable formats in various operating systems) and omits them from **sppath.conf**.

This prevents them from being put under SANpath’s control.

If a device is to be ignored, each of its underlying device paths (and not the SPD device name) should be specified with **-I** options. Multiple devices can be specified in a single **sppath** command, but each device specified must be preceded by **-I**. Once specified, the ignored device is remembered in sppath.conf and is ignored until the list of ignored devices is cleared with **sppath** using the **-D** option. The ignored devices behave like standard disk drives not under the control of SANpath. Run the following commands to ignore a device:

```
# sppath -I <devices>
# setsp -g
# reboot
```

Note – The **`sppath -I`** (ignore) command should not be confused with the **`setsp -e`** (exclude) command. The **`sppath -I`** (ignore) command removes the device completely from SANpath's control, treating it exactly as though it is incompatible with SANpath and could not be recognized and claimed.

The **`setsp -e`** command is intended chiefly for multiple host configurations and prevents particular logical devices from being accessed by a host. (For more information on device exclusion, see "setsp Command Options" on page 10 and "Turning the Exclusion Setting Off and On" on page 19.)

The **`-D`** option clears the entire list of ignored devices, allowing any eligible device to be placed under SANpath's control on the next reboot.

Run the following commands to clear the list of ignored devices:

```
# sppath -D
# setsp -g
# reboot
```

Understanding the setsp –a Screen

Use the **`setsp -a`** command to display SANpath's configuration:

```
================================================================================
 spd   Path/disk          Status   Pri Exc Buf Balance RtrCnt  RtrDly FailBack
================================================================================
   0   c4t2d0/sd33         Good     X       32    0      20     3000      1
       c15t2d0/sd246       Good
 spd0 = c6t2d0                          ID = "DotHill SANnetII 0002-31E88DA7-00"
================================================================================
```

Figure 3-2. Sample setsp –a Display in a Solaris Environment for SANnet II

```
================================================================================
 spd   Path/disk     Status Primary Exclude Buf Balance RtrCnt  RtrDly FailBack
================================================================================
   0   c0t1d0/5      Good     X              32    0      20     3000      1
       c3t0d0/7      Excluded         X
 spd0 = hdisk1               ID = "DotHill SANnetII 0002-31E88DA7-00"
================================================================================
   1   c0t1d1/6      Good                    32    0      20     3000      1
       c3t0d1/8      Good     X
 spd1 = hdisk2               ID = "DotHill SANnetII 0002-31E88DA7-01"
================================================================================
   2   c0t1d2/9      Good     X              32    0      20     3000      1
       c3t0d2/11      Good
 spd2 = hdisk3               ID = "DotHill SANnetII 0002-31E88DA7-02"
================================================================================
```

Figure 3-3. Sample setsp –a Display in an IBM AIX Environment for SANnet II

The column headings identify the various fields on this screen, the last seven of which are user-configurable parameters for the device. The **setsp** output fields (with their default values, when applicable) are described below. The commands used to change the default settings are described in the following section.

spd field

spd shows the spd (SANpath device) number, an ID assigned to the device by SANpath, and the name of the spd special device file created by SANpath to access the storage.

- In Solaris, the spd device is displayed in the form **spdN = cXtYdZ**, and provides the spd number (*N* in the **spdN** field) and the virtual device name (in the format **cXtYdZ**). This device number also appears in errors reported in the **/var/adm/messages** file.
- In Microsoft Windows, the disk number is given as **HardDisk X**, where **X** is a number used by Disk Administrator (Windows NT) or Disk Management (Windows 2000), and the Drive Letter(s) assigned by Disk Administrator (Windows NT) or Disk Management (Windows 2000). This device number also appears in errors reported in the (System) Event Log.
- In IBM AIX, the disk number is given as **hdiskX**, where **X** is a number used by ODM database.
- In Linux, the spd device is displayed in the form **spdN = spdX**, and provides the spd number (*N* in the **spdN** field) and the virtual device name (in the format **spdX**). This device name also appears in errors reported in the **/var/log/messages** file.

Path/disk field

Path/disk shows the device names and disk numbers for each of the redundant physical paths to the device. Their appearance in the **setsp -a** output facilitates interpreting these events in terms of the spd device names by which applications access devices.

- In Solaris, this field shows both the disk number in the form **cXtYdZ** and the number assigned by the sd driver (**sdnn**). The **sdnn** versions of the names appear in the file **/var/adm/messages** when the sd driver reports hardware events.
- In Microsoft Windows, this field shows both the disk number in the form **cWbXtYdZ** and the number assigned by Disk Administrator (Windows NT) or Disk Management (Windows 2000).
- In IBM AIX, this field shows the disk number in the form **hdiskN**.
- In Linux, this field shows the disk number in the form **cWbXtYdZ**.

Status field

Status shows the current state of the path. Good paths are functioning normally. Bad paths have failed. Excluded paths are unavailable to applications on this host.

Primary field

Primary shows which of the physical I/O paths connecting the device to the host's HBAs (or controllers) is defined as primary (marked by an **X**). Initially, primary path assignments are distributed evenly among the available paths. Figure 1-2 on page 6 shows this as an alternating pattern in a dual-path configuration: **spd0** has a primary path through controller 7, **spd1** uses its path through controller 8 as primary, and **spd2** alternates back to controller 7. The device's duplicate path(s) are not used unless the primary path fails or the load balancing option is selected for that device.

Exclude field

Exclude indicates the device's exclusion setting, which can be used to keep a host from seeing particular logical drives. As a safety measure, SANpath excludes all devices from host access by default, giving them an exclusion setting of 1. Excluded devices are marked by an **X** in this column.

Buf field

Buf is the number of buffer pointers (or buffer structures) pre-allocated for each logical device. For peak performance, **Buf** should be approximately equal to the maximum useful queue depth of the logical unit. Values between 1 and 100 are permitted. The default value is 32.

Balance field

Balance indicates whether dynamic load balancing is enabled for the device. When load balancing is enabled, SANpath tracks the volume of I/O on each path and automatically sends I/O requests to the path with the lightest I/O load. Automatic load balancing can be used with the SANnet storage systems only.

RtrCnt field

RtrCnt is the number of times SANpath retries the I/O operation on the primary path after an I/O operation has failed on all alternate paths. When the specified number of retries has failed, the I/O fails. The default value is 20. The highest value allowed is 1024.

RtrDly field

RtrDly is the time interval, in milliseconds, between the retry attempts described in the preceding parameter. The default value is 3000 ms. This value cannot be set above 100,000 ms (100s).

FailBack field

FailBack indicates whether failback is enabled for the logical device. When failback is enabled (the default setting of 1), SANpath continues testing a path that has failed and returns it to service (as the primary path or in load balancing) as soon as the path has been restored.

ID= identifier

In addition to the information defined by the **setsp -a** output's column headings, the last part of the last line for each device (**ID =**) shows the physical device's unique identifier, which is derived from the device's inquiry data.

Changing the Configuration

The information displayed by **setsp -a** is stored in the **spd.conf** configuration file, which should never be edited directly.

User-configurable parameters must be changed exclusively through the **setsp** command options provided for that purpose and described in more detail in the sections below.

Specifying a Device for setsp

To name a specific device in any setsp command, use the **-l** option (NOTE that this is a lowercase letter L, and not the number 1) followed by the device's spd number, as expressed in the syntax illustrations used in the remainder of this chapter as **-l <x>**. A device's spd number is listed in the first column of the **setsp -a** output. (See **setsp -a** examples under "Understanding the setsp –a Screen" on page 15.) To name all devices under SANpath's control, use **all**.

Whether you are applying the configuration command to a single device or to all the devices, only one parameter can be changed per command.

Assigning a New Primary Path

The syntax for changing a device's primary data path is:

```
setsp -l<x> -p<n>
```

where **<x>** is the spd number (or all) and **<n>** is the number of the new path. The path number can be obtained by simply counting down setsp's list of physical paths (in the **Path/disk** column), starting from zero.

The command to change the primary path shown in Figure 1-2 on page 6 for the storage system device with the spd ID of 0 from its default path through controller 7 to the path through controller 8, then, is:

```
setsp -l0 -p1
```

If you run a **setsp** command with the verbose option (**-v**), the configuration change is displayed on screen.

```
# setsp -v -l0 -p1
================================================================================
 spd   Path/disk     Status Primary Exclude Buf Balance RtrCnt  RtrDly FailBack
================================================================================
   0   c7t0d0/sd66    Good                   32    0      20     3000      1
       c8t0d0/sd88    Good     X
 spd0 = c3t0d0                 ID = "DotHill SANnetII 0002-31E88DA7-00"
================================================================================
```

Figure 3-4. Using setsp –v in Verbose Mode

Turning the Exclusion Setting Off and On

The syntax for changing the exclusion setting for a device is

```
setsp -l <x> -e{0|1}
```

where **<x>** is the spd number (or all) and the **-e** option takes one of two arguments:

- **-e0** turns exclusion off (makes the device visible to the host).
- **-e1** turns exclusion on (excludes the device from the host).

In a single-host configuration, all devices should be visible to the host.

Devices can be included (or unexcluded) by using the command:

```
setsp -l all -e0
```

All devices may be included, because no other host can access them at the same time.

However, in a multiple-host environment, where all spds are visible to SANpath on all hosts, spds must be either excluded or included so that a host shares no spds. Use the ID number under the spd column on the setsp –a output to identify devices (see page 6 for examples). Do not use the **spdX** number.

Redefining the Buffer Pointer Allocation

The syntax for changing the number of buffer pointers pre-allocated for a given device is:

```
setsp -l<x> -n<n>
```

where **<x>** is the numerical element of the spd number and **<n>** is the new value. The system must be rebooted for this change to take effect. The number of buffer pointers recommended for a given device is approximately equal to the logical unit's maximum useful queue depth; the default value of 32 suits most storage system devices.

Turning Load Balancing On and Off

Load balancing is on by default. The syntax for changing a device's load balancing mode is:

```
setsp -l<x> -b{0|1|2}
```

```
setsp -l<x> -b{0|1}
```

where **<x>** is the spd number (or all) and the **-b** option takes one of three arguments:

- **-b0** turns load balancing off.
- **-b1** turns load balancing on.
- **-b2** turns load balancing on for HACMP only.

Changing the Retry Count and Retry Delay

The syntax for changing the retry count for a device is:

```
setsp -l<x> -r<n>
```

where **<x>** is the numerical element of the spd number and **<n>** is the number of times a failed I/O is retried on the primary path (after its alternate paths have been tried unsuccessfully) before the path is marked as failed (with a Status of Bad).

The syntax for changing the retry delay for a device is:

```
setsp -l<x> -d<n>
```

where **<x>** is the numerical element of the spd number and **<n>** is the interval, in milliseconds, between the retries specified by the retry count parameter.

Turning Failback Off and On

The syntax for changing a device's failback mode is:

```
setsp -l<x> -f{0|1}
```

where **<x>** is the numerical element of the spd number and the **-f** option takes one of two arguments:

- **-f0** turns failback off.
- **-f1** turns failback on.

Dynamic Device Detection

You may be able to add new storage devices and place them under SANpath's control without requiring a reboot of the host. This is also known as dynamic LUN allocation.

Claiming New Devices in Windows

To add a fibre channel device to an existing path, perform the following steps after the devices are physically connected. Under Windows NT only, if the device is mapped to a LUN other than 0, a modification to the Registry may be necessary.

1. Run Disk Administrator (Windows NT) or Disk Management (Windows 2000).

   This causes new devices to be detected by Microsoft Windows. If more than one path exists for a device, only write the disk signature once.

2. Run this command to cause SANpath to detect the new devices:

   ```
   # sppath -v
   ```

3. Run setsp –a and check for a newly created spd number.

   ```
   # setsp -a
   ```

4. To create an updated configuration file, run:

   ```
   # setsp -g
   ```

5. To start SANpath on the new device, run:

   ```
   # setsp -S -l <new_spd_number>
   ```

6. Lastly, unexclude the device:

```
# setsp -e0 -l <new_spd_number>
```

Claiming New Devices in Solaris

To add a fibre channel device to an existing path, perform the following steps after the devices are physically connected. These commands are intended for use only if you are using Sun HBAs.

1. Run **luxadm** to create a loop initialization, which causes the ssd driver to recognize new devices.

   Before running these commands, you can determine the Path from the second column of the **setsp -a** output. For example, the two paths for spd0 in Figure 1-2 on page 6 are **c7t0d0** and **c8t0d0**.

```
# luxadm -e forcelip /dev/rdsk/ <Path1 of spd0>
```

```
# luxadm -e forcelip /dev/rdsk/ <Path2 of spd0>
```

2. The following command checks for new devices:

```
# cfgmgr
```

```
# drvconfig -i  ssd
```

Note – This command also causes SANpath to detect the new drives (**sppath -v**), to create a new configuration file (**setsp -g**), and to start on the new devices (**setsp -S -l all**).

---

3. Next, create a device file for the newly-recognized devices:

```
# disks
```

4. Run this command to detect the new drives:

```
# sppath -v
```

5. To create an updated configuration file, run:

```
# setsp -g
```

6. To start SANpath on the new device, run:

```
# setsp -S -l <new_spd_number>
```

7. Run **setsp -a** and check for a newly created spd number.

```
# setsp -a
```

8. Lastly, unexclude the device:

```
# setsp -e0 -l <new_spd_number>
```

Claiming New Devices in IBM AIX

To add a device to an existing path, perform the following steps after the devices are physically connected, to detect “defined” devices. However, the system may have to be rebooted.

1. The following command causes the system to check for new devices:

```
# cfgmgr
```

2. Next, view the newly-recognized devices:

```
# lsdev -Cc disk
```

3. Run this command to detect the new drives:

```
# sppath -v
```

4. To create an updated configuration file, run:

```
# setsp -g
```

5. To start SANpath on the new device, run:

```
# setsp -S -l <new_spd_number>
```

6. Lastly, unexclude the device:

```
# setsp -e0 -l <new_spd_number>
```

Claiming New Devices in Linux

Claiming new devices in Linux is not supported from the command line. To add new devices, reboot the host or reload the driver.

Using SANpath with SANscape

Microsoft Windows, Solaris, Linux, and IBM AIX

If you are installing SANpath after SANscape has already been installed, do the following:

1. After installing SANpath each logical drive that will be monitored by SANscape must be unexcluded with the command:

```
# setsp -e0 -l<n>
```

2. Reboot the server, and restart SANscape. The new SANpath nodes are displayed, allowing you to monitor SANpath through SANscape (see Figure 3-5.).

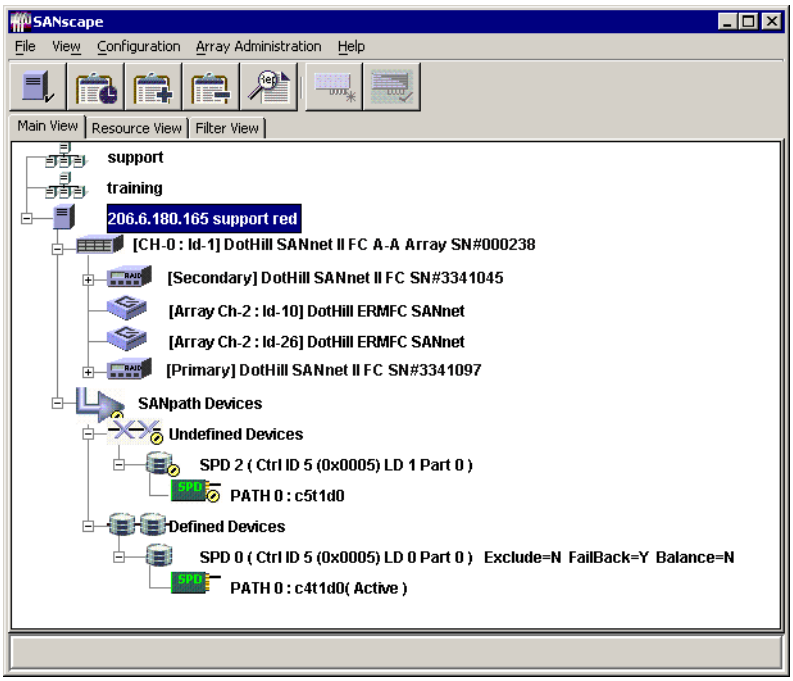


Figure 3-5. SANscape Main Control Panel

3. If you are installing SANscape after SANpath, you must first unexclude a logical drive in SANpath with the following command in order for SANscape to see your storage system:

```
# setsp -e0 -l<n>
```

Monitoring SANpath through SANscape

SANpath parameters cannot be changed through SANscape.

Note – **`spmon`** should not be used when SANpath is used with SANscape.

When SANscape is running the following SANpath nodes display in the main window:

- SANpath Device
- Undefined Devices
- Defined Devices
- SPD #
- Path #

1. In the main window, select **SANpath Devices**, then **SPD #** (SANpath driver number).

   You should see the paths displayed with an (**Active**) and (**Standby**) beside them. All icons should be green now. Quick reference information is available beside the “SPD” icon.

2. Double-click the **SANpath Devices** node to open the SANpath Management window which displays all qualifying Logical devices.

   The drives being used for the current SANpath configuration are displayed under the Define SP devices window. The devices not being used are displayed under **Undefined SP devices**.

3. Double-click the **Defined Devices** or **Undefined Devices** node to access the SANpath Devices List window.

4. Double-click the SPD or Path node to access the SANpath Device Information window.

   All of SANpath’s current configuration properties are displayed here.

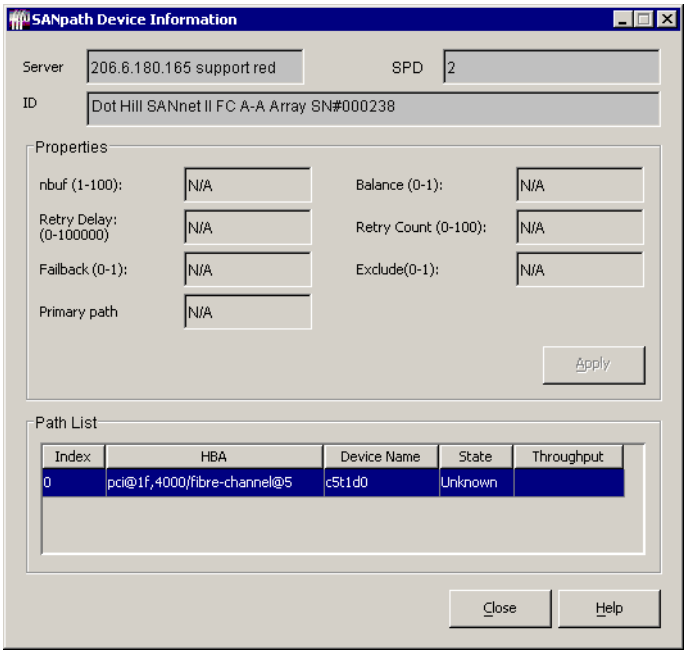


Figure 3-6. SANpath Device Information Window

In the event of a path failure, the following occurs:

- The "Path" icon turns gray, with all higher-level icons turning red, including the server icon.
- When a new LG is created with a SANpath configuration present, the SANpath icons turn red until SANpath is reconfigured.

Search SANpath Devices

The Search SANpath Devices menu option allows you to search for qualifying SANpath devices (SPDs).

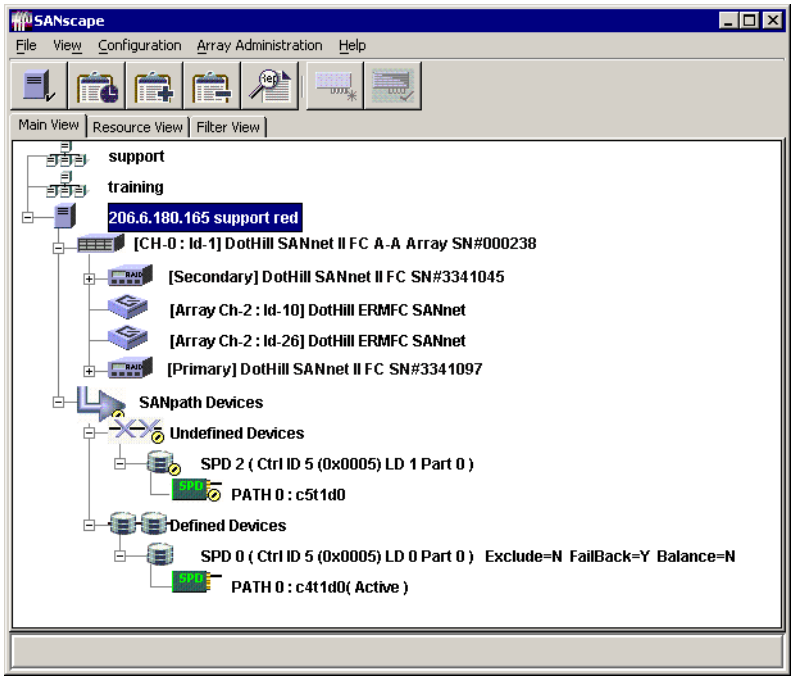
1. In the main window, select **SANpath devices**, and then choose **Configuration** → **Search SANpath Devices**.

Note – Before continuing, you need to be assigned the privileges of an ssconfig user to configure or reconfigure SPDs. If you are not currently logged in as ssconfig, a login dialog appears.

---

2. The message "Searching for SANpath Devices" is displayed.

   After the search is complete, the qualifying devices are displayed under the Undefined Devices icon in the SANscape main window.



Managing SANpath Devices

You can use the Manage SANpath devices command to select the devices to be used in SANpath. You can also use a drag and drop technique to move the SPDs (SANpath Devices) between Undefined Devices and Defined Devices.

To Manage SANpath Devices from the Main Window

1. Select the SANpath Device that you want to manage in the main window.
2. Log in as a user assigned the privileges of an ssconfig user to configure or reconfigure SPDs.
3. Select **Configuration →Manage SANpath Devices**. The **SANpath Management** window is displayed.
4. To select the devices to be used in the SANpath configuration, select the desired device from the **Undefined SANpath Devices** list and click **Add**. The selected devices move to the **Defined SANpath Devices** list.
5. Optionally, to remove the device from the SANpath configuration, select the device in the Defined SANpath Devices list and click **Remove**. This moves the selected device into the Undefined SANpath Devices list.

   Devices not used for SANpath remain in the Undefined SANpath Devices list.

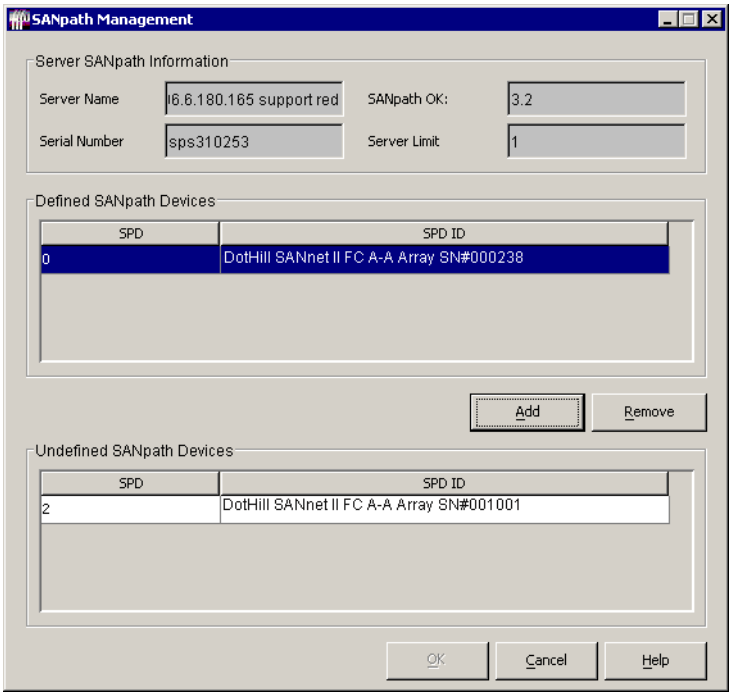
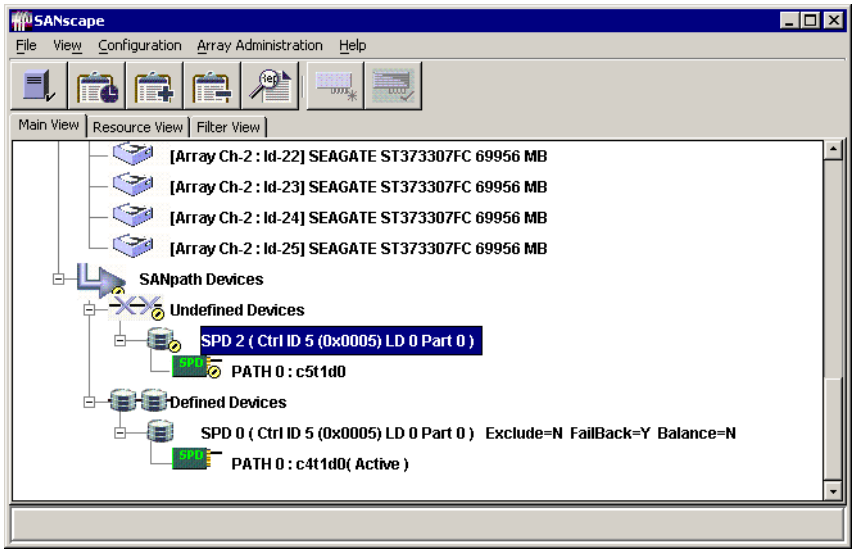


Figure 3-7. SANpath Management Window with Defined and Undefined SANpath Devices

To Manage SANpath Devices Using Drag and Drop

1. Log in as a user assigned the privileges of an ssconfig user to configure or reconfigure SPDs.
2. From the main window, select the desired SPD within the Undefined Devices group and drag it to the Defined Devices group while holding down the left mouse button.



3. Release the SPD icon once you have placed it within the Defined Devices group.
4. Conversely, SPDs from the Defined Devices group can be dragged to the Undefined Devices group.

SANpath Dynamic LUN Assignments

This section describes how to manage SANpath Dynamic LUN assignments.

SANscape allows the user to remotely manipulate SANpath storage devices (SPDs/LUNs) if the version of the SANpath software installed is 3.1 or later.

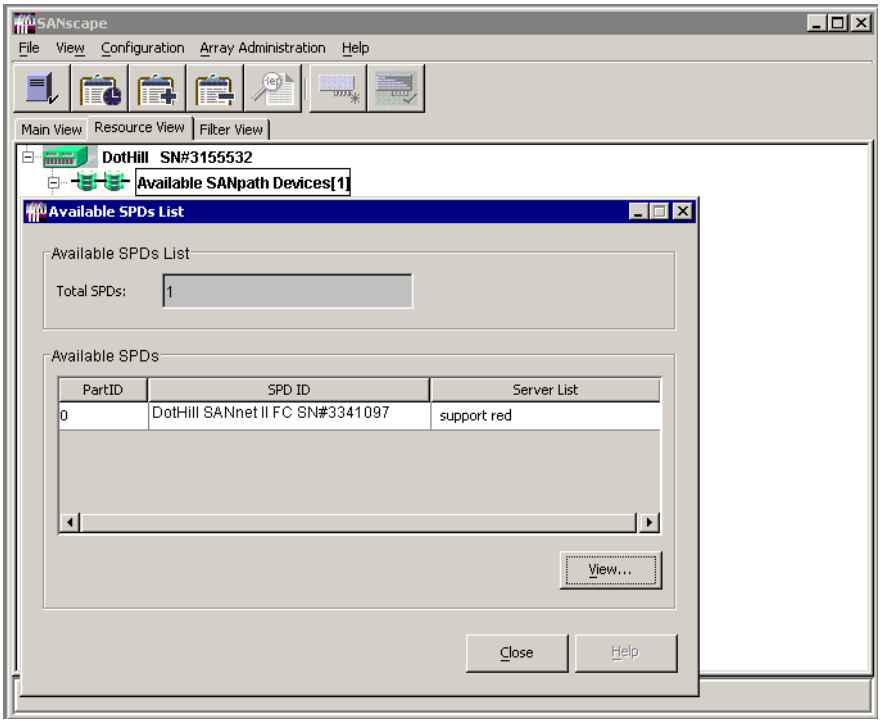
Switching to the Resource View

Using the Resource View, you can drag and drop (attach) SPDs to a selected server and between servers. The Resource View also provides you with details concerning associated devices, such as their TCP/IP addresses and assigned domain names.

1. Click the **Resource View** tab located directly below the toolbar in the main window to toggle between the Main View and the Resource View.

   The Resource View shows the SANpath storage subsystem at the root of the tree view. All the available SPDs and servers that have visibility to this SANpath storage subsystem are shown under this SANpath tree node when expanded.

2. Double-click the **Available SANpath Devices** icon to display all the SPDs that can be assigned. Also you can expand each SPD to see the list of servers to which the SPD can be allocated.

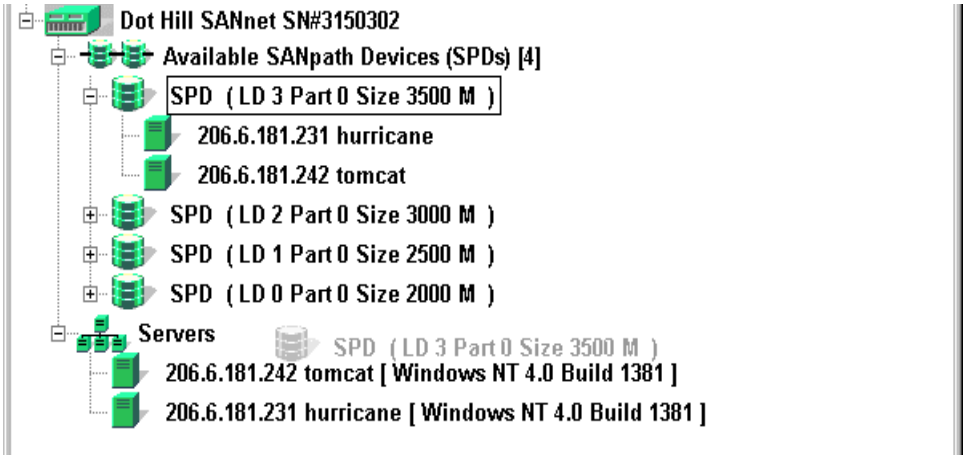


Additionally, you can expand Servers to display the servers to which one or more of the Available SANpath Devices can be assigned.

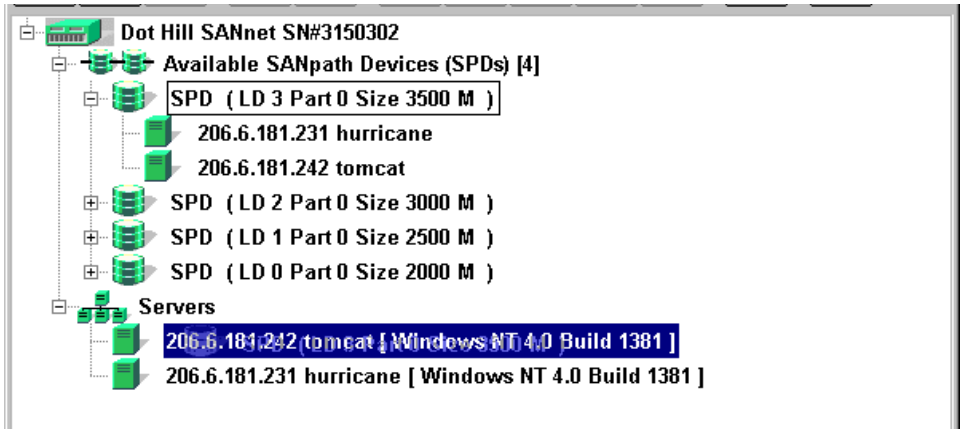
Example of Assigning SPDs to a New Server

Below are the steps to assign a SPD to a specific server, using the drag and drop resource allocation method.

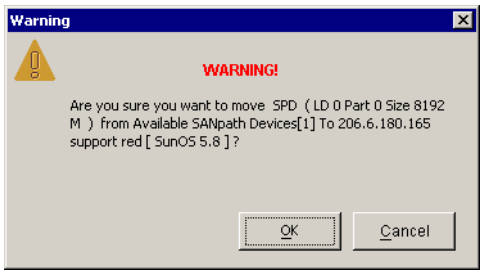
1. Log in as a user with the privileges of an ssconfig user to assign storage resources. Login as ssconfig user to each server that is participating in storage resource assignment.
2. Click the **Resource View** tab to go to the Resource View. Select the desired SPD icon from the available SPDs.
3. Click an SPD icon and drag it to the desired server icon to be assigned.



4. When the desired server icon is highlighted, release the icon.

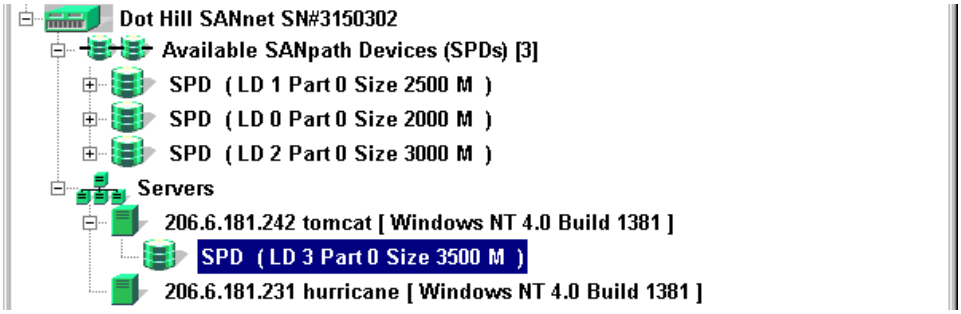


5. A confirmation dialog is displayed. If the information provided is correct, click **OK**.



If you do not have ssconfig privileges, a login dialog may be displayed for you to login as an ssconfig user before the operation can be completed. If the SPD resource allocation succeeds, the SPD will be attached to the specified server.

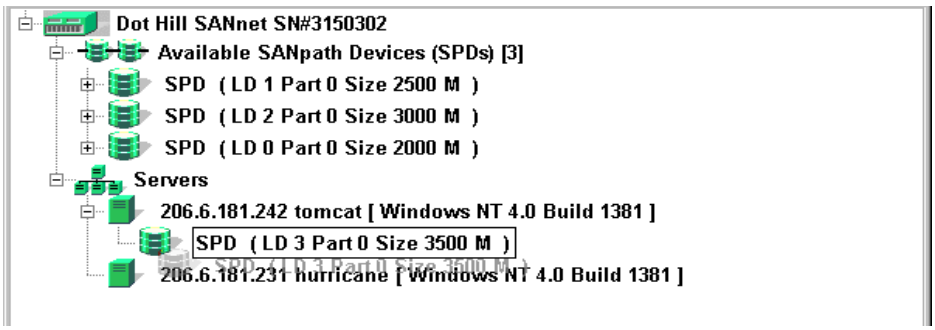
Now the SPD is associated with the specified server for this example. In this case, you could now format, create file systems and mount the file systems, or assign a drive letter for this device on the server.



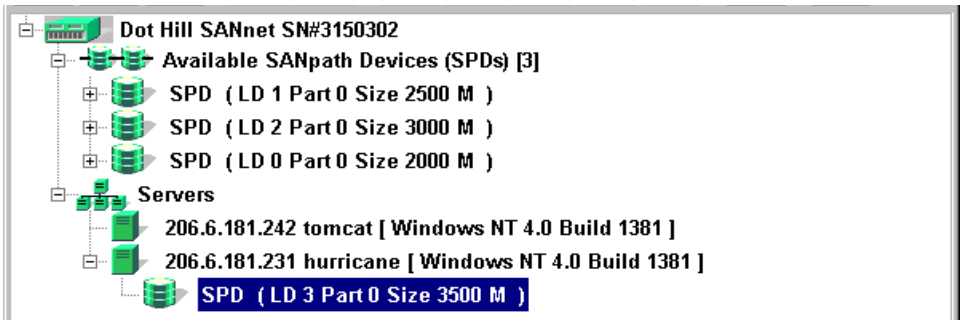
Example of Assigning SPDs to Different Server

Make sure that no application running on the host is currently using the device on the SPD to be reassigned from one server to another. For example, under Windows NT, make sure that the drive letter assigned to this SPD is not currently in use. Under UNIX make sure that the file system on this SPD device is not mounted and in use.

1. Select the SPD from the server from which you want it to be unassigned, and drag it to the server to which you want it to be assigned.
2. When the desired server icon (drop target) is highlighted, release the icon.



A confirmation prompt is then displayed. If the information provided is correct, click **OK**. If the SPD resource reallocation succeeds, the SPD is now displayed under the specified server.



Dynamic LUN or Volume Reassignment

You can use this feature to re-assign the LUN/volume either from one server to another or within the same server.

1. Make sure that you have formatted and created file system or assigned drive letter to the device on the server that you want to re-assign.

   If the storage resource is not formatted for use by the operating system, then the resource cannot be dynamically reassigned and mounted or assigned drive letter for use by the application automatically.

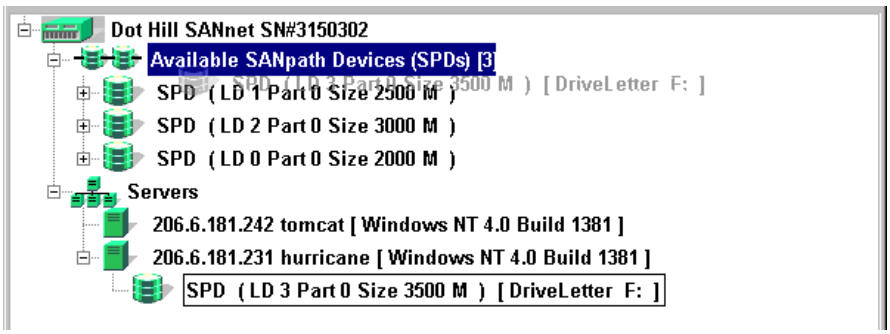
   In the Resource View, each tree node is listed with a descriptive tag. The descriptions listed in Table 3-4 can help you decipher the tree view.

Table 3-4. Tag Descriptions in Resource Allocation Tree

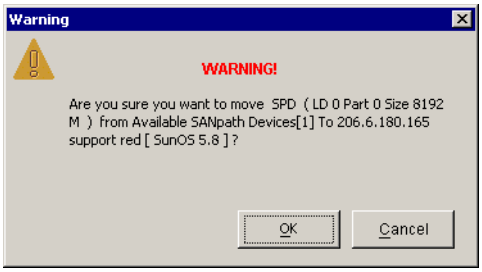
Tag	Description
<Vendor> <Product ID><SN#>	<Vendor> = vendor name, <Product ID> = product name and <SN#> = serial number of RAID controller, such as ***Dot Hill SANnet II FC SN#3062615***
Available SANpath Devices (SPDs) [*n*]	*n* is the number of Available SANpath Devices (SPDs)
SPD (LD *n* Part *p* Size *s* M)	*n* = Logical Drive number, *p* = partition number, *s* = size of logical drive, such as ***SPD (LD 3 Part 0 Size 3500 M)***
<IP Address> <Server Name>	IP address and name of the server such as ***206.6.18.23 Hurricane***
Servers <IP Address> <Server Name> <OS Platform>	IP address, name and OS platform of the server, such as ***206.6.18.23 Hurricane Windows NT 4.0 Build 1381***

2. Verify that the no application is using this storage resource before continuing.

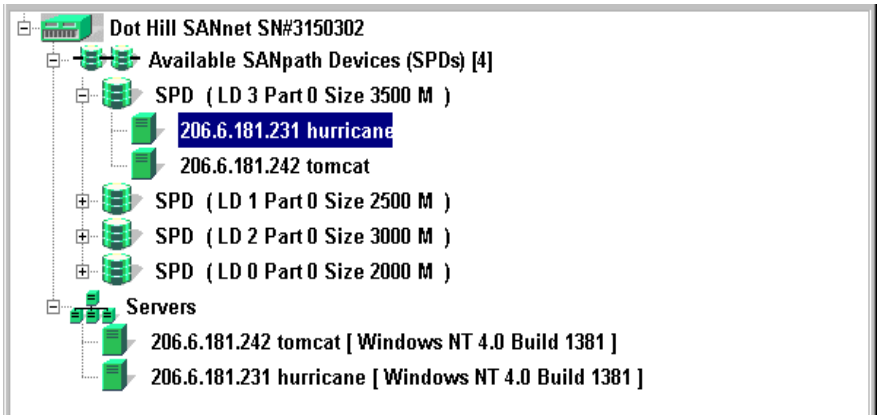
3. Select the SPD that you want re-assigned under the server and drag it to the Available SANpath Devices icon as shown in the following figure.



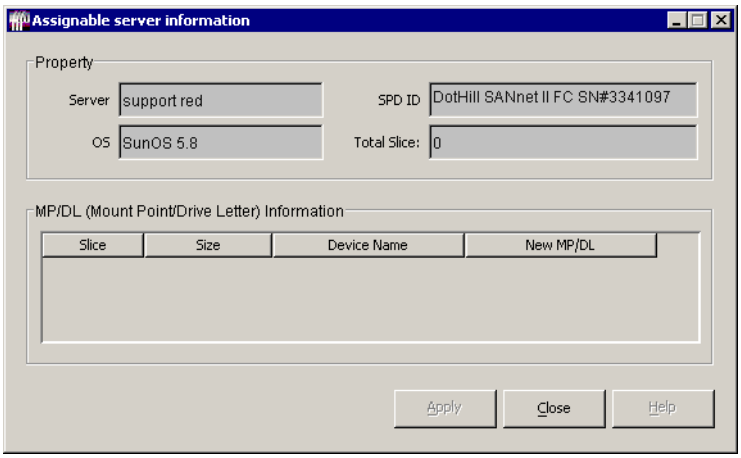
4. If the file system on the resource to be reassigned is in use by any application, the following prompt appears (for example, if the device has a mounted file system, or application such as Windows Explorer currently has this drive selected.).



5. If the operation succeeds, the SPD is displayed under Available SANpath Devices.



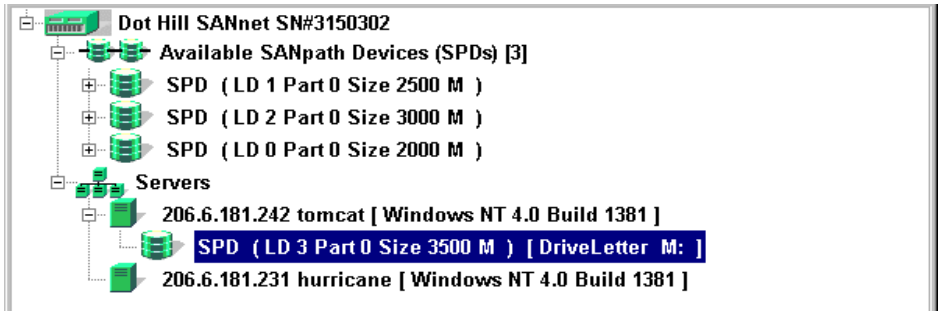
6. Expand the SPD that was just moved to **Available SANpath Devices**. Display the servers to which this resource can be reassigned dynamically by double-clicking the server name.



Note – In the above view, the field **New MP/DL** in the list box is editable and can be used to input information regarding the absolute path for the mount point under Solaris or drive letter under the Windows operating system.

---

7. Click **New MP/DL** in the list box and specify the new mount point or the driver letter under which you want this resource to be reassigned on the server. Make sure that you press Enter after the new mount point or driver letter is entered to enable Apply.
8. Click **Apply** and then close the view.
9. Select this SPD icon and drag it to the server to which this resource is to be reassigned



Now the resource is available on the server under the new mount point or drive letter specified. Any application can access this resource for use.

Note – Under Solaris, if you have made use of this dynamic LUN assignment feature, the table of file system defaults such as **`/etc/vfstab`** might have been modified to ensure the availability of the resource across system reboots. If you uninstall the SANpath software or reconfigure the SANpath, make sure to verify the entries in the file system table defaults file such as **`/etc/vfstab`**.

CHAPTER 4

Setting Up SANpath on Solaris

This chapter describes how to install and configure SANpath on the Solaris operating system. Topics covered in this chapter include:

Note – SANpath 4.0 is incompatible with RAIDscape and versions of SANscape before 2.2. Before installing SANpath on a system running SANscape verify that the SANscape agent running on the system is version 2.2 or higher. For more information on installing and configuring SANpath with SANscape, see "Using SANpath with SANscape" on page 24.

Installing SANpath on Solaris

SANpath is distributed as the Solaris package file, **`HILsp.pkg`**.

Note – Before installing SANpath, be sure to read the release notes for your array.

Follow these steps to install the SANpath driver and its supporting files:

1. Set up your system hardware according the instructions in their respective user manuals and in “Hardware Preparation” on page 5.
2. Before installing SANpath software, it is imperative that the host is able to see and access all storage devices through all available paths For example, If you have two HBAs and redundant paths to your storage system, each logical drive should be displayed twice in the output of the command:

```
# format
```

   If you can not see all available storage devices through every path, verify that you have the latest fibre channel or SCSI HBA drivers loaded on your system.

3. If a previous version of SANpath is installed on your system, remove it before continuing with this installation.
4. If you chose to disable SANpath LUN exclusion (default behavior) edit the **`/etc/system`** file to include the following line:

```
set spd:spd_exclusion_enable = 0
```

Note – This is not recommended for multi-host environments where data corruption might occur if multiple hosts inadvertently access the same LUNs.

---

5. To install the software, insert the software CD, or download the Solaris SANpath program from www.dothill.com/support/software.htm.
6. Install SANpath by becoming root and using the **`pkgadd`** command:

```
# pkgadd -d/cdrom/dothill/solaris/sanpath/4.0/HILsp.pkg   all
```

7. Run this command to enter the license serial number and authorization code:

```
# sppath  -a
```

8. Verify that all available drives are seen by SANpath by running the command:

```
# sppath -v
```

9. Run the following command to save and implement changes to configuration files:

```
# setsp -g
```

10. Reboot the host.

Note – To choose individual devices to be claimed by SANpath, use **–l** in the next step, as described in “Specifying a Device for setsp” on page 18.

---

11. SANpath excludes all devices from host access by default. To turn the exclusion setting off for all devices and make all SANpath-compatible devices accessible by the host, run the command:

```
# setsp -e0 -l all
```

Device exclusion is covered in more detail in Table 3-1. and “Turning the Exclusion Setting Off and On” on page 19.

12. Run format to verify that SANpath has claimed all appropriate devices. Each disk device appears once, represented by a device path beginning with **/pseudo/**. The final part of the pathname, shown as **spd@X,Y**, represents a SANpath device at target **X, LUN Y** in Figure 4-1..

```
AVAILABLE DISK SELECTIONS:
       0. c0t0d0 <SUN9.0G cyl 4924 alt 2 hd 27 sec 133>  /pci@1f,4000/scsi@3/sd@0,0
       1. c0t1d0 <SEAGATE-ST34572WC-0784 cyl 6240 alt 2 hd 8 sec 178>/pci@1f,4000/scsi@3/sd@1,0
       2. c1t1d0 <DotHill-SANnet-0223 cyl 2598 alt 2 hd 64 sec 32> /pseudo/spn@2/spd@1,0
       3. c1t1d1 <DotHill-SANnet-0223 cyl 2598 alt 2 hd 64 sec 32> /pseudo/spn@2/spd@1,1
       4. c1t1d2 <DotHill-SANnet-0223 cyl 2598 alt 2 hd 64 sec 32> /pseudo/spn@2/spd@1,2
```

Figure 4-1. Format Output after SANpath Is Installed

13. Edit any application-specific files（**/etc/vfstab**, for example) to reflect the new device names. New device files are generated during SANpath installation, and any applications already configured to use the older device files to access the storage system must be reconfigured to use the new pathnames (described in “SANpath Device Naming in Solaris” on page 41).

Note – If you are using VERITAS Volume Manager™ and follow the directions under “SANpath Device Naming in Solaris” on page 41, they should require no reconfiguration.

Installed SANpath Files

During installation, these files are placed in your system.

Table 4-1. Installed Solaris SANpath Files

File	Description
/kernel/drv/spn	nexus (virtual HBA) driver, 32-bit mode
/kernel/drv/sparcv9/spn	nexus driver, 64-bit mode
/kernel/drv/spn.conf	spn configuration file
/kernel/drv/spd	SANpath driver, 32-bit mode
/kernel/drv/sparcv9/spd	SANpath driver, 64–bit mode
/kernel/drv/spd.conf	spd configuration file
/kernel/drv/ap	see “SANpath Device Naming in Solaris” on page 41.
/usr/sbin/sppath	qualifies and claims storage devices for SANpath control
/usr/sbin/setsp	configures SANpath parameters
/etc/sppath.conf	sppath configuration file
/etc/spd/bin/spmon	daemon that interacts with SANnet series controllers
/etc/spd/bin/badlinks	removes inactive links during uninstall process
/etc/spd/bin/forceload_add	adds forceload statements to /etc/system (invoked by setsp)
/etc/spd/bin/forceload_rm	removes forceload statements from /etc/system (invoked by setsp)
/etc/init.d/spconfigure	configures SANpath devices at reconfiguration reboot

If SANpath is uninstalled, all the files in Table 4-1. are removed, except **`/kernel/drv/ap`**.

Uninstalling SANpath on Solaris

To remove SANpath, enter the package remove command:

```
# pkgrm HILsp
```

Then, reboot the system.

Note – During the removal process, three SANpath configuration files, **spd.conf**, **spn.conf** and **sppath.conf** are placed in a tar archive file located in **/var/tmp**. The tar file will contain a name in the form:

sp-configuration-backup-YYYYMMDDhhmm.tar

where

YYYY is the 4–digit year
MM is the 2–digit month
DD is the 2–digit day
hh is the 2–digit hour in military format
mm is the current minute

This format allows multiple backups of the configurations files to be archived. Should you wish to reinstall SANpath and restore the last configuration, you can extract the content of this file. Otherwise, if SANpath is not to be reinstalled, this file can be deleted manually.

SANpath Device Naming in Solaris

In a typical, single-path disk storage system, each physical disk is represented in the host's **/dev** directory by a set of special device files representing the raw and block mode device instances for each possible disk partition on that device.

For simplicity, we refer to this set of device files as a single device file name and disregard both the first parts of the pathnames that distinguish between raw and block modes and the suffixes that identify individual partitions.

As a layered driver that runs on top of the standard Solaris disk driver (**sd** or **ssd**), SANpath creates its own device files for physical devices, and it is through these file names that applications access the devices.

When multiple paths to a single device exist, multiple device files are present, one for each path via the native disk driver. In these cases, SANpath creates a single additional device file name for applications to access the device and manages the original device files transparently to those applications.

Note – The virtual device file is used by applications to access that device. The original and redundant data paths should never be used to access the device, or the data it contains could be corrupted.

For example, a dual-ported disk subsystem might present a single physical disk device to the Solaris host as both **c1t0d0** and **c2t0d0**. When SANpath is installed, it creates a third set of device files named **c3t0d0**, and blocks applications' access to the original two device files, which are not protected by SANpath.

How Device File Names Are Chosen

To provide interoperability with complementary storage management software (for example, Solstice Disk Suite and VERITAS Volume Manager™), SANpath uses standard Solaris device names in the form:

`CXtYdZsP`

where

`cX` = a controller or HBA number (*X*)

t*Y* = a SCSI target number (*Y*)

`dZ` = a SCSI LUN (*Z*)

`sP` = a slice or partition number (*P*)

When SANpath adds new device files to the system and changes the device names by which pre-existing devices must be accessed, the new device files, in order to be as easily understood as possible, retain the SCSI target and LUNs from the original device files.

For example, a set of physical devices might originally be accessible via HBAs **`c1`** and **`c2`**. When SANpath is installed, a new, virtual HBA, **`c3`**, is created, along with virtual disk device files. The virtual disk device file names start with **`c3`** and have the same target and LUN numbers as the original device files. Therefore, a device originally accessible via the SCSI disk driver device files **`c1t4d0`** and **`c2t4d0`** will, after SANpath is installed, be accessed through the SANpath device file **`c3t4d0`**, as shown in Figure 4-2..

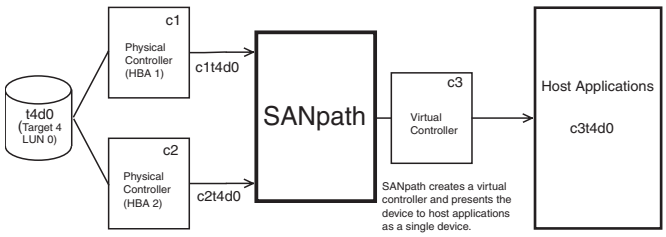


Figure 4-2. SANpath Device File Name Management

If the target and LUN numbers assigned to the device are different on each physical path, SANpath uses the target and LUN number associated with the lowest numbered HBA. If a device is originally accessible as **`c1t4d0`** and **`c2t2d0`**, for example, the c1t4d0 device name has the lower controller number (**`c1`**) and thus SANpath takes the target (**`t4`**) and LUN (**`d0`**) from it to construct the new device name **`c3t4d0`**.

If there are more than one set of redundant paths, there could be more than one device with a given target and LUN number. For this reason, SANpath creates a different virtual HBA for each set of redundant physical HBAs. For example, if one device is accessible via **`c1t0d0`** and **`c2t0d0`**, and another device is accessible via **`c3t0d0`** and **`c4t0d0`**, SANpath would create new device files **`c5t0d0`** (for **`c1t0d0`** and **`c2t0d0`**) and **`c6t0d0`** (for **`c3t0d0`** and **`c4t0d0`**).

SANpath does not have direct control over the controller number used; instead, the number is assigned by the disks(1m) program automatically during the reconfiguration reboot process, just as it would be for any new physical HBA added to the system.

Devices with Only One Path to the Host

SANpath creates virtual device files for all supported devices and blocks access to them through their original device file names *whether or not they are accessible via redundant paths*.

Virtual device files are created for devices that have only one physical path for two reasons:

- a device could actually have redundant paths but only one was functional at the time that SANpath was installed, and
- the device could be part of a SAN configuration where it is necessary to prohibit applications on the local host from accessing the device because the device was assigned to another host on the SAN.

Note – Boot devices do not qualify as supported devices, and virtual device files are never created for them (For a complete description of qualifying devices, see "The sppath Command" on page 11.)

Reconfiguration for Existing Applications

As explained in the preceding section, any physical device supported by SANpath and in use prior to SANpath's installation is, from the perspective of host applications, renamed during SANpath installation.

This has no effect on storage encapsulated by the VERITAS Volume Manager™ or Sun Enterprise Volume Manager, but other applications need to be redirected to the new file names, by either editing **`/etc/vfstab`** or modifying the configuration of the individual application to reflect the new device names.

Underlying Device Path Names

Following Solaris convention, the device files in **`/dev/dsk`** and **`/dev/rdsk`** are actually symbolic links to real device files in the /devices directory tree.

A typical SCSI disk driver device file is

`/devices/pci@1f,4000/scsi@3/sd@4,0`

which refers to a disk at target 4, LUN 0 attached to the SCSI HBA in PCI slot 3.

In some hardware configurations, the word **scsi** may be replaced by the name of a specific HBA driver, such as **`isp`** or **`glm`**. Also, the number after **`scsi@`** may not reflect the physical PCI slot.

The corresponding SANpath device file is similar. For example, **`/devices/pseudo/spn@1/spd@4,0`** indicates an **`spd`** (SANpath driver) device with target 4 and LUN 0, attached to SANpath virtual HBA (**`spn`**) number 1. These device paths are also displayed by format (**`1m`**) and certain other utilities.

CHAPTER 5

Troubleshooting Solaris

This chapter provides Solaris troubleshooting suggestions. Topics covered in this chapter include:

Comparing setsp with System Events

SANpath interfaces with system components at the I/O path level, which does not support sophisticated device error reporting.

The application reports failed I/O to **/var/adm/messages** as well as when a data path is found to have stopped functioning, when I/O is redirected to an alternate path, and when the failed path resumes functioning.

Whether a path failure is intermittent or is caused by a hardware failure can usually be deduced from the events listed in **/var/adm/messages**, and a faulty device can be located physically by cross-referencing the output of **setsp -a**. Figure 5-1. shows the example configuration used in this section.

```
# setsp -a
================================================================================
 spd   Path/disk     Status Primary Exclude Buf Balance RtrCnt  RtrDly FailBack
================================================================================
   0   c7t0d0/sd66    Good     X             32    0       20     3000      1
       c8t0d0/sd88    Good
 spd0 = c3t0d0           ID = "DotHill SANnetII 0002-31E88DA7-00"
================================================================================
   1   c7t0d1/sd67    Good                   32    0       20     3000      1
       c8t0d1/sd89    Good     X
 spd1 = c3t0d1           ID = "DotHill SANnetII 0002-31E88DA7-01"
================================================================================
   2   c7t0d2/sd68    Good     X             32    0       20     3000      1
       c8t0d2/sd90    Good
 spd2 = c3t0d2           ID = "DotHill SANnetII 0002-31E88DA7-02"
================================================================================
```

Figure 5-1. Example setsp –a Output Showing No Failures

Figure 5-2. illustrates the lines from **/var/adm/messages** that appear when a cable is pulled during active I/O. The **sd** driver performs a number of retries before reporting error status 5 (**i/o errno = 5** in **/var/adm/messages**) to the spd driver.

Note – No value other than 5 is expected, but it may be possible to see other values such as 6 (ENXIO--No such device or address) or 22 (EINVAL--Invalid argument) if there is a configuration problem or hardware failure. A reconfiguration reboot should resolve configuration problems.

```
unix: WARNING: /pci@1f,4000/scsi@2/sd@0,0 (sd66):
    SCSI transport failed: reason 'incomplete': retrying command
unix: WARNING: /pci@1f,4000/scsi@2/sd@0,0 (sd66):
    SCSI transport failed: reason 'incomplete': retrying command
unix: WARNING: /pci@1f,4000/scsi@2/sd@0,0 (sd66):
    SCSI transport failed: reason 'reset': retrying command
unix: WARNING: /pci@1f,4000/scsi@2/sd@0,0 (sd66):
    SCSI transport failed: reason 'incomplete': retrying command
unix: WARNING: /pci@1f,4000/scsi@2/sd@0,0 (sd66):
    SCSI transport failed: reason 'reset': retrying command
unix: WARNING: /pci@1f,4000/scsi@2/sd@0,0 (sd66):
    disk not responding to selection
unix: spd0: path 0 error (i/o errno=5)
```

Figure 5-2. Messages Generated when a Cable Is Pulled

In the final message above, **spd0** can be located in the output from **setsp -a** to determine that the affected device is **c3t0d0**. The message also calls out **path 0** that corresponds to **c7t0d0/sd66** in the **setsp -a** output, which matches the device name (**sd66**) called out in the earlier messages.

The paths associated with a SANpath device [spd] are numbered from 0 to *n*–1 and are listed in that order in the **setsp -a** output, so, for example, spd2 path 1 is **c8t0d2** in the **setsp -a** output above.

Cable Failure Errors

Errors for other `spd` devices, representing the same physical I/O path interrupted by a pulled cable, is reported, as shown in Figure 5-3..

```
unix: WARNING: /pci@1f,4000/scsi@2/sd@0,2 (sd68): disk not responding to selection
unix: spd2: path 0 error (probe failed; errno=5)
unix: WARNING: /pci@1f,4000/scsi@2/sd@0,1 (sd67): disk not responding to selection
unix: spd1: path 0 error (probe failed; errno=5)
```

Figure 5-3. Additional Messages for the Same Pulled Cable

Even when an **spd** device is idle, a SCSI Test Unit Ready command is sent periodically to the device to confirm that it is functioning. A failure of this test is reported as "**probe failed**" along with the **errno** value as described above.

Failover Error Reporting

Failover events are recorded in **/var/adm/messages** as well. The event in Figure 5-4. records the I/O for the device **spd0** is redirected from path 0 (**c7t0d0**) to path 1 (**c8t0d0**).

```
unix: spd0: path
```

Figure 5-4. The Failover Event

The output from **setsp -a** (Figure 5-5.) now shows that every device's path 0 (those with device file names beginning **c7**) have a Status of **Bad**.

```
# setsp -a
================================================================================
 spd   Path/disk     Status Primary Exclude Buf Balance RtrCnt  RtrDly FailBack
================================================================================
   0   c7t0d0/sd66    Bad      X             32    0      20     3000      1
       c8t0d0/sd88    Good
 spd0 = c3t0d0           ID = "DotHill SANnetII 0002-31E88DA7-00"
================================================================================
   1   c7t0d1/sd67    Bad                    32    0      20     3000      1
       c8t0d1/sd89    Good     X
 spd1 = c3t0d1           ID = "DotHill SANnetII 0002-31E88DA7-01"
================================================================================
   2   c7t0d2/sd68    Bad      X             32    0      20     3000      1
       c8t0d2/sd90    Good
 spd2 = c3t0d2           ID = "DotHill SANnetII 0002-31E88DA7-02"
================================================================================
```

Figure 5-5. setsp –a Output after the Failed Path Is Detected

Recovering from a Failure

Path failures generate a lot of output, resulting primarily from the disk driver's attempts at error recovery (Figure 5-6.).

```
unix: WARNING: /pci@1f,4000/scsi@2/sd@0,0 (sd66):
    disk not responding to selection
unix: WARNING: /pci@1f,4000/scsi@2/sd@0,2 (sd68):
    disk not responding to selection
unix: WARNING: /pci@1f,4000/scsi@2 (glm3):
    Connected command timeout for Target 0.1
```

Figure 5-6. Messages from Disk Driver's Retry Attempts

Finally, when the cable is plugged back in, SANpath detects that the primary I/O path for `spd0` is back to normal and redirects data to it (Figure 5-7.).

```
unix: spd0: path 0 ok (probe errno=0)
unix: spd0: path failover from 1 to 0
```

Figure 5-7. The Failback Event

The other paths are recovered, as well (Figure 5-8.) and the output of **`setsp -a`** returns to normal (Figure 5-1.). Events were not reported for these recoveries in our example because I/O was not redirected for these devices (spd1's primary path did not fail, and spd2 was idle during the failure).

```
unix: spd1: path 0 ok (probe errno=0)
unix: spd2: path 0 ok (probe errno=0)
```

Figure 5-8. Other Paths Recovered

CHAPTER 6

Setting Up SANpath on Linux

This chapter describes how to install and configure SANpath on the Linux operating system. Topics covered in this chapter include:

Note – The installation instructions may refer to specific versions of this package (for instance, 4.0–1). The current version should be substituted where appropriate.

Requirements

Requirements for installing SANpath on the Linux operating system include:

- Red Hat Software. A Linux system running Red Hat Linux 7.3 with kernel 2.4.18-3.

Caution – Other kernels or customizations are unsupported. Continuing with the installation of SANpath using other kernels or customizations will result in the loss of such customization and can potentially render the system unbootable.

Installing SANpath on Linux

Note – In the installation instructions, the tag <KERNEL–VERSION> is used as a placeholder for the specific version of the Red Hat Kernel. For example, if SANpath is installed on a Red Hat 7.3 system with kernel 2.4.18-3, replace <KERNEL–VERSION> with 2.4.18-3.

The Linux SANpath driver and applications consist of two **rpm** files including:

- SANpath–driver–4.0–9.i386.rpm – This supplies the driver for non-smp (uni-processor or "up") and "smp" (Symmetric Multiprocessor) kernels.

  /etc/spd.conf

  /etc/sppath.conf

  /usr/share/doc/SANpath-driver-4.0-9/README

  /usr/local/dothill/sanpath/kernel/INSTALL

  /usr/local/dothill/sanpath/kernel/<KERNEL-VERSION>/spd.o

  /usr/local/dothill/sanpath/kernel/<KERNEL-VERSION>/spd-smp.o

- SANpath-utils–4.0–9.i386.rpm – This contains the utility applications to control the behavior of the SANpath driver.

  /usr/local/dothill/sanpath/bin/setsp

  /usr/local/dothill/sanpath/bin/spmon

  /usr/local/dothill/sanpath/bin/sppath

  /usr/sbin/setsp

  /usr/sbin/spmon

  /usr/sbin/sppath

  /sbin/setsp

  /sbin/sppath

Note – Before installing SANpath, be sure to read the release notes for your array.

To install SANpath, perform the following commands.

1. If a previous version of SANpath is installed on your system, remove it before continuing with this installation.
2. To install the software, insert the software CD, or download the Linux SANpath program from www.dothill.com/support/software.htm.
3. If you are installing from a CD, perform the following steps:

   a. Mount the cd if it is not already mounted.

```
# mount /dev/cdrom /mnt/cdrom
```

b. Change the directory:

```
# cd /mnt/cdrom/product/linux
```

4. Install the packages in the following ways:

   a. To install the driver, type:

```
# rpm -ivh SANpath-driver-4.0-9.i386.rpm
```

   This configures and starts SANpath at boot time.

   b. Run the installation script:

```
# /usr/local/dothill/sanpath/kernel/INSTALL
```

   When prompted, “Do you wish to patch /etc/rc.sysinit? [yes or no],” type **yes**. The script installs drivers in the appropriate module’s directory.

   c. To install the utilities, type:

```
# rpm -ivh SANpath-utils-4.0-9.i386.rpm
```

5. After SANpath is installed, to load the SANpath driver manually without having to reboot the server, run the following command:

```
# insmod spd
```

Uninstalling SANpath

To remove SANpath from Red Hat 7.3, type:

```
# rpm -e SANpath-utils
# rpm -e SANpath-driver
```

SANpath Device Naming in Linux

To display the current configuration of SANpath devices, run the command:

```
setsp -a
```

```
================================================================================
 spd   Path/disk          Status   Pri Exc Buf Balance RtrCnt  RtrDly FailBack
================================================================================
   9   c0b0t0d0/sda        Good     X       32    0      20     3000      1
       c1b0t0d0/sdc        Good
 spd9 = /dev/spdj                 ID = "DotHill SANnet II FC 0F7B-5792D56C-00"
================================================================================
  10   c0b0t0d1/sdb        Good             32    0      20     3000      1
       c1b0t0d1/sdd        Good     X
 spd10 = /dev/spdk                ID = "DotHill SANnet II FC 0F7B-5792D56C-01"
================================================================================
```

Figure 6-1. setsp –a Linux Device Names for SANnet II

For a broader explanation of setsp and its uses, see “The setsp Command” on page 9 and “Understanding the setsp –a Screen” on page 15.

This naming convention correlates to the device structure where

cW represents Scsi Port W,

bX represents SCSI Bus X,

tY represents Target Id Y

dZ represents LUN Z.

CHAPTER 7

Troubleshooting Linux

This chapter describes how to troubleshoot Linux. Topics covered in this chapter include:

Before Installing SANpath

Before installing SANpath software, it is imperative that the host is able to see and access all storage devices through all available paths: For instance, if you have two HBAs and redundant paths to your storage system, each logical drive should be displayed twice by the **`cat /proc/scsi/scsi`** command.

```
Attached devices:
Host: scsi0 Channel: 00 Id: 00 Lun: 00
  Vendor: DotHill  Model: SANnet II FC     Rev: 327M
  Type:   Direct-Access                    ANSI SCSI revision: 03
Host: scsi0 Channel: 00 Id: 00 Lun: 01
  Vendor: DotHill  Model: SANnet II FC     Rev: 327M
  Type:   Direct-Access                    ANSI SCSI revision: 03
Host: scsi1 Channel: 00 Id: 00 Lun: 00
  Vendor: DotHill  Model: SANnet II FC     Rev: 327M
  Type:   Direct-Access                    ANSI SCSI revision: 03
Host: scsi1 Channel: 00 Id: 00 Lun: 01
  Vendor: DotHill  Model: SANnet II FC     Rev: 327M
  Type:   Direct-Access _                  ANSI SCSI revision: 03
```

Tip – If you cannot see all available storage devices through every path, verify that you have the latest fibre channel or SCSI HBA drivers loaded on your system.

Once the proper driver is loaded, the system can communicate with your HBA. All devices on the bus are listed under the HBA within the **Devices** menu. If the host is unable to see the HBA and/or its devices, upgrade to the latest driver. Most drivers can be obtained from the HBA manufacturer's web site.

If the latest driver is installed, review the hardware configuration attached to the host. See "Hardware Preparation" on page 5 for examples.

Note – The system must be rebooted whenever the hardware attached to it changes. Without a reboot, the system will not recognize new devices. Unrecognized devices are inaccessible to the user.

Troubleshooting Linux

Failover Error Reporting in Linux

The output from **`setsp -v`** now shows that every device's path 0 (those corresponding to device file names beginning c7) have a Status designation of **Bad**.

```
================================================================================
 spd   Path/disk          Status   Pri Exc Buf Balance RtrCnt  RtrDly FailBack
================================================================================
   9   c0b0t0d0/sda        Bad     X       32    0      20     3000      1
       c1b0t0d0/sdc        Good
 spd9 = /dev/spdj                 ID = "DotHill SANnet II FC 0F7B-5792D56C-00"
================================================================================
  10   c0b0t0d1/sdb        Bad             32    0      20     3000      1
       c1b0t0d1/sdd        Good    X
 spd10 = /dev/spdk                ID = "DotHill SANnet II FC 0F7B-5792D56C-01"
================================================================================
```

Figure 7-1. setsp –v Output After the Failed Path Is Detected

Recovering from a Linux Path Failure

Path failures generate a lot of output, resulting primarily from the disk driver's attempts at error recovery. The output of **`setsp -v`** will return to normal (see Figure 7-1.).

```
================================================================================
 spd   Path/disk          Status   Pri Exc Buf Balance RtrCnt  RtrDly FailBack
================================================================================
   9   c0b0t0d0/sda        Good    X       32    0      20     3000      1
       c1b0t0d0/sdc        Good
 spd9 = /dev/spdj                 ID = "DotHill SANnet II FC 0F7B-5792D56C-00"
================================================================================
  10   c0b0t0d1/sdb        Good            32    0      20     3000      1
       c1b0t0d1/sdd        Good    X
 spd10 = /dev/spdk                ID = "DotHill SANnet II FC 0F7B-5792D56C-01"
================================================================================
```

Figure 7-2. setsp –v Output After the Failed Path Is Corrected

CHAPTER 8

Setting Up SANpath on Windows

This chapter describes how to install SANpath on hosts running Windows NT or Windows 2000. Topics covered in this chapter include:

Note – If you are using Microsoft Cluster Server software, additional steps may be required before installing SANpath. See "Microsoft Clustering Software" on page 57 for more information.

SANpath 4.0 is incompatible with RAIDscape and versions of SANscape before 2.2. Before installing SANpath with SANscape verify that the SANscape agent running on the system is version 2.2 or higher. For more information on installing and configuring SANpath with SANscape, read the section titled "Using SANpath with SANscape" on page 24.

Installing SANpath on Windows NT/2000

SANpath is distributed as the file *setup.exe* in the **`\winntand2000\sanpath\4.0`** directory.

Note – Before installing SANpath, be sure to read the release notes for your array.

Follow these steps to install the SANpath driver and its supporting files.

1. Set your system hardware up according to the instructions in their respective user manuals and in "Hardware Preparation" on page 5.
2. If a previous version of SANpath is installed on your system, remove it before continuing with this installation.
3. Login as Administrator.

4. To install the software, insert the software CD, or download the Windows SANpath program from www.dothill.com/support/software.htm.
5. Navigate to the **\winntand2000\sanpath\4.0** directory.
6. Double-click the **setup.exe** program and follow the step-by-step instructions during the installation process.
7. Run this command to enter the license serial number and authorization code:

```
# sppath -a
```

8. Open a Command Prompt and verify that all available drives are seen by SANpath by running the following command from the installation directory:

```
# sppath -v
```

9. Run the following command to save and implement changes to configuration files:

```
# setsp -g
```

Note – To chose individual devices to be claimed by SANpath, use **-l** in the next step, as described in "Specifying a Device for setsp" on page 18.

---

10. SANpath excludes all devices from host access by default. To turn the exclusion setting off for all devices and make all SANpath-compatible devices accessible by the host, run the command:

```
# setsp -e0 -l all
```

Device exclusion is covered in more detail in Table 3-1. and "Turning the Exclusion Setting Off and On" on page 19.

11. Reboot the host.
12. Verify that all available drives are seen by SANpath by running the command:

```
# setsp -a
```

Installed Windows Files

These files are placed in whichever directory is selected at the time of install (with the exception of **spd.sys**). The default directory is **\Program Files\Dot Hill\ SANpath 4.0**.

Table 8-1. Installed Microsoft Windows SANpath Files

File	Description
\%windir%\System32\drivers\ spd.sys	SANpath driver, 32–bit mode
spd.conf	spd configuration file
sppath.exe	qualifies and claims storage devices for SANpath control
setsp.exe	configures SANpath parameters
sppath.conf	sppath configuration file
Uninst.isu	uninstall script used by Install Shield

These files are removed if SANpath is uninstalled.

Uninstalling with Windows

1. From the Control Panel, open **Add/Remove Programs** (Windows NT) or **Add/Remove Software** (Windows 2000).
2. Select **SANpath 4.0** and chose **Add/Remove** (Windows NT) or **Change/Remove** (Windows 2000). Select **Yes** when asked to confirm the removal of the software.
3. Reboot the host.

Microsoft Clustering Software

If you are using Microsoft NT Enterprise Edition with Microsoft Cluster support (MSCS), you can install SANpath. In addition to Clustering detecting node failure, SANpath detects data path and HBA failures.

MSCS Requirements and Configuration

SANpath must be installed on both nodes in a cluster.

Microsoft Clustering works with any of the SANnet II 200 SCSI array storage devices, providing they contain firmware revision 3.12G or later. Consult your SANnet user manual for information on determining the firmware revision of your system.

Any two clients in a local area network (LAN) can become clustering nodes, as shown in Figure 8-1..

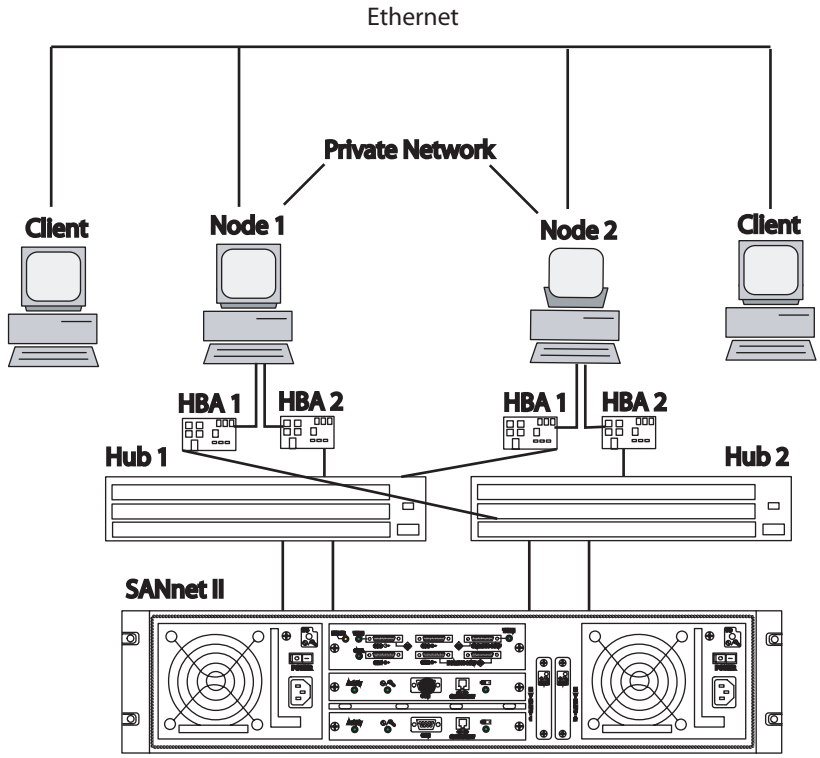


Figure 8-1. Hardware Configuration for MSCS Support

In the example configuration, there are four clients comprising a LAN, two of which are cluster nodes. Each node contains two HBAs, and are connected as follows:

- Node 1, HBA 1 is plugged into one of the ports on HUB 2.
- Node 1, HBA 2 is plugged into one of the ports on HUB 1.
- Node 2, HBA 1 is plugged into one of the ports on HUB 1.
- Node 2, HBA 2 is plugged into a port on HUB 2.
- HUB 1 is connected to Controller 1 on the SANnet.
- Hub 2 is connected to Controller 2.

The two nodes form a private network while remaining on the LAN.

Installing SANpath Prior to MSCS

1. Install SANpath by following the instructions in “Installing SANpath on Windows NT/2000” on page 55.
2. Configure SANpath by following the instructions in “SANpath Operation” on page 9.
3. Before installing MSCS, make sure that all devices that will be cluster resources share the same drive letters on both servers.
4. Install MSCS.

Installing SANpath after MSCS

If resources have already been created for MSCS prior to installing SANpath

1. Follow the instructions in your MSCS manual to offline the resources using the MS Cluster Administrator.
2. Install SANpath by following the directions in “Installing SANpath on Windows NT/2000” on page 55.
3. Use the MS Cluster Administrator to view the resources online.

SANpath Device Naming in Windows

To display the current configuration of SANpath devices, run the command:

```
setsp -a
```

This naming convention correlates to the device structure in the Windows Registry, where

cW represents Scsi Port W,

bX represents SCSI Bus X,

tY represents Target Id Y

dZ represents LUN Z.

SANpath creates no new device names. Instead, Disk Administrator (Windows NT) and Disk Management (Windows 2000) see only the logical drives as described in the Registry.

```
setsp -a
================================================================================
spd   Path/disk     Status Primary Exclude Buf Balance RtrCnt  RtrDly FailBack
================================================================================
0   c3b0t1d0/6     Good     X             32    0      20     3000      1
    c4b0t0d0/12    Good
    HardDisk 6   I:               ID = "DotHill SANnetII 0002-31E88DA7-00"
================================================================================
1   c3b0t1d1/7     Good     X             32    0      20     3000      1
    c4b0t0d1/13    Good
    HardDisk 7                   ID = "DotHill SANnetII 0002-31E88DA7-01"
================================================================================
2   c3b0t1d2/8     Good     X             32    0      20     3000      1
    c4b0t0d2/14    Good
    HardDisk 8                   ID = "DotHill SANnetII 0002-31E88DA7-02"
================================================================================
```

Figure 8-2. setsp –a Windows Device Names for SANnet II

For a broader explanation of setsp and its uses, see “The setsp Command” on page 9 and “Understanding the setsp –a Screen” on page 15.

For a physical disk with multiple paths, Disk Administrator (Windows NT) and Disk Management (Windows 2000) show each path as its own device, although each path is pointing to the same physical device.

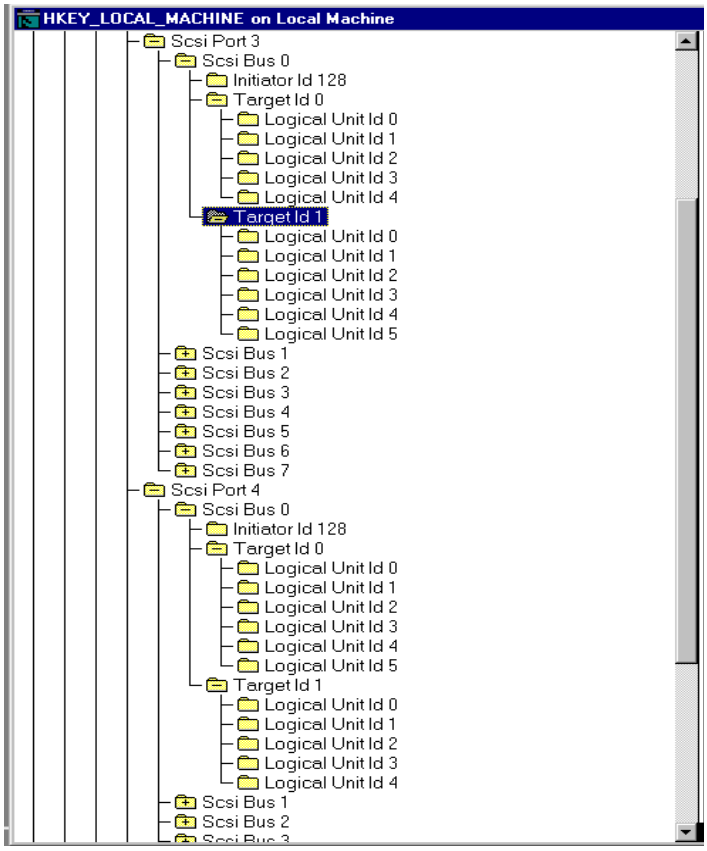


Figure 8-3. Physical Devices Seen in the Windows NT Registry

For example, a dual-ported disk array connected to a single host is seen by the Disk Administrator (Windows NT) and Disk Management (Windows 2000) as Disk 0 and Disk 1. When SANpath is installed and these logical drives are not excluded, Disk 0 is accessible while Disk 1 is inaccessible, as seen by Disk Administrator (Windows NT) and Disk Management (Windows 2000).

Note – A multiple-ported physical disk (such as a dual-ported fibre channel drive) is not a supported configuration within Microsoft Windows. Without SANpath software, disk errors and data corruption will occur when data is written to the disk.

CHAPTER 9

Troubleshooting Windows

This chapter describes how to troubleshoot Windows 2000/NT. Topics covered in this chapter include:

Before Installing SANpath

Before installing SANpath software, it is imperative that the host is able to see and access all storage devices through all available paths.

For instance, if you have two HBAs and redundant paths to your storage system, each logical drive should be displayed twice by the Disk Administrator (Windows NT) or Disk Management (Windows 2000) program.

If you cannot see all available storage devices through every path, verify that you have the latest fibre channel or SCSI HBA drivers loaded on your system.

Windows NT

To load HBA drivers in Windows NT, run the **SCSI Adapters** program in the **Control Panel** and click the **Drivers** tab. Drivers for fibre channel HBAs are also installed using the SCSI Adapters program. Once the proper driver is loaded, the system can communicate with your HBA. All devices on the bus are listed under the HBA within the **Devices** menu. If the host is unable to see the HBA and/or its devices, upgrade to the latest driver. Most drivers can be obtained from the HBA manufacturer's web site. If the latest driver is installed, review the hardware configuration attached to the host. See "Hardware Preparation" on page 5 for examples.

Windows 2000

In Windows 2000, new devices are detected at boot time, prompting a wizard that guides you through choosing and installing an HBA driver. If a new device is not automatically detected by Windows 2000, or if the wizard fails to install a driver, click the **Add/Remove Hardware** icon under the **Control Panel** and follow the onscreen directions. All devices on the bus are listed under the HBA within the **Device Manager** menu, which can be accessed by clicking **Control Panel**, then **Administrative Tools**, and then **Computer Management**. If the host is unable to see the HBA and/or its devices, upgrade to the latest driver. Most drivers can be obtained from the HBA manufacturer's web site. If the latest driver is installed, review the hardware configuration attached to the host. See "Hardware Preparation" on page 5 for examples.

Caution – The system must be rebooted whenever the hardware attached to it is changed. Without a reboot, the system will not recognize new devices. Unrecognized devices are inaccessible to the user.

Recognizing Non-Zero LUNS

In order for Windows NT 4.0 to recognize new devices that use LUNs with values other than 0, one change must be made to the Registry. These steps are not required for Windows 2000.

1. Start the regedt32 Registry Editor, and, under the following subkey:
   `\\HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\Disk`
2. Add the following value:
   Value name: **`LunRescan`**
   Data type: **`REG_MULTI_SZ`**
   The Data field for this value can be left **`NULL`**, which allows a rescan of all devices.
   The Windows NT operating system searches for LUNs beginning at LUN0 and scans progressively forward. NT ends its scan at the first non-existent LUN it encounters.

Errors in the Event Viewer

All changes in SANpath devices and activity on devices under SANpath's control are recorded as System events in the Windows Event Logs, and can be viewed with the Event Viewer utility.

If a path to a storage system becomes unusable, the disk driver reports a "*device not ready for access"* error (Figure 9-1.).

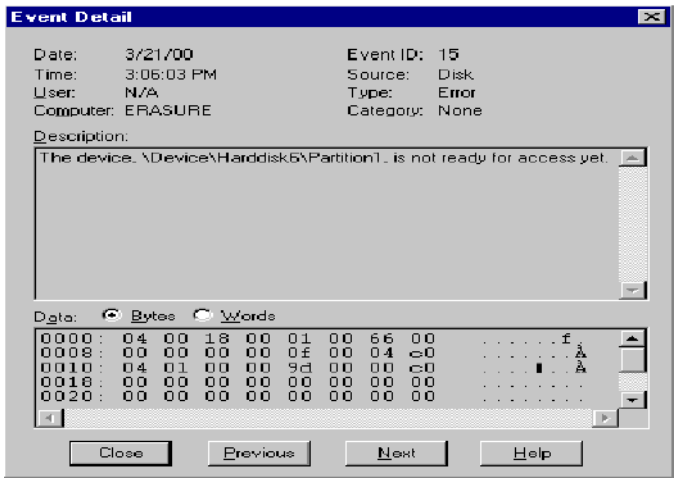


Figure 9-1. Sample Disk Driver Error in Windows NT

Meanwhile, the SPD driver reports an "*SPD driver detects an IO path failure*" warning (Figure 9-2.).

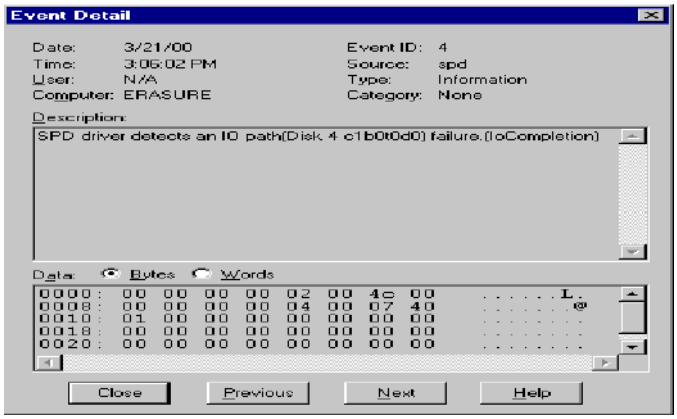


Figure 9-2. Sample SPD Driver Error in Windows NT

An "*SPD's TUR command failed*" error occurs when the system is unable to communicate with the device after the system sends out a TUR (test unit ready) request. The error notes the name of the failed path, but does not pinpoint the source of the failure.

In the event of a path failure, use the Disk Administrator and the SCSI Adapter (Windows NT) or Disk Management and Device Manager (Windows 2000) utilities to troubleshoot the problem. A quick check of the bus on which the device had failed is also recommended.

CHAPTER10

Setting Up SANpath on IBM AIX

This chapter describes how to set up and install SANpath on IBM AIX. Topics covered in this chapter include:

Overview

SANpath supports IBM AIX version 5.1.

Note – If a previous version of SANpath is installed on your system, remove it before continuing with this installation (see "Uninstalling on IBM AIX" on page 67).

To determine if an older version of SANpath is present on your system examine the output of the command:

```
# lslpp -L |grep Dot
```

Installing SANpath on IBM AIX

Installation of SANpath in IBM AIX is performed by the **`installp`** command, which can be run from the command line, from a Graphical User Interface (GUI), or invoked through SMIT (which is recommended).

The following instructions illustrate using the command line. However, the same tasks can be accomplished through the GUI. For more information on the GUI alternative, consult your IBM AIX documentation for **`installp`**.

Note – Before installing SANpath, be sure to read the release notes for your array.

Follow these steps to manually install the SANpath driver and its supporting files.

1. Set your system hardware up according the instructions in their respective user manuals and in “Hardware Preparation” on page 5.

2. Before installing SANpath software, it is imperative that the host is able to see and access all storage devices through all available paths. For example, if you have two HBAs and redundant paths to your storage system, each logical drive should be displayed twice by the command:

```
# lsdev -Cc disk
```

   If you cannot see all available storage devices through every path, verify that you have the latest fibre channel or SCSI HBA drivers loaded on your system.

3. To install the software, insert the software CD, or download the AIX SANpath program from www.dothill.com/support/software.htm.

4. Install SANpath by logging on as root and using the **installp** command as follows:

   a. Make a “temp” directory called **/tmp/sanpath**.

   b. Copy the SANpath package to the previously created “temp” directory.

   c. Go to the temp directory:

```
cd /tmp/sanpath
```

   d. Enter the following command:

```
# installp -ac -d /tmp/sanpath DotHill.SANpath
```

   e. Run this command to enter the license serial number and authorization code:

```
# sppath  -a
```

   f. Optionally, remove the **/tmp/sanpath** directory.

   g. Reboot the host.

Uninstalling on IBM AIX

To remove SANpath:

1. If the SANscape application is installed, enter the following command to stop the SANscape agent:

```
/etc/ssagent stop
```

2. Enter the following command:

```
setsp -T
```

3. Enter the following command:

```
/etc/rc.sanpath stop
```

4. Enter the following commands:

```
setsp -x -lall
```

where **#** is the spd number; example: "**spd22**"

To list all spd's, enter:

```
lsdev -C | grep spd
```

5. Enter the following command:

```
rmdev -d -l spdctrl
```

6. Enter the following command:

```
installp -u DotHill.SANpath
```

7. Reboot the system.
8. Restart SANscape, if desired, by typing the following command:

```
/etc/ssagent start
```

SANpath Device Naming in AIX

Disk device file names in IBM AIX have names in the following format:

/dev/hdiskX

/dev/rhdiskX

where X = the disk driver instance number. A sample listing follows:

```
hdisk1 Available 30-60-00-0,0 Fibre Channel SCSI FCP Disk Drive
hdisk2 Available 30-60-00-1,0 Fibre Channel SCSI FCP Disk Drive
hdisk3 Available 30-78-00-0,0 Fibre Channel SCSI FCP Disk Drive
hdisk4 Available 30-78-00-1,0 Fibre Channel SCSI FCP Disk Drive
```

In a typical, single-path disk storage system, each physical disk is represented in the host's **/dev** directory by two special device files representing the character and block mode device instances. For simplicity, we reference the set of device files as a single device file name and disregard the first part of the pathnames that distinguish between raw and block modes.

When multiple paths to a single device are present, multiple device files are present, one for each path via the native disk driver. When more than one hdisk device name refers to the same device, SANpath only permits one of the device files – the lowest numbered hdisk – to be opened by user applications. Redundant hdisk devices that refer to the same physical device cannot be opened by user applications.This ensures that there is a one-to-one relationship between user-openable device files and real devices.

SMIT

SMIT is a disk management system provided by IBM in all versions of AIX 4.3 or later. SMIT allows you to manage storage as logical volumes and to install software. You can use SMIT to install SANpath. For more detailed information, consult the man pages for **smit mkvg** and the *IBM–AIX System Administration* manual.

CHAPTER11

Troubleshooting IBM AIX

This chapter describes how to troubleshoot IBM AIX. Topics covered in this chapter include:

Before Installing SANpath

Before installing SANpath software, it is imperative that the host is able to see and access all storage devices through all available paths: For instance, if you have two HBAs and redundant paths to your storage system, each logical drive should be displayed twice by the **`lsdev -Cc disk`** command.

- If you cannot see all available storage devices through every path, verify that you have the latest fibre channel or SCSI HBA drivers loaded on your system.
- To load HBA drivers in IBM AIX, run **`installp`** or use the SMIT utility.

Once the proper driver is loaded, the system can communicate with your HBA. All devices on the bus are listed under the HBA within the **`Devices`** menu. If the host is unable to see the HBA and/or its devices, upgrade to the latest driver. Most drivers can be obtained from the HBA manufacturer's web site.

If the latest driver is installed, review the hardware configuration attached to the host. See "Hardware Preparation" on page 5 for examples.

Note – The system must be rebooted whenever the hardware attached to it is changed. Without a reboot, the system will not recognize new devices. Unrecognized devices are inaccessible to the user.

Troubleshooting IBM AIX

Failover Error Reporting in AIX

The output from **`setsp -v`** (Figure 11-1.) now shows that the primary paths for spd every device's path 0 and spd 1 (those corresponding to device file names beginning c7) have a Status designation of **Bad**.

```
# setsp -v
================================================================================
 spd   Path/disk          Status   Pri Exc Buf Balance RtrCnt  RtrDly FailBack
================================================================================
   0   c2t0d0/5            Bad      X        32     0       20      3000       1
       c3t0d0/3            Good
 spd0 = hdisk3                ID = "DotHill SANnet RAID X300 0063-6BAF279B-00"
================================================================================
   1   c2t1d0/6            Bad              32     0       20      3000       1
       c3t1d0/4            Good     X
 spd1 = hdisk4                ID = "DotHill SANnet RAID X300 0063-59E9ADB7-00"
================================================================================
# 
```

Figure 11-1.setsp –v Output after the Failed Path Is Detected

Recovering from an AIX Path Failure

Path failures generate a lot of output, resulting primarily from the disk driver's attempts at error recovery. The output of **`setsp -v`** will return to normal as shown in the following figure.

```
# setsp -v
================================================================================
 spd   Path/disk          Status   Pri Exc Buf Balance RtrCnt  RtrDly FailBack
================================================================================
   0   c2t0d0/5            Good     X        32     0       20      3000       1
       c3t0d0/3            Good
 spd0 = hdisk3                ID = "DotHill SANnet RAID X300 0063-6BAF279B-00"
================================================================================
   1   c2t1d0/6            Good             32     0       20      3000       1
       c3t1d0/4            Good     X
 spd1 = hdisk4                ID = "DotHill SANnet RAID X300 0063-59E9ADB7-00"
================================================================================
# 
```

Figure 11-2.setsp –v Output after the Failed Path Is Recovered

Emulex Driver Setup

Note – Emulex drivers are supported for AIX 4.3 only. For drivers for AIX 5.x and later, check with IBM.

It is important to set the Emulex setup bindings as shown in the next example with 2 HBAs:

```
 LightPulse Common Utility for AIX. Version 1.2a16 (10/24/2000).
 Copyright (c) 2000, Emulex Network Systems, Inc.
  Emulex Fibre Channel Host Adapters Detected: 2
 Host Adapter 0 (lpfc0) is an LP7K (Ready Mode)
 Host Adapter 1 (lpfc1) is an LP8K (Ready Mode)

 MAIN MENU
 1. List Adapters
 2. Adapter Information
 3. Firmware Maintenance
 4. Reset Adapter
 5. Persistent Bindings
 0  Exit

 Enter choice => 5
```

```
PERSISTENT BINDINGS MENU
1. Display Current Bindings
2. Display All Nodes
3. Duplicate Adapter Bindings
4. Bind Target Manually
5. Bind Automapped Targets
6. Delete Binding(s)
0  Return to Main Menu

Enter choice => 2
0. lpfc0
1. lpfc1

Select an adapter (0-1) => 0
Visible Nodes:

Node                    Target   WWPN                        WWNN

Local Adapter           0        10-00-00-00-c9-22-c6-7d     10-00-00-00-c9-22-c6-7d

Unmapped IP Node        0        00-00-00-00-00-00-00-00     20-00-00-d0-23-30-00-01

In Transition           0        22-00-08-00-20-80-d4-38     20-00-08-00-20-80-d4-38

Mapped FCP Node         2        22-00-00-d0-23-20-00-01     20-00-00-d0-23-20-00-01

Mapped FCP Node         3        22-00-00-d0-23-30-00-01     20-00-00-d0-23-30-00-01


Press any key to continue:
```

```
PERSISTENT BINDINGS MENU
1. Display Current Bindings
2. Display All Nodes
3. Duplicate Adapter Bindings
4. Bind Target Manually
5. Bind Automapped Targets
6. Delete Binding(s)
0. Return to Main Menu

Enter choice => 2
0. lpfc0
1. pfc1

Select an adapter (0-1) => 1

Visible Nodes:

Node                    Target  WWPN                      WWNN

Unmapped IP Node        0       10-00-00-00-c9-21-1d-ae   20-00-00-00-c9-21-1d-ae

Unmapped IP Node        0       00-00-00-00-00-00-00-00   20-00-00-d0-23-10-00-01

Inaccessible FCP        4       21-00-00-d0-23-00-00-01   20-00-00-d0-23-00-00-01

Inaccessible FCP        5       21-00-00-d0-23-10-00-01   20-00-00-d0-23-10-00-01

Unmapped IP Node        0       21-00-08-00-20-80-d4-38   20-00-08-00-20-80-d4-38

Unmapped IP Node        0       20-00-00-e0-8b-01-87-52   20-00-00-e0-8b-01-87-52


Press any key to continue:
```

```
PERSISTENT BINDINGS MENU
1. Display Current Bindings
2. Display All Nodes
3. Duplicate Adapter Bindings
4. Bind Target Manually
5. Bind Automapped Targets
6. Delete Binding(s)
0. Return to Main Menu

Enter choice => 0
```

```
MAIN MENU
1. List Adapters
2. Adapter Information
3. Firmware Maintenance
4. Reset Adapter
5. Persistent Bindings
0. Exit

Enter choice => 0
```

APPENDIX A

Error Messages

This appendix provides a list of error codes and error and status messages. Topics covered include:

sppath Error Codes

The following table describes the error codes used in **`sppath`** errors.

Table A-1 sppath Command Line Parameters

Error Codes	Description
-a	enter a valid authorization code
-d	display debug information
-v	display detailed information
-D	clear list of “ignored” devices
-I cXtYdZ	add device-name to “ignored” list (arg must be in the form cX or cXtY or cXtYdZ)
-I sanid	add sanid to “ignored” list ex: -I “DotHill SANnet RAID X300 0001-0043BF50-04”
-b	Enable or disable the paths of boot devices ex: -b0 ignores the boot devices. Default value is 0 ex: -b1 includes the boot devices

sppath Error/Status Messages

The following table lists the Error/Status messages for **`sppath`**.

Table A-2 sppath Error/Status Messages

Error/Status Messages
Inquiry failure
Get VPD data failure
devices/pseudo/spd@1023:ctrl
/Cannot open <%s>
Cannot getting SANpath data
Cannot get state of SPD %d
Cannot get status of SPD %d
kernel: SPD=%d dev=%d,%d type=%d SANID="%s"
DISK c%dt%dd%d skipped, it is a root disk
DISK c%dt%dd%d open failed
sppath: can't ignore "%s"(MAXIGNOREITEM exceeded)
sppath: can't ignore "%s"(duplicated item "%s" exist already)
sppath: can't ignore "%s"(no matched disk)
Cannot stat %s
Cannot lstat %s
Could not read symbolic link %s
%s is not a symbolic link

Table A-2 sppath Error/Status Messages *(Continued)*

Error/Status Messages
Skipping invalid format entry %s
No enough memory
sppath: unexpected format of ignore item. (-I cXtYdZ or -I sanid)
sppath: unexpected format of ignore item "%s"
sppath: superuser privileges required
sppath: reserved spd_id %d (SANID=%s) is reallocated
sppath: there is no free spd_id for SANID=%s
invalid parameter: -%c %s, a number is expected after -%c
invalid parameter: -%c %s, out of range(%d-%d)
NOTE: To activate SANpath, you must enter a valid authorization code. If you don't have an authorization code, contact Dot Hill Customer Service (877-368-7924). Run "sppath -a" to activate SANpath.
Enter SANpath serial number
Enter your company name
Enter authorization code
Authorization code accepted
Authorization code rejected

setsp Error Codes

The following table describes the error codes used in **`setsp`** errors.

Table A-3 setsp Error Codes

Error Code	Description
-a	show current device status
-b	set balance for an SPD device
-d	set retrydelay(ms) for an SPD device. Range: 0-100000
-e	set exclusion for an SPD device Ex: -e1 Exclude, -e0 Don't exclude
-f	set failback for an SPD device. Ex: -f1 Enable failback, -f0 Disable failback
-g	generate kernel configuration files
-i	show contents of driver configuration files
-l	specify an SPD device Ex: -l2 specifies spd2 or -l "DotHill SANnet RAID X300 0001-0043BF50-04"
-n	set number of buffers for an SPD device (Range: %d-%d). This option is used after reboot. setsp -i -v can verify it
-p	set primary path for an SPD device
-r	set retrycount for an SPD device. Choose a value between 0-100
-u	show configured disks(-u1), unconfigured disks(-u2), or all available disks(-u0)
-v:	show verbose details

Table A-3 setsp Error Codes *(Continued)*

Error Code	Description
-x	remove an SPD device from the configuration file Ex: -x -l2 The spd driver will no longer configure it after reboot
-L	list SPDs with condition Ex: -L -e1 List excluded LUNs, -L -s0 List bad paths
-N	don't apply changes specified with options below to the running system (just for the configuration files)
-S	Start an SPD device Ex: -S -l2
-T	Stop an SPD device. Ex: -T -l2

setsp Error/Status Messages

The following table lists the error and status messages for **`setsp`**.

Table A-4 setsp Error Messages

Error/Status Messages
spd%d: cannot open spd controller device
spd%d: cannot start device
spd%d: start device OK
spd%d: cannot stop device
setsp: can't undef "%s"(MAXUNDEFITEM exceeded)
No spd devices found
No spd devices matched
invalid spd_id = %d

Table A-4 setsp Error Messages *(Continued)*

Error/Status Messages
setsp: ignore spd_id=%d, SANID="%s"
setsp: "setsp -g -l <spd_id>" restores an ignored SPD
Run "setsp -g" to generate correct configuration file
No errors found
Warning: spd%d's exclude must be 0 because it is a boot device
setsp: cannot exclude the spd%d
setsp: cannot open <%s>
setsp: cannot get path info of <%s>. err = %d
setsp: cannot change settings of spd%d. err = %d
setsp: spd %d is deleted from spd.conf, while it is in kernel yet
It is better to run "setsp -T -l <spd_id>" first
setsp: cannot get SANpath SPD data
setsp: cannot get status of spd%d
setsp: superuser privileges required
setsp: please specify an drive letter, like "setsp -U G:"
setsp: please specify only one of -o or -O
setsp -U may not be run with other arguments
setsp -g may not be run with other arguments

Table A-4 setsp Error Messages *(Continued)*

Error/Status Messages
No enough memory
invalid parameter: -l %s
must specify a spd_id, ex: -l2 or -l all
invalid primarypath = %d
setsp: cannot lstat %s
setsp: cannot stat %s
Could not read symbolic link %s
%s is not a symbolic link
spd%d: stop device OK
setsp: remove c%dt%dd%d for original spd %d
setsp: spd %d's device name changes to c%dt%dd%d

Error Messages for the SPD Driver

The following table lists the error messages for the SPD driver.

Table A-5 SPD Driver Error/Status Messages

Error/Status Messages
spd driver disabled because booted with "-a" and spd:spd_safe_boot != 0
spd%d: could not allocate kernel memory
spd%d: could not allocate buf
spd%d: disk excluded by this host

Table A-5 SPD Driver Error/Status Messages *(Continued)*

Error/Status Messages
spd: use /usr/sbin/setsp to change exclusion status
spd%d: device inquiry data mismatch--device disabled
spd%d: device inquiry data mismatch
spd%d: no good paths found
spd%d: %d/%d paths operating
spd%d: could not create minor block node
spd%d: could not create minor raw node
spd%d: could not create control raw node
spd%d: can't detach: i/o in progress
spd%d: can't detach: probe or retried i/o in progress
spd%d: can't detach: configured
spd%d: offset %d is not an integral number of sectors
spd%d: transfer length %d is not an integral number of sectors
spd%d: offset %d is not an integral number of sectors
spd%d: transfer length %d is not an integral number of sectors
spd%d: SVTOC failed (error %d on primary path %d)
spd%d: GVTOC failed (error %d on path %d)
spd%d: GVTOC failed (error %d on path %d)

Table A-5 SPD Driver Error/Status Messages *(Continued)*

Error/Status Messages
spd%d: path failover from %d to %d
spd: could not create kernel thread
spd%d: path %d ok (%s%d)
spd%d: path %d error (%s%d)