NEC Storage Software

NEC Storage PathManager
User's Manual
(Windows version)

IS201-5E

Preface

This document illustrates how to use NEC Storage PathManager.

NEC Storage PathManager multiplexes paths between a server and a storage unit in a system with Express5800 and the NEC Storage Disk Array SubSystem.

Notes: (1) Functions described in this document are supported by the following software:

NEC Storage PathManager 3.1 Enterprise for Windows

NEC Storage PathManager 3.1 Standard for Windows

(2) Microsoft(R), Windows(R), and Windows NT(R) are registered trademarks or trademarks of Microsoft Corporation in the United States and other countries.

(3) If you have any comments or requests regarding this manual or if the content of this manual requires further clarification, fill in the "Comment form" provided at the end of this document and submit it to our sales representatives or SEs.

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Part I   Overview

Chapter 1   Overview of NEC Storage PathManager

NEC Storage PathManager software multiplexes paths between a server and a storage unit in a system with Express5800 and the NEC Storage series Disk Array SubSystem.   This software automatically switches paths to be used in case of failures in paths currently in use.   Also, this software uses multiple paths simultaneously to distribute loads to the paths.

This document will provide basic information such as an overview, hardware configuration, and software configuration of NEC Storage PathManager.   This document will also illustrate features of the software.

⚠ In this document, "NEC Storage series Disk Array SubSystem" will be referred to as "NEC Storage" hereinafter.

1.1   About NEC Storage PathManager

Availability is one of the important points when constructing a SAN system and needless to say this availability largely relies on the storage subsystem.   This is because a storage subsystem is one of the most common places in a system to experience failures.

A variety of methods have been found and used so far in order to reduce failure occurrence in storage units and smoothly recover from failures.   Examples include RAIDs, hot spares, and replications.   These functions are also provided in NEC Storage to achieve high availability.

Unfortunately, these solutions are only effective for media errors.   If failures occur in host bus adapters, controllers, or physical paths (such as fibre channel cables and switches) between a server and a storage unit, spindle redundancy alone will not be sufficient to continue operating the system.   This is because there will be no means for accessing data in the storage unit even though the data themselves are intact.   Even a heavily protected storage unit will lose all its power once a path failure occurs.   This also applies to NEC Storage.

1.1.1   Handling path failures

NEC Storage PathManager provides an infrastructure to multiplex paths and eliminate the abovementioned vulnerability present between a server and a storage unit in a system.

When a failure occurs in a path and a storage unit can no longer be accessed during system operation, NEC Storage PathManager will detect the event.   NEC Storage PathManager then switches the path to be used from the failed path to a normal path so that access to the storage unit can continue.   No I/O will be lost

during the course of switching the paths.   Applications can continue their processing without being aware of the path failure.

1.1.2   Load balancing function

NEC Storage PathManager has a load balancing function that uses multiplexed paths to distribute loads. Static load balancing and dynamic load balancing methods are used so that it is possible to take advantage of the features of NEC Storage.   Using this function will improve the access efficiency of NEC Storage.

1.1.3   Support for cluster systems

NEC Storage PathManager works together with NEC Storage to support CLUSTERPRO and MSCS (Microsoft Cluster System) Environments.   As a result, cluster systems and multiplexed paths are combined, and systems that are more solid than before can be constructed.   Using NEC Storage PathManager eliminates the necessity to use the failover function for nodes in cluster systems in order to avoid path failures.

1.2   Configuration of NEC Storage PathManager

NEC Storage PathManager operates on servers such as Express5800 and monitors the paths connected by FC cables between the HBA (host bus adapter) at the server and the HP (host port) of NEC Storage.

NEC Storage PathManager consists of the following modules:

/1/ NEC Storage PathManager driver

This is a group of drivers that form the core of NEC Storage PathManager.   It controls basic functions of NEC Storage PathManager such as multiplexed paths and load balancing.

/2/ Operation command (spscmd)

This is a command used to check status or make settings for actions or paths of NEC Storage PathManager.   Use the command prompt to use this command.   This operation command is used in most of the NEC Storage PathManager related operations.

/3/ Path patrol service (iSpmWatcher)

This service offers a path patrol function that automatically monitors status of the paths.   It issues requests for path monitoring to the NEC Storage PathManager driver every specified period of time.

/4/ Log service (iSpmLogger)

This service offers a log extract function that writes log information related to NEC Storage PathManager in the event log.   From internal information of NEC Storage PathManager, it writes important information in the event log.
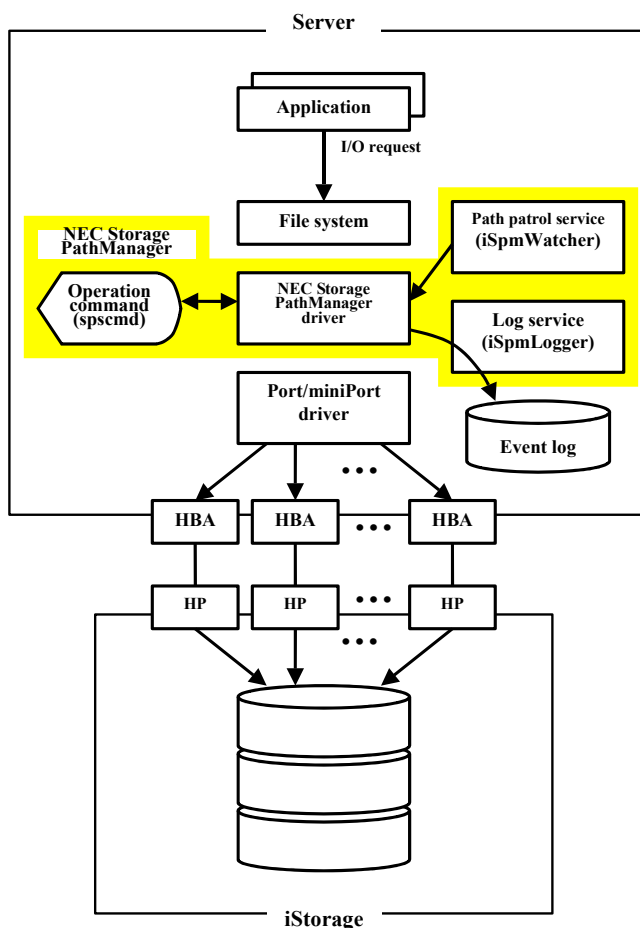

Figure 1-1   Configuration of NEC Storage PathManager

1.3   System configuration

A basic configuration example of a system to which NEC Storage PathManager is installed will be illustrated below.

1.3.1   Single-server configuration

In this configuration, a server and NEC Storage are directly connected.   The system is relatively small, and the configuration is the most common.

Express5800

Storage PathManager

NEC Storage

Figure 1-2   Single-server configuration

1.3.2   Multiple-server configuration

In this system, multiple servers are directly connected to NEC Storage.   This system configuration is used when multiple servers having different tasks share a relatively large NEC Storage.   Exclusive control such as access control is necessary among logical units used by respective servers.

Express5800   Express5800

Storage PathManager   Storage PathManager
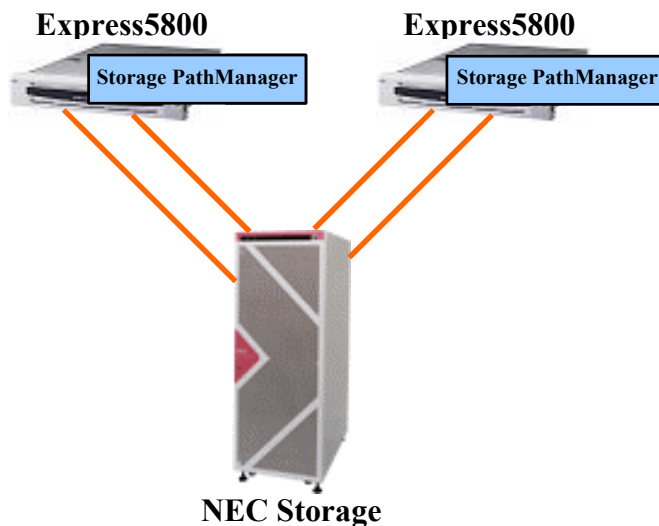
NEC Storage

Figure 1-3   Multiple-server configuration

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1.3.3   Cluster configuration

Below is an example of a cluster system configuration.   There are FC switches between the server and NEC Storage so that multiple servers will make the same logical unit visible.
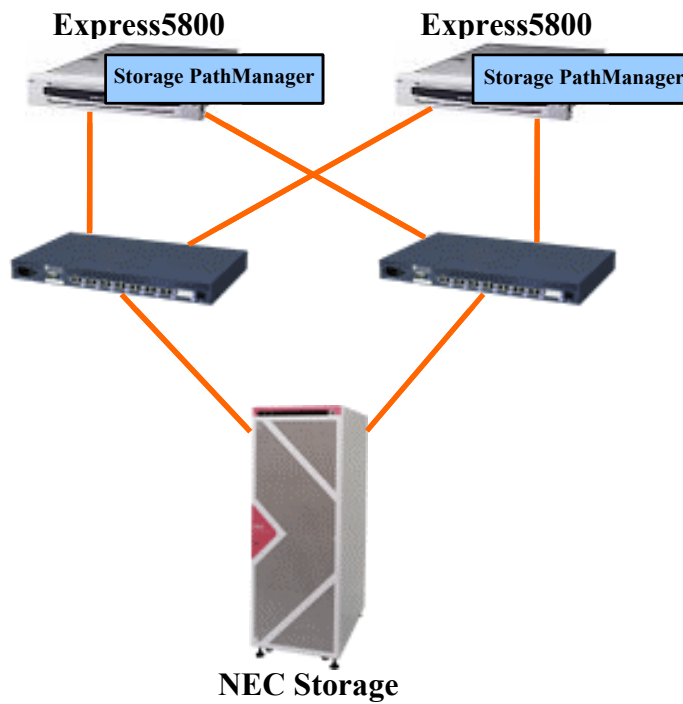

Figure 1-4   Cluster configuration

Part II   Installation

Chapter 2   Installing NEC Storage PathManager

2.1   Operating environment

Operating environment for NEC Storage PathManager is shown below:

Table 2-1   Operating environment

	Enterprise	Standard
OS	Windows 2000 Server (Service Pack 3 or later) Windows 2000 Advanced Server (Service Pack 3 or later) Windows Server 2003, Standard Edition Windows Server 2003, Enterprise Edition (both 32-bit and 64-bit(*1))	
Server	Express5800/100 series, 1000 series, ft series	
Memory	Necessary memory for OS + 10 MB, or more	
Disk	Program size: 13 MB Necessary disk size for program operation: more than 23 MB	
HBA	Host bus adapter specified by NEC Storage	
NEC Storage	- 4000 series - 3000 series - 2800 series - 2000 series - 1000 series - 100 series	- 2800 series - 2000 series - 1000 series - 100 series

(*1) Storage PathManager on IA64 servers does not support NEC Storage S100 series.

2.2   Setup

The Setup CD is used to install/uninstall NEC Storage PathManager. The Setup CD allows the following actions:

/1/   Installation

It installs the program to the server and registers the HBA in NEC Storage PathManager.

/2/   Uninstallation

It completely removes NEC Storage PathManager from the server.

/3/   Version upgrade

Users who are using previous versions of this software can use this mode and easily prepare for installation of this version.

Procedures for each action will be illustrated in the following sections. For further details, refer to the "Storage PathManager Installation Guide."

⚠️ After installing NEC Storage PathManager and before starting its operation, make sure to read "Chapter 4 Operating NEC Storage PathManager" and check operation status and make settings.

2.2.1   Before setup

Read the following notes before starting the setup of NEC Storage PathManager.

/1/ **Make sure to use HotFix (Q323289_W2K_SP4_X86_EN.exe) on the Setup CD when working in a Windows 2000 Service Pack 3 environment.   HotFix solves the Windows 2000 memory leak problem that would affect NEC Storage PathManager.   HotFix is for use only in a Service Pack 3 environment.   Never use HotFix in any other environments.   This HotFix is included in Service Pack 4.**

/2/ Do not connect the server and NEC Storage via multiple paths until setup of NEC Storage PathManager is complete.   Turning on the server while multiple paths connect the server and NEC Storage may result in fatal damage to file systems.

/3/ Follow the HBA setup procedure manual to set up the FibreChannel driver.

/4/ Set the cross call of NEC Storage to "On."   For settings of the cross call, refer to the NEC Storage manual.

/5/ If "Alert Manager Main Service" is active, temporarily stop the service and then set up NEC Storage PathManager in order to ensure successful registration of liaison functions.

/6/ When using EXPRESSCLUSTER (CLUSTERPRO) or MSCS, make sure to set up NEC Storage PathManager first and then EXPRESSCLUSTER (CLUSTERPRO) or MSCS.

/7/ When upgrading NEC Storage PathManager in an environment using EXPRESSCLUSTER (CLUSTERPRO) or MSCS, the upgrade must be conducted at one node at a time.   If a group is in operation at the node where upgrading will be conducted, move the group beforehand to any other node.   Move the group back to the original node after completing the upgrade.   Refer to manuals of respective products for how to move groups.

2.2.2   Installation

Use the Setup CD and follow the procedures below to install NEC Storage PathManager.

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Make sure to use HotFix (Q323289_W2K_SP4_X86_EN.exe) contained in the Setup CD when installing NEC Storage PathManager in a Windows 2000 Service Pack 3 environment.   HotFix solves the Windows 2000 memory leak problem that would affect NEC Storage PathManager. HotFix is for use only in a Windows 2000 Service Pack 3 environment. Never use HotFix in any other environments. This HotFix is included in Windows 2000 Service Pack 4.

/1/   Completely disconnect the server and NEC Storage while the server is turned off.

/2/   Turn the server on and log in as an administrative user.

/3/   Insert the Setup CD into the CD drive unit.

/4/   Follow the instructions of the installer to install NEC Storage PathManager.

/5/   Once the installation is complete, connect NEC Storage and the server used in installation (if you are requested to reboot the system, first reboot the system and then make the above connection).

For further information regarding installation procedures, refer to the "Storage PathManager Installation Guide."

2.2.3   Uninstallation

Use the Setup CD and follow the procedures below to uninstall NEC Storage PathManager.

/1/   Completely disconnect the server and NEC Storage while the server is turned off.

/2/   Turn the server on and log in as an administrative user.

/3/   Insert the Setup CD into the CD drive unit.

/4/   The dialogue box [Storage PathManager Maintenance] will be displayed.   Click on the [Uninstall] button.

/5/   Follow the instructions of the installer to uninstall NEC Storage PathManager.

For further information regarding uninstallation procedures, refer to the "Storage PathManager Installation Guide."

When turning on the server after uninstalling NEC Storage PathManager, make sure that the connection between the server and NEC Storage is not redundant. You can also set the cross call of NEC Storage to "Off." Turning on the server while the connection is redundant may result in unexpected damage to the file systems. For cross call settings, refer to the NEC Storage manual.

2.2.4   Version upgrade

Use the Setup CD and follow the procedures below to upgrade NEC Storage PathManager.

/1/ Completely disconnect the server and NEC Storage while the server is turned off.

/2/ Turn the server on and log in as an administrative user.

/3/ Insert the Setup CD into the CD drive unit.

/4/ Follow the instructions of the installer to upgrade NEC Storage PathManager.

If the previous version of NEC Storage PathManager and EXPRESSCLUSTER (CLUSTERPRO) were used in combination, **the X-CALL DISK setting information of EXPRESSCLUSTER (CLUSTERPRO) will be lost** during the course of the version upgrade. Refer to the "Storage PathManager Installation Guide" and use the CLUSTERPRO Disk Administrator to remake the X-CALL DISK settings.

For further information regarding procedures for version upgrade refer to the "Storage PathManager Installation Guide."

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Part III   Functions

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Chapter 3   Functions of NEC Storage PathManager

</div>

This chapter describes functions that NEC Storage PathManager offers.   Basic functions of NEC Storage PathManager can be roughly categorized as follows:

/1/   Path state display

This function displays information regarding state of paths.

/2/   Path control

This function sets the state of paths.

/3/   Load balancing

This function distributes I/O loads to multiple paths.

/4/   Cluster liaison

This function enables the program to operate in a cluster environment (such as CLUSTERPRO and MSCS).

/5/   Path patrol

This function monitors the state of paths.   It also detects failures and recovery from failures as they occur.

/6/   Failure avoidance and failure recovery

This function shuts down failed paths when failures occur, uses the failover function to use alternative paths, and uses the failback function at the time of failure recovery.

/7/   Log extraction

This function outputs operation information and failure information to system log files and dedicated log files as operation histories.

/8/   Message (ESMPRO liaison)

This function issues notifications to operators as performance or failure information is outputted.

3.1   Path state display

The path state display function is the most basic function of NEC Storage PathManager.   For each logical unit, this function lists the state of the paths that are managed by NEC Storage PathManager.

An spscmd will activate the path state display function.   The state of the paths managed by NEC Storage PathManager will first be described below.   Then corresponding spscmd options such as the -getlun option used in path state display will be described.

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3.1.1   Path state

There are roughly four types of path state:

/1/   In use

This is the path that is currently in use.   For each logical unit, there can only be one path in use.

/2/   Active

This is a path that is ready for use, and the priority given to this path is in effect.

/3/   Standby

This is a path that is ready for use, and the priority given to this path is not in effect.

/4/   Failed
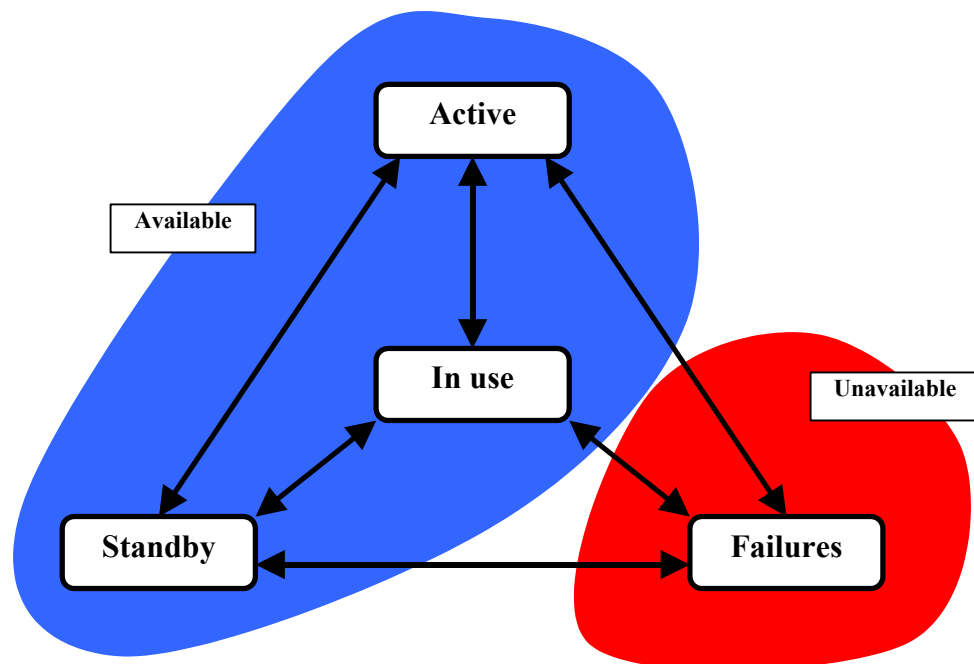
This is the path that is unavailable due to failures.

Figure 3-1   State transition

3.1.2   Path list display

Use the -getlun option of the spscmd to check the state of all paths that are managed by NEC Storage PathManager.   This will allow you to check which path is currently being used in each logical unit, which path is experiencing failures, and the settings for load balancing.   Use the command prompt to execute the spscmd.   An example of command execution will be shown below.

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```
C:\>spscmd -getlun
*** LogicalUnit #0 ***    /1/
>   0: Priority=2, PathNumber=4:0:0:0
    1: Priority=1, PathNumber=5:0:1:0
  /2/   /3/                          /4/
*** LogicalUnit #1 ***
  X 0: Priority=1, PathNumber=4:0:0:1
>   1: Priority=2, PathNumber=5:0:1:1

+++ LogicalUnit #2 +++ [round robin]
>   0: Priority=2, PathNumber=5:0:1:2
  @ 1: Priority=1, PathNumber=4:0:0:2

C:\>
```

A list of recognized paths is displayed for each logical unit.   The image above shows that there are three logical units and two paths are recognized for each of the logical units.

/1/   Logical unit number

This shows logical unit numbers and the state of load balancing.   The logical unit that is dynamically distributing the loads is displayed with a "+++" symbol before and after the logical unit number as seen in LogicalUnit #2 in the above image.   After the "+++" symbol attached to the end of the logical unit name, the type of dynamic load balancing is displayed (NEC Storage PathManager 2.0 only supports "round robin" as a type of dynamic load balancing).   Other logical unit numbers are surrounded by the "***" symbol.

/2/   Path state

This shows the state of each path.

- ">": In use.   This is the path that is currently being used.

- "X": Failed.   This path is not used due to failures.

- "@": Standby.   This path is on standby.

- No symbol: Active.   This path is active.

/3/   Priority

This shows priorities given to the paths.   Priority is used to specify the order of paths to be used in each logical unit.   For example, priority assigns a path to be used next when loads are dynamically distributed (in the round robin method).   In other cases, priority determines which path is to be used as an alternative in case of failures in the paths currently in use.

Priority must be an integer between 1 and 254, and is uniquely determined in each of the logical units.   Priority becomes higher as the number becomes larger.

/4/   Path number

Path number uniquely assigns a path and is displayed in four numbers with a colon (:) in between.   These four numbers respectively correspond to PortNumber, PathId, TargetId, and Lun that are displayed in the -v option.

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⚠ When devices become completely invisible due to disconnection of the FC cable for example, the corresponding path information disappears instead of the path state being displayed as "Failed."

```
C:\>spscmd -getlun

*** LogicalUnit #0 ***
>   0: Priority=2, PathNumber=4:0:0:0
    1: Priority=1, PathNumber=5:0:1:0

C:\>
```

⬇ Disconnection occurs in the path 4:0:0:0.

```
C:\>spscmd -getlun

*** LogicalUnit #0 ***
>   0: Priority=1, PathNumber=5:0:1:0

C:\>
```

The path information disappears.

3.1.3   Detailed path list display

Use the -getlun option of the spscmd with the -v option to see detailed information on each path.   An example is shown below.

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```
C:\>spscmd -getlun -v

*** LogicalUnit #0 ***
 State=0x0
 Config=0x0
 LBMode=0x0
 LogialDiskNumber='00000'
 ProductId='iStorage 2000   '
 SerialNumber='1234123412341234'
>   0: Priority=2, PortNumber=4, PathId=0, TargetId=0, Lun=0
       BusNumber=0, SlotNumber=9
       Wwpn=34129078:56341221

>   1: Priority=1, PortNumber=5, PathId=0, TargetId=1, Lun=0
       BusNumber=1, SlotNumber=1
       Wwpn=34129078:56341223

*** LogicalUnit #1 ***
 State=0x0
 Con
```
```
  @  1: Priority=1, PortNumber=4, PathId=0,
       BusNumber=1, SlotNumber=1
       Wwpn=34129078:56341223

C:\>
```

- State: (not used)

- Config: (not used)

- LBMode: settings for dynamic load balancing

- LogicalDiskNumber: number given to a logical disk

- ProductId: product ID of NEC Storage

- SerialNumber: serial number given to an NEC Storage unit

- PortNumber: number given to a port

- PathId: ID of a path

- TargetId: ID of a target for SCSI

- Lun: number given to a logical unit

- BusNumber: PCI bus number of an HBA

- SlotNumber: PCI device number of an HBA

- Wwpn: WWpn (World Wide port name)

3.1.4   Sorted path list display

Use the -getlun option of the spscmd with the -s0, -s1, and -s2 options to specify the order of path display for each logical unit. (This function is not for Windows Server 2003.)

- s0: For the logical unit that is dynamically distributing the loads, the paths will be displayed in the order

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of their number.   For other logical units, the paths will be displayed in the order of priority.   If not specifically set, this display order will be applied.

- s1: Paths will be displayed in the order of their number.

- s2: Paths will be displayed in the order of priority.

The following image shows a display example when the -s1 option is used.

```
C:\>spscmd -getlun -s1

*** LogicalUnit #0 ***
>   0: Priority=2, PathNumber=4:0:0:0
    1: Priority=1, PathNumber=5:0:1:0

*** LogicalUnit #1 ***
  X 0: Priority=1, PathNumber=4:0:0:1
>   1: Priority=2, PathNumber=5:0:1:1

+++ LogicalUnit #2 +++ [round robin]
 @  0: Priority=1, PathNumber=4:0:0:2
>   1: Priority=2, PathNumber=5:0:1:2

C:\>
```

As seen in the above image, the paths are displayed in the order of their number for the logical unit #2.

3.2   Path control

Path control is a function to specify the state of each path managed by NEC Storage PathManager.   Use an spscmd to use this function.   Path priority, which becomes important when controlling the paths, will be described first.   Then spscmd options to be used in path control will be described.

3.2.1   Path priority

Path priority is assigned to each path in each logical unit and is used to specify the order of paths to be used in the respective logical units.   Priority is expressed as an integer between 1 and 254 and is uniquely determined in each logical unit.   Priority becomes higher as the number becomes larger.

Path priority is mainly used to determine which path is to be used as an alternative in case of failures in the path currently being used.   Therefore, the path with the highest priority will be first used.   However, when failures occur in this path, then the path with the second highest priority will be used.

When loads are dynamically distributed (in the round robin method), path priority is used to determine the order of multiple paths to be used in dynamic load balancing.   This means that the paths will be used in the

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order of priority, from the highest to the lowest for each I/O.   After the path with the lowest priority is used, the order returns to the path with the highest priority.

When path priority or path state has been changed by the spscmd described below, the result will immediately be in effect for the currently used path.

3.2.2   Disabling priority

When you wish to have particular paths unused due to maintenance work for example, use the -notavail option of the spscmd to temporarily disable priority.   The state of a path with deactivated priority will turn from "In use" or "Active" to "Standby."
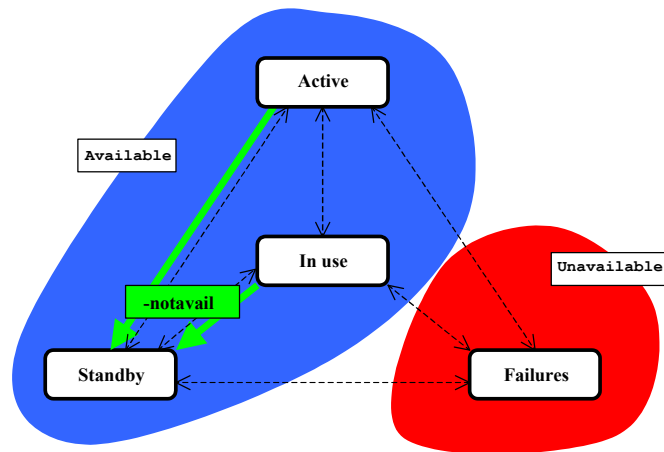
Figure 3-2   -notavail option

In the following example, priority of the path 4:0:0:0 has been deactivated.   After executing the -notavail option, the path 4:0:0:0 will have the "@" symbol which stands for a standby state.   Also in the example, the ">" symbol indicates that the path 5:0:1:0 is in use even though the path 4:0:0:0 has a higher priority than the path 5:0:1:0.

```
C:\>spscmd -getlun

*** LogicalUnit #0 ***
>   0: Priority=2, PathNumber=4:0:0:0
    1: Priority=1, PathNumber=5:0:1:0

C:\>spscmd -notavail 4:0:0:0

C:\>spscmd -getlun

*** LogicalUnit #0 ***
 @  0: Priority=2, PathNumber=4:0:0:0
>   1: Priority=1, PathNumber=5:0:1:0

C:\>
```

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A path with disabled priority will be excluded from the decision process of the order of path use by priority and dynamic load balancing process. Note that this does not mean that this path will be absolutely unavailable. Instead, this path is treated as a path having an even lower priority than the path with the lowest priority. Therefore, a path with disabled priority will be used in case of failures in all the other paths. In this case, the priority of this path will be enabled before it is used. The following figure shows the priority relationship between normal paths, which are the paths with enabled priority, and paths with disabled priority.
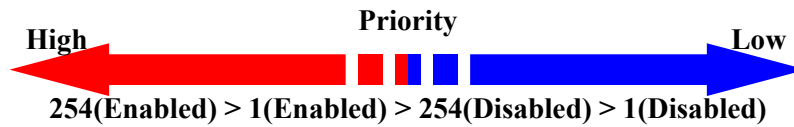
Figure 3-3   Priority size relationship

Use the -avail option of the spscmd to enable the priority of a path that had been disabled. The state of the path with newly enabled priority will turn from "Standby" to "In use" or "Active."
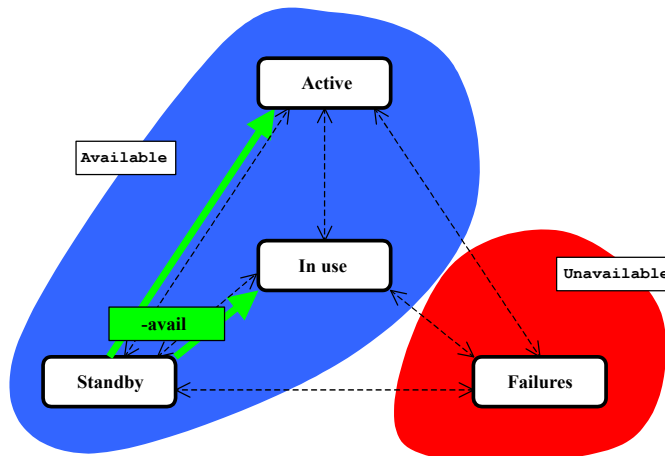

Figure 3-4   -avail option

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The following image shows an example when the -avail option is used.

```
C:\>spscmd -getlun

*** LogicalUnit #0 ***
 @  0: Priority=2, PathNumber=4:0:0:0
>   1: Priority=1, PathNumber=5:0:1:0

C:\>spscmd -avail 4:0:0:0

C:\>spscmd -getlun

*** LogicalUnit #0 ***
>   0: Priority=2, PathNumber=4:0:0:0
    1: Priority=1, PathNumber=5:0:1:0

C:\>
```

3.2.3   Changing paths for use

Use the -path option of the spscmd to change the path to be used.   The -path option assigns a specified path as a path to be used by enabling the priority of the specified path and by switching the priorities of the specified path and the currently used path.   Note that the priorities will not be switched if the specified path becomes the path to be used only by enabling its priority.   The priority of the path specified by the -path option will become enabled even if the priority of the currently used path is disabled, meaning that there is no path with enabled priority.   The -path option cannot specify failed paths.

As seen below, use a path number (PathNumber) displayed in the -getlun option to specify a path.

```
C:\>spscmd -getlun

*** LogicalUnit #0 ***
>   0: Priority=2, PathNumber=4:0:0:0
    1: Priority=1, PathNumber=5:0:1:0

C:\>spscmd -path 5:0:1:0

C:\>spscmd -getlun

*** LogicalUnit #0 ***
    0: Priority=1, PathNumber=4:0:0:0
>   1: Priority=2, PathNumber=5:0:1:0

C:\>
```

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When using the -path option to specify a path, a path number (PathNumber) displayed in the -getlun option is inputted as an argument.　Here, part of the path number input can be omitted.　If multiple paths in the same logical unit match the result of partially omitted path number input, the first matched path will be specified.　The following image shows an example.

```
C:\>spscmd -path 5:::0    <- Changes to any path of PortNumber=5 for LUN0

C:\>spscmd -path 5:::     <- Changes to any path of PortNumber=5 for all LUNs

C:\>spscmd -path ::1:     <- Changes to any path of TargetId=1 for all LUNs

C:\>
```

Path numbers can be omitted in all spscmd options that require specification of path numbers.

3.2.4　　Switching priorities

Use the -swap option of the spscmd to switch the orders of paths to be used.　The -swap option switches priorities of two specified paths.　Note that the enabled/disabled status of the priorities will not be switched. This option is mainly used to change priorities between paths that are not being used.　However, currently used paths can also be specified.

```
C:\>spscmd -getlun

*** LogicalUnit #0 ***
>   0: Priority=3, PathNumber=4:0:0:0
    1: Priority=2, PathNumber=5:0:1:0
    2: Priority=1, PathNumber=6:0:2:0

C:\>spscmd -swap 5:0:1:0 6:0:2:0

C:\>spscmd -getlun

*** LogicalUnit #0 ***
>   0: Priority=3, PathNumber=4:0:0:0
    1: Priority=2, PathNumber=6:0:2:0
    2: Priority=1, PathNumber=5:0:1:0

C:\>
```

3.2.5　　Changing priority

Use the -priority option of the spscmd to directly change the priority of a path.　Specify a path number and an integral value so that the -priority option changes the priority value of the specified path to the

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specified integer.

```
C:\>spscmd -getlun

*** LogicalUnit #0 ***
>   0: Priority=2, PathNumber=4:0:0:0
    1: Priority=1, PathNumber=5:0:1:0

C:\>spscmd -priority 5:0:1:0 3

C:\>spscmd -getlun

*** LogicalUnit #0 ***
    0: Priority=2, PathNumber=4:0:0:0
>   1: Priority=3, PathNumber=5:0:1:0

C:\>
```

⚠ Priority specified in the -priority option must be an integer between 1 and 254, and each path must have a unique priority in a logical unit. Multiple numbers of the same priority cannot exist in a logical unit. When specifying a priority, paths that are not displayed due to failures must be taken into consideration. When a path with a particular priority recovers from failures and the same priority already exists in the same logical unit, the priority of the path that has failed back will be changed (refer to "4.1.2 Initial settings").

As described above, the -priority option must be used with much caution. Unless it is absolutely necessary, use the -path option or the -swap option instead.

3.3   Load balancing

This function distributes I/O loads to available paths that are managed by NEC Storage PathManager.   In NEC Storage PathManager, there are two types of load balancing: static load balancing and dynamic load balancing.   Each type of load balancing will be described below.

3.3.1   Static load balancing

In this method, loads will be distributed through static distribution of paths by the logical units.   As seen in the figure below, loads will be distributed by separating paths that access logical unit 0 from paths that access logical unit 1.
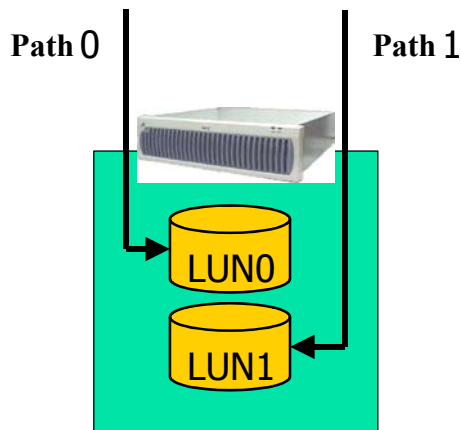
Figure 3-5   Static load balancing

Use the -path option or the -swap option of the spscmd to make settings for static load balancing.

The following image shows an example.

```
C:\>spscmd -getlun

*** LogicalUnit #0 ***
>   0: Priority=2, PathNumber=4:0:0:0
    1: Priority=1, PathNumber=5:0:1:0

*** LogicalUnit #1 ***
>   0: Priority=2, PathNumber=4:0:0:1
    1: Priority=1, PathNumber=5:0:1:1

C:\>
```


In this example, path 0 (path number 4:0:0:x) will be used when accessing logical units 0 and 1.   Once the settings for static load balancing are made, path 0 will be used to access logical unit 0 and path 1 will be used to access logical unit 1.

```
C:\>spscmd -path 5:0:1:1

C:\>spscmd -getlun

*** LogicalUnit #0 ***
>   0: Priority=2, PathNumber=4:0:0:0
    1: Priority=1, PathNumber=5:0:1:0

*** LogicalUnit #1 ***
    0: Priority=1, PathNumber=4:0:0:1
>   1: Priority=2, PathNumber=5:0:1:1

C:\>
```


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It is possible to confirm that static load balancing is in effect once the -path option is applied to the logical unit 1.

3.3.2   Dynamic load balancing

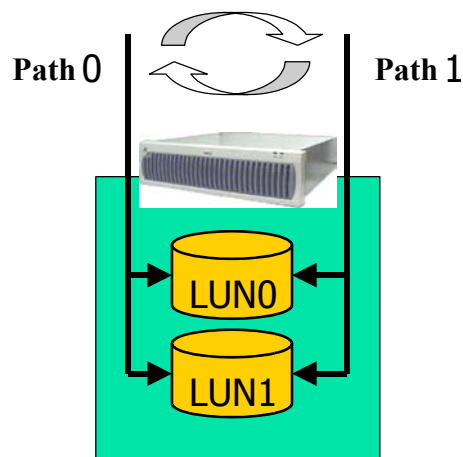In this method, loads are distributed by dynamically changing the paths to be used among multiple paths.

Figure 3-6   Dynamic load balancing

Use the -lbmode option of the spscmd to make settings for dynamic load balancing.   The following image shows an example.

```
C:\>spscmd -getlun

*** LogicalUnit #0 ***
>   0: Priority=2, PathNumber=4:0:0:0
    1: Priority=1, PathNumber=5:0:1:0

C:\>spscmd -lbmode 4:0:0:0 1

C:\>spscmd -getlun

+++ LogicalUnit #0 +++ [round robin]
>   0: Priority=2, PathNumber=4:0:0:0
    1: Priority=1, PathNumber=5:0:1:0

C:\>
```

In this example, the path to logical unit 0 which exists in NEC Storage is used in dynamic load balancing.

Use the first argument in the -lbmode option to specify a path number of the logical unit to execute dynamic load balancing.   Then use the second argument to specify the method of load balancing.   Settings

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for dynamic load balancing must be set for each unit.

Second argument 0: do not execute dynamic load balancing (specified when load balancing will not be

executed or when static load balancing will be executed)

Second argument 1: execute dynamic load balancing (in the round robin method)

Note also that the settings for dynamic load balancing cannot be made if the program is working with MSCS.

3.4   Cluster liaison

The cluster liaison function enables the use of NEC Storage PathManager in a cluster environment.   When abnormalities occur in I/O, NEC Storage PathManager first attempts to switch paths.   If this does not work, then the cluster control program will switch nodes.   NEC Storage PathManager can be used in EXPRESSCLUSTER (CLUSTERPRO) and MSCS (Microsoft cluster system) environments.

3.4.1   EXPRESSCLUSTER(CLUSTERPRO) liaison

This function allows NEC Storage PathManager to work in liaison with EXPRESSCLUSTER (CLUSTERPRO).   No particular settings are necessary to use this function.

3.4.2   MSCS liaison

This function allows NEC Storage PathManager to be used in an MSCS environment.   Use the -setmscsmode option of the spscmd to enable the MSCS liaison function.   This function is disabled by default.   Use the -getmscsmode option to check the current settings.

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```
C:\>spscmd -getmscsmode

MSCS : Disable

C:\>spscmd -setmscsmode E

C:\>spscmd -getmscsmode

MSCS : Enable

C:\>
```

The -getmode option of the spscmd can also be used to check the settings for MSCS liaison.

```
C:\>spscmd -getmode

   Class : Enterprise
Failback : Active
    MSCS : Disable

C:\>
```

Note also that the settings for dynamic load balancing cannot be made if the program is working with MSCS.

3.5   Path patrol

   This function periodically monitors the state of all paths that are available or unavailable for use.   NEC Storage PathManager has a health check function and a recovery check function.   In the health check function, paths that are available for use are monitored, and the failover function is automatically activated in case of failures.   In the recovery check function, paths that are not used due to failures are monitored, and the failback function is automatically activated at the time of failure recovery.   The path patrol service and the NEC Storage PathManager driver allow execution of these functions.

   The path patrol service issues requests for path monitoring to the NEC Storage PathManager driver every specified period of time.   Once the NEC Storage PathManager driver receives requests, it checks the state of specified paths.   The NEC Storage PathManager driver issues monitoring I/O if the paths have not been used for a certain period of time.   When the I/O is successfully complete, the paths are regarded as being available

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for use.   If the I/O results in an error or if it is not complete before time-out, the paths are regarded as being unavailable for use.

3.5.1   Health check

This function detects failed paths and makes them fail over by periodically issuing monitoring I/O to available paths that have not been used for a certain period of time.   This function is used mainly to monitor failures in alternative paths in environments except for those in which dynamic load balancing is conducted.
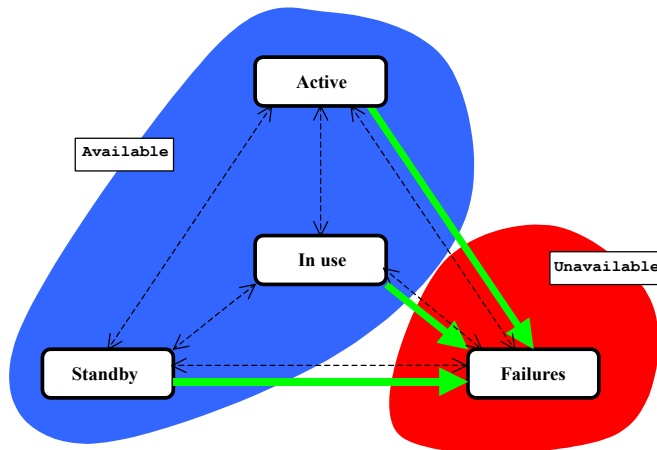

Figure 3-7   Failover as a result of health check

3.5.2   Recovery check

This function detects paths that recovered from failures and makes them fail back by periodically issuing monitoring I/O to failed paths.   This function is used for archiving active failback or standby failback.
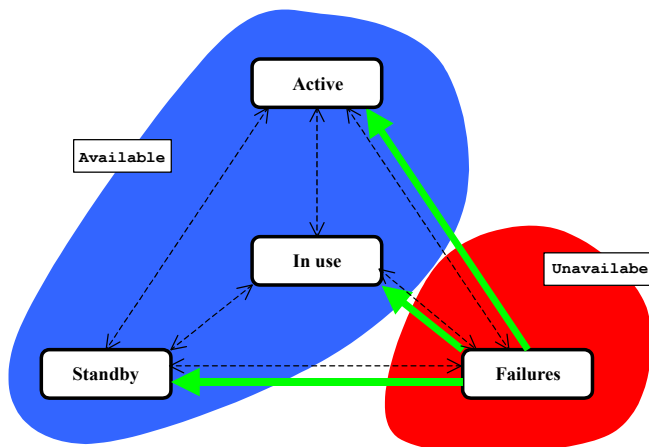
Figure 3-8   Failback as a result of recovery check

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3.5.3   Settings for path patrol

Use the -setwatcher option of the spscmd to make settings for path patrol.   Use the -getwatcher option to check the settings.

[For Windows 2000]

```
C:\>spscmd -setwatcher 3:120:30:180
                       /1//2//3/ /4/
C:\>spscmd -getwatcher

     Health check : Enable  .../1/
   Recovery check : Enable  .../1/
 Request interval : 120 sec .../2/
         Threshold : 30 sec  .../3/
 Timeout duration : 180 sec .../4/

C:\>
```

[For Windows Server 2003]

```
C:\>spscmd -setwatcher 1:30::
                       /1//2/
C:\>spscmd -getwatcher

     Health check : Enable .../1/
 Request interval : 30 sec .../2/

C:\>
```

Four numbers with a colon (:) in between are specified as arguments of the -setwatcher option.   They correspond to respective parameters displayed in the -getwatcher option.

/1/   Health check / Recovery check

This shows the status of the health check function and the recovery check function.

In the -getwatcher option

Enable: functions are available for use

Disable: functions are unavailable for use

In the -setwatcher option

0: health check disabled, recovery check disabled

1: health check enabled, recovery check disabled

2: health check disabled, recovery check enabled

3: health check enabled, recovery check enabled

(Default: 3 (health check enabled, recovery check enabled))

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(Recovery check is not for Windows Server 2003.)

/2/   Request interval

The path patrol service issues monitoring requests for each path to the NEC Storage PathManager driver at this interval (default: 60, unit: seconds).

/3/   Threshold

This refers to a period of time in which paths have not been used.   Threshold is used to determine if monitoring I/O should be issued to the designated paths when the NEC Storage PathManager driver receives monitoring requests.   Monitoring I/O will be issued if paths have not been used for longer than this period of time (default: 60, unit: seconds).

(This parameter is not for Windows Server 2003.)

/4/   Timeout duration
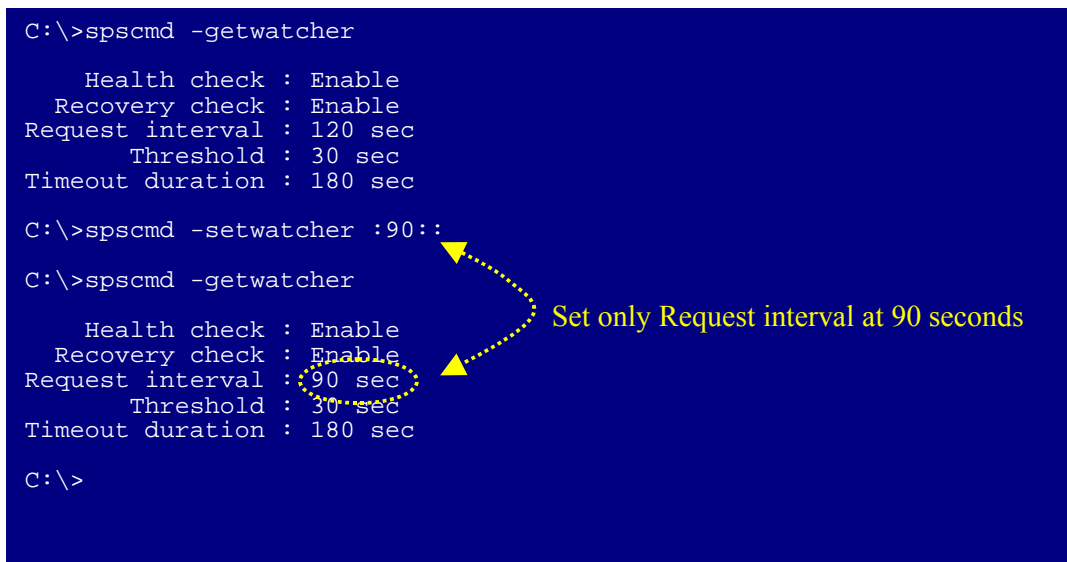
This refers to the timeout duration for monitoring I/O.   NEC Storage PathManager will decide that failures have occurred if monitoring I/O is not complete within the timeout duration (default; 120, unit: seconds).

(This parameter is not for Windows Server 2003.)

Parameters of arguments specified in the -setwatcher option can be omitted like in the case when specifying path numbers in the -path option.
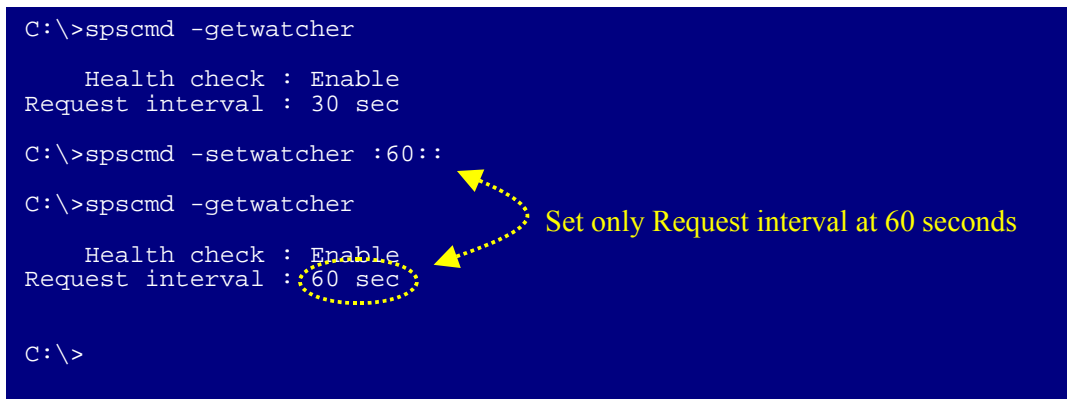
[For Windows 2000]

```
C:\>spscmd -getwatcher

     Health check : Enable
  Recovery check : Enable
Request interval : 120 sec
      Threshold : 30 sec
Timeout duration : 180 sec

C:\>spscmd -setwatcher :90::

C:\>spscmd -getwatcher

     Health check : Enable
  Recovery check : Enable
Request interval : 90 sec
      Threshold : 30 sec
Timeout duration : 180 sec

C:\>
```

Set only Request interval at 90 seconds

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[For Windows Server 2003]

```
C:\>spscmd -getwatcher

    Health check : Enable
Request interval : 30 sec

C:\>spscmd -setwatcher :60::

C:\>spscmd -getwatcher

    Health check : Enable
Request interval : 60 sec


C:\>
```

Set only Request interval at 60 seconds

3.6   Failure avoidance and failure recovery

Failure avoidance and failure recovery are functions that shut down paths in case of path failures, execute failover so that alternative paths will be used, and execute failback at the time of failure recovery.   The abovementioned path patrol executes failover and failback by using these functions.

3.6.1   Failover and failback

When failures occur in the paths, NEC Storage PathManager automatically switches paths to be used from failed paths to normal paths.   This action is referred to as failover.   When unavailable paths due to failures recover from the failures and become available again, NEC Storage PathManager automatically recognizes this event and adds these recovered paths to the group of available paths.   This action is referred to as failback.
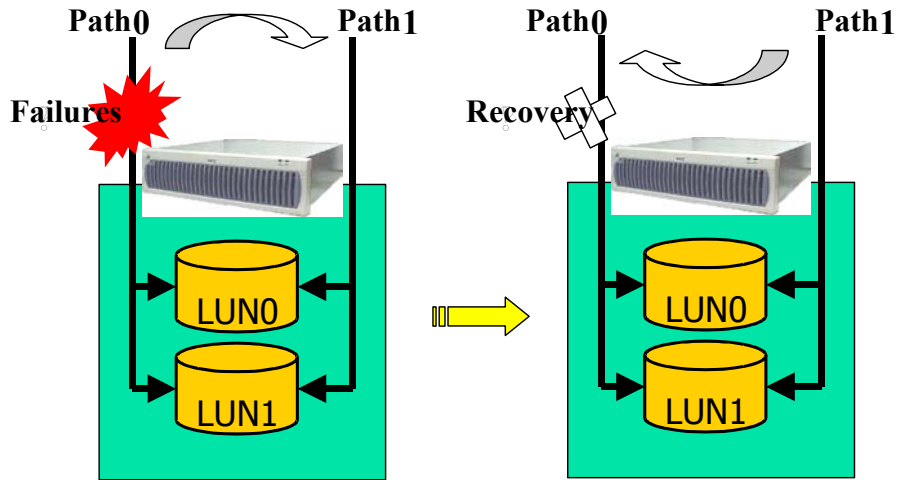
Figure 3-9   Failover (left) and failback (right)
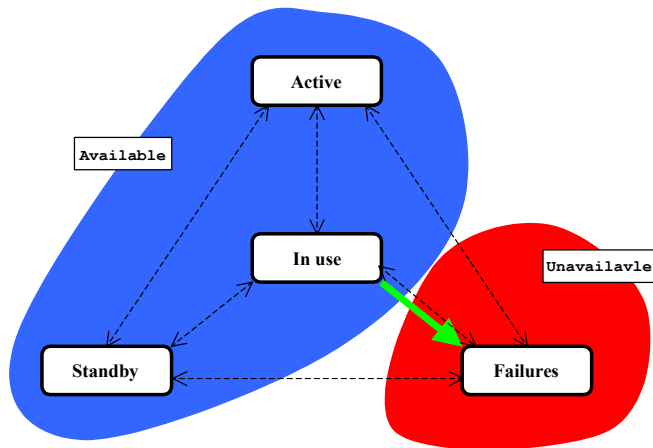
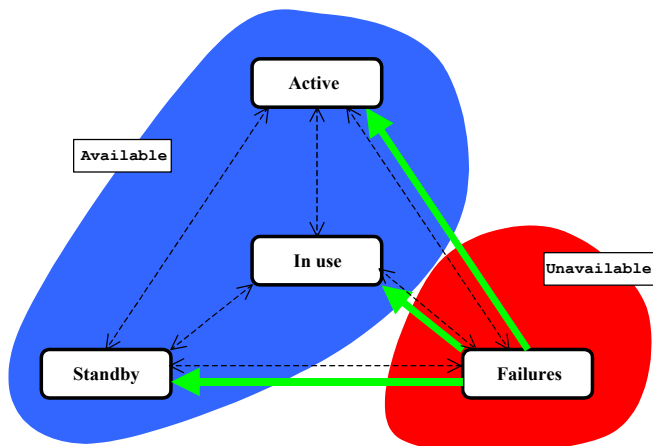Figure 3-10   Failover as a result of failure avoidance

Figure 3-11   Failback as a result of failure recovery

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3.6.2   Selecting a method of failback

In NEC Storage PathManager, two types of failback methods are available: active failback and standby failback.

/1/   Active failback

Failback is executed and the state of the path becomes active.   The priority of a path that failed back becomes enabled.   There may be a case where paths are switched at the time of failback, and the state of the path becomes "In use."

/2/   Standby failback

Failback is executed and the state of the path becomes standby.   The priority of a path that failed back becomes disabled.   Select standby failback when you do not wish to have any extra path switching at the time of failback.   If this type of failback is selected, it is necessary to manually enable the path priority after failback is complete.

Use the -setfbmode option of the spscmd to select the type of failback.

```
C:\>spscmd -setfbmode active
C:\>spscmd -getfbmode
Failback : Active
C:\>
```

In this example, active failback is selected.

/1/   Active failback

Specify "active" or simply "a" as an argument.

/2/   Standby failback

Specify "standby" or simply "s" as an argument

Use the -getfbmode option of the spscmd to check which type of failback has been selected.   "Active" will be displayed if active failback is selected, and "Standby" will be displayed if standby failback is selected. The -getmode option can also be used to check the same.

```
C:\>spscmd -getmode

   Class : Enterprise
Failback : Active
    MSCS : Enable

C:\>
```

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3.6.3   Manual failback

When the abovementioned recovery check function is disabled, failback will not be executed even though failed paths have recovered from the failures.   In such a case, use the -failback option or the -failbackall option of the spscmd to execute forced failback. (This function is not for Windows Server 2003.)

```
C:\>spscmd -getlun

*** LogicalUnit #0 ***
  X 0: Priority=2, PathNumber=4:0:0:0
>   1: Priority=1, PathNumber=5:0:1:0

C:\>spscmd -failback 4:0:0:0

C:\>spscmd -getlun

*** LogicalUnit #0 ***
>   0: Priority=2, PathNumber=4:0:0:0
    1: Priority=1, PathNumber=5:0:1:0

C:\>
```

The -failback option executes failback targeting the specified paths.   Meanwhile, the -failbackall option executes failback targeting all failed paths.   In both cases, failback will be unsuccessful for the paths yet to be recovered.

```
C:\>spscmd -getlun

*** LogicalUnit #0 ***
  X 0: Priority=2, PathNumber=4:0:0:0
>   1: Priority=1, PathNumber=5:0:1:0

*** LogicalUnit #1 ***
  X 0: Priority=2, PathNumber=4:0:0:1
>   1: Priority=1, PathNumber=5:0:1:1

C:\>spscmd -failbackall

C:\>spscmd -getlun

*** LogicalUnit #0 ***
>   0: Priority=2, PathNumber=4:0:0:0
    1: Priority=1, PathNumber=5:0:1:0

*** LogicalUnit #1 ***
>   0: Priority=2, PathNumber=4:0:0:1
    1: Priority=1, PathNumber=5:0:1:1

C:\>
```

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3.7   Log extraction

This function outputs log information related to NEC Storage PathManager to an event log.   NEC Storage PathManager internally holds log information (SPS logs).   From the log information, the log service outputs important information to the event log (system).
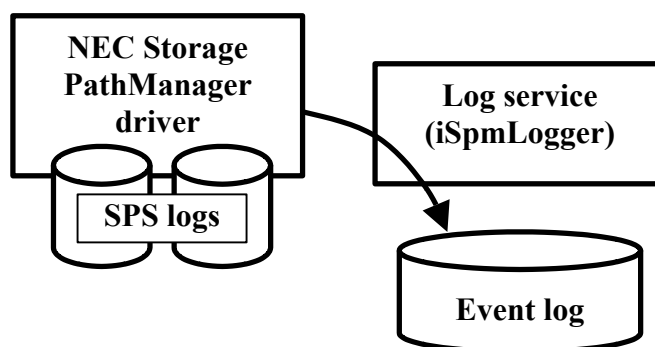

Figure 3-6   Log extraction

3.7.1   SPS logs

SPS logs refer to log information internally held by NEC Storage PathManager, and information regarding operation of NEC Storage PathManager and failed I/O are recorded in the SPS logs.   SPS logs are stored in a log storage folder (installation directory \Log) and consist of a currently used log file and the previous log file. At the time of program installation, only the currently used log file exists.

The currently used log file is named "spsevent.log" and stores logs up to the size of 5 MB, which is the maximum size of the file.
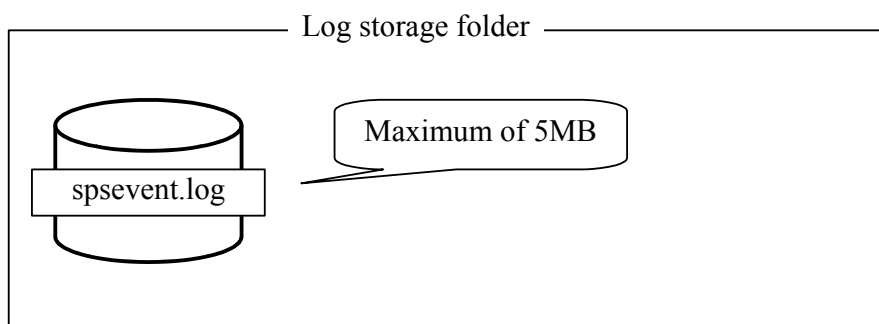
Figure 3-7   Storing SPS logs (1)

When the currently used log file becomes full, the file name changes to "spsevent.log.old."   This will be kept as the log file of the previous generation.   Then a new "currently used log file" named "spsevent.log" is created, and logs will be stored in this file.
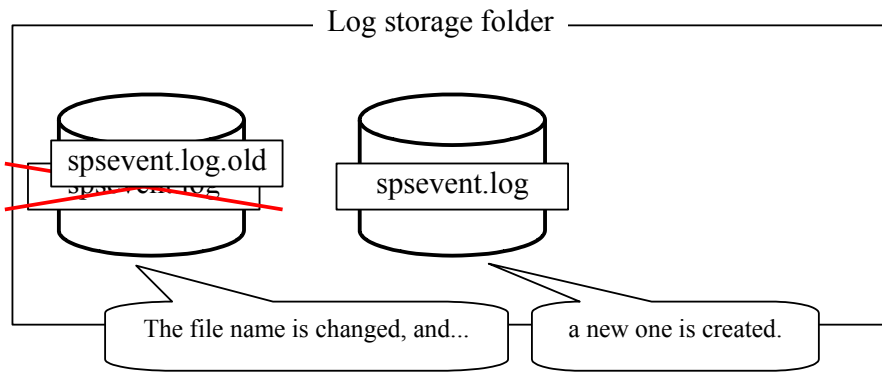
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Figure 3-8   Storing SPS logs (2)

When the new "spsevent.log" becomes full, the previous log file "spsevent.log.old" will be deleted.   Then "spsevent.log" becomes "spsevent.log.old."   A new "spsevent.log" is created, and logs will be stored in this file.
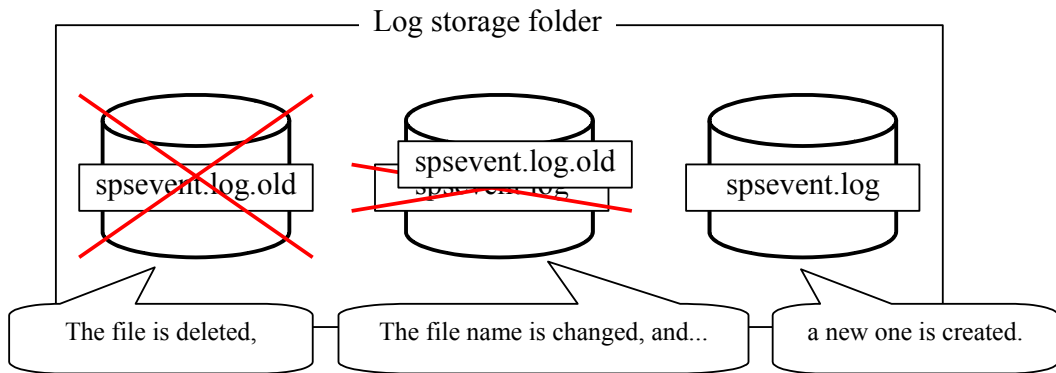

Figure 3-9   Storing SPS logs (3)

The above actions will be repeated every time the log file becomes full.   As a result, only the previous log file and the currently used log file exist.

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3.7.2   Ξvent logs

Among the pieces of information stored in the SPS logs, important information such as information related to failover and failback will be outputted to the event log (system) by the log service.

Refer to the following table for the outputted event log information.

Table 3-1   Event log list

Source(*1)	EventID(*1)	Detected event	LV	Output details
ispsvb (spsdsm)	257 (513)	Failover started	Info	Failover started%. %1 Date&Time %2
	258 (514)	Failover was done	Warn	I/O Path was changed%. %1 Date&Time %2
	259 (515)	Failover failed	Err	Failover failed%. %1 Date&Time %2
	260	Failback started	Info	Failback started%. %1 Date&Time %2
	261	Failback was done	Info	Failback finished successfully%. %1 Date&Time %2
	262	Failback failed	Err	Failback failed%. %1 Date&Time %2
	263	Failback completed	Info	Failback was already completed. %1 Date&Time %2
	264	Start Changing priority	Info	Start Changing Path Priority%. %1 Date&Time %2
	265	Changing Priority was done	Info	Path Priority was changed successfully%. %1 Date&Time %2
	266	Failed to change Priority	Err	Failed to change Path Priority%. %1 Date&Time %2
	267	Start changing LBMode	Info	Start changing LoadBalancing Mode%. %1 Date&Time %2
	268	LBMode was changed	Info	LoadBalancing Mode was changed successfully%. %1 Date&Time %2
	269	Failed to change LBMode	Info	Failed to change LoadBalancing Mode%. %1 Date&Time %2
	270	Path error	Info	Path error was detected%. %1 Date&Time %2
	271	Path error	Info	Path error was detected%. %1 Date&Time %2
	272	AFB started	Info	AutoFailback started%. %1 Date&Time %2
	273	AFB was done	Info	AutoFailback was done and some paths were recovered%. %1 Date&Time %2
	274 (530)	Path was removed	Info	Path was removed%. %1 Date&Time %2
	275	Effectiveness was changed	Info	Effectiveness of Path was changed%. %1 Date&Time %2
	276	Failed to change Effectiveness	Warn	Failed to change Effectiveness of Path%. %1 Date&Time %2
	277	Mode changed	Info	Mode was changed successfully%. %1 Date&Time %2
	278	Some Paths are not redundant	Warn	Some paths are not redundant

(*1) In NEC Storage PathManager 3.0 for Windows, Source and EventID in parentheses is used if any. In this case, the information on details and Date&Time is not outputted.

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3.8   Message(ESMPRO liaison)

The message function of ESMPRO reports the most important events among those outputted to the event log by NEC Storage PathManager.   No particular settings are required in NEC Storage PathManager to use this function.

Refer to the following table for event log information to be reported.

Table 3-2   List of event logs to be reported

Source(*1)	EventID(*1)	Detected event	LV	Reports to ALIVE(*2)	Repots to ESMPRO Manager
ispsvb (spsdsm)	257 (513)	Failover started	Info	No (Yes)	Yes
	258 (514)	Failover was done	Warn	Yes	Yes
	259 (515)	Failover failed	Err	Yes	Yes
	262	Failback failed	Err	No	Yes
	263	Failback completed	Info	No	Yes
	264	Start Changing priority	Info	No	Yes
	265	Changing Priority was done	Info	No	Yes
	266	Failed to change Priority	Err	No	Yes
	267	Start changing LBMode	Info	No	Yes
	268	LBMode was changed	Info	No	Yes
	269	Failed to change LBMode	Info	No	Yes
	270	Path error	Info	No	Yes
	271	Path error	Info	No	Yes
	272	AFB started	Info	No	Yes
	273	AFB was done	Info	Yes	Yes
	274 (530)	Path was removed	Info	Yes	Yes
	275	Effectiveness was changed	Info	No	Yes
	276	Failed to change Effectiveness	Warn	No	Yes
	277	Mode changed	Info	No	Yes
	278	Some Paths are not redundant	Warn	Yes	Yes

(*1) In Windows Server 2003, Source and EventID in parentheses is used if any. In this case, the information on details and Date&Time is not outputted.

(*2) In Windows Server 2003, EventID and Reports to ALIVE in parentheses is used if any.

If you would like to use the Alert Manager feature of ESMPRO Manager, you have to set up the registries shown below on the server which ESMPRO Manager is installed.

/1/   Set the registries shown below.

[HKEY_LOCAL_MACHINE\SOFTWARE\NEC\NVBASE\AlertViewer\AlertType\StoragePath]

WavDefault : REG_SZ : Default.wav

AniDefault : REG_SZ : Default.bmp

Image   : REG_SZ : Default.bmp

SmallImage : REG_SZ : Default.bmp

/2/   Set the permissions shown below.

[HKEY_LOCAL_MACHINE\SOFTWARE\NEC\NVBASE\AlertViewer\AlertType\StoragePath]

Administrators : Full Control

Everyone : Read

SYSTEM : Full Control

   "ESMPRO User Group" : Full Control

You can find "ESMPRO User Group" in the following registry value.

[HKEY_LOCAL_MACHINE\SOFTWARE\NEC\NVBASE]

LocalGroup

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Part IV   Operation

Chapter 4   Operating NEC Storage PathManager

4.1   Operation in normal state

4.1.1   Starting operation

After installation of NEC Storage PathManager is complete and connection is established between the server and NEC Storage, NEC Storage PathManager automatically recognizes disk subsystems and paths. Then operation starts.   From then on, NEC Storage PathManager automatically starts up when the system starts up, and it automatically stops when the system stops.   When the system starts up, NEC Storage PathManager automatically groups paths for each logical unit and conceals the paths in applications (to make only one path visible).

Use an spscmd to check current NEC Storage PathManager operation status such as path state display and path control.   Refer to "Chapter 3 Functions of NEC Storage PathManager" for the spscmd.

4.1.2   Checking operation status

After installing NEC Storage PathManager and before starting its operation, make sure that multiple paths connect the server and NEC Storage and that NEC Storage PathManager is properly functioning.   The most basic methods to check operation status of NEC Storage PathManager are described below.

Use the -getlun option of the spscmd.   Follow the steps shown below:

(1) Activate the command prompt.
(2) Input "spscmd -getlun" and press the return key.

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```
C:¥WINNT¥System32¥cmd.exe
Microsoft Windows 2000 [Version 5.00.2195]
(C) Copyright 1985-2000 Microsoft Corp.

C:¥>spscmd -getlun

*** LogicalUnit #0 ***
>   0: Priority=1, PathNumber=4:0:6:0
@   1: Priority=2, PathNumber=5:0:8:0

*** LogicalUnit #1 ***
>   0: Priority=1, PathNumber=4:0:6:1
@   1: Priority=2, PathNumber=5:0:8:1

C:¥>_
```

During redundant operation, multiple paths are displayed under each "LogicalUnit."　The example above shows that there are two logical units and two paths in NEC Storage.　Refer to "Chapter 3 Functions of NEC Storage PathManager" for detailed information about the display.

⚠ It may take some time (up to a minute) for the spscmd to return its result if the spscmd is used right after the server starts up.　This is because the spscmd waits for WMI to start up, and this is not a failure. Wait for the spscmd to return the result.

⚠ If only one path is displayed in the -getlun option of the spscmd, first refer to "4.2.1 FAQs and troubleshooting" to see if solutions can be found before making inquiries.

4.1.3　Initial settings

(1) Priority

NEC Storage PathManager determines the initial value of the priority in the following ways.

/1/　When a new path, or a path to a newly recognized logical unit, is found, the path priority becomes enabled with a priority level of 1.

/2/　When a new path to an already recognized logical unit is found, the priority of the path will become the highest priority among the paths to the logical unit + 1, and the path priority will become disabled.

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/3/　For an already recognized path to an already recognized logical unit, the state of priority will be maintained even after the system is rebooted.

/4/　When a path is already recognized as a path to an already recognized logical unit, and is recovered from path failures, the path will have a priority level that it had prior to the failures.　Whether the priority is disabled or enabled will depend on the failback mode.　When a path having a certain priority is recovered from failures, and a different path having the same priority exists in the same logical unit, then the priority will be determined in accordance with /2/ above.

To summarize, if a newly found path is the first path found in a logical unit, its priority becomes 1 and enabled.　As other paths are found after that in the logical unit, they will be sequentially allocated with priority that goes up by 1 for each path.　Their priorities will be disabled.　Once priority is allocated, after the system is rebooted the same priority will be allocated unless changes are made.　The following image shows an example of path state immediately after installation of NEC Storage PathManager.

```
C:\>spscmd -getlun

*** LogicalUnit #0 ***
>   0: Priority=1, PathNumber=4:0:0:0
 @  1: Priority=2, PathNumber=5:0:1:0
 @  2: Priority=3, PathNumber=6:0:2:0
 @  3: Priority=4, PathNumber=7:0:3:0

*** LogicalUnit #1 ***
>   0: Priority=1, PathNumber=4:0:0:1
 @  1: Priority=2, PathNumber=5:0:1:1
 @  2: Priority=3, PathNumber=6:0:2:1
 @  3: Priority=4, PathNumber=7:0:3:1

C:\>
```

As seen in the image, only the path that is found first is enabled in each logical unit immediately after installation of NEC Storage PathManager.　NEC Storage PathManager can operate as it is; however, it is recommended that all paths be enabled and settings for priority be made as necessary before starting operation unless there is a special reason not to do so.

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```
C:\>spscmd -avail :::

C:\>spscmd -getlun

*** LogicalUnit #0 ***
    0: Priority=1, PathNumber=4:0:0:0
    1: Priority=2, PathNumber=5:0:1:0
    2: Priority=3, PathNumber=6:0:2:0
>   3: Priority=4, PathNumber=7:0:3:0

*** LogicalUnit #1 ***
    0: Priority=1, PathNumber=4:0:0:1
    1: Priority=2, PathNumber=5:0:1:1
    2: Priority=3, PathNumber=6:0:2:1
>   3: Priority=4, PathNumber=7:0:3:1

C:\>
```

If the HBA driver is reinstalled, priority setting information may be lost.   After installing the HBA driver, make sure to check the settings for priority and make settings again as needed.

(2) Failback method

When NEC Storage PathManager is installed, the failback method is set to standby failback.   This is based on a policy that once failures occur in a path, that path should not be used until its complete recovery is confirmed.   This setting can avoid unnecessary switching of paths due to repetition of failover and failback by unstable paths.

(3) MSCS liaison

The MSCS function is disabled when NEC Storage PathManager is installed.

(4) Path patrol

The following shows initial values in settings for the path patrol function.

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[For Windows 2000]

```
C:\>spscmd -getwatcher

    Health check : Enable
  Recovery check : Enable
Request interval : 60 sec
       Threshold : 60 sec
Timeout duration : 120 sec

C:\>
```

[For Windows Server 2003]

```
C:\>spscmd -getwatcher

    Health check : Enable
Request interval : 60 sec

C:\>
```

4.1.4   Recommended settings for priority

In a system having a configuration with two paths, there will be only one available path when failures occur in the path in use.   Therefore, setting priority does not have any significant meaning except for when executing load balancing.   However, in a system having a larger number of paths, attention must be paid to settings for priority in order to secure smooth switching of paths in case of failures and to secure dynamic load balancing performance.

When failures occur in a path in use, NEC Storage PathManager attempts to use a path having the second highest priority.   If this path is also experiencing failures, then a path having the third highest priority will become the next candidate.   It may seem rare that more than two paths experience failures at the same time; however, this can happen depending on system configuration.

In the figure below, the system has a configuration with four paths and two FC switches, and path priorities are set to 4, 3, 2, and 1 to respective paths from left to right.   Therefore, the path having priority 4 is currently in use.   When the left FC switch fails in this system, the path having priority 4 will fail.   Therefore, failover is executed so that the path with priority 3 is be used.   However, since the left FC switch has failed, the path having priority 3 has also failed.   As a result, failover is executed again so that the path with priority 2 will be used.   As described above, there will be unnecessary failover processing from the path having priority 4 to the path having priority 2 since it must be conducted via the path having priority 3.   NEC Storage PathManager takes the longest to recognize path failures when I/O timeout occurs.   In such cases, it will take up to a minute for NEC Storage PathManager to be aware of the failures.   So in the above example it may

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take up to a minute longer for NEC Storage PathManager to recognize path failures due to execution of failover.   To avoid such situations, it is recommended that paths having priorities in numerical sequence do not have common resources.
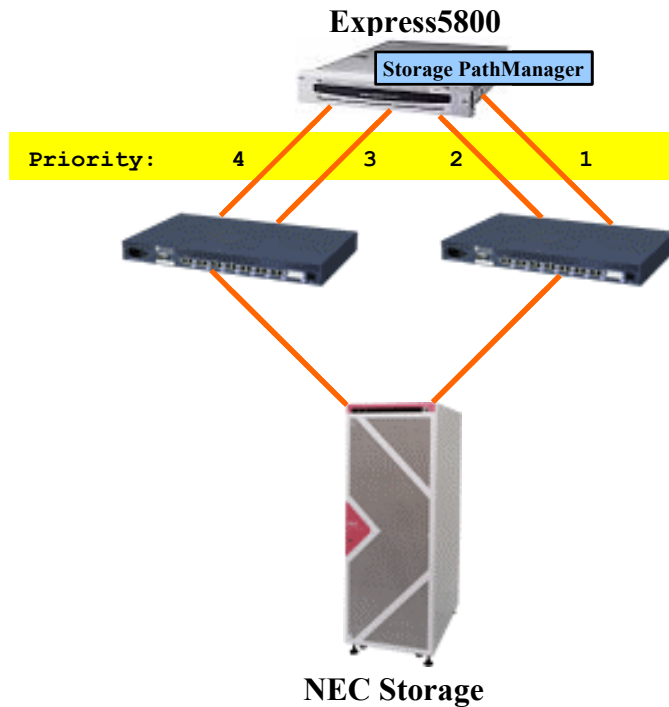
Figure 4-1   Setting priority (1)

   In the next figure, path priorities are set to 4, 2, 3, and 1 from left to right.   In this case, only one execution of failover is necessary to determine which path is going to be used next in the case of failures in a FC switch or failures in the NEC Storage controller.
   This setting is effective when conducting dynamic load balancing.   Since paths having priorities that are in numerical sequence do not share any resources, performance decrement due to resource problems is not likely to occur.

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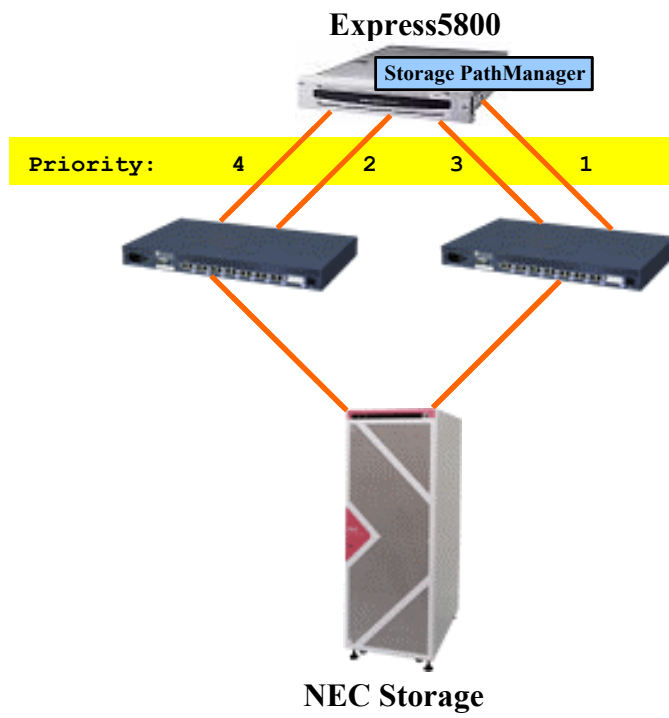
Figure 4-2   Setting priority (2)

4.2　Handling abnormalities

4.2.1　FAQs and troubleshooting

　　If only one path is displayed in the -getlun option of NEC Storage PathManager, causes may be found in the table below.　Refer to the descriptions in the table before making inquiries.

Table 4-1　FAQs and troubleshooting

Inquiry (event)	Points to check	Handling
Only one path is visible	Is the cross call function of NEC Storage set to Off?	Set the cross call function of NEC Storage to On. Use iSM to change the settings. Refer to the iSM manual for detailed information on how to change the settings.
	Is the installed HBA driver an appropriate one? Check to see if you are using the Windows 2000 driver in Windows Server 2003 or the other way around.	Reinstall the appropriate HBA driver.
	In Windows 2000, have you selected "Allow Multiple paths to SCSI Targets" check box on the Emulex Configuration Tool (elxcfg.exe) ?	Select "Allow Multiple paths to SCSI Targets" check box of all HBAs managed by NEC Storage PathManager. Refer to the HBA manual for detailed information on the Emulex Configuration Tool.
	Is NEC Storage connected with the server?	Confirm the connection between NEC Storage and the server. When fibre channel fabrics exist between NEC Storage and the server, confirm also that those fabrics are turned on.
	Is the configuration of Access Control of NEC Storage correctly set?	Confirm the configuration of Access Control of NEC Storage. Confirm also the server and NEC Storage connected logically.

4.2.2　Information gathering necessary in case of failures

　　When path failures occur or when some kind of trouble occurs in NEC Storage PathManager, collect the basic information such as date of failure, details of failure, and system configuration that is necessary when investigating the failure. Also collect the following information that is necessary in investigation from the viewpoint of NEC Storage PathManager.　If information is collected only in part or if no information is collected, causes of failure may not be identified since sufficient investigation cannot be carried out.

(1) System information

　　Extract system information from "Computer Management" of Windows.

/1/ Open [Start] -> [Settings] -> [Control Panel] -> [Administrative tools] -> [Computer Management].

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/2/ Select [System Information] from the tree.

/3/ Select [Action] -> [Save as System Information File...] from the menu bar.

/4/ Specify [File Name].

/5/ Click on [Save].

System information will be collected in a file with the specified file name.

(2) Disk drive information

Use "Device Manager" of Windows to collect disk drive information (bitmap image).

/1/   Open [Start] -> [Settings] -> [Control Panel] -> [Administrative tools] -> [Computer Management].

/2/   Select [Device Manager] from the tree.

/3/   Open [Disk drives].

/4/   Take a screen shot.

(3) Logical drive information

Use "Disk Management" of Windows to collect logical drive information (bitmap image).

/1/   Open [Start] -> [Settings] -> [Control Panel] -> [Administrative tools] -> [Computer Management].

/2/   Select [Disk Management] from the tree.

/3/   Take a screen shot.

(4) Event logs

Collect event logs (system and application) from "Event Viewer" of Windows.

/1/   Open [Start] -> [Settings] -> [Control Panel] -> [Administrative tools] -> [Event Viewer].

/2/   Select [System] from the tree.

/3/   Select [Action] -> [Save Log File As…] from the menu bar.

/4/   Specify [File Name].

/5/   Set [Save as type] to "Event Log (*.evt)."

/6/   Click on [Save].

System logs will be collected in a file having the specified file name.

Then starting from step /2/ above, select [Application] instead of [System] to collect application logs using the same procedures.

(5) SPS logs

Collect the SPS log file "spsevent.log."

If the default installation destination of NEC Storage PathManager (C:\Program Files\NEC\SPS) is used, spsevent.log will exist at:

C:\Program Files\NEC\SPS\Log\spsevent.log

(6) Path information

Execute the spscmd to collect path information.

/1/　Activate [Start] -> [Programs] -> [Accessories] -> [Command Prompt].

/2/　Using the command prompt, execute the following command:

C:\>spscmd -getlun -v > [file name]

Path information will be saved in a file specified in [File Name].

(7) Registry

Use "Registry Editor" of Windows to collect registry information (HKEY_LOCAL_MACHINE \SYSTEM).

/1/　Activate [Start] -> [Run...].

/2/　Input "regedt32" in [Open] and click [OK].

/3/　Select [HKEY_LOCAL_MACHINE] -> [SYSTEM].

/4/　Select [Registry] -> [Save Subtree As...] from the menu bar.

/5/　Specify [File Name].

/6/　Click on [Save].

Subtrees will be collected in a file with the specified file name.

Then starting from step /4/ above, select [Save Key...] instead of [Save Subtree As...] to collect key information using the same procedures.

In Windows Server 2003, Select [File(F)] -> [export(E)…] in step /4/.

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Appendix

Appendix A   spscmd

[Name]

spscmd - Settings for NEC Storage PathManager and display of its status.

[Syntax]

```
spscmd –avail path_number

spscmd –failback path_number

spscmd –failbackall

spscmd –getfbmode

spscmd –getlun [-v] [-s0 | -s1 | -s2]

spscmd –getmode

spscmd –getmscsmode

spscmd –getver

spscmd –getwatcher param

spscmd –lbmode path_number mode

spscmd –notavail path_number

spscmd –path path_number

spscmd –priority path_number priority

spscmd –setfbmode state

spscmd –setmscsmode state

spscmd –setwatcher param

spscmd –swap path_number1 path_number2
```

[Description]

It is used to make settings for NEC Storage PathManager and to display its status.

●Options

spscmd recognizes the following options and arguments:

```
spscmd –avail path_number
```
        It enables priority of the path specified by "path_number."

```
spscmd –failback path_number
```
        It executes failback targeting the path specified by "path_number."

2

spscmd –failbackall

      It executes failback targeting all paths that are unavailable
      for use.

spscmd –getfbmode

      It displays the failback method currently set.

       Active: active failback

       Standby: standby failback

spscmd –getlun [-v] [-s0 | -s1 | -s2]

      It displays a path list.

      It displays a detailed list if the -v option is specified.

      The -s0, -s1, and -s2 options allow specification of the order
      of path display.

        -s0: For the logical unit that is dynamically distributing the
           loads, the paths will be displayed in the order of their
           number. For other logical units, the paths will be
           displayed in the order of priority. If not specifically
           set, this display order will be applied.

        -s1: Paths will be displayed in the order of their number.

        -s2: Paths will be displayed in the order of priority.

      (This function is not for Windows Server 2003.)

spscmd –getmode

      It displays status of the following settings:

      /1/ Types of NEC Storage PathManager (Enterprise/Standard)

      /2/ Failback method (Active/Standby)

      /3/ MSCS liaison (Enable/Disable)

spscmd –getmscsmode

      It displays status of settings for MSCS liaison
      (Enable/Disable).

spscmd –getmscsmode

      It displays the version of NEC Storage PathManager install.

      (This function is only for Windows Server 2003.)

spscmd –getwatcher

3

It displays settings for path control.

Health check: Settings for health check (Enable/Disable)

Recovery check: Settings for recovery check (Enable/Disable)

Request interval: Interval for issuing monitoring requests
(in seconds)

Threshold: Duration of time that a path has not been used
(in seconds).
This information is necessary for issuance of
monitoring I/O.

Timeout duration: Duration before timeout for monitoring I/O
(in seconds).

(Recovery check, Threshold, and Timeout duration are not for
Windows Server 2003.)

spscmd –lbmode *path_number mode*

For a logical unit with the path specified by "path_number," "mode" will
set dynamic load balancing.

Mode = 0: Dynamic load balancing will not be executed (no load balancing
will be executed or static load balancing will be executed)

Mode = 1: Dynamic load balancing will be executed (in the round robin
method).

spscmd –notavail *path_number*

It disables the priority of the path specified by "path_number."

spscmd –path *path_number*

It disables the priority of the path specified by "path_number."

spscmd –priority *path_number priority*

It changes priority of the path specified by "path_number" to
an integer specified as "priority."

spscmd –setfbmode *state*

It sets failback method to the method specified by "state."

state = Active or A: Active failback

state = Standby or S: Standby failback

spscmd –setmscsmode *state*

It sets MSCS liaison to the state specified by "state."

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state = Enable or E: MSCS liaison is enabled

state = Disable or D: MSCS liaison is disabled

spscmd –setwatcher *param*

It sets the state of path control to the state specified by "param."

Specify "param" using four numbers with a colon (:) in between (param = /1/:/2/:/3/:/4/)

/1/ Health check / Recovery check

0: health check disabled, recovery check disabled

1: health check enabled, recovery check disabled

2: health check disabled, recovery check enabled

3: health check enabled, recovery check enabled

/2/ Request interval

Interval for issuing monitoring requests (in seconds)

/3/ Threshold

Duration of time that a path has not been used

(in seconds).

This information is necessary for issuance of monitoring I/O.

/4/ Timeout duration

Duration before timeout for monitoring I/O

(in seconds).

(Recovery check, Threshold, and Timeout duration cannot be set up for Windows Server 2003.)

spscmd –swap *path_number1 path_number2*

It switches priorities between the paths specified by "path_number1" and "path_number2."

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