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Hitachi Freedom Storage™ 7700E/9900

Hitachi Path Manager

for Windows NT®/Windows 2000®

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Preface

The Hitachi Path Manager software resides on a Windows NT host system that is attached to a Hitachi Disk Array Subsystem. It uses redundant paths between the server and disk storage to enhance performance and availability. The Hitachi Path Manager provides the following functions without modifying application software.

- Failover:

  Permits applications to run without interruption when path errors occur

- Load Balance:

  Automatically balances the workload across paths. Load balance is not valid in the Failover Only version.

Note: The Hitachi Path Manager consists of two versions. One is the Failover and Load Balance version (full-function), and the other is the Failover Only version. The former contains the load balance function, the latter does not.

Contents

List of Tables

Chapter 1 Introducing the Hitachi Path Manager

The Hitachi Path Manager software, which resides in the host server with the disk device driver for the Hitachi Disk Array Subsystem, uses redundant paths between the host server and disk storage in a Hitachi Disk Array Subsystem to enhance performance and data availability. These connections comprise many different components through which data flows during input and output processes. Redundancy and the ability to switch between these components provides many different paths for the data to travel.

Note: You cannot run Path Manager in an environment where more than one host is attached to the same logical unit (LUN) on a Hitachi Disk Array Subsystem, for example, a multi-host environment. This restriction includes clustered hosts, such as PC servers running Windows NT 4.0 Cluster Server (MSCS).

The Hitachi Path manager provides these functions:

■ Load Balance

  Multi-path load balancing of data flow prevents a single path from becoming overloaded, causing input-output (I/O) congestion that occurs when many I/O operations are directed to common devices along the same input-output path. Normally, selection is performed on a global rotating basis.

■ Failover

  In most cases, host servers are configured with multiple host adapters and SCSI connections to a Hitachi Disk Array Subsystem that provides internal component redundancy. With dual clusters and multiple host interface adapters, the Hitachi Disk Array Subsystem provides more flexibility in the number of input-output paths that are available. When there is a failure, the Hitachi Path manager reroutes input-output operations from the failed path to the remaining paths. This prevents a bus adapter on the host server, external SCSI cable, or cluster or host interface adapter on the Hitachi Disk Array Subsystem from disrupting data access. In the event of failure in one input-output path, current operations are automatically switched to another input-output path. This automatic switching in the event of failure is called *failover*.

This document includes the following information:

■ System Configuration Requirements

■ Defining Basic Concepts

■ Installing of Hitachi Path Manager on a Windows Host

■ Using Commands

■ Path Repair Procedure

Chapter 2 System Configuration Requirements

The minimum configuration requirements are listed in the following table.

Specifications		Quantity
Host PC	Windows NT 4.0 with Service Pack 3, 4, or 5 Windows 2000	1
SCSI Host Adapters	Adaptec AHA2944UW SCSI adapter or Qlogic QLA2100F Fibre adapter or Emulex LP7000 Fibre adapter	2
7700E	SCSI or Fibre Interface	1
9900	Fibre Interface	1
I/F Cables	SCSI or Fibre Interface	2

The software fits on a single floppy disk. (For specific installation information, see Installing Hitachi Path Manager on a Windows Host on page 7.)
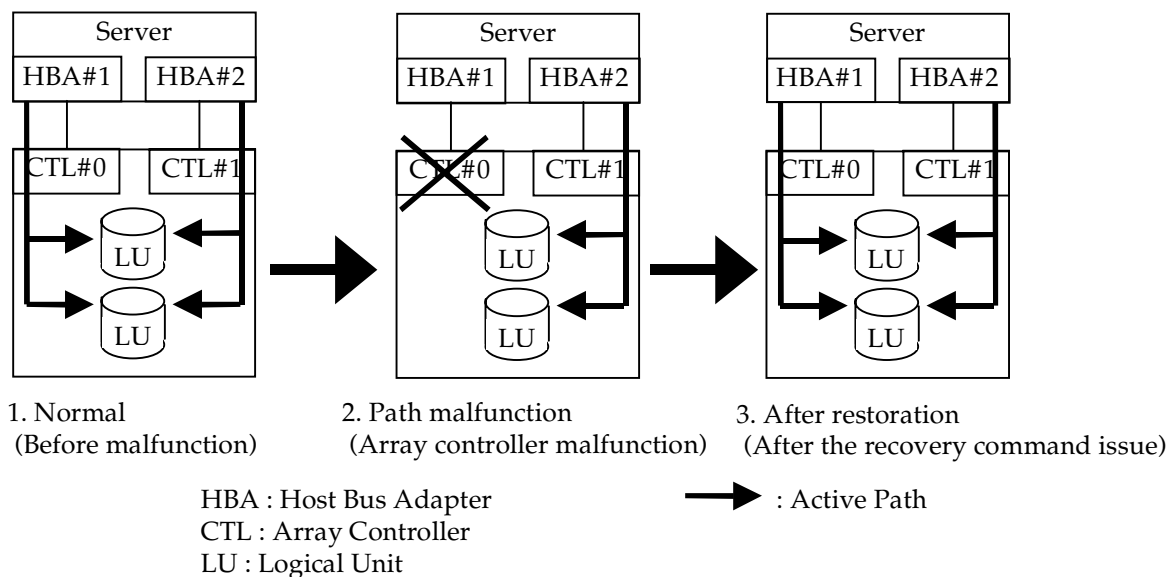
Chapter 3   Defining Basic Concepts

This section defines three basic Hitachi Path Manager concepts:

- Load Balance
- Failover

3.1   Load Balance

This function can be explained in three sections (see the diagram below):

1. Normal
   (Before malfunction)

2. Path malfunction
   (Array controller malfunction)

3. After restoration
   (After the recovery command issue)

HBA : Host Bus Adapter
CTL : Array Controller
LU : Logical Unit

→ : Active Path

1. Normal

   This function supports the I/O execution by the two (2) controllers. Both controllers take charge of part of the I/O operation. In this case, both paths (HBA#1 and HBA#2) are the active path.

2. Path Malfunction

   When one controller (HBA#1) malfunctions, the other controller (HBA#2) accepts all I/O operations. This function is called *failover*. Failover action is executed automatically.

3. After Restoration

   After the path which malfunctioned is repaired, you need to execute the command for the recovering path (see "Path Repair Procedure" on page 19). The repaired path is then available and both paths are ready to accept I/O access.

3.2 Failover

This function can be explained in three sections (see the diagram below):

1. Normal
   (Before malfunction)

2. Path malfunction
   (Array controller malfunction)

3. After restoration
   (After the recovery command issue)

HBA : Host Bus Adapter   → : Active Path
CTL : Array Controller   ▪▪▪▶ : Standby Path
LU : Logical Unit

1. Normal

   This function does not support the Load Balance function. One controller (HBA#1) always manages the I/O operation (Active Path) while the other Standby Path waits for failover action.

2. Path Malfunction

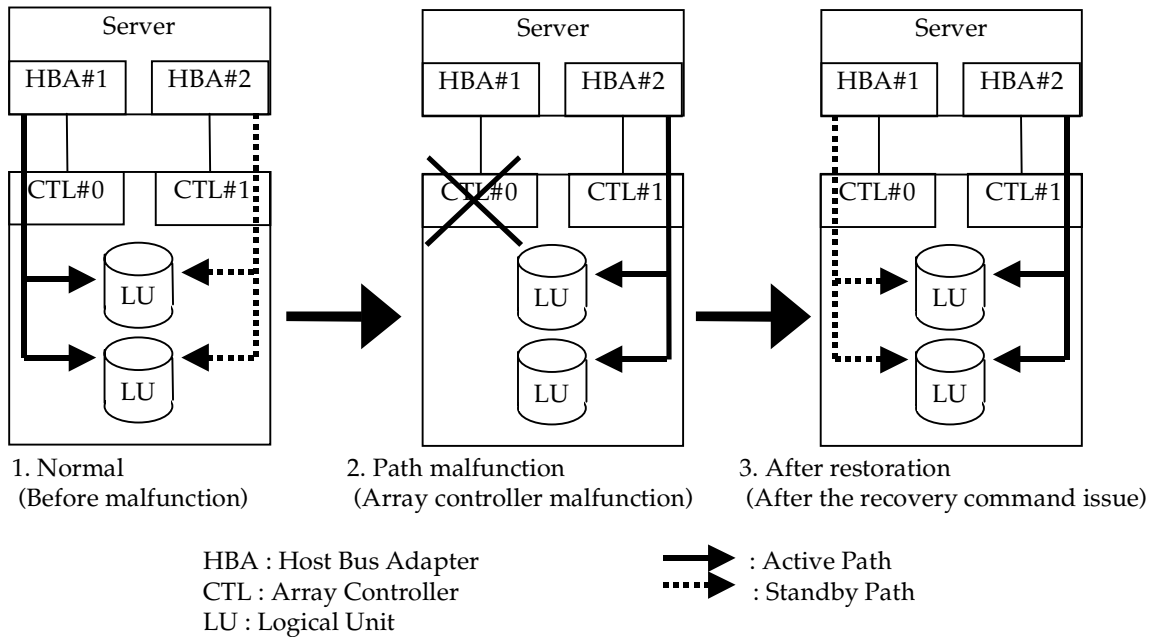   When one controller (HBA#1) malfunctions, the other controller (HBA#2) accepts the I/O operation. This failover action is executed automatically.

3. After the path which malfunctioned is repaired, you need to execute the command for the recovering path (see "Path Repair Procedure" on page 19). The repaired path is then available and is now the standby path. In failover only, both paths do not accept I/O access.

Chapter 4   Installing Hitachi Path Manager on a Windows Host

This chapter provides instructions to install and set up the Hitachi Path Manager on a Windows host system attached to an Hitachi Disk Array Subsystem.

Note: You must have Windows NT 4.0 Service Pack 3, 4, or 5 installed on your system.

This section includes the following:

- Configuring Host Adapters for the Windows Hitachi Path Manager

- Configuring the Disk Array Subsystem

- Installing the Hitachi Path Manager on a Windows Host System

- Rebooting the PC After Changing Disk Partitions

- Removing the Hitachi Path Manager from a Windows Host System

4.1   Configuring Host Adapters for the Windows Hitachi Path Manager

Before you install and use the Hitachi Path Manager, you must configure your SCSI adapters. For SCSI adapters that attach boot devices, ensure the BIOS for the adapter is *enabled*. For all other adapters that attach non-boot devices, ensure the BIOS for the adapter is *disabled*.

Note: When the adapter shares the SCSI bus with other adapters, the BIOS must be *disabled*.

4.2   Configuring the Disk Array Subsystem

Confirm and set the systems parameters according to the Release Note for each disk array subsystem.

- Hitachi Path Manager supports up to 32 SCSI ports.

- Hitachi Path Manager can control up to 128 LUNs.

Note: When you create a new LU on Windows 2000, reboot the system afterwards. Do not use the dynamic reconfiguration.

4.3 Installing the Hitachi Path Manager on A Windows Host System

Note 1: You must log on as an Administrator to install the Hitachi Path Manager.

Note 2: The Device Manager of Windows 2000 cannot display the disk device; the disk device is not recognized in the Device Manager. If this device is displayed, an error message is displayed.

To install the Hitachi Path Manager, you must have one (1) MB of disk space available, and you must have Windows NT 4.0 Service Pack 3, 4, or 5 installed on your system.

Perform the following steps to install the Hitachi Path Manager driver and application programs on your system:

1. Log on as the administrator user.

2. Insert the Hitachi Path Manager installation FD into the selected drive.

3. Choose **Run** from within the Start menu and enter **A:\Setup.exe** in the text box, where A: is the installation disk drive letter. Click **OK** to begin the installation. The Hitachi Path Manager screen displays.

4. Click on **Next**. The User Information screen displays.

5. Enter your name and your company name.

6. Click on **Next**. The Choose Destination Location screen displays.

7. Click on **Next**. The Setup Complete screen displays.

8. Click on **Finish**. The Hitachi Path Manager program prompts you to start your computer again.

9. Click on **Yes** to start your computer again. When you log on again, you will see a **Path Manager** entry in your Program menu containing the following files:
   – Path management
   – Read me file

End of procedure

4.4 Rebooting the PC after Changing Disk Partitions

The Hitachi Path Manager automatically recognizes the devices (disk partitions) which are connected when a PC boot occurs. However, after the boot, Hitachi Path Manager does not dynamically recognize a disk partition that is created using the Windows Disk Administrator unless you reboot. After creating or deleting a disk partition, you must reboot the PC.

Note: The devices on the storage array must be preformatted before they can be recognized and used on the Hitachi Path Manager and Windows.

4.5 Removing the Hitachi Path Manager from a Windows Host System

To remove the Hitachi Path Manager from a Windows host system, follow these steps:

1. Open the **Control Panel** and select **Add/Remove Programs**.
2. Click on **Path Manager** from within the scroll box
3. Click **Add/Remove** (on Windows NT) or **Change/Remove** (on Windows 2000).

Note: If the following messages are displayed during the removal procedure, install and remove the Hitachi Path Manager again.

- Internal error, unable to load or call external DLL. Please contact your vendor for more information.

- Unable to locate the installation log file "E:\xxx\Uninst.isu." Uninstallation will not continue.

Installing Hitachi Path Manager on a Windows Host

Chapter 5   Using Commands

The Hitachi Path Manager provides commands which enable you to display the status of adapters that are used to access managed devices, or to display the status of devices that the device driver manages. You can also set individual path conditions either to online or offline, or set all paths that are connected to an adapter or bus either to online or offline. This chapter describes these commands.

 Note: No graphic user interface (GUI) is used with this product. Use the command line to enter these commands.

This section includes the following:

- Command Syntax Conventions

- Datapath Query Adapter

- Datapath Query Device

- Datapath Set Adapter

- Datapath Set Device

5.1   Command Syntax Conventions

The following syntax conventions are used for the Hitachi Path Manager commands:

- Use the word **datapath** to begin all Hitachi Path Manager commands.

- Use the word **query** to display information.

- Use the word **set** to change the state of the datapath.

- All commands apply to either an **adapter** or a **device**. This will be the last word in the command.

Note: You must log on as an Administrator user to use these commands.

Table 3 provides an alphabetical list of these commands, a brief description, and where to go in this chapter for more information.

Table 3. Commands

Command	Description	Page Number
Datapath query adapter	Displays information about adapters.	12
Datapath query device	Displays information about devices	13
Datapath set adapter	Sets all device paths that are attached to an adapter.	16
Datapath set device	Sets the path of a device.	17

5.2 Datapath Query Adapter

The **datapath query adapter** command displays information about a single adapter or all adapters. After the Windows server completes startup, use this command to confirm that Hitachi Path Manager can use all the paths.

5.2.1 Syntax

```
datapath query adapter [adapter_number]
```

5.2.2 Parameters

adapter_number

The adapter number for which you want information displayed. If you do not enter an adapter number, information about all adapters is displayed.

5.2.3 Examples

```
datapath query adapter
```

This example might provide the following output:

Adpt #	Adapter Name	State	Mode	Select	Errors	Paths	Active
0	Scsi Port0 Bus0	NORMAL	ACTIVE	36098	0	4	4
1	Scsi Port1 Bus0	DEGRAD	ACTIVE	2124	6	4	2

The following table defines the terms used in the previous example:

Term	Definition
Adpt #	The number of the adapter.
Adapter Name	The name of the adapter.
State	The condition of the named adapter. It can be either: **NORMAL** Adapter is in use. **DEGRADED** One or more paths are not functioning. **FAILED** The adapter is no longer being used by the Hitachi Path Manager.
Mode	The mode of the named adapter. It is either **ACTIVE** or **OFFLINE**.
Select	The number of times this adapter was selected for input or output.
Errors	The number of errors on a path that is attached to this adapter.
Paths	The number of paths that are attached to this adapter. Note: On Windows, this is the number of physical and logical devices that are attached to this adapter.
Active	The number of functional paths that are attached to this adapter. The number of functional paths is equal to the number of paths minus any that are failed or offline.

5.3   Datapath Query Device

The **datapath query device** command displays information about a single device or all devices. If you do not enter a device number, information about all devices is displayed. After the Windows server completes startup, use this command to confirm that Hitachi Path Manager can use all the devices.

5.3.1   Syntax

```
datapath query device [device_number]
```

5.3.2   Parameters

device_number

The device number for which you want information displayed. If you do not enter a device number, information about all devices is displayed.

5.3.3 Examples

```
datapath query device
```

This example might provide the following output:

```
Dev#:   0    Device Name: Disk0 Part0    TYPE: xxxxx    SERIAL: 12340000

================================================

 Path#              Adapter/Hard Disk    State    Mode    Select    Errors
                                         OPEN    NORMAL      43        0
    0      Scsi Port2 Bus0/Disk1 Part0   OPEN    NORMAL
                                                            43        0
    1      Scsi Port3 Bus0/Disk3 Part0


Dev#:   1    Device Name: Disk1 Part0    TYPE: xxxxx    SERIAL: 12340000

================================================

 Path#              Adapter/Hard Disk    State    Mode    Select    Errors
                                         OPEN    NORMAL   219643       0
    0      Scsi Port2 Bus0/Disk1 Part0   OPEN    NORMAL
                                                          220565       0
    1      Scsi Port3 Bus0/Disk3 Part0


Dev#:   2    Device Name: Disk2 Part0    TYPE: xxxxx    SERIAL: 12340000

================================================

 Path#              Adapter/Hard Disk    State    Mode    Select    Errors
                                         OPEN    NORMAL      31        1
    0      Scsi Port2 Bus0/Disk2 Part0   DEAD   OFFLINE
                                                            43        0
    1      Scsi Port3 Bus0/Disk4 Part0


Dev#:   3    Device Name: Disk3 Part0    TYPE: xxxxx    SERIAL: 12340000

================================================

 Path#              Adapter/Hard Disk    State    Mode    Select    Errors
                                         OPEN    NORMAL    1210        0
    0      Scsi Port2 Bus0/Disk2 Part0   DEAD    NORMAL
                                                           210        20
    1      Scsi Port3 Bus0/Disk4 Part0
```

The following table defines the terms in the previous example:

Term	Definition
Dev#	The number of this device.
Name	The name of this device.
Type	The device product ID from Inquiry data.
Serial	The logical unit (LUN) serial number for this device.
Path#	The path number.
State	The condition of the named device. **OPEN** Path is in use. **CLOSE** Path is not being used. **DEAD** Path is no longer being used. It was either removed by the Hitachi Path Manager due to errors, or manually removed using the datapath command.
Mode	The mode of the named device. It is either **NORMAL** or **OFFLINE**.
Select	The number of times this path was selected for input or output.
Errors	The number of errors on a path that is attached to this device.

The following table shows the relationship between State and Mode:

State	Mode	Contents
CLOSE	NORMAL	Path is not being used.
OPEN	NORMAL	Path is in use.
DEAD	NORMAL	Path is no longer being used. It was removed by Path Manager due to I/O errors.
DEAD	OFFLINE	Path is no longer being used. It was manually removed using the **datapath** command.

5.4   Datapath Set Adapter

The **datapath set adapter** command sets all device paths that are attached to an adapter either to online or offline.

Note: This command will not remove the last path to a device.

5.4.1   Syntax

```
datapath set adapter adapter_number {online|offline}
```

5.4.2   Parameters

adapter_number

The adapter number that you want to change.

```
online
```

Set adapter online.

```
offline
```

Set adapter offline.

5.4.3   Examples

```
datapath set adapter 0 online
```

Note: This command will not remove the last path to a device.

5.5 Datapath Set Device

The **datapath set device** command sets the path of a device either to online or offline.

5.5.1 Syntax

datapath set device *device_number* path *path_number* {online|offline}

5.5.2 Parameters

device_number

The device number that you want to change.

path_number

The path number that you want to change.

online

Set path online.

offline

Remove the path from service.

Note: You cannot remove the last path to a device from service. This prevents data access failure.

5.5.3 Examples

datapath set device O path O online

Chapter 6   Path Repair Procedure

When one path has malfunctioned, failover action is executed automatically. But, after you repair the path, you need to execute the following procedure to recover the failed path.

1. Repair the failed path using the appropriate manual for the 7700E or 9900.

2. After repairing, you need to change the status of all paths from offline to online by using the "datapath set adapter" command. (Refer to Datapath Set Adapter on page 16.)

   We recommend that you execute this command immediately after the recovery operation; if the surviving path experienced a failure prior to recovery of the repaired path the system will be severely impacted or will experience an outage.

3. Confirm the state of adapter by using "datapath query adapter" command. (Refer to Datapath Query Adapter on page 12.)

4. Use the following procedure when the "Fail-over only" version of Hitachi Path Manager is used. After a path is repaired it will serve as a standby path in the event the functioning path fails. To verify the repaired path is functioning properly, use the following procedure. This procedure should be performed during the next available maintenance outage to avoid inducing a production outage.

   a) Change the status of the active path from online to offline by issuing the datapath set adapter command. (Refer to Datapath Set Adapter on page 16.) This will force I/O to the repaired path.

   b) Confirm that the repaired path is functioning properly by issuing the datapath query adapter command. (Refer to Datapath Set Adapter on page 16.) Check the SELECT column of the output of the datapath query adapter command. The SELECT column represents the number of times the path has serviced an I/O. If the repaired path continues to malfunction, the STATE column will display DEGRADE or FAILED status. Repair the failure and retry this step.

   c) After the path has been successfully repaired and verified, the user can elect to use the datapath set adapter command to change the repaired path from online to offline to serve as the standby path, or allow the repaired path to function as the primary path.

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