user guide

HP Smart Array Multipath Software

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About this guide

This guide discusses the following topics:

- Smart Array Multipath software
- Installing the product
- Uninstalling the product
- Troubleshooting

Intended audience

This guide is intended for:

- Network Engineers
- Administrators
- Any one who wants to install, monitor, or manage the HP Smart Array Multipath software

NOTE:

HP assumes you are qualified in the servicing of computer equipment and trained in recognizing hazards in products with hazardous energy levels.

Related documentation

To learn more about HP and HP products, services, and support, visit the HP website at:

http://www.hp.com

For FAQs, software updates, and contact information for HP products, visit the HP Support website at:

http://www.hp.com/go/storage

Typographical conventions and symbols

Table 1 lists the conventions used in this document.

Table 1 Document conventions

Convention	Element
Medium blue text: Related documentation	Cross-reference links and e-mail addresses
Medium blue, underlined text (http://www.hp.com)	Website addresses
Bold font	• Key names • Text typed into a GUI element, such as into a box • GUI elements that are clicked or selected, such as menu and list items, buttons, and check boxes
Italic font	Text emphasis
`Monospace font`	• File and directory names • System output • Code • Text typed at the command line
`Monospace, italic font`	• Code variables • Command-line variables
`Monospace, bold font`	Emphasis of file and directory names, system output, code, and text typed at the command line

△ CAUTION:

Indicates that failure to follow directions can result in damage to equipment or data.

IMPORTANT:

Provides clarifying information or specific instructions.

NOTE:

Provides additional information.

HP technical support

Telephone numbers for worldwide technical support are listed on the HP support website: http://www.hp.com/support/

Collect the following information before calling:

- Technical support registration number (if applicable)
- Product serial numbers
- Product model names and numbers
- Applicable error messages
- Operating system type and revision level
- Detailed, specific questions

For continuous quality improvement, calls may be recorded or monitored.

HP recommends that customers sign up online using Subscriber's choice website: http://www.hp.com/go/e-updates

- Subscribing to this service provides you with e-mail updates on the latest product enhancements, newer versions of drivers, and firmware documentation updates, as well as instant access to numerous other product resources.
- After signing up, you can quickly locate your products by selecting **Business support** and then **Storage** under Product Category.

HP-authorized reseller

For the name of your nearest HP-authorized reseller:

- In the United States, call 1-800-345-1518.
- In Canada, call 1-800-263-5868.
- Elsewhere, visit the HP web site: http://www.hp.com, and click **Contact HP** to find locations and telephone numbers.

1 Overview

This chapter discusses the following topics:

- Software overview
- Software distribution
- Minimum requirements
- Supported operating systems
- Supported four-node configurations

Software overview

Smart Array Multipath software delivers dual path functionality, and supports failover capability for a redundant HBA in a server with redundant cabling to an HP StorageWorks Modular Smart Array 500 Generation 2 storage system. This fault-tolerant tool enhances availability in clustering and DAS solutions with up to two servers, managing up to 2 TB of stored data.

The software supports multiple I/O paths to the same logical volumes. When a path fails, the software moves the logical drives from the failed path to the path of the redundant HBA in the same server.

Smart Array Multipath software works differently with Microsoft and Linux products, to provide specific features that are compatible with the operating system functionality.

Software distribution

Smart Array Multipath software is included with the 4-port U320 Shared Storage Module option. Smart Array Multipath software version 2.0B and later contain only Multipath I/O deliverables for Microsoft Windows operating systems and is available only for web download from the HP website: http://h18007.www1.hp.com/support/files/server

For Linux operating systems, see the procedures in this guide to configure the standard Linux drivers for multipath usage.

Minimum requirements

Ensure that your solution comprises the following hardware:

- At least one server with two supported HBAs (Smart Array 642 adapters or future supported adapters) with updated firmware
- A supported operating system installed on the server or MSA500 G2 storage system
- An MSA500 G2 storage system with the following:
  - At least one HP StorageWorks Modular Smart Array 500 Generation 2 Controller
  - A 2-Port Shared Storage Module and two SCSI cables

    or
  - A 4-Port Shared Storage Module and four SCSI cables

For the latest versions of firmware, see the HP storage website at:

http://www.hp.com/support/proliantstorage

Supported operating systems

The Smart Array Multipath software supports the following operating systems:

- Microsoft
  - Windows 2000 Server and Advanced Server with Service Pack 4
  - Windows Server 2003 with Service Pack 1 (x86)
  - Windows Server 2003 R2
  - Windows Server 2003 x64 Edition
  - Windows Server 2003 x64 Edition R2
- Linux
  - Red Hat Enterprise Linux
  - UnitedLinux

For information about the most current operating system support, errata kernels, and service pack requirements, see the HP ProLiant Packaged Clusters website at: http://www.hp.com/products/sharedstorage

Microsoft feature support

- Static LUN balancing enables the administrator to optimize I/O, by assigning specific volumes to specific paths in the storage system. If one path fails, the storage system moves volumes to the path for the redundant HBA for I/O management.
- Server-based PCI Hot Plug functionality supports online HBA addition and replacement.
- Logical volume hot-add functionality supports online array expansion, extension, or both.
- Device Manager extension provides point-and-click multipath management.
- Configuration flexibility enables boot volumes for DAS solutions to reside on the storage system.

Linux feature support

- Static load (read-only) balancing enables the HBAs to optimize I/O with dual paths, to the same volumes in the storage system. If one HBA fails, the storage system moves volumes to the path for the redundant HBA for I/O management.
- Depending on the operating system, servers maintain boot volumes and enable greater storage capacity on the storage system.

Multiple operating system support

For multipath configurations with multiple operating systems, use Shared Storage Presentation (SSP) to restrict HBAs from accessing logical volumes containing data from a different operating system. For more information about SSP, see the documentation shipped with the 4-Port Shared Storage Module.

Supported four-node configurations

The following sections discuss supported multipath configurations with their respective 4-Port Shared Storage Module connections and locations, for boot and data volumes. These configurations require two or three servers attached with four SCSI cables, to the MSA500 G2 storage system.

Two-server external boot configuration

All boot and data volumes reside on the MSA500 G2 storage system. Table 2 lists the boot volume and data volume location for the two-server external boot configuration.

Table 2 Two-server external boot configuration

Server	Port (bus)	Boot volume location	Data volume location
1	A1 B1	Storage system*	Storage system
2	A2 B2	Storage system*	Storage system
* Red Hat Enterprise Linux operating systems support boot volumes on servers only. For a mixed or external boot configuration in a multiple operating system environment, always locate the Linux boot volumes on servers.			

Two-server internal boot configuration

Boot volumes reside on their respective servers, while data volumes reside on the MSA500 G2 storage system. Table 3 lists the boot volume and data volume location for the two-server internal boot configuration.

Table 3 Two-server internal boot configuration

Server	Port (bus)	Boot volume location	Data volume location
1	A1 B1	Server 1	Storage system
2	A2 B2	Server 2	Storage system

Two-server mixed boot configuration

One boot volume resides on the respective server, while the other boot volume resides on the MSA500 G2 storage system. Both data volumes reside on the MSA500 G2 storage system. Table 4 lists the boot volume and data volume location for the two-server mixed boot configuration.

Table 4 Two-server mixed boot configuration

Server	Port (bus)	Boot volume location	Data volume location
1	A1 B1	Storage system*	Storage system
2	A2 B2	Server 2	Storage system
*Red Hat Enterprise Linux operating systems support boot volumes on servers only. For a mixed or external boot configuration in a multiple operating system environment, always locate the Linux boot volumes on servers.			

Two-server cluster configuration

Identical servers (hardware and software configuration) connect to the MSA500 G2 storage system. Boot volumes reside on their respective servers, while both data volumes reside on the storage system. Table 5 lists the boot volume and data volume location for the two-server cluster configuration.

Table 5 Two-server cluster configuration

Server	Port (bus)	Boot volume location	Data volume location
1	A1 B1	Server 1	Storage system
2	A2 B2	Server 2	Storage system

Three-server external boot configuration

All boot and data volumes reside on the MSA500 G2 storage system. One server connects to two ports. Table 6 lists the boot volume and data volume location for the two-server cluster configuration.

Table 6 Three-server external boot configuration

Server	Port (bus)	Boot volume location	Data volume location
1	A1 B1	Storage system*	Storage system
2	A2	Storage system*	Storage system
	B2	Storage system*	Storage system
* Red Hat Enterprise Linux operating systems support boot volumes on servers only. For a mixed or external boot configuration in a multiple operating system environment, always locate the Linux boot volumes on servers.			

Three-server internal boot configuration

Boot volumes reside on their respective servers, while data volumes reside on the MSA500 G2 storage system. One server connects to two ports. Table 7 lists the boot volume and data volume location for the three-server internal boot configuration.

Table 7 Three-server internal boot configuration

Server	Port (bus)	Boot volume location	Data volume location
1	A1 B1	Server 1	Storage system
2	A2	Server 2	Storage system
	B2	Server 3	Storage system

Three-server mixed boot configuration

Two boot volumes reside on their respective servers, while one boot volume resides on the MSA500 G2 storage system. All data volumes reside on the MSA500 G2 storage system. One server connects to two ports. Table 8 lists the boot volume and data volume location for the three-server mixed boot configuration.

Table 8 Three-server mixed boot configuration

Server	Port (bus)	Boot volume location	Data volume location
1	A1 B1	Storage system*	Storage system
2	A2	Server 2	Storage system
	B2	Server 3	Storage system
* Red Hat Enterprise Linux operating systems support boot volumes on servers only. For a mixed or external boot configuration in a multiple operating system environment, always locate the Linux boot volumes on servers.			

2 Installation and operation in Microsoft environments

This chapter discusses the following topics:

- Pre-installation hardware setup for Microsoft
- Installing the Smart Array Multipath software
- Installing the Smart Array Multipath software in cluster configurations
- Post-installation hardware setup for Microsoft
- Uninstalling the Smart Array Multipath software
- Using Silent Installation
- Static LUN balancing

Pre-installation hardware setup for Microsoft

To prepare for software installation, complete the following steps:

1. Complete the MSA500 G2 storage system hardware installation, as follows:

   NOTE:
   For hardware and option installation procedures, see the appropriate storage system user guide or the documentation that is shipped with the option.

   a. Install the MSA500 G2 storage system.
   b. Install the 4-Port Shared Storage module.
   c. Install the MSA500 G2 controllers.
   d. Update the system firmware, if needed.
2. Complete the server installation, as follows:
   a. Install all hardware, including a second supported HBA. For more information, see the appropriate server user guide.

      IMPORTANT:
      The server supports only one SCSI path during installation. If the server is already cabled for a multipath configuration, disconnect the SCSI cable connected from the redundant HBA to the storage system.

   b. Install one of the supported operating systems.
   c. Reboot the server.
3. Install multipath cabling for one of the Supported four-node configurations.
4. Ensure that only one SCSI cable is connected from the server to the MSA500 G2 storage system. During installation, the Smart Array Multipath software supports only one SCSI path per Microsoft based server.
5. Power up the storage system.

   Wait for the controller display to provide a `Startup Complete` message.
6. Power up one of the servers.

Installing the Smart Array Multipath software

△ CAUTION:

Before installing Smart Array Multipath software, update the HBA and MSA500 G2 controller drivers.

To install the Smart Array Multipath software, complete the following steps:

NOTE:

You can install this software prior to attaching the hardware.

1. Ensure that only a single path is connected to the storage devices.
2. Configure the storage sets.
3. Insert the Smart Array Multipath software CD-ROM on your server or a network drive.
4. Choose one of the following options to access the CD-ROM:
   - From your server: If you have enabled AutoRun on your server, the setup program starts automatically. Otherwise, select **Start** > **Run**, and then locate the `Launch.exe` program on the CD-ROM drive.
   - From your network drive: If you are accessing the CD-ROM on a network drive, select **Start** > **Run**, and then locate the `Launch.exe` program on the network drive.
5. In the launch window, click **Install Smart Array Multipath software**.
6. Follow the on-screen instructions to complete the installation.
7. Restart the server.
8. Add the redundant paths to the storage devices.

Installing the Smart Array Multipath software in cluster configurations

To install Smart Array Multipath Software on each member of a cluster configuration, complete the following steps:

NOTE:

In a cluster configuration, the Smart Array Multipath software must be installed on one node at a time for all nodes of the cluster.

1. Complete the pre-installation tasks.
2. Using Cluster Administrator, perform the following tasks :
   a. Move all cluster resources owned by the current node to another node in the cluster.
   b. Pause the current cluster node.
   c. Select **Resource Attributes** > **Disable failback** for all groups containing resources managed by the current node.
3. Install Smart Array Multipath software on the current node by following the steps described in Installing the Smart Array Multipath software.
4. Resume the current cluster node using the Cluster Administrator.

   NOTE:

   Repeat steps 2–4 for all nodes in the cluster.

5. Using Cluster Administrator, perform the following tasks:
   a. Restore failback for all groups containing resources, as needed.
   b. Redistribute cluster, resources as desired.

Post-installation hardware setup for Microsoft

To prepare for software operation, complete the following steps:

1. Reconnect the SCSI cable from the redundant HBA to the MSA500 G2 storage system.
2. Cycle the server power.
3. Repeat steps 1 and 2 for each server.
4. Use the appropriate software for multipath operations.

Uninstalling the Smart Array Multipath software

To remove the Smart Array Multipath software, you must reconfigure SAN and reboot your server.

△ CAUTION:

Removing multipathing software from a multipath hardware configuration can cause data loss or corruption. You must disconnect the server from the multipath storage, or eliminate all but one path to that storage from the server, prior to removing the Smart Array Multipath software.

To remove the Smart Array Multipath software, complete the following steps:

1. Back up all user data on multipath storage.
2. If possible, disconnect the storage from the server. If it is necessary to maintain single-path connection from the server to the storage (as in the case of servers that boot from a SAN device), use the following guideline:
   - If it is a one-host or one-storage array, HP recommends removing redundant cable connections.

NOTE:

Ensure that you perform step 1 and step 2 before proceeding further.

3. Select **Start** > **Settings** > **Control Panel** > **Add or Remove Programs**.
4. Select **Smart Array Multipath Software** from the Remove Program drop-down list.
5. Click **Remove**, and follow the on-screen instructions.

   The system displays a cautionary message advising of the potential data loss or corruption that may result from removing this software.
6. Close the Add/Remove Programs window.

NOTE:

The LUNs may be inaccessible at this time.

7. Reboot the system.

Using Silent Installation

Silent installation can be run from the CD-ROM on your system, or from a network drive. The Smart Array Multipath software installs with little manual intervention. Silent installation is useful if you are installing the software on a large number of servers that require software installation.

This section describes the following topics:

- Installing the Smart Array Multipath software
- Uninstalling the Smart Array Multipath software

Following is the syntax of the command for executing silent installation:

```
<install drive>:\MPInstall\setup.exe /s /f1“C:\setup.iss” /f2“C:\MPSIn-
stallLog.txt”
```

The `<install drive>` refers to the drive which contains the installation media. The `setup.iss` is the response file from which information is taken for silent installation. The `MPSInstallLog.txt` file records information about the silent installation.

The ResponseResult section of the `MPSInstallLog.txt` log file displays the result code, indicating whether or not the silent installation succeeded. An integer value is assigned to the ResultCode keyname in the ResponseResult section.

Table 9 lists the common return values along with their descriptions in the ResultCode key.

Table 9 List of common return values

Result Code	Description
0	Success
–1	General error
–3	Required data not found in the `setup.iss` file
–4	Not enough memory available
–5	File does not exist
–6	Cannot write to the response file
–7	Unable to write to the log file
–8	Invalid path to the InstallShield Silent response (.iss) file
–51	Cannot create the specified folder
–52	Cannot access the specified file or folder

NOTE:

The C: in /f1C: and /f2C: refers to a local drive on the system, or a network drive that is used to obtain the response file and write the MPSInstallLog.txt (provided there is write permission in the directory).

<Default_Target_Dir> = C:\Program Files\Hewlett-Packard\HP MPIO DSM\SMART ARRAY DSM

<User_Target_Dir> = a directory on the system on which the new installation is to be done or the directory of an existing installation.

You must enclose the paths to the response file and the log file, which records the information about the silent installation, in quotes(”).

Installing the Smart Array Multipath software

To perform silent installation, complete the following steps:

1. Create a copy of the `new.iss` file in the installation kit.
2. Rename this copy of the file as `setup.iss`.
3. Choose one of the following options:
   - To install the Microsoft MPIO Framework component along with the DSM component, use the renamed default `setup.iss` file.

- To install only the DSM component (when the Microsoft MPIO Framework already exists on your system), edit the renamed default `setup.iss` file, as follows:
  a. In line 34, replace Component-count=2 with Component-count=1.
  b. Remove line 35.
  c. In line 36, replace Component-1=DSM with Component-0=DSM.

4. If you want to install in a directory other than the default directory, replace szDir = <Default_Target_Dir> with szDir = <User_Target_Dir>, in lines 27 and 32 of the `setup.iss` file.
5. If you want to disable the automatic reboot feature, edit the `setup.iss`, file as follows:
   a. In line 50, replace Result=6 with Result=1.
   b. In line 51, replace BootOption=3 with BootOption=0.

Uninstalling the Smart Array Multipath software

To perform silent un-installation, complete the following steps:

1. Create a copy of the `uninstall.iss` file in the installation kit.
2. Rename this copy of the file as `setup.iss`.
3. If you want to avoid the automatic reboot feature, edit the renamed `setup.iss` file, as follows:
   a. In line 28, replace Result=6 with Result=1.
   b. In line 29, replace BootOption=3 with BootOption=0.

NOTE:

On systems configured either for Boot From SAN, or systems with page, hibernate, or dump files on the disk array, uninstalling the last DSM may not remove all the related components. To work around this issue, ensure that the MPIO framework is installed along with the DSM during the subsequent installation of any supported HP MPIO DSM. Failure to do so can result in an unsuccessful system boot.

Static LUN balancing

The Smart Array Multipath software and Microsoft operating system support static LUN balancing. The drives can be moved to specific paths locally using a Device Manager Extension (DME).

To balance LUNs with the DME, complete the following paths:

1. From the desktop, right-click **My Computer**.
2. Click **Manage**. The Device Manager window opens.
3. Click **SCSI and RAID Controllers**.
4. Right-click one of the array controller icons, and click **Properties**.
5. When the Properties window opens, click the **Redundancy Configuration** tab.

   From the Redundancy Configuration tab, the administrator can view the following controller information:

   - Name
   - Slot number
   - Status
   - Slot number of redundant controller
   - Controller tree
6. In the controller tree, right-click one of the logical volumes, and then click **Switch Path**. The system moves the logical volume to the other path.

3 Installation and operation in Red Hat Enterprise Linux 2.1 environments

This chapter discusses the following topics:

- Pre-installation configuration for Red Hat Enterprise Linux 2.1
- Modifying the RAIDTAB configuration file
- Multipath installation for Red Hat Enterprise Linux 2.1
- Static load (read-only) balancing in Red Hat Enterprise Linux 2.1

Pre-installation configuration for Red Hat Enterprise Linux 2.1

Before installing Smart Array Multipath software on a server with a Linux Red Hat operating system perform the following tasks:

- Create a new Linux kernel that recognizes the multipath hardware configuration.
- Modify the raidtab configuration file to ensure that it contains the appropriate information.

Editing the active kernel

To configure the system for multipath operations, complete the following steps:

1. Modify the makefile.
2. Overwrite the active config file.
3. Edit the .config file, and make the kernel.
4. Insert the new kernel into the GRUB or LILO boot-loader.

The procedures described in this section provide examples for all these basic steps.

Alternatively, you can install the modules without rebuilding the kernel.

IMPORTANT:

Modules not installed in a kernel are not loaded at boot time, requiring you to remake modules after every power cycle or reboot. HP recommends that you install the modules into the kernel, using the procedure described in this section.

Modifying the Makefile

IMPORTANT:

The following procedure is for Red Hat Linux only.

To modify the Makefile, complete the following steps:

1. Identify the name of the active kernel, as follows:
   a. At the root level of the kernel source tree (usually /usr/src/linux-xxx), enter:

      uname -a

   b. Remember this name for use in later procedures.
2. Use an editor to modify the Makefile. For example, enter the command:

   ```
   vi Makefile
   ```

3. In the EXTRAVERSION field, replace the current value (typically -3.ecustom) by entering:

   ```
   E3.multipath
   ```

NOTE:
Do not use the same name suffix as the active kernel. This naming ensures that any misconfiguration does not harm the current configuration.

Overwriting the active .config file

IMPORTANT:
Before overwriting any file, create a backup of the original file.

To overwrite the active .config file for Red Hat operating systems, complete the following steps:

1. Locate the specific .config file for the modified kernel, as follows:
   a. From the root level of the kernel source, enter the following command:

      ```
      cd configs
      ```

   b. Identify the appropriate .config file by name, for example:

      2.4.9-i686-enterprise.config
2. Copy the kernel to the root level of the kernel source and overwrite the active `.config` file. Enter the following command:

   ```
   cp kernel-2.4.9-i686-enterprise.config ../.config
   ```

3. When prompted to overwrite the existing file, enter:

   y

Editing the .config file and making the kernel

To edit the .config file and make the kernel, complete the following steps:

1. Open the configuration menu. Enter the following command:

   ```
   make menuconfig
   ```

2. Select **Multi-device support (RAID and LVM)**.
3. Select **RAID support**.
4. Ensure that the RAID support option is selected with an asterisk. If it is not selected, use the space bar to cycle through the settings until an asterisk appears next to the option.
5. Select **Multipath I/O support**.
6. Be sure that the Multipath I/O support option is set as a module. If it is not set as a module, use the space bar to cycle through the settings until an "M" appears next to the option.
7. Press the **Esc** key twice to exit the menus.
8. When prompted to save the new kernel configuration, press the **Enter** key to select **Yes**.

9. Make the kernel, as follows:
   a. From the root level, enter the following commands:

```
mrproper
make dep
make bzImage
make modules
make modules_install
```

   b. Wait for the kernel to be made. Depending on the hardware configuration, this process can take up to 30 minutes.
10. Insert the new kernel into either GRUB or LILO, as follows:
   a. Copy the new kernel boot image to the /boot directory (use the Tab key to autocomplete directory names or display possible options). Name the boot image vmlinuz-xxxx where xxxx is the kernel version number with the name you used in the very first step (ex., vmlinuz-2.4.9- Emultipath).

```
cp /usr/src/linux-xxx/arch/ixxx/boot/bzImage /boot/vmlinuz-xxxxx
```

   b. Make the boot image bootable:

      mkinitrd vmlinuz-xxxx xxxxx

   c. Update the GRUB or LILO configuration file to include the new kernel, by doing one of the following:
      - To update GRUB, edit /boot/grub/menu.lst in a text editor, copy one of the entries, and change the values to match those of the new kernel boot image and the title GRUB will use to display.
      - For LILO, edit the /etc/lilo.conf by copying one of the entries and changing the values to match those of the new kernel boot image and the title LILO will use to display. To apply the new configuration, run the following command:

        /sbin/lilo

      The new kernel is ready for use.
11. Reboot and select the new kernel at the GRUB or LILO prompt. If the new kernel does not work properly, select the original kernel to boot from and remake the kernel or reconfigure the operating system.

Installing the module without modifying the kernel

To install the module without modifying the kernel, complete the following steps:

1. Enter the following command to load the module:

```
insmod multipath
```

2. Verify that the module is installed and loaded by listing all modules. Enter:

```
lsmod
```

The kernel is now ready for multipath operations. However, to support multipath, you must enter these commands each time the server is restarted.

Modifying the RAIDTAB configuration file

To perform multipath operations in a Linux operating system, a raidtab configuration file must be present. The following section describe how to ensure that the raidtab configuration file contains the appropriate information.

RAIDTAB terms

Use the following definitions for raidtab terms:

- **raiddev** — introduces the configuration for a particular device
- **nr-raid-disks** — the number of raid disks in the array; specified in the /dev/cciss directory
- **persistent-superblock** — must be set to 1 if an md device is to be mounted or used during a reboot
- **chunk-size** — sets the stripe size in bytes, in the power of 2
- **device** — the physical device that makes up the RAID array
- **raid-disk** — the index of the device in the RAID array

For more information, see the operating system documentation.

Sample RAIDTAB configuration file

The following raidtab sample file is for a multipath configuration with three partitions (/dev/md0, /dev/md1, and /dev/md2), where each md device represents a partition on the device. If another partition is needed, add it as /dev/md3 with the same characteristics as the preceding partitions.

The limit for number of partitions is four primary partitions. However, creating one of the four partitions as a type "type 0xf" Win 95 Ext'd (LBA) partition enables you to create extended logical partitions inside of the primary partition. Inside of the extended partition, you can create additional Linux partitions.

The raidtab configuration file must reside in the /etc directory. The contents of /etc/raidtab must resemble the following:

```
raiddev /dev/md0
raid-level                multipath
nr-raid-disks             2
persistent-superblock     1
chunk-size                8
device                    /dev/cciss/c0d2p1
raid-disk                 0
device                    /dev/cciss/c1d2p1
raid-disk                 1

raiddev /dev/md1
raid-level                multipath
nr-raid-disks             2
persistent-superblock     1
chunk-size                8
device                    /dev/cciss/c0d2p2
raid-disk                 0
device                    /dev/cciss/c1d2p2
raid-disk                 1

raiddev /dev/md1
raid-level                multipath
nr-raid-disks             2
persistent-superblock     1
chunk-size                8
device                    /dev/cciss/c0d2p3
raid-disk                 0
device                    /dev/cciss/c1d2p3
raid-disk                 1
```

Completing the Linux multipath setup

After a valid raidtab file is created in the /etc directory, verify that the correct drivers and modules are loaded.

1. Verify that the md and multipath drivers are loaded, either statically or by a module load. Enter:

   ```
   lsmod
   ```

   This command reveals which modules are running. Examining the boot-time messages reveals the static loaded drivers.

IMPORTANT:

If you have made configuration changes to the kernel (including the multipath or /dev/md driver) and have not rebooted from the new kernel, you must reboot before continuing further. Red Hat typically includes the md driver in the kernel.

2. Verify that the md driver is in the kernel by entering the following command:

   ```
   dmesg | grep md | more
   ```

   This command displays the boot-time messages. If the md driver was loaded, several messages must appear, similar to the following messages:

   ```
   md: md driver version X.X
   md: Autodetecting RAID arrays
   md: autorun…
   md: …autorun DONE
   ```

3. If the multipath driver was built as a module but not loaded, load the module by entering the following command:

   ```
   insmod multipath
   ```

   This command loads the driver. If the driver does not load the multipath module, rebuild the module.

4. After verifying loaded drivers, make the raid files. For a sample partition table in the Sample RAIDTAB Configuration File section, enter the following commands:

   ```
   mkraid /dev/md0
   mkraid /dev/md1
   mkraid /dev/md2
   mkraid /dev/md3
   ```

CAUTION:

Do not use Fdisk or mkraid to create any other partitions on this logical drive. This action can result in data corruption and data loss.

5. If mkraid responds that the partition contains existing data, do the following:
   a. Force the mkraid to run by entering the following command:

      ```
      mkraid – f
      ```

   b. Make filesystems on the raid devices by entering the following command:

      ```
      mkfs –t ext2 /dev/md0
      mkfs –t ext2 /dev/md1
      mkfs –t ext2 /dev/md2
      mkfs –t ext2 /dev/md3
      mkfs –t ext2 /dev/md4
      ```

IMPORTANT:

The example in step 5b uses ext2, because known bugs in the ext3 filesystem can cause data corruption.

6. The multipath RAID device should be functioning. To mount the device /dev/md0, enter the following command:

   ```
   mount /dev/md0 /spare_filesystem
   ```

   If necessary, you can stop or start the RAID device with the following commands:

   - To stop the RAID device, enter the following command:

     ```
     raidstop /dev/md0
     ```

     This command may need to start the md device after a reboot. Place the command in the rc /etc configuration files for mounted filesystems at boot time.

   - To start the RAID device, enter the following command:

     ```
     raidstart /dev/md0
     ```

     This command can be placed in the shutdown scripts in /etc.

     For more information, see the operating system documentation.

Pre-installation hardware setup for Red Hat Enterprise Linux 2.1

To prepare for software installation, complete the following steps:

1. Complete the MSA500 G2 storage system hardware installation, as follows:

   NOTE:
   For hardware and option installation procedures, see the appropriate storage system user guide or the documentation that is shipped with the option.

   a. Install the MSA500 G2 storage system.
   b. Install the 4-Port Shared Storage module.
   c. Install the MSA500 G2 controllers.
   d. Update the system firmware, if needed.
2. Complete the server installation, as follows:
   a. Install all hardware, including a second supported HBA. See the appropriate server user guide or the documentation that is shipped with the option.
   b. Install one of the supported operating systems.
   c. Reboot the server.
3. Install multipath cabling for one of the Supported four-node configurations.
4. Power up the storage system.

   Wait for the controller display to provide a `Startup Complete` message.
5. Power up one of the servers.

Multipath installation for Red Hat Enterprise Linux 2.1

Use the following procedure for supported versions of Red Hat operating systems.

IMPORTANT:

Red Hat Enterprise ES/AS users must obtain the RPM and DDI files from the OS base media. To use the Smart Array Multipath Software with a Linux operating system, download the required driver RPM.

To download the driver RPM, complete the following steps:

1. Insert the Smart Array Multipath Software CD in to the CD-ROM drive of the server.
2. Open a console prompt.
3. Mount the CD-ROM.
4. Change to the Linux directory.
5. List the contents of the directory, and select the proper RPM for the current operating system.
6. Install the proper RPM using the following command:

   ```
   rpm -ihv cpq_cciss_<os version>.i386.rpm
   ```

7. After successful installation, reboot the server.
8. Repeat steps 1 through 7 for each server connected to the MSA500 G2 storage system.

Static load (read-only) balancing in Red Hat Enterprise Linux 2.1

The Smart Array Multipath software and Linux operating system support the static load (read-only) balancing functionality. To create, add, or extend logical volumes, use ACU Version 7.10 or later. Locate ACU on the SmartStart CD. For more information on the ACU see *HP Array Configuration Utility User Guide* on the SmartStart CD, or see the HP website (http://www.hp.com).

4 Installation and operation in Red Hat Enterprise Linux 3.0 and 4.0 environments

This chapter discusses the following topics:

- Pre-installation hardware setup for Red Hat Enterprise Linux 3.0 and 4.0
- Multipath installation for Red Hat Enterprise Linux 3.0 and 4.0
- Post-installation configuration for Red Hat Enterprise Linux 3.0 and 4.0
- Static load (read-only) balancing in Red Hat Enterprise Linux 3.0 and 4.0

Pre-installation hardware setup for Red Hat Enterprise Linux 3.0 and 4.0

To prepare for software installation, complete the following steps:

1. Complete the MSA500 G2 storage system hardware installation, as follows:

   NOTE:
   For hardware and option installation procedures, see the appropriate storage system user guide or the documentation that ships with the option.

   a. Install the MSA500 G2 storage system.
   b. Install the 4-Port Shared Storage module.
   c. Install the MSA500 G2 controllers.
   d. Update the system firmware, if needed.
2. Complete the server installation, as follows:
   a. Install all hardware, including a second supported HBA. See the server user guide or the documentation that ships with the option.
   b. Install one of the supported operating systems.
   c. Reboot the server.
3. Install multipath cabling for one of the Supported four-node configurations.
4. Power up the storage system.

   Wait for the controller display to display a `Startup Complete` message.
5. Power up one of the servers.

Multipath installation for Red Hat Enterprise Linux 3.0 and 4.0

Use the following procedure for supported versions of Red Hat Enterprise Linux operating systems.

To use the Smart Array Multipath Software with a Linux operating system, download the required driver RPM.

To download the driver RPM, complete the following steps:

1. Insert the Smart Array Multipath Software CD into the CD-ROM drive of the server.

2. Open a console prompt.
3. Mount the CD-ROM.
4. Change to the Linux directory.
5. List the contents of the directory, and select the proper RPM for the current operating system.
6. Install the proper RPM using the following command:

   #rpm_-Uhv –replacefiles cpq_cciss_<os version> .i686.rpm
7. After successful installation, reboot the server.
8. Repeat steps 1 through 7 for each server connected to the MSA500 G2 storage system.

Post-installation configuration for Red Hat Enterprise Linux 3.0 and 4.0

After installing Smart Array Multipath software on a server with a Red Hat Enterprise Linux operating system, configure for multipath operations.

Review the following sample configuration procedure. This procedure assumes that the user wants to set /dev/cciss/c1d0p2 and /dev/cciss/c2d0p2 to point to the same volume as a multipath device.

To configure the system for multipath use, complete the following steps:

1. Ensure that the MSA500 G2 storage system contains two identical MSA500 G2 controllers connected to the same logical volume.
2. To create multipath device /dev/md0, enter the following command:

   ```
   mdadm --create --level multipath –n 2 /dev/md0 /dev/cciss/c1d0p2
   /dev/cciss/c2d0p2
   ```
3. To review the status, enter the following command:

   ```
   mdadm –D /dev/md0
   ```

   The output displayed must be similar to the following:

   ```
     /dev/md0
     Version : 00.90.00
     Creation Time : Mon Apr 29 09:15:00 2003
     Raid Level : multipath
     Array Size : 14683328 (14.00 GiB 15.08 GB)
     Raid Devices : 2
     Total Devices : 2
     Preferred Minor : 0
     Persistence : Superblock is persistent
     Update Time : Mon Apr 29 09:02:00 2003
     State : dirty, no-errors
     Active Devices : 2
     Working Devices : 2
     Failed Devices : 0
     Spare Devices : 0
   Number Major    Minor     RaidDevice       State
   0 106     2       0     active sync     /dev/cciss/c2d0p2
   1 105     2       1     active sync     /dev/cciss/c1d0p2
   UUID : b1ec5895:5ed49b44:7ec7d4a8:397e19b1
   ```

IMPORTANT:

You can also review status by entering the following command:

```
cat /proc/mdstat
```

The output displayed must be similar to the following:

```
Personalities : [multipath]
read_ahead 1024 sectors
md0 : active multipath cciss/c2d0p2[0] cciss/c1d0p2[1]
14683328 blocks [2/2] [UU]
unused devices : <none>
```

4. To format the volume, enter the following command:

   ```
   mkfs –t ext2 /dev/md0
   ```

5. To mount the volume, enter the following command:

   ```
   mount /dev/md0 /spare_filesystem
   ```

6. To make md device available after reboot, enter the following command:

   ```
   echo 'DEVICE <device1 ...  devicen>'> /dev/mdadm.conf
   mdadm-detail-scan>>/etc/mdadm.conf
   ```

   For more information on the `mdadm` command, enter the following command:

   ```
   man mdadm
   ```

Configuration is complete.

Static load (read-only) balancing in Red Hat Enterprise Linux 3.0 and 4.0

The Smart Array Multipath software and Linux operating system support static load (read-only) balancing functionality. To create, add, or extend logical volumes, use ACU Version 7.10 or later. Locate ACU on the SmartStart CD. For more information on the ACU see *HP Array Configuration Utility User Guide* on the SmartStart CD, or see the HP website (http://www.hp.com).

5 Installation and operation in UnitedLinux environments

This chapter discusses the following topics:

- Pre-installation hardware setup for UnitedLinux
- Multipath installation for UnitedLinux
- Post-installation configuration for UnitedLinux
- Static load (read-only) balancing in UnitedLinux

Pre-installation hardware setup for UnitedLinux

To prepare for software installation, complete the following steps:

1. Complete the MSA500 G2 storage system hardware installation, as follows:

   NOTE:
   For hardware and option installation procedures, see the storage system user guide or the documentation that is shipped with the option.

   a. Install the MSA500 G2 storage system.
   b. Install the 4-Port Shared Storage Module.
   c. Install the MSA500 G2 controllers.
   d. Update the system firmware, if needed.
2. Complete the server installation, as follows:
   a. Install all hardware, including a second supported HBA. See the server user guide or the documentation that is shipped with the option.
   b. Install one of the supported operating systems.
   c. Reboot the server.
3. Install multipath cabling for one of the Supported four-node configurations.
4. Power up the storage system.

   Wait for the controller display to provide a `Startup Complete` message.
5. Power up one of the servers.

Multipath installation for UnitedLinux

Use the following procedure for supported versions of UnitedLinux operating systems.

To use the Smart Array Multipath Software with a Linux operating system, download the required driver RPM.

To download the driver RPM, complete the following steps:

1. Insert the Smart Array Multipath Software CD into the CD-ROM drive of the server.
2. Open a console prompt.
3. Mount the CD-ROM.
4. Change to the Linux directory.
5. List the contents of the directory and select the proper RPM for the current operating system.

6. Install the proper RPM by entering the following command:

   ```
   #rpm_-Uhv --replacefiles cpq_cciss_<os version> .i586.rpm
   ```

7. After successful installation, reboot the server.
8. Repeat steps 1 through 7 for each server connected to the MSA500 G2 storage system.

Post-installation configuration for UnitedLinux

After installing Smart Array Multipath software on a server with a UnitedLinux operating system, configure for multipath operations.

Review the following sample configuration procedure. This sample assumes that the user wants to set /dev/cciss/c1d0p2 and /dev/cciss/c2d0p2 to point to the same volume as a multipath device.

To configure the system for multipath, complete the following steps:

1. Be sure that the MSA500 G2 storage system contains two identical MSA500 G2 controllers connected to the same logical volume.
2. To create multipath device /dev/md0, enter the following command:

   ```
   mdadm --create --level multipath –n 2 /dev/md0 /dev/cciss/c1d0p2
   /dev/cciss/c2d0p2
   ```

3. To review the status, enter the following command:

   ```
   mdadm –D /dev/md0
   ```

   The output displayed must be similar to the following:

   ```
   /dev/md0


     Version : 00.90.00
     Creation Time : Mon Apr 29 09:15:00 2003
     Raid Level : multipath
     Array Size : 14683328 (14.00 GiB 15.08 GB)
     Raid Devices : 2
     Total Devices : 2
     Preferred Minor : 0
     Persistence : Superblock is persistent
     Update Time : Mon Apr 29 09:02:00 2003
     State : dirty, no-errors
     Active Devices : 2
     Working Devices : 2
     Failed Devices : 0
     Spare Devices : 0
   Number   Major    Minor   RaidDevice     State
   0 106     2      0         active sync      /dev/cciss/c2d0p2
   1 105     2      1         active sync      /dev/cciss/c1d0p2
   UUID : b1ec5895:5ed49b44:7ec7d4a8:397e19b1
   ```

IMPORTANT:

You can also review status by running:

```
cat /proc/mdstat
```

Results would look similar to the following:

```
Personalities : [multipath]
read_ahead 1024 sectors
md0 : active multipath cciss/c2d0p2[0] cciss/c1d0p2[1]
14683328 blocks [2/2] [UU]
unused devices : <none>
```

4. To format the volume, enter the following command:

```
mkfs –t ext2 /dev/md0
```

5. To mount the volume, enter the following command:

```
mount /dev/md0 /spare_filesystem
```

Configuration is complete.

Static load (read-only) balancing in UnitedLinux

The Smart Array Multipath software and Linux operating system support static load (read-only) balancing functionality. To create, add, or extend logical volumes, use ACU Version 7.10 or later. Locate ACU on the SmartStart CD. For more information on the ACU see *HP Array Configuration Utility User Guide* on the SmartStart CD, or see the HP website (http://www.hp.com).

6 Troubleshooting

This chapter discusses the following topics:

- Problem diagnosis
- Problems during installation
- HBA failure
- Cable failure

Problem diagnosis

If the problem is related to the multipath I/O, consult the Insight Management Agents and do one of the following:

- For Microsoft operating systems:
  - Use the ProLiant Storage Manager or ProLiant Multipath Manager FAQs.
  - Use the ProLiant Storage Manager with ProLiant Multipath Manager software, and the DME to identify the I/O path status.
- For Linux operating systems, enter the following command to identify HBA status, multipath status, and I/O block transfer size:

  ```
  cat /proc/mdstatus
  ```

Problems during installation

This section describes how to troubleshoot the most common problems encountered during software installation.

To troubleshoot the problems encountered during installation, complete the following steps:

1. In a Microsoft environment, uninstall any previous version of the multipath software first.
2. Ensure that the firmware is upgraded for all HBAs and both the MSA500 G2 controllers, if installed.
3. Ensure that the hardware installation meets the Minimum requirements.
4. Ensure that the SCSI cabling matches one of the Supported four-node configurations.
5. Ensure that the HBA is functioning properly. Refer to the appropriate server and HBA documentation. If the HBA has failed, see HBA failure.
6. Ensure that the SCSI cables are functioning properly. If a SCSI cable fails, see Cable failure.
7. Ensure that you followed operating system-specific instructions:
   - If the server has a Red Hat operating system, ensure that the active kernel is edited properly.
   - If the server has a Microsoft operating system, ensure that the SCSI cable from the redundant HBA is disconnected before Smart Array Multipath software installation.

   IMPORTANT:

   After establishing a redundant configuration and adding a logical volume, use Windows Disk Manager to detect the new volume.

   - If these steps do not solve the installation problem, contact an authorized reseller.

HBA failure

If one of the HBAs in the server fails, the redundant HBA performs all I/O operations.

To replace the failed HBA, complete the following steps:

1. Power down the HBA in one of the following ways:
   - For a PCI-based HBA in a Microsoft operating system environment, use the PCI Hot Plug functionality in the server, to power down the HBA while the server is online.
   - For an embedded HBA in a Microsoft operating system environment, power down the server.
   - For an HBA in a Linux operating system environment, power down the server.
2. Disconnect the SCSI cable from the connector on the HBA, or from the external VHDCI connector on the server.
3. Remove the failed HBA. For more information, see the documentation that is shipped with the server or HBA.
4. Install a replacement HBA. For more information, see the documentation that ships with the server or HBA.
5. Connect the SCSI cable to the connector on the HBA, or to the external VHDCI connector on the server.
6. Power up the HBA in one of the following ways:
   - Use PCI Hot Plug functionality to restore power.
   - Power up the server.

   IMPORTANT:

   In a Microsoft environment, the software recognizes the replacement HBA and automatically restores redundancy.

7. If operating in a Linux environment, reconfigure I/O for multipath operation.

Cable failure

To replace the failed cable, complete the following steps:

1. Power down the HBA in one of the following ways:
   - For a PCI-based HBA in a Microsoft operating system environment, use the PCI Hot Plug functionality in the server, to power down the HBA while the server is online.
   - For an embedded HBA in a Microsoft operating system environment, power down the server.
   - For an HBA in a Linux operating system environment, power down the server.
2. Disconnect the SCSI cable, as follows:
   a. Disconnect the cable from the MSA500 G2 storage system.
   b. Disconnect the cable from the connector on the HBA or from the external VHDCI connector on the server.
3. Connect the replacement cable, as follows:
   a. Connect the cable to the connector on the HBA, or to the external VHDCI connector on the server.
   b. Connect the cable to the MSA500 G2 storage system.
4. Power up the HBA in one of the following ways:
   - Use the PCI Hot Plug functionality to restore power.
   - Power up the server.

A Acronyms and abbreviations

MPIO	Multipath IO
DSM	Device specific modules
MSA	Modular Storage Array
SCSI	Small Computer System Interface
DAS	direct attached storage
DME	device manager extension
HBA	host bus adapter
LBA	logical block addressing
LUN	logical unit number
RPM	Red Hat Package Manager
SSP	Selective Storage Presentation
VHDCI	Very High Density Cable Interconnect

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