

# HP Smart Array Multipath Software User Guide



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### Audience assumptions

This document is for the person who installs, administers, and troubleshoots servers and storage systems. HP assumes you are qualified in the servicing of computer equipment and trained in recognizing hazards in products with hazardous energy levels.

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# Overview

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## 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 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 only contains Multipath I/O deliverables for Microsoft® Windows® operating systems and is only available for web download from the HP website (<http://h18007.www1.hp.com/support/files/server>).

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

## Minimum requirements

Be sure that your solution consists of 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 cablesor
  - A 4-Port Shared Storage Module and four SCSI cables

For the latest versions of firmware, refer to the HP website (<http://www.hp.com/support/proliantstorage>).

# Supported operating systems

Supported operating systems include:

- Microsoft®
  - Windows® 2000
  - Windows® Server 2003
- Linux
  - Red Hat Enterprise Linux
  - UnitedLinux

For information about the most current operating system support, errata kernels, and service pack requirements, refer to the HP website (<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.
- ProLiant Storage Manager with the ProLiant Multipath Manager software and device manager extension provide 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 SSP to restrict HBAs from accessing logical volumes containing data from a different operating system. For more information about SSP, refer to the documentation that ships with the 4-Port Shared Storage Module.

# Supported four-node configurations

The following sections identify 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.

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 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.

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 its respective server, while the other boot volume resides on the MSA500 G2 storage system. Both data volumes reside on the MSA500 G2 storage system.

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 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.

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.

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

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

Server	Port (bus)	Boot volume location	Data volume location
1	A1 B1	Storage system*	Storage system
2	A2	Server 2	Storage system
3	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 Linux boot volumes on servers.

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# Installation and operation in Microsoft environments

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## Pre-installation hardware setup for Microsoft

To prepare for software installation:

1. Complete the MSA500 G2 storage system hardware installation:



**NOTE:** For hardware and option installation procedures, refer to the 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:
    - a. Install all hardware, including a second supported HBA. Refer to the server user guide.




**IMPORTANT:** The server only supports 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 (on page 6).
  4. Be sure 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.


# Uninstalling the Smart Array Multipath software driver

 **CAUTION:** Before uninstalling the software driver in a Microsoft® Windows® Server 2003 clustering environment, use the Cluster Administrator to stop the cluster service on the appropriate node.

1. Power down the server.
2. Disconnect all SCSI cables from any controller in the storage system, unless the boot drive is attached.
3. Power up the server.
4. Select **Start>Settings>Control Panel**.
5. Select **Add/Remove Programs**.
6. From the list of components, select **HP Smart Array Multipath Software 2.0C**.

 **NOTE:** For Microsoft® Windows® Server 2003 only, the selection is HP Smart Array Multipath Driver.

7. Click **Change/Remove**.
8. Click **OK**.


 **NOTE:** A Microsoft® Windows® Server 2003 system does not indicate progress during the removal. Wait at least 10 minutes to allow the system to complete the removal.

9. Click **Cancel**.
10. Shut down the server.
11. Disconnect the SCSI cable from the redundant HBA.

## Installation for an existing 2-node cluster with Microsoft Windows 2000

1. Log on to one node of the cluster with an account having domain administrator privileges.
2. Open the **Cluster Administrator** and move all cluster groups to the second node.
3. On the first node, stop the cluster service and set the startup type to **Manual**.
4. Install the HP Smart Array Multipath Software. Refer to "Multipath installation for Microsoft (on page 11)."
5. Reboot as instructed.
6. Log on to Windows® 2000 with an account having domain administrator privileges.
7. Click **Yes** or **OK** for any new hardware found or installed.
8. Shut down the system. Do not reboot.
9. Install the second HBA and connect the cable from second HBA to the storage system.
10. Power up the server.
11. Log in to Windows® 2000 with an account having domain administrator privileges after the startup completes.
12. Start the cluster service and set the startup type to **Automatic**.
13. Open the **Cluster Administrator**.
14. Move the disk groups from the second node to the first node and verify that all groups come online.
15. Repeat all steps for the second node.

# Multipath installation for Microsoft

 **CAUTION:** Before installing Smart Array Multipath Software, be sure to uninstall any previous versions of the software and update the HBA and MSA500 G2 controller drivers.

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



**IMPORTANT:** If autorun is disabled, run `setup.exe` from the CD.

2. To agree to the software license agreement, click **Agree**.
3. When the **Main** screen displays, select **Install Multipath Software**.
4. Click **OK**.



**IMPORTANT:** If HP web-based applications have not been installed on the system, the Web-based Management Setup Wizard displays. The wizard prompts you to provide an administrator login and password. Follow the on-screen instructions.

The CD installs the Smart Array Multipath Manager, the ProLiant Storage Manager, and the redundancy driver.

5. When the system prompts for a reboot, remove the CD then click **Cancel**.
6. Shut down the server.
7. Connect the SCSI cable to the redundant HBA.
8. Power up the server.
9. After the server boots, open a browser window and enter:  
`https://localhost:2381`  
The system prompts you with a security certificate.
10. To accept the certificate and proceed to the login, select **Yes**.
11. Enter the administrator login and password.  
The System Management Homepage displays.
12. Click the **Settings** tab.
13. Click **Options**.
14. In the Configuration Options section, select **Local Access**.
15. Click **Save Configuration**.
16. Repeat steps 1 through 15 for each server connected to the MSA500 G2 storage system.

## Post-installation hardware setup for Microsoft

To prepare for software operation:

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.

## Microsoft browser security settings

For Windows® Server 2003, the modified version of Internet Explorer 6.0 defaults all servers to the "Internet zone," which enables the highest level of security. At this security level, browsing to HP Management agents generates many security messages.

To avoid these security messages:

1. Open Internet Explorer 6.0.
2. Select **Tools>Internet Options**.
3. Select the **Security** tab.
4. Click **Local intranet**.
5. Manually set the servers to the Local intranet zone by entering:  
`http://<servername or IP address>:2301`  
`https://<servername or IP address>:2381`

## Static LUN balancing

The Smart Array Multipath software and Microsoft operating system support static LUN balancing. The movement of drives to specific paths can be done two ways:

- Locally with a DME
- Remotely with the Smart Array Multipath found on the Smart Array Multipath Software CD

To balance LUNs with the DME:

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.

To manage your redundant configuration:

1. First-time users must install the software. Install the ProLiant Storage Manager software and Smart Array Multipath Manager software ("[Multipath installation for Microsoft](#)" on page 11).
2. Browse to the System Management Homepage by entering:  
`https:\\<name of server>:2381`



**IMPORTANT:** If you encounter numerous security messages on a Microsoft® Windows® Server 2003 platform, review the Microsoft browser security settings (on page 11).

3. To accept the security certificate, click **Yes**. The system may prompt for the administrator password established during the original software installation. The System Management Homepage opens.
4. Click the **Home** tab.
5. Select **ProLiant Storage Manager**. A new window opens.
6. Click the appropriate controller on the Device View tab.
7. Click **Multipath Management**. The Multipath Management and Configuration screen displays.

8. From the Multipath Management and Configuration screen, do one of the following:
  - To move all drives from the current path to the redundant path, click the link for the controller and select **Switch All Paths**. The system moves all drives to the redundant path.
  - To move a drive from one path to the redundant path, click the link for the drive and select **Switch Path**.



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

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# Installation and operation in Red Hat Enterprise Linux 2.1 environments

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## 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:

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

### Editing the active kernel

To configure the system for multipath operations, HP recommends the following steps:

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

The procedures 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 steps in this section.

### Modifying the Makefile



**IMPORTANT:** The following procedure is for Linux Red Hat only.

To modify the Makefile:

1. Identify the name of the active kernel:
  - 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:

```
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:

1. Locate the specific `.config` file for the modified kernel:
  - a. From the root level of the kernel source, enter:  

```
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:  

```
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:

1. Open the configuration menu. Enter:  

```
make menuconfig
```
2. Select **Multi-device support (RAID and LVM)**.
3. Select **RAID support**.
4. Be sure that the RAID support option is checked with an asterisk. If it is not checked, 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:
  - a. From the root level, enter:  

```
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 last up to 30 minutes.
10. Insert the new kernel into GRUB or LILO.

- 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-xxxx
```

- 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

1. Load the module. Enter:

```
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, but to support multipath, you must enter these commands each time the server is restarted.

## Modifying the RAIDTAB configuration file

To perform multipath operations with a Linux operating system, a `raidtab` configuration file must be present. Use the instructions in the following sections to be sure the `raidtab` configuration file contains the appropriate information.

### RAIDTAB terms

Observe 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/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, refer to 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 should 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. Red Hat typically includes the `md` driver in the kernel.

2. Verify that the `md` driver is in the kernel. Enter:

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

This command shows the boot-time messages. If the `md` driver was loaded, several messages should 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. Enter:

```
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 the sample partition table in the "Sample RAIDTAB Configuration File (on page 17)" section, enter:

```
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 results 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. Enter:

```
mkraid - f
```

- b. Make filesystems on the raid devices. Enter:

```
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:

```
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:

```
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:

```
raidstart /dev/md0
```

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

For more information, refer to the operating system documentation.

## Pre-installation hardware setup for Red Hat Enterprise Linux 2.1

To prepare for software installation:

1. Complete the MSA500 G2 storage system hardware installation:



**NOTE:** For hardware and option installation procedures, refer to the 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:
    - a. Install all hardware, including a second supported HBA. Refer to the server user guide.
    - b. Install one of the supported operating systems.
    - c. Reboot the server.
  3. Install multipath cabling for one of the supported four-node configurations (on page 6).
  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:

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 -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 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. Refer to the HP Array Configuration Utility User Guide on the SmartStart CD or refer to the HP website (<http://www.hp.com>).

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

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

To prepare for software installation:

1. Complete the MSA500 G2 storage system hardware installation:



**NOTE:** For hardware and option installation procedures, refer to the 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:
    - a. Install all hardware, including a second supported HBA. Refer to the server user guide.
    - b. Install one of the supported operating systems.
    - c. Reboot the server.
  3. Install multipath cabling for one of the supported four-node configurations (on page 6).
  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 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:

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 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 use:

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`, run:

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

3. To review the status, run:

```
mdadm -D /dev/md0
```

Results should look 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, run:

```
mkfs -t ext2 /dev/md0
```

5. To mount the volume, run:

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

6. To make md device available after reboot, run:

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

For more information run:

```
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. Refer to the HP Array Configuration Utility User Guide on the SmartStart CD or refer to the HP website (<http://www.hp.com>).

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# Installation and operation in UnitedLinux environments

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## Pre-installation hardware setup for UnitedLinux

To prepare for software installation:

1. Complete the MSA500 G2 storage system hardware installation:



**NOTE:** For hardware and option installation procedures, refer to the 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:
    - a. Install all hardware, including a second supported HBA. Refer to the server user guide.
    - b. Install one of the supported operating systems.
    - c. Reboot the server.
  3. Install multipath cabling for one of the supported four-node configurations (on page 6).
  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:

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> .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 use:

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`, run:

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

3. To review the status, run:

```
mdadm -D /dev/md0
```

Results should look 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, run:

```
mkfs -t ext2 /dev/md0
```

5. To mount the volume, run:

```
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. Refer to the HP Array Configuration Utility User Guide on the SmartStart CD or refer to the HP website (<http://www.hp.com>).

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# Troubleshooting

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## Problem diagnosis

When a problem exists with 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 I/O path status.
- For Linux operating systems, use the following command to identify HBA status, multipath status, and I/O block transfer size:

```
cat /proc/mdstatus
```

## Problems during installation

This section provides systematic instructions on what to try and where to go for help for the most common problems encountered during software installation.

If you encounter problems during installation:

1. In a Microsoft® environment, be sure to uninstall any previous version of the multipath software first.
2. Be sure that the firmware is upgraded for all HBAs and both MSA500 G2 controllers, if installed.
3. Be sure that the hardware installation meets the minimum requirements (on page 5).
4. Be sure that the SCSI cabling matches one of the supported four-node configurations (on page 6).
5. Be sure that the HBA is functioning properly. Refer to the appropriate server and HBA documentation. If the HBA has failed, refer to "HBA failure (on page 28)."
6. Be sure that the SCSI cables are functioning properly. If a SCSI cable fails, refer to "Cable failure (on page 28)."
7. Be sure that you followed operating system-specific instructions:
  - If the server has a Red Hat operating system, be sure that the active kernel is edited properly.
  - If the server has a Microsoft® operating system, be sure that the SCSI cable from the redundant HBA was 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.

8. 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:

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. Refer to the server maintenance and service guide.
4. Install a replacement HBA. Refer to 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 the I/O for multipath operation.

# Cable failure

To replace the failed cable:

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:
  - 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:
  - 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 PCI Hot Plug functionality to restore power.
  - Power up the server.

---

# Acronyms and abbreviations

## 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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