

SAS2 BIOS Configuration Utility



# User's Guide



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**Note:** Before using this information and the product it supports, read the information in Appendix B, "Notices," on page 27.

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## Chapter 1. Introduction

This chapter provides an introduction to the features and benefits of the SAS2 integrated RAID solution for SAS2 controllers.

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### Overview

The integrated RAID solution provides cost benefits for the server or workstation market that requires the extra performance, storage capacity, and redundancy of a RAID configuration. The integrated RAID solution includes the following RAID features:

- The integrated mirroring solution, which provides features of RAID 1
- The integrated mirroring + striping solution, which provides features of RAID 10
- The integrated mirroring enhanced solution, which provides features of RAID 1 enhanced (RAID 1E)
- The integrated striping solution, which provides features of RAID 0

LSI Fusion-MPT™ firmware supports integrated mirroring volumes, integrated mirroring + striping volumes, integrated mirroring enhanced volumes, and integrated striping volumes. You can create up to two integrated RAID volumes on each SAS2 controller.

The integrated RAID solution supports the following SAS2 controllers and the host bus adapters based on these controllers:

- LSI SAS2004
- LSI SAS2008

The integrated RAID firmware uses the same device drivers as the standard LSI Fusion-MPT-based controllers. To conserve system resources, the integrated RAID firmware operates independently from the operating system. The BIOS-based configuration utility, documented in Chapter 3, “Using the SAS2 BIOS configuration utility to create mirrored volumes,” on page 9 and Chapter 5, “Using the SAS2 BIOS configuration utility to create integrated striping volumes,” on page 19, enables you to configure mirrored and striped volumes.

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### Features

The integrated RAID solution has the following benefits and features:

- Support for up to 10 disks per integrated RAID volume, with one or two volumes on each SAS2 controller. Each controller can support 14 volume drives, including one or two hot spare disks.
- Support for two-disk integrated mirroring volumes (RAID 1)
- Support for online capacity expansion (OCE) for RAID 1 volumes. OCE enables you to increase the size of a RAID 1 volume by replacing the disk drives with higher-capacity drives.
- Low-cost RAID volume creation, which meets the needs of most internal RAID installations
- Easy installation and configuration
- Support for booting from any kind of integrated RAID volume
- Ability to operate without special operating-system specific software
- High reliability and data integrity

- Nonvolatile write journaling
- Physical disks in a volume are not visible to the operating system or to application software
- Low host CPU and PCI bus utilization
- Processing power provided by Fusion-MPT architecture
  - Shared-memory architecture minimizes external memory requests
  - Device hardware and firmware contain the functionality

## Host interface

The integrated RAID host interface uses the Message Passing Interface, as described in the *Fusion-MPT Message Passing Interface Specification*. The Fusion-MPT interface gives the host operating system access to the RAID volumes and to additional non-RAID physical disks.

## Metadata support

The integrated RAID firmware supports metadata, which describes the logical drive configuration stored on each member disk of a volume. After initialization, the firmware queries each member disk to read the metadata and verify the configuration. The firmware reduces the usable disk space for each member disk when it creates the volume, which makes room for the metadata.

## SMART support

The Self-Monitoring, Analysis and Reporting Technology (SMART) monitors disk drives for signs of future disk failure and generates an alert if it detects such signs. The integrated RAID firmware polls each physical disk in the volume at regular intervals. If the firmware detects a SMART ASC/ASCQ code on a physical disk in the volume, it processes the SMART data and stores it in a log. The volume does not support SMART directly because it is only a logical representation of the physical disks in the volume.

## Fusion-MPT support

The integrated RAID BIOS uses the LSI Fusion-MPT interface to communicate to the SAS2 controller and firmware. This process includes reading the Fusion-MPT configuration to access the parameters that define behavior between the SAS2 controller and the devices that connect to it. The Fusion-MPT drivers for all supported operating systems implement the Fusion-MPT interface to communicate with the controller and firmware.

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## Notices in this document

The following notices are used in this document:

- **Note:** These notices provide important tips, guidance, or advice.
- **Important:** These notices provide information or advice that might help you avoid inconvenient or problem situations.
- **Attention:** These notices indicate potential damage to programs, devices, or data. An attention notice is placed just before the instruction or situation in which damage might occur.

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## Chapter 2. Overview of integrated RAID mirrored volumes

This chapter provides an overview of the integrated RAID features that support the creation of mirrored arrays.

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### Introduction

The mirroring features of the integrated RAID solution provide data protection for the system boot volume, which safeguards the operating system and other critical information on servers and high-performance workstations. The integrated RAID solution supports the following types of mirrored arrays:

- The integrated mirroring solution, which provides features of RAID 1
- The integrated mirroring + striping solution, which provides features of RAID 10
- The integrated mirroring enhanced solution, which provides features of RAID 1 enhanced (RAID 1E)

These three mirroring solutions provide a robust, high-performance, fault-tolerant solution to data storage needs at a lower cost than a dedicated RAID controller.

Mirrored volumes can have from 2 - 10 disks to provide fault-tolerant protection for critical data. Mirrored volumes also support one or two global hot spare drives, with a maximum of 14 drives on each SAS2 controller.

**Note:** Fourteen drives is the maximum for a single SAS2 controller, although the controller itself might support less than 14 drives. You can also configure one mirrored volume and one integrated striping volume on the same SAS2 controller.

Each SAS2 controller can have two global hot spare disks available to automatically replace a failed disk in the one or two mirrored volumes configured on the controller. The hot spares make the mirrored volumes even more fault-tolerant.

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### Integrated mirroring and integrated mirroring enhanced features

Integrated mirroring, integrated mirroring + striping, and integrated mirroring enhanced volumes support the following features:

- Configurations of one or two mirrored volumes on each SAS2 controller. Each volume can consist of two mirrored disks for an integrated mirroring volume; 3 - 10 mirrored disks for an integrated mirroring enhanced volume; or four, six, eight, or ten mirrored disks for an integrated mirroring + striping volume.
- (Optional) Two global hot spare disks per SAS2 controller to automatically replace failed disks in mirrored volumes.
- Ability of mirrored volumes to run in optimal mode or in degraded mode if one mirrored disk in an integrated mirroring volume fails or if one or more mirrored disks fail in an integrated mirroring + striping volume or integrated mirroring enhanced volume.
- Support for hot swapping.
- Support for online capacity expansion (OCE) for RAID 1 volumes. OCE enables you to increase the size of a RAID 1 volume by replacing the existing disk drives with higher-capacity disk drives. Data is protected during the expansion process, and the RAID 1 volume remains online.
- Presentation of a single, virtual drive to the operating system for each mirrored volume.

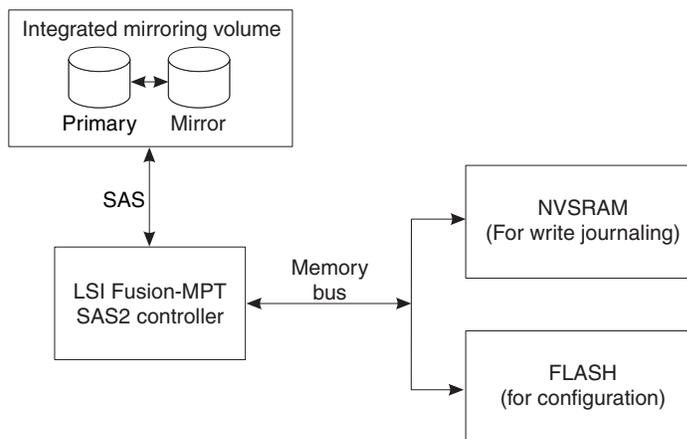
- Support for both SAS and SATA disks, although you cannot combine the two types of disks in the same volume. However, an SAS2 controller can support one volume with SATA disks and a second volume with SAS disks.
- Automatic background initialization after volume creation.
- Consistency checking.
- Fusion-MPT architecture.
- Menu-driven, BIOS-based configuration utility.
- Error notification, in which the drivers update an operating system-specific event log.
- Support for SCSI Enclosure Services (SES) status LED.
- Write journaling, which enables automatic synchronization of potentially inconsistent data after unexpected power down situations.
- Use of metadata to store volume configuration on disks in a mirrored volume.
- Automatic background resynchronization while host I/Os continue.
- Background media verification, which ensures that data on mirrored volumes is always accessible.

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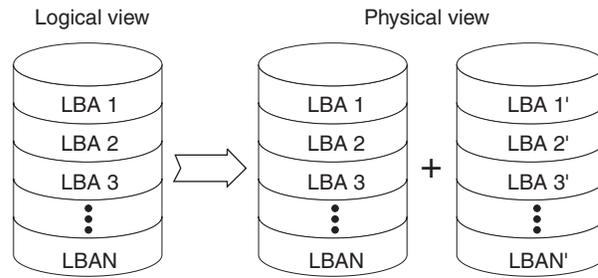
## Operation of mirrored volumes

The integrated RAID solution supports one or two mirrored volumes on each SAS2 controller (or one mirrored volume and one integrated striping volume). Typically, one of these volumes is the boot volume. Boot support is available through the firmware of the SAS2 controller that supports the standard Fusion-MPT interface. The runtime mirroring of the boot disk is transparent to the BIOS, the drivers, and the operating system. Host-based status software monitors the state of the mirrored disks and reports any error conditions.

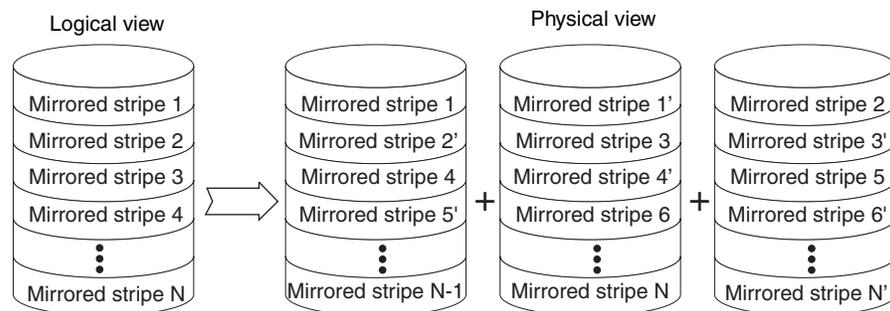
The following figure shows an integrated mirroring volume in which the second disk is a mirrored copy of the data on the first (primary) disk.



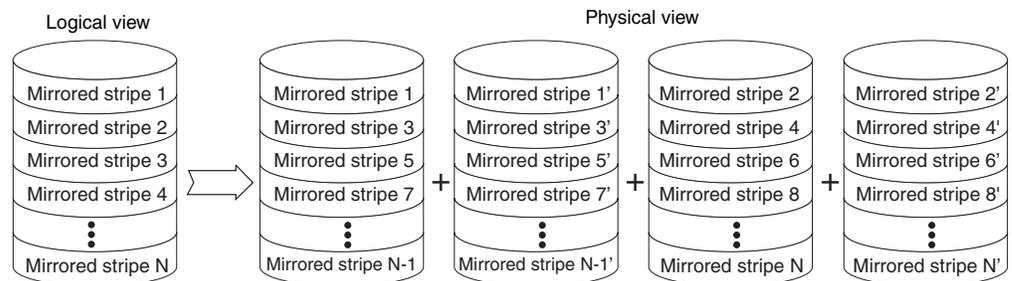
The following illustration shows the logical view and physical view of an integrated mirroring volume. Each logical block address (LBA) is mirrored on the second disk.



You can configure an integrated mirroring enhanced volume with up to 10 mirrored disks. The following figure shows the logical view and physical view of an integrated mirroring enhanced volume with three mirrored disks. The firmware writes each mirrored stripe to a disk and mirrors it to an adjacent disk. RAID 1E is another term for this type of mirrored configuration.



You can configure an integrated mirroring + striping volume with an even number of disks, ranging from four minimum to ten maximum. The following figure shows the logical view and physical view of an integrated mirroring + striping volume with four mirrored disks. The firmware writes each mirrored stripe to a disk and mirrors it to an adjacent disk. RAID 10 is another term for this type of mirrored/striped configuration.



The SAS2 BIOS configuration utility enables you to create mirrored volumes during initial setup and to reconfigure them in response to hardware failures or changes in the environment.

**Attention:** The SAS2 BIOS configuration utility deletes all existing data from the disk drives when you select them to use for a mirrored volume.

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## Mirrored volume features

This section describes features of integrated mirroring, integrated mirroring + striping, and integrated mirroring enhanced volumes. You can configure one or two mirrored volumes on each SAS2 controller.

## Resynchronization with concurrent host I/O operation

The integrated RAID firmware enables host I/O transactions to continue on a mirrored volume while it resynchronizes the volume in the background. The firmware automatically starts resynchronizing data after a disk failure activates a hot spare, or after a disk in a mirrored volume has been hot swapped.

## Hot swapping

The integrated RAID firmware supports hot swapping, and it automatically resynchronizes the hot-swapped disk in the background without any host or user intervention. The firmware detects hot-swap removal and disk insertion.

After a hot-swap event, the firmware makes sure that the new physical disk has enough capacity for the mirrored volume. The firmware resynchronizes all replaced hot-swapped disks, even if the same disk is reinserted. In a mirrored volume with an even number of disks, the firmware marks the hot-swapped disk as a secondary disk and the other disk with data as the primary disk. The firmware resynchronizes all data from the primary disk onto the new secondary disk. In a mirrored volume with an odd number of disks, primary and secondary sets include three disks instead of two.

## Hot spare disk

You can configure two disks as global hot spare disks to protect data on the mirrored volumes configured on the SAS2 controller. If the integrated RAID firmware fails one of the mirrored disks, it automatically replaces the failed disk with a hot spare disk and then resynchronizes the mirrored data. The firmware automatically receives a notification when a hot spare replaces the failed disk, and it then designates that disk as the new hot spare.

## Online capacity expansion

The OCE feature enables you to expand the capacity of an existing two-disk integrated mirroring (RAID 1) volume by replacing the original disk drives with higher capacity drives that have the same protocol (SAS or SATA).

**Note:** The new drives must have at least 50 GB more capacity than the original drives of the volume.

After you replace the disk drives and run the OCE command, you must use a vendor software tool specific to the operating system to move or increase the size of the partition on the volume.

## Media verification

The integrated RAID firmware supports a background media verification feature that runs at regular intervals when the mirrored volume is in the Optimal state. If the verification command fails for any reason, the firmware reads the data from the other disk for this segment and writes it to the failing disk in an attempt to refresh the data. The firmware periodically writes the current media verification logical block address to nonvolatile memory so that the media verification can continue from where it stopped before a power cycle.

## Disk write caching

By default, the integrated RAID firmware disables disk write caching for mirrored volumes. It does this to make sure that the write journal entry stored in nonvolatile static RAM (NVSRAM) is always valid. If you enable disk write caching (not recommended), you might cause the disk write log to be invalid.

## NVSRAM usage

The integrated RAID firmware requires at least a 32 KB NVSRAM to perform write journaling for mirrored volumes on SAS2 controllers. The NVSRAM also preserves configuration information across reboots. The firmware uses write journaling to verify that the disks in the mirrored volume are synchronized with each other.

## Background initialization

Background initialization (BGI) is the process of copying data from primary to secondary disks in a mirrored volume. The integrated RAID firmware starts BGI automatically as a background task when it creates a volume. The volume remains in the Optimal state while BGI is in progress.

## Consistency check

A consistency check is a background process that reads data from primary and secondary disks in a mirrored volume and compares it to make sure that the data is identical on both disks. You can use the SAS2 BIOS configuration utility to run a consistency check on a mirrored volume.



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## Chapter 3. Using the SAS2 BIOS configuration utility to create mirrored volumes

This chapter explains how to create integrated mirroring, integrated mirroring + striping, and integrated mirroring enhanced volumes with the SAS2 BIOS Configuration Utility (SAS2 BIOS configuration utility).

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### Mirrored volume configuration overview

The SAS2 BIOS configuration utility is a menu-driven utility program that enables you to configure and manage integrated RAID volumes. You can use the SAS2 BIOS configuration utility to create one or two mirrored volumes on each SAS2 controller, with up to two optional global hot spare disks. You must connect all disks in a mirrored volume to the same SAS2 controller.

Although you can use disks of different sizes in mirrored volumes, the smallest disk in the volume determines the logical size of all disks in the volume. The volume does not use the excess space of the higher-capacity member disks. For example, if you create an integrated mirroring enhanced volume with two 100 GB disks and two 120 GB disks, the volume uses only 100 GB on each of the 120 GB disks.

For more information about the features of integrated mirroring, integrated mirroring + striping, and integrated mirroring enhanced volumes, see Chapter 2, “Overview of integrated RAID mirrored volumes,” on page 3.

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### Creating mirrored volumes

The SAS2 BIOS configuration utility is part of the Fusion-MPT BIOS. When the BIOS loads during startup sequence and a message is displayed about the configuration utility, press Ctrl-C to start it. The following message is displayed:

```
Please wait, invoking SAS Configuration Utility.
```

After a brief pause, the main menu (Adapter List window) of the SAS2 BIOS configuration utility opens; however, on some systems, the following message is displayed:

```
LSI Corp Configuration Utility will load following initialization!
```

In this case, the configuration utility loads after the server has completed its power-on self-test (POST).

You can configure one or two integrated mirroring, integrated mirroring + striping, or integrated mirroring enhanced volumes on each SAS2 controller. You can also configure one mirrored volume and one integrated striping volume on the same controller, up to a maximum of 14 disk drives for the two volumes. This includes one or two optional hot spare disks for the mirrored volumes.

- All physical disks in the volume must be either SATA (with extended command set support) or SAS (with SMART support). You cannot combine SAS and SATA disks in the same volume. However, you can create one volume with SAS disks and a second volume with SATA disks on the same controller.
- Disks must have 512-byte blocks and must not have removable media.
- Integrated mirroring volumes must have two disks, integrated mirroring enhanced volumes can have 3 - 10 disks, and integrated mirroring + striping volumes can have an even number of disks ranging from 4 - 10 disks.

**Note:** You should create global hot spare disks for all mirrored volumes to increase the level of data protection. If a disk in a mirrored volume fails, the integrated RAID firmware rebuilds it using one of the global hot spares, and the data is safe. If you create two mirrored volumes on an SAS2 controller, either of the two mirrored volumes can use the global hot spares if a disk fails.

## Creating an integrated mirroring volume

To create a 2-disk integrated mirroring (RAID 1) volume with the SAS2 BIOS configuration utility, complete the following steps. The steps begin with the Adapter List window that opens when the SAS2 BIOS configuration utility starts.

1. On the Adapter List window, use the arrow keys to select the controller, and then press Enter. The Adapter Properties window opens.



2. Use the arrow keys to select **RAID Properties** and press Enter. The Create Array window opens.
3. Select **Create RAID 1 Volume**. The Create New Array window opens.
4. Move the cursor to the RAID Disk column and select a line that has a No entry in this column, indicating that the disk is not already part of the volume you are creating. To add the disk to the new array, change the No to Yes by pressing the space bar. This is the Primary disk in the array.

**Attention:** The SAS2 BIOS configuration utility deletes all existing data from the disks drives when you select them to use in a mirrored volume.

5. Move the cursor to another line and press the space bar to add the second disk to the array. This is the secondary disk in the array.
6. Press C to create the array. A menu window opens.
7. From the menu options, select **Save changes then exit this menu**.

A processing message is displayed briefly, and then the SAS2 BIOS configuration utility returns to the Adapter Properties window. Initialization of the new array continues in the background.

**Notes:**

1. To create a second integrated mirroring volume, repeat these instructions beginning with step 2 on page 10. Alternatively, follow the instructions in the following section to create an integrated mirroring enhanced or integrated mirroring + striping volume.
2. If you want to create one or two global hot spares, see the instructions in “Managing hot spare disks” on page 12.

## Creating an integrated mirroring enhanced or integrated mirroring + striping volume

Integrated mirroring enhanced volumes can have from 3 - 10 physical disks. Data is written to a disk and mirrored on an adjacent disk. Integrated mirroring + striping volumes can have a minimum of four and a maximum of 10 physical disks, in even numbers. In an integrated mirroring enhanced or integrated mirroring + striping volume, the data is both mirrored and striped.

To create an integrated mirroring enhanced volume or an integrated mirroring + striping (RAID 10) volume with the SAS2 BIOS configuration utility, complete the following steps:

1. On the Adapter List window, which opens when the configuration utility starts, use the arrow keys to select the controller, and then press Enter. The Adapter Properties window opens.
2. Use the arrow keys to select **RAID Properties** and press Enter. The Create Array window opens.
3. When you are prompted to select a volume type, select **Create RAID 1E Volume**. The Create New Array window opens and shows a list of disks that you can add a volume.
4. Move the cursor to the RAID Disk column and select a line that has a No entry in this column, which indicates that the disk is not already part of the volume you are creating. To add the disk to the new array, change the No to Yes by pressing the space bar.

**Attention:** The SAS2 BIOS configuration utility deletes all existing data from the disk drives when you select them to use for a mirrored volume.

5. Move the cursor to another line and press the space bar to add another disk to the array.

If you select an odd number of disks, the SAS2 BIOS configuration utility creates an integrated mirroring enhanced array. If you select an even number of disks, it creates an integrated mirroring + striping array. As you add disks, the Array Size field changes to reflect the size of the new array.

6. Press C to create the array. A menu window opens.
7. From the menu options, select **Save changes then exit this menu**.

A processing message is displayed briefly, and then the SAS2 BIOS configuration utility returns to the Adapter Properties window. Initialization of the new array continues in the background.

**Notes:**

1. To create a second integrated mirroring enhanced or integrated mirroring + striping volume, repeat the previous instructions.
2. To create one or two global hot spares, see the instructions in “Managing hot spare disks” on page 12.

## Expanding an integrated mirroring volume with OCE

You can use the online capacity expansion (OCE) feature to expand the capacity of a 2-disk integrated mirroring (RAID 1) volume by replacing the original disks with two higher-capacity disk drives while the volume remains online. This process maintains data integrity at all times, even if one of the disks fails during the replacement process. The new disks must have at least 50 GB more capacity than the disks they are replacing, and they must use the same protocol (SAS or SATA) as the disks they are replacing.

To expand an existing RAID1 volume with OCE, complete the following steps:

1. Physically replace one of the two volume disk drives with a drive that has at least 50 GB more capacity.  
If necessary, you can identify the disks in the volume by following the instructions in “Locating disk drives in a volume” on page 15.
2. Wait until synchronization is completed on the new disk and the volume returns to the Optimal state, as indicated in the Adapter Properties window of the SAS2 BIOS configuration utility.
3. Physically replace the other volume disk drive with a drive that has at least 50 GB more capacity.
4. Again, wait until synchronization is completed on the new disk and the volume returns to the Optimal state.
5. In the Adapter List window of the SAS2 BIOS configuration utility, use the arrow keys to select the SAS2 controller with the RAID 1 volume, and then press Enter. The Adapter Properties window opens.
6. Use the arrow keys to select **RAID Properties** and press Enter. The Select New Array Type window opens.
7. Select **View Existing Array**. The View Array window opens. If necessary, press Alt+N to switch to the RAID 1 volume with the new, higher-capacity disk drives.
8. Select **Manage Array**. The Manage Array window opens.
9. Select **Online Capacity Expansion**. A menu window opens with a warning message and with options to start the expansion process or quit.
10. Press Y to start the expansion. The RAID Properties window opens when the expansion process is completed.
11. Run a vendor software tool that is specific to the operating system to move or increase the size of the partition on the newly expanded RAID 1 volume.

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## Managing hot spare disks

You can create one or two global hot spare disks to protect the data on mirrored volumes on an SAS2 controller. You can also delete hot spare disks.

## Creating hot spare disks

To add global hot spare disks to an existing volume, complete the following steps. The steps begin with the Adapter List window that opens when the configuration utility starts:

1. In the Adapter List window, use the arrow keys to select the SAS2 controller on which you want to create hot spare disks, and then press Enter. The Adapter Properties window opens, <<< **NEED CROSS REF???** as shown in **Figure 5>>>**.

- Use the arrow keys to select **RAID Properties** and press Enter. The Select New Array Type window opens.
- Select **View Existing Array**. The View Array window opens. If necessary, press Alt+N to switch to another array on this adapter.
- Select **Manage Array**. The Manage Array window opens.
- Select **Manage Hot Spares**, which is the first option, as shown in the following illustration.



The Manage Hot Spares window opens.

- Identify a disk that is not part of a RAID volume (for example, the value in the Drive Status column is not RAID) and that is not already identified as a hot spare disk.

A global hot spare disk must have 512-byte blocks and nonremovable media. The disk type must be either SATA with extended command set support or SAS with SMART support.

- Select the **Hot Spr** (Hot Spare) field for this disk, and press the space bar. The Hot Spare status changes to Yes.

Repeat this step to select a second global hot spare disk.

- Press C to create the hot spare disk.

A menu window opens. An error message is displayed if the selected disk is not at least as large as the smallest disk used in the existing volumes. An error message also is displayed if you try to add a SATA disk as a hot spare for volumes that use SAS disks, or vice versa.

- Select **Save changes then exit this menu** to create the hot spare disks. The configuration utility pauses while it configures the global hot spares.

## Deleting hot spare disks

To delete a global hot spare disk, complete the following steps:

- Follow step 1 on page 12 through step 5 in “Creating hot spare disks” on page 12 to open the Manage Hot Spares window.
- Select a hot spare disk for deletion and press C.
- Select **Save changes then exit this menu**. The configuration utility pauses while the global hot spare is removed.

---

## Other configuration tasks

This section explains how to perform other configuration and maintenance tasks for mirrored volumes.

### Viewing volume properties

To view the RAID properties of the mirrored volumes, complete the following steps:

1. In the configuration utility, select a controller from the Adapter List. The Adapter Properties window opens.
2. Select **RAID Properties**. The Select New Array Type window opens.
3. Select **View Existing Array** and press Enter.

The View Array window opens, showing information about the array and each disk in it. The window includes global hot spare information, if any exists.

**Note:** If you create one volume using SAS disks, another volume using SATA disks, and one or two global hot spare disks, the hot spare disks are displayed only when you view the mirrored volume that has the same type of disks as the hot spare disks.

4. If the currently displayed array is not the one you want, press Alt+N to view another array on the controller.

### Running a consistency check

Use the Consistency Check command to verify that the data is synchronized on the mirrored disks in the volume.

To run a consistency check on a selected mirrored volume, complete the following steps:

1. In the Adapter List window, use the arrow keys to select a SAS2 controller. The Adapter Properties window opens.
2. Use the arrow keys to select **RAID Properties** and press Enter. The Select New Array Type window opens.
3. Select **View Existing Array**. The View Array window opens. If necessary, press Alt+N to switch to another array on this adapter.
4. Select **Manage Array**. The Manage Array window opens.
5. Select **Consistency Check** on the Manage Array window. A menu window opens.
6. Press Y to start the consistency check.

The consistency check runs a read-read-compare algorithm in the background. If it encounters any data mismatches, it stores the information in a bad block table.

### Activating an array

A volume (array) can become inactive if, for example, you remove it from one controller or computer and install it on a different one. The Activate Array option enables you to reactivate an inactive volume. This option is available only when the selected volume is currently inactive.

To activate a selected volume, complete the following steps:

1. In the Adapter List window, use the arrow keys to select a SAS2 controller. The Adapter Properties window opens.

2. Use the arrow keys to select **RAID Properties** and press Enter. The Select New Array Type window opens.
3. Select **View Existing Array**. The View Array window opens. If necessary, press Alt+N to switch to another array on this adapter.
4. Select **Manage Array**. The Manage Array window opens.
5. Select **Activate Array** on the Manage Array window. A menu window opens.
6. Press Y to activate the array. After a pause, the array becomes inactive.

## Deleting an array

**Attention:** To prevent the loss of data, before you delete an array, you must back up all data on the array that you want to keep.

To delete a selected volume (array), complete the following steps:

1. In the Adapter List window, use the arrow keys to select a SAS2 controller. The Adapter Properties window opens.
2. Use the arrow keys to select **RAID Properties** and press Enter. The Select New Array Type window opens.
3. Select **View Existing Array**. The View Array window opens. If necessary, press Alt+N to switch to another array on this adapter.
4. Select **Manage Array**. The Manage Array window opens.
5. Select **Delete Array**. A menu window opens.
6. Either press Y to delete the array or press N to cancel the deletion process. After a pause, the utility deletes the array. If there is another remaining array and one or two hot spare disks, the BIOS checks the hot spare disks to determine if they are compatible with the remaining volume. If they are not compatible (too small or wrong disk type) the BIOS deletes them also.

## Locating disk drives in a volume

You can use the SAS2 BIOS configuration utility to locate and identify a specific physical disk drive in a disk enclosure by flashing the drive LED. You can also flash the LEDs of all the disk drives in a RAID volume, if they are in a disk enclosure.

When you add a disk drive to a new mirrored volume, the LED on the disk drive starts flashing. The LED stops flashing when you finish creating the volume.

You can locate individual disk drives from the SAS Topology window by flashing their LEDs. To do this, complete the following steps:

1. Select a SAS2 controller on the Adapter List window and press Enter. The Adapter Properties window opens.
2. Select **SAS Topology** and press Enter. The SAS Topology window opens.
3. Select the disk in the Device Identifier column and press Enter. The LED on the disk flashes until you press a key to stop it.
4. To identify all the disk drives in a volume, select the volume in the left column of the SAS Topology window, and press Enter.

The LEDs flash on all disk drives in the volume until you press a key to stop them.

**Note:** The LEDs on the disk drives flash as previously described if the firmware configuration is correct and the drives are in a disk enclosure.

## Selecting a boot disk

You can select a boot disk in the SAS Topology window. The next time you start the computer, the firmware moves this disk to scan ID 0, making it the new boot disk. This makes it easier to set BIOS boot device options and to keep the boot device constant during device additions and removals. You can also select an alternative boot device. If the BIOS cannot find the preferred boot device when it loads, it attempts to start from the alternate device.

To select a boot disk, complete the following steps:

1. In the configuration utility, select a controller from the Adapter List.
2. Select the **SAS Topology** option. If a device is currently designated as the boot device, the Device Info column on the SAS Topology window lists the word **Boot**, as shown in the following illustration.



If a device is currently designated as the alternate boot device, the Device Info column shows the word **Alt**.

3. To select the preferred boot disk, move the cursor to the disk, and press **Alt+B**.
4. To remove the boot designator, move the cursor to the current boot disk and press **Alt+B**. This controller no longer has a disk designated as boot.
5. To change the boot disk, move the cursor to the new boot disk and press **Alt+B**. The boot designator moves to this disk.
6. To select an alternate boot disk, move the cursor to the disk, and press **Alt+A**.

**Note:** To change the alternate boot device from one disk to another, repeat steps 4 and 5, but use **Alt+A** instead of **Alt+B**.

---

## Chapter 4. Overview of integrated striping

This chapter provides an overview of the integrated RAID features that support the creation of striped arrays.

---

### Introduction

The integrated RAID solution enables you to create integrated striping volumes for applications that require the faster performance and increased storage capacity of striping. The low-cost integrated striping feature has many of the advantages of a more expensive RAID striping solution. You can configure an integrated striping volume as the boot disk or as a data disk.

The integrated striping solution provides better performance and more capacity than individual disks, without burdening the host CPU. The firmware distributes host I/O transactions over multiple disks and presents the disks as a single, logical drive. In general, striping is transparent to the BIOS, the drivers, and the operating system.

You can use the SAS2 BIOS Configuration Utility to configure integrated striping volumes. These volumes can consist of two-to-ten disks.

---

### Integrated striping features

Integrated striping supports the following features:

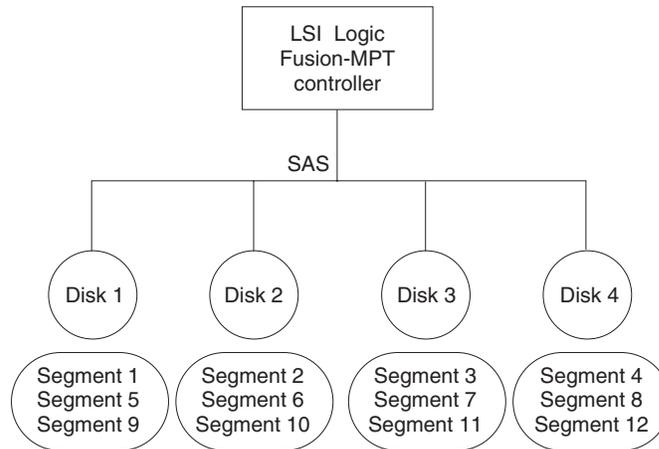
- Support for volumes with two-to-ten disks
- Support for two integrated striping volumes with up to 14 drives total on a SAS2 controller.
- Support for combining one integrated striping volume and one integrated mirroring, integrated mirroring + striping, or integrated mirroring enhanced volume on a single controller.
- Support for both SAS and SATA drives, although you cannot combine the two types of drives in one volume
- Fusion-MPT architecture
- Easy-to-use SAS2 BIOS configuration utility
- Error notification
- Disk write caching, which is enabled by default on all integrated striping volumes
- Use of metadata to store volume configuration on disks
- Operating-system specific event log
- Error display inside the Fusion-MPT BIOS
- SCSI enclosure services (SES) status LED support for drives used in integrated striping volumes

---

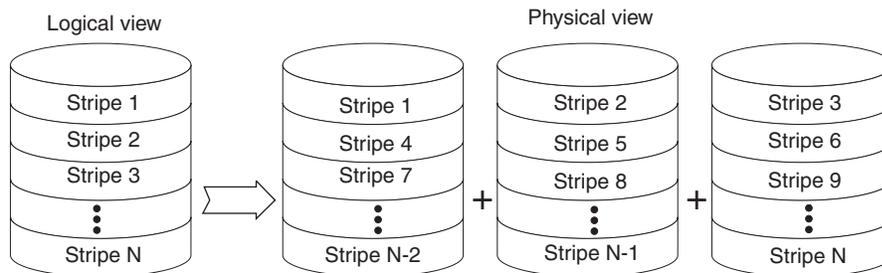
### Integrated striping description

On integrated striping volumes, the firmware writes data across multiple disks instead of onto one disk. The storage space on each disk is partitioned into 64 KB stripes. The firmware interleaves the stripes round-robin so that the combined storage space is composed alternately of stripes from each disk.

For example, the following illustration shows an example of integrated striping. The firmware writes segment 1 to disk 1, segment 2 to disk 2, segment 3 to disk 3, and so on. When the firmware reaches the end of the disk list, it continues writing data at the next available segment of disk 1.



The following illustration shows a logical view and a physical view of an integrated striping volume with three disks.



The primary advantage of the integrated striping solution is speed because it transfers data to or from multiple disks simultaneously. However, there is no data redundancy. To avoid losing unsaved data if one disk fails, back up the data on other media.

---

## Chapter 5. Using the SAS2 BIOS configuration utility to create integrated striping volumes

This chapter describes how to create integrated striping volumes by using the SAS2 BIOS configuration utility.

---

### Integrated striping configuration overview

The SAS2 BIOS configuration utility is a menu-driven utility program that enables you to configure and manage integrated RAID volumes. You can use the configuration utility to create one or two integrated striping volumes on each SAS2 controller. Each volume can have from two-to-ten drives. All disks in an integrated striping volume must be connected to the same SAS2 controller.

Although you can use disks of different sizes in integrated striping volumes, the smallest disk in the volume determines the logical size of all disks in the volume. In other words, the firmware does not use the excess space of the higher-capacity member disks. For example, if you create an integrated striping volume with two 100 GB disks and two 120 GB disks, the firmware uses only 100 GB on each of the 120 MB disks for the volume. The supported stripe size is 64 KB.

For more information about integrated striping volumes, see “Integrated striping features” on page 17.

---

### Creating integrated striping volumes

The SAS2 BIOS configuration utility is part of the Fusion-MPT BIOS. When the BIOS loads during startup and a message is displayed about the SAS2 BIOS configuration utility, press Ctrl-C to start it. The following message is displayed:  
Please wait, invoking SAS Configuration Utility.

After a brief pause, the main menu of the SAS2 BIOS configuration utility opens; however, on some servers the following message is displayed:  
LSI Corp Configuration Utility will load following initialization!

In this case, the configuration utility loads after the server has completed its power-on self-test (POST).

You can configure one or two integrated RAID volumes on each SAS2 controller. For a two-volume configuration, you can have two integrated striping (RAID 0) volumes, two mirrored volumes, or one volume of each type. The two volumes can have a maximum of 14 disk drives. (This configuration includes one or two hot spare disks for mirrored volumes.)

The following guidelines apply when creating an integrated striping volume:

- All physical disks in an integrated striping volume must be either SATA (with extended command set support) or SAS (with SMART support). You cannot combine SAS and SATA disks in the same volume. However, you can create one volume with SAS disks and a second volume with SATA disks on the same controller.
- Disks must have 512-byte blocks and must not have removable media.
- Integrated striping volumes must have at least two disks and no more than 10 disks. Integrated striping volumes do not support hot spare disks.

To configure an integrated striping volume with the SAS2 BIOS configuration utility, complete the following steps. The steps begin with the Adapter List window that opens when the configuration utility starts.

1. On the Adapter List window of the SAS2 BIOS configuration utility, select the adapter and press Enter. The Adapter Properties window opens.



2. Select **RAID Properties** and press Enter. The Create Array window opens.
3. Select **Create RAID 0 Volume**. The Create New Array window opens.
4. Move the cursor to the RAID Disk column, and select a line that has a No entry in this column, which indicates that the disk is not already part of the volume you are creating. To add the disk to the new array, change the No to Yes by pressing the space bar.
5. Move the cursor to another line and press the space bar to add another disk to the array.
6. Continue adding disks in this way until you have added the number of disks that you want.
7. Press C to create the array. A menu window opens.
8. From the menu options, select **Save changes then exit this menu**.  
A Processing message is displayed briefly, and then the SAS2 BIOS configuration utility returns to the Adapter Properties window. Initialization of the new array continues in the background.

**Note:** Repeat the previous instructions to create a second integrated striping volume, if you want, and if enough additional disks are available.

---

## Other configuration tasks

This section explains how to perform other configuration and maintenance tasks for integrated striping volumes.

### Viewing volume properties

To view the RAID properties of a volume, complete the following steps:

1. In the SAS2 BIOS configuration utility, select a controller from the Adapter List. The Adapter Properties window opens.
2. Select **RAID Properties**. The Select New Array Type window opens.
3. Select **View Existing Array**. The View Array window opens, showing information about the array and each disk in it.
4. If the currently displayed array is not the one you want, press Alt+N to view another array on the adapter.

## Activating an array

A volume (array) can become inactive if, for example, you remove it from one controller or computer and install it on a different one. The “Activate Array” option enables you to reactivate an inactive volume. This option is available only when the selected volume is currently inactive.

To activate a selected volume, complete the following steps:

1. In the Adapter List window, use the arrow keys to select a SAS adapter and press Enter. The Adapter Properties window opens.
2. Select **RAID Properties** and press Enter. The Select New Array Type window opens.
3. Select **View Existing Array**. The View Array window opens. If necessary, press Alt+N to switch to another array on this adapter.
4. Select **Manage Array**. The Manage Array window opens.
5. Select **Activate Array** on the Manage Array window. A menu window opens.
6. Press Y to activate the array. The array becomes active after a pause.

## Deleting an array

**Attention:** To prevent the loss of data, before you delete an array, you must back up all data on the array that you want to keep.

To delete a selected volume (array), complete the following steps:

1. In the Adapter List window, use the arrow keys to select a SAS adapter. The Adapter Properties window opens.
2. Use the arrow keys to select **RAID Properties** and press Enter. The Select New Array Type window opens.
3. Select **View Existing Array**. The View Array window opens. If necessary, press Alt+N to switch to another array on this adapter.
4. Select **Manage Array**. The Manage Array window opens.
5. Select **Delete Array**. A menu window opens.
6. Press Y to delete the array.

After a pause, the firmware deletes the array.

## Locating disk drives in a volume

You can use the SAS2 BIOS configuration utility to locate and identify a specific physical disk drive in a disk enclosure by flashing the LED on the drive. You can also use the SAS2 BIOS configuration utility to flash the LEDs of all the disk drives in a RAID volume.

When you add a disk drive to a new mirrored volume, the LED on the disk drive starts flashing. The LED stops flashing when you finish creating the volume.

You can locate individual disk drives from the SAS Topology window by flashing their LEDs. To do this, complete the following steps:

1. Select the SAS2 controller that you want on the Adapter List window, and press Enter. The Adapter Properties window opens.
2. Select **SAS Topology** and press Enter. The SAS Topology window opens.
3. Select the disk in the Device Identifier column and press Enter. The LED on the disk flashes until you press a key to stop it.
4. To identify all the disk drives in a volume, select the volume in the left column of the SAS Topology window, and press Enter. The LEDs flash on all disk drives in the volume until you press a key to stop them.

**Note:** The LEDs on the disk drives flash as previously described, if the firmware configuration is correct and the drives are in a disk enclosure.

## Selecting a boot disk

You can select a boot disk in the SAS Topology window. The next time you start the computer, the firmware moves this disk to scan ID 0, making it the new boot disk. This makes it easier to set BIOS boot device options and to keep the boot device constant during device additions and removals. You can also select an alternative boot device. If the BIOS cannot find the preferred boot device when it loads, it attempts to start from the alternate device.

To select a boot disk, complete the following steps:

1. In the configuration utility, select a controller from the Adapter List.
2. Select the **SAS Topology** option. If a device is currently designated as the boot device, the Device Info column on the SAS Topology window lists the word **Boot**, as shown in the following illustration.



If a device is currently designated as the alternate boot device, the Device Info column shows the word **Alt**.

3. To select the preferred boot disk, move the cursor to the disk, and press Alt+B.
4. To remove the boot designator, move the cursor to the current boot disk and press Alt+B. This controller no longer has a disk designated as boot.

5. To change the boot disk, move the cursor to the new boot disk and press Alt+B. The boot designator moves to this disk.
6. To select an alternate boot disk, move the cursor to the disk, and press Alt+A.

**Note:** To change the alternate boot device from one disk to another, repeat steps 4 on page 22 and 5, but use Alt+A instead of Alt+B.



---

## Appendix A. Getting help and technical assistance

If you need help, service, or technical assistance or just want more information about IBM® products, you will find a wide variety of sources available from IBM to assist you. This section contains information about where to go for additional information about IBM and IBM products, what to do if you experience a problem with your system, and whom to call for service, if it is necessary.

---

### Before you call

Before you call, make sure that you have taken these steps to try to solve the problem yourself:

- Check all cables to make sure that they are connected.
- Check the power switches to make sure that the system and any optional devices are turned on.
- Use the troubleshooting information in your system documentation, and use the diagnostic tools that come with your system. Information about diagnostic tools is in the *Problem Determination and Service Guide* on the *IBM Documentation CD* that comes with your system.
- Go to the IBM support website at <http://www.ibm.com/supportportal/> to check for technical information, hints, tips, and new device drivers or to submit a request for information.

You can solve many problems without outside assistance by following the troubleshooting procedures that IBM provides in the online help or in the documentation that is provided with your IBM product. The documentation that comes with IBM systems also describes the diagnostic tests that you can perform. Most systems, operating systems, and programs come with documentation that contains troubleshooting procedures and explanations of error messages and error codes. If you suspect a software problem, see the documentation for the operating system or program.

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### Using the documentation

Information about your IBM system and preinstalled software, if any, or optional device is available in the documentation that comes with the product. That documentation can include printed documents, online documents, readme files, and help files. See the troubleshooting information in your system documentation for instructions for using the diagnostic programs. The troubleshooting information or the diagnostic programs might tell you that you need additional or updated device drivers or other software. IBM maintains pages on the World Wide Web where you can get the latest technical information and download device drivers and updates. To access these pages, go to <http://www.ibm.com/supportportal/> and follow the instructions. Also, some documents are available through the IBM Publications Center at <http://www.ibm.com/shop/publications/order/>.

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### Getting help and information from the World Wide Web

On the World Wide Web, the IBM website has up-to-date information about IBM systems, optional devices, services, and support. The address for IBM System x® and xSeries® information is <http://www.ibm.com/systems/x/>. The address for IBM BladeCenter® information is <http://www.ibm.com/systems/bladecenter/>. The address for IBM IntelliStation® information is <http://www.ibm.com/systems/intellistation/>.

You can find service information for IBM systems and optional devices at <http://www.ibm.com/supportportal/>.

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## Software service and support

Through IBM Support Line, you can get telephone assistance, for a fee, with usage, configuration, and software problems with System x and xSeries servers, BladeCenter products, IntelliStation workstations, and appliances. For information about which products are supported by Support Line in your country or region, see <http://www.ibm.com/services/supline/products/>.

For more information about Support Line and other IBM services, see <http://www.ibm.com/services/>, or see <http://www.ibm.com/planetwide/> for support telephone numbers. In the U.S. and Canada, call 1-800-IBM-SERV (1-800-426-7378).

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## Hardware service and support

You can receive hardware service through your IBM reseller or IBM Services. To locate a reseller authorized by IBM to provide warranty service, go to <http://www.ibm.com/partnerworld/> and click **Find Business Partners** on the right side of the page. For IBM support telephone numbers, see <http://www.ibm.com/planetwide/>. In the U.S. and Canada, call 1-800-IBM-SERV (1-800-426-7378).

In the U.S. and Canada, hardware service and support is available 24 hours a day, 7 days a week. In the U.K., these services are available Monday through Friday, from 9 a.m. to 6 p.m.

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## IBM Taiwan product service

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台灣國際商業機器股份有限公司  
台北市松仁路7號3樓  
電話：0800-016-888

IBM Taiwan product service contact information:  
IBM Taiwan Corporation  
3F, No 7, Song Ren Rd.  
Taipei, Taiwan  
Telephone: 0800-016-888

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## Important notes

Processor speed indicates the internal clock speed of the microprocessor; other factors also affect application performance.

CD or DVD drive speed is the variable read rate. Actual speeds vary and are often less than the possible maximum.

When referring to processor storage, real and virtual storage, or channel volume, KB stands for 1024 bytes, MB stands for 1 048 576 bytes, and GB stands for 1 073 741 824 bytes.

When referring to hard disk drive capacity or communications volume, MB stands for 1 000 000 bytes, and GB stands for 1 000 000 000 bytes. Total user-accessible capacity can vary depending on operating environments.

Maximum internal hard disk drive capacities assume the replacement of any standard hard disk drives and population of all hard disk drive bays with the largest currently supported drives that are available from IBM.

Maximum memory might require replacement of the standard memory with an optional memory module.

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Some software might differ from its retail version (if available) and might not include user manuals or all program functionality.

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