SAS3 Integrated RAID Solution

User Guide

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Revision History

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Chapter 1

Introduction to the Integrated RAID Solution

This chapter provides an introduction to the features and benefits of the LSI Integrated RAID solution for LSI SAS3 controllers.

1.1 Overview

The LSI Integrated RAID solution provides cost benefits for the server or workstation market that requires the extra performance, storage capacity, and/or redundancy of a RAID configuration. The LSI 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

By simplifying the configuration options and by providing firmware support in its SAS3 host adapters, LSI can offer the Integrated RAID solution at a lower cost than a hardware RAID implementation.

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 LSI SAS3 controller.

The LSI Integrated RAID solution supports the following LSI SAS3 controllers and the host bus adapters based on these controllers:

- LSISAS2004
- LSISAS2008
- LSISAS2108
- LSISAS2208
- LSISAS2304
- LSISAS2308

LSI Integrated RAID firmware uses the same device drivers as the standard LSI Fusion-MPT-based controllers. This eliminates the need for complex backup software or expensive RAID hardware. To conserve system resources, the Integrated RAID firmware operates independently from the operating system. The BIOS-based configuration utility, documented in Chapter 3 and Chapter 5, makes it easy to configure mirrored and striped volumes. The Integrated RAID solution is currently available as an optional component of the Fusion-MPT architecture on LSI SAS3 controllers.

1.2 Benefits and Features

The LSI 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 SAS3 controller. Each controller can support 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 allows 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 (OS) 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

1.2.1 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 OS access to the RAID volumes as well as to additional non-RAID physical disks.

1.2.2 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 the volume, which makes room for the metadata.

1.2.3 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.

1.2.4 Fusion-MPT Support

The Integrated RAID BIOS uses the LSI Fusion-MPT interface to communicate to the SAS3 controller and firmware. This process includes reading the Fusion-MPT configuration to access the parameters that define behavior between the SAS3 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.

Chapter 2

Overview of Integrated RAID Mirrored Volumes

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

2.1 Introduction

As a result of the shift towards network-attached storage (NAS), Internet service providers need a cost-effective, fault-tolerant solution to protect the operating systems on small form-factor, high-density, rack-mountable servers. The mirroring features of the LSI 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 may have from two-to-ten 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 LSI SAS3 controller.

NOTE: Fourteen drives is the *theoretical* upper limit for a single LSI SAS3 controller, although the controller itself may support fewer than 14 drives. You can also configure one mirrored volume and one Integrated Striping volume on the same LSI SAS controller.

Each SAS3 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.

2.2 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 LSI SAS3 controller. Each volume can consist of two mirrored disks for an Integrated Mirroring volume; three-to-ten 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 LSI SAS3 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 allows 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 LSI SAS3 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 OS-specific event log.
- Support for SCSI Enclosure Services (SES) status LED.
- Write journaling, which allows automatic synchronization of potentially inconsistent data after unexpected powerdown 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.

2.3 Operation of Mirrored Volumes

The LSI Integrated RAID solution supports one or two mirrored volumes on each LSI SAS3 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 LSI SAS3 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.

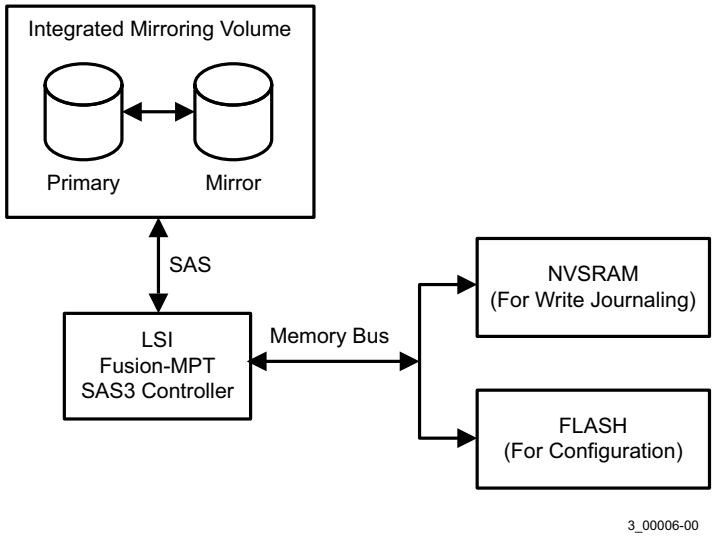

Figure 1: Typical Integrated Mirroring Implementation

The following figure shows the logical view and physical view of an Integrated Mirroring volume. Each logical block address (LBA) is mirrored on the second disk.

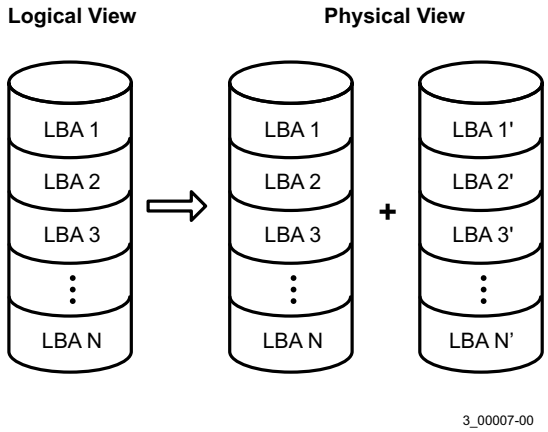

Figure 2: Integrated Mirroring Volume

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.

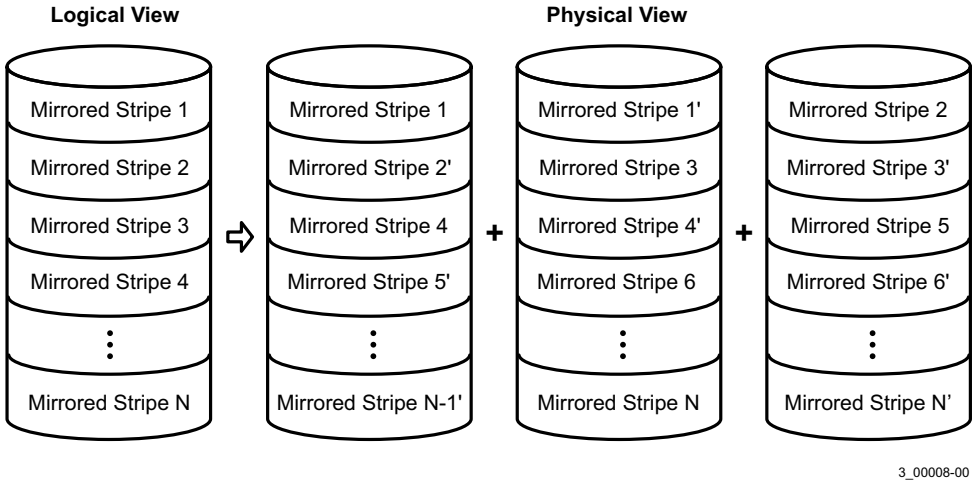

Figure 3: Integrated Mirroring Enhanced with Three Disks

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.

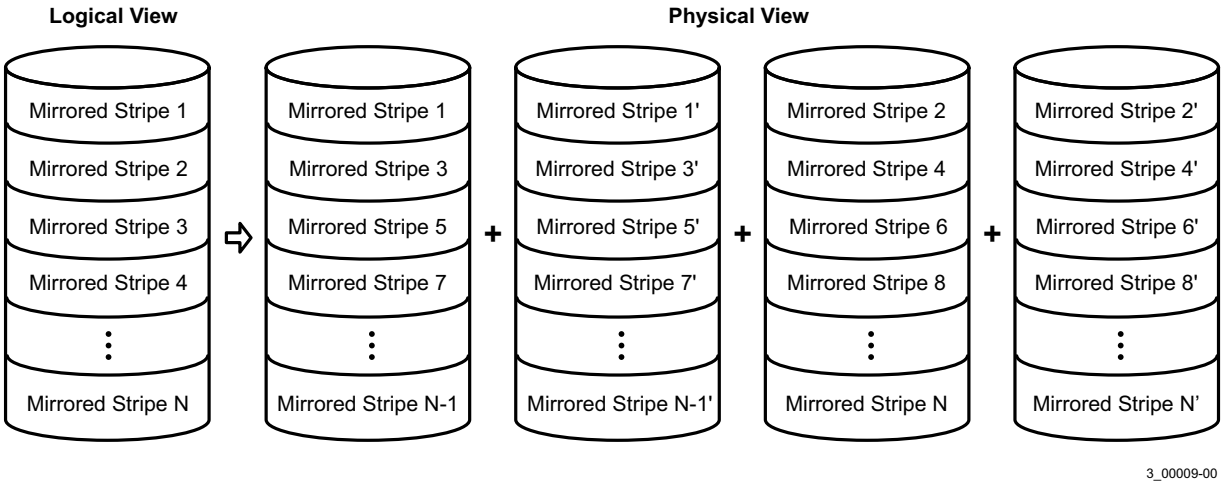

Figure 4: Integrated Mirroring + Striping with Four Disks

The LSI SAS3 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.

CAUTION: The SAS3 BIOS CU deletes all existing data from the disks drives when you select them to use for a mirrored volume.

2.4 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 LSI SAS3 controller.

2.4.1 Resynchronization with Concurrent Host I/O Operation

The Integrated RAID firmware allows 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*.

2.4.2 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.

Following a hot-swap event, the firmware verifies 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 re-inserted. 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.

2.4.3 Hot Spare Disk

You can configure two disks as *global hot spare* disks to protect data on the mirrored volumes configured on the SAS3 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.

2.4.4 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 commercial tool specific to the operating system to move or increase the size of the partition on the volume.

2.4.5 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 other disk's data 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 prior to a power cycle.

2.4.6 Disk Write Caching

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

2.4.7 NVSRAM Usage

The Integrated RAID firmware requires at least a 32-KB NVSRAM to perform write journaling for mirrored volumes on LSI SAS3 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.

2.4.8 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.

2.4.9 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 the data is identical on both disks. You can use the LSI SAS3 BIOS Configuration Utility to run a consistency check on a mirrored volume.

2.4.10 Make Data Consistent

If it is enabled in the Integrated RAID firmware, the make data consistent (MDC) process starts automatically and runs in the background when you move a redundant volume from one SAS controller to another SAS controller. MDC compares the data on the primary and secondary disks. If MDC finds inconsistencies, it copies data from the primary disk to the secondary disk.

Chapter 3

Creating Mirrored Volumes

This chapter explains how to create Integrated Mirroring, Integrated Mirroring + Striping, and Integrated Mirroring Enhanced volumes with the LSI SAS3 BIOS Configuration Utility (SAS3 BIOS CU).

3.1 Mirrored Volume Configuration Overview

The LSI SAS3 BIOS CU is a menu-driven utility program that enables you to easily configure and manage Integrated RAID volumes. You can use the SAS3 BIOS CU to create one or two mirrored volumes on each LSI SAS3 controller, with up to two optional global hot spare disks. You must connect all disks in a mirrored volume to the same LSI SAS3 controller.

Although you can use disks of different size in mirrored volumes, the smallest disk in the volume determines the *logical* size of all disks in the volume. In other words, the volume does not use the excess space of the higher-capacity member disk(s). 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.

Refer to Chapter 2, *Overview of Integrated RAID Mirrored Volumes*, for more information about the features of Integrated Mirroring, Integrated Mirroring + Striping, and Integrated Mirroring Enhanced volumes.

3.2 Creating Mirrored Volumes

The SAS3 BIOS CU is part of the Fusion-MPT BIOS. When the BIOS loads during the startup sequence and you see the message about the LSI Configuration Utility, press **Ctrl-C** to start the SAS3 BIOS CU. After you do this, the message changes to:

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

After a brief pause, the main menu (Adapter List window) of the SAS3 BIOS CU appears. On some systems, however, the following message appears next:

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

In this case, the SAS3 BIOS CU loads after the system completes its power-on self-test.

You can configure one or two Integrated Mirroring, Integrated Mirroring + Striping, and Integrated Mirroring Enhanced volumes on each LSI SAS3 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 volume(s).

- All physical disks in a 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 three-to-ten disks, and Integrated Mirroring + Striping volumes can have an even number of disks ranging from four-to-ten disks.

NOTE: LSI strongly recommends that you 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 LSI SAS 2 controller, either of the two mirrored volumes can use the global hot spares if a disk fails.

3.2.1 Creating an Integrated Mirroring Volume

Follow these steps to create a two-disk Integrated Mirroring (RAID 1) volume with the SAS3 BIOS CU. The steps begin with the Adapter List window that appears when the SAS3 BIOS CU starts:

1. On the Adapter List window, use the arrow keys to select an LSI SAS adapter, and then press **Enter**.

   The Adapter Properties window appears, as the following figure shows.

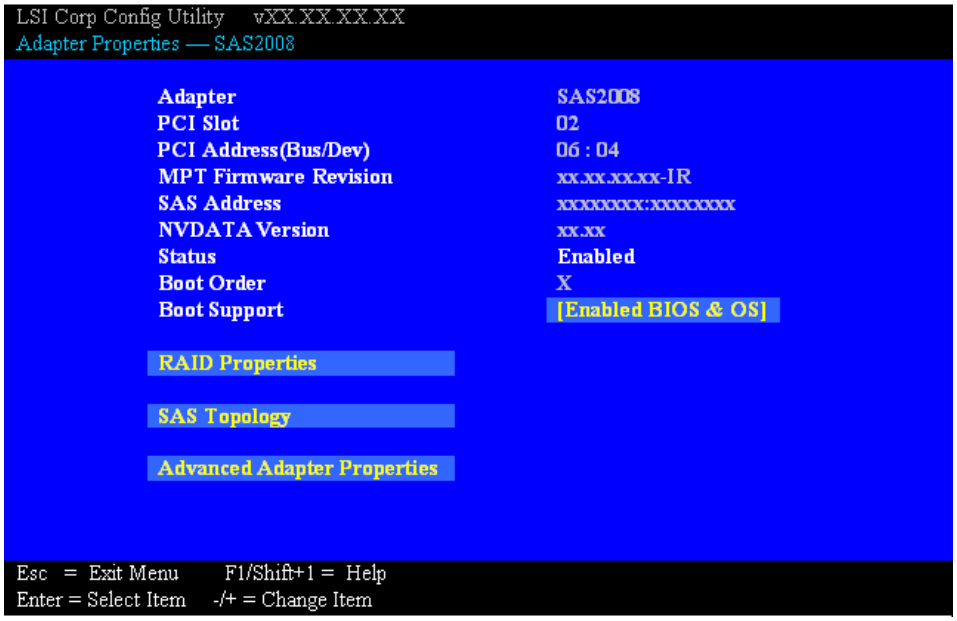

Figure 5: Adapter Properties Window

2. Use the arrow keys to select **RAID Properties**, and then press **Enter**.

   The Create Array window appears.

3. Select **Create RAID 1 Volume**.

   The Create New Array window appears.

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.

CAUTION: The SAS3 BIOS CU 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 appears.

7. From the menu options, select **Save changes then exit this menu**.

   A *processing* message appears briefly, and then the SAS3 BIOS CU returns to the Adapter Properties window. Initialization of the new array continues in the background.

NOTE: To create a second Integrated Mirroring volume, repeat these instructions starting with step 2. Alternatively, follow the instructions in the following section to create an Integrated Mirroring Enhanced or Integrated Mirroring + Striping volume.

NOTE: See the instructions in Section 3.3, *Managing Hot Spare Disks*, if you want to create one or two global hot spares.

3.2.2 Creating an Integrated Mirroring Enhanced or Integrated Mirroring + Striping Volume

Integrated Mirroring Enhanced volumes can have from three-to-ten 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.

Follow these steps to create an Integrated Mirroring Enhanced (RAID 1E) or Integrated Mirroring + Striping (RAID 10) volume with the SAS3 BIOS CU. The steps begin with the Adapter List window that appears when the configuration utility starts:

1. On the Adapter List window, use the arrow keys to select an LSI SAS adapter, and then press **Enter**.

   The Adapter Properties window appears, as shown in Figure 5.

2. Use the arrow keys to select **RAID Properties**, and then press **Enter**.

   The Create Array window appears.

3. Select **Create RAID 1E Volume**.

   The Create New Array window appears.

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.

CAUTION: The SAS3 BIOS CU deletes all existing data from the disks 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 SAS3 BIOS CU 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 appears.

7. From the menu options, select **Save changes then exit this menu**.

   A processing message appears briefly, and then the SAS3 BIOS CU returns to the Adapter Properties window. Initialization of the new array continues in the background.

NOTE: To create a second Integrated Mirroring Enhanced or Integrated Mirroring + Striping volume, repeat the instructions above.

NOTE: See the instructions in Section 3.3, *Managing Hot Spare Disks*, if you want to create one or two global hot spares.

3.2.3 Expanding an Integrated Mirroring Volume with OCE

You can use the online capacity expansion (OCE) feature to expand the capacity of a two-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.

Follow these steps to expand an existing RAID1 volume with OCE:

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 Section 3.4.5, *Locating Disk Drives in a Volume*.

2. Wait until synchronization completes on the new disk and the volume returns to the Optimal state, as indicated in the Adapter Properties window of the SAS3 BIOS CU.
3. Physically replace the other volume disk drive with a drive that has at least 50 GB more capacity.

4. Again, wait until synchronization completes on the new disk and the volume returns to the Optimal state.
5. In the Adapter List window of the SAS3 BIOS CU, use the arrow keys to select the LSI SAS adapter with the RAID 1 volume, and then press **Enter**.

   The Adapter Properties window appears.
6. Use the arrow keys to select **RAID Properties**, and then press **Enter**.

   The Select New Array Type window appears.
7. Select **View Existing Array**.

   The View Array window appears. 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 appears.
9. Select **Online Capacity Expansion**.

   A menu window appears 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 appears when the expansion process completes.
11. Run a commercial tool specific to the operating system to move or increase the size of the partition on the newly expanded RAID1 volume.

3.3 Managing Hot Spare Disks

You can create one or two global hot spare disks to protect the data on mirrored volumes on an LSI SAS3 controller. You can also delete hot spare disks.

3.3.1 Creating Hot Spare Disks

Follow these steps to add global hot spare disks to an existing volume. The steps begin with the Adapter List window that appears when the configuration utility starts:

1. In the Adapter List window, use the arrow keys to select the LSI SAS adapter on which you want to create hot spare disks, and then press **Enter**.

   The Adapter Properties window appears, as shown in Figure 5.
2. Use the arrow keys to select **RAID Properties**, and then press **Enter**.

   The Select New Array Type window appears.
3. Select **View Existing Array**.

   The View Array window appears. If necessary, press **Alt + N** to switch to another array on this adapter.
4. Select **Manage Array**.

   The Manage Array window appears.
5. Select **Manage Hot Spares**, which is the first option, as shown in the following figure.

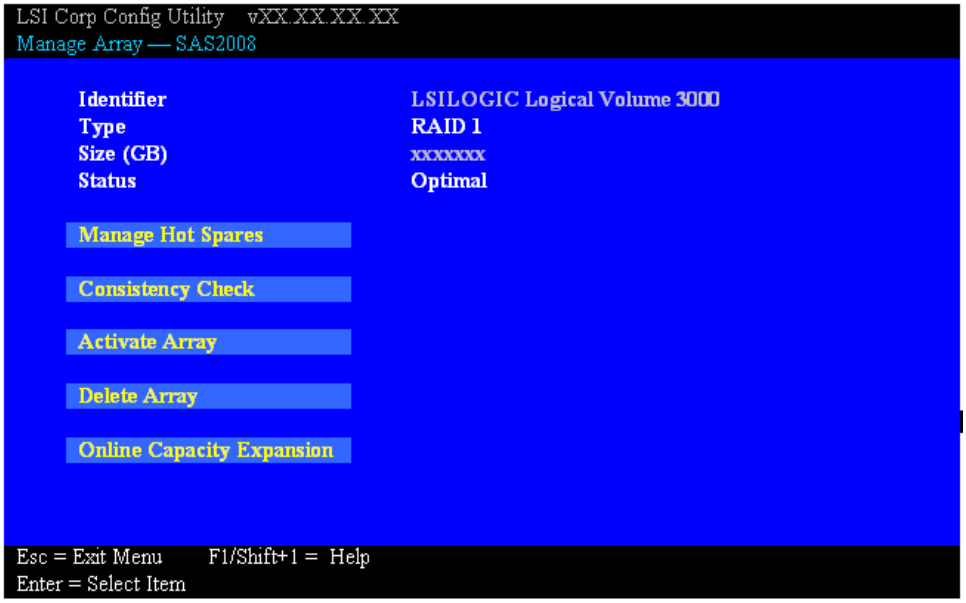

Figure 6: Manage Array Window

The Manage Hot Spares window appears.

6. Identify a disk that is not part of a RAID volume (i.e., 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.

7. Select the *Hot Spr* (Hot Spare) field for this disk, and press the space bar.

   The *Hot Spare* status changes to **Yes**.

8. (Optional) Repeat the preceding step to select a second global hot spare disk
9. Press **C** to create the hot spare disk.

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

10. Select **Save changes then exit this menu** to create the hot spare disk(s).

    The SAS3 BIOS CU pauses while it configures the global hot spares.

3.3.2 Deleting Hot Spare Disks

Follow these steps to delete a global hot spare disk:

1. Access the Manage Hot Spares window by following steps 1 through 5 of the previous section.
2. Select a hot spare disk for deletion, and press **C**.
3. Select **Save changes then exit this menu** to commit the changes.

   The configuration utility pauses while it removes the global hot spare.

3.4 Other Configuration Tasks

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

3.4.1 Viewing Volume Properties

Follow these steps to view the RAID properties of the mirrored volume(s):

1. In the SAS3 BIOS CU, select an LSI SAS3 adapter from the Adapter List.

   The Adapter Properties window appears.

2. Select **RAID Properties**.

   The Select New Array Type window appears.

3. Select **View Existing Array**.

   The View Array window appears, 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 only appear when you view the mirrored volume that uses 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 adapter.

3.4.2 Running a Consistency Check

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

Follow these steps to run a consistency check on a selected mirrored volume:

1. In the Adapter List window, use the arrow keys to select an LSI SAS adapter.

   The Adapter Properties window appears.

2. Use the arrow keys to select **RAID Properties**, and then press **Enter**.

   The Select New Array Type window appears.

3. Select **View Existing Array**.

   The View Array window appears. If necessary, press **Alt + N** to switch to another array on this adapter.

4. Select **Manage Array**.

   The Manage Array window appears.

5. Select **Consistency Check** on the Manage Array window.

   A menu window appears.

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 miscompares, it stores the information in a bad block table.

3.4.3 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 allows you to reactivate an inactive volume. This option is available only when the selected volume is currently inactive.

Follow these steps to activate a selected volume:

1. In the Adapter List window, use the arrow keys to select an LSI SAS adapter and press **Enter**.

   The Adapter Properties window appears.

2. Select **RAID Properties**, and then press **Enter**.

   The Select New Array Type window appears.

3. Select **View Existing Array**.

   The View Array window appears. If necessary, press **Alt + N** to switch to another array on this adapter.

4. Select **Manage Array**.

   The Manage Array window appears.

5. Select **Activate Array** on the Manage Array window.

   A menu window appears.

6. Press **Y** to activate the array.

   The array becomes active after a pause.

3.4.4 Deleting an Array

CAUTION: Before you delete an array, be sure to back up all data on the array that you want to keep.

Follow these steps to delete a selected volume (array):

1. In the Adapter List window, use the arrow keys to select an LSI SAS adapter.

   The Adapter Properties window appears.

2. Use the arrow keys to select **RAID Properties**, and then press **Enter**.

   The Select New Array Type window appears.

3. Select **View Existing Array**.

   The View Array window appears. If necessary, press **Alt + N** to switch to another array on this adapter.

4. Select **Manage Array**.

   The Manage Array window appears.

5. Select **Delete Array**.

   A menu window appears.

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.

3.4.5 Locating Disk Drives in a Volume

You can use the SAS3 BIOS CU to locate and identify a specific physical disk drive in a disk enclosure by flashing the drive's 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, follow these steps:

1. Select the desired SAS3 controller on the Adapter List window, and press **Enter**.

   The Adapter Properties window appears.

2. Highlight **SAS Topology**, and press **Enter**.

   The SAS Topology window appears.

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.

3.4.6 Selecting a Boot Disk

You can select a boot disk in the SAS Topology window. The next time you boot 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 will attempt to boot from the alternate device.

Follow these steps to select a boot disk:

1. In the SAS3 BIOS CU, select an adapter 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 figure.

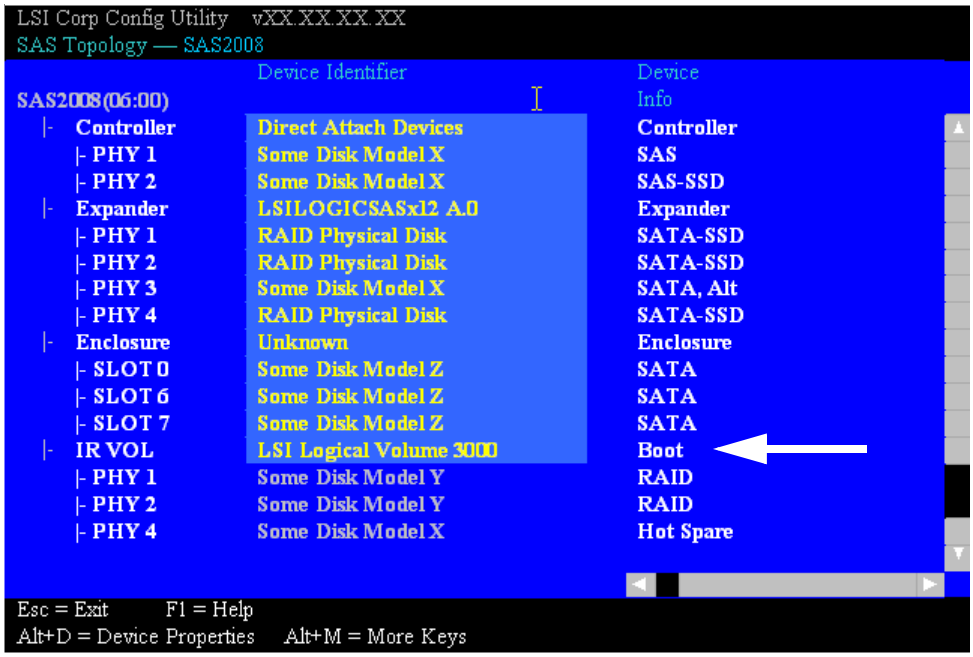

Figure 7: Boot Device on SAS Topology Window

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, follow 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 LSI Integrated RAID features that support the creation of striped arrays.

4.1 Introduction

The LSI 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 LSI SAS3 BIOS CU to configure Integrated Striping volumes. These volumes can consist of two-to-ten disks.

4.2 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 SAS3 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 SAS BIOS configuration utility
- Error notification
- Disk write caching, which is enabled by default on all Integrated Striping volumes
- Use of metadata to store volume configurations on disks
- OS-specific event log
- Error display inside the Fusion-MPT BIOS
- SCSI Enclosure Services (SES) status LED support for drives used in Integrated Striping volumes

4.3 Integrated Striping Description

On Integrated Striping volumes, the firmware writes data across multiple disks instead of onto one disk. It does this by partitioning each disk's storage space into 64-KB stripes. The firmware interleaves the stripes round-robin so that the combined storage space consists alternately of stripes from each disk.

The following figure 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.

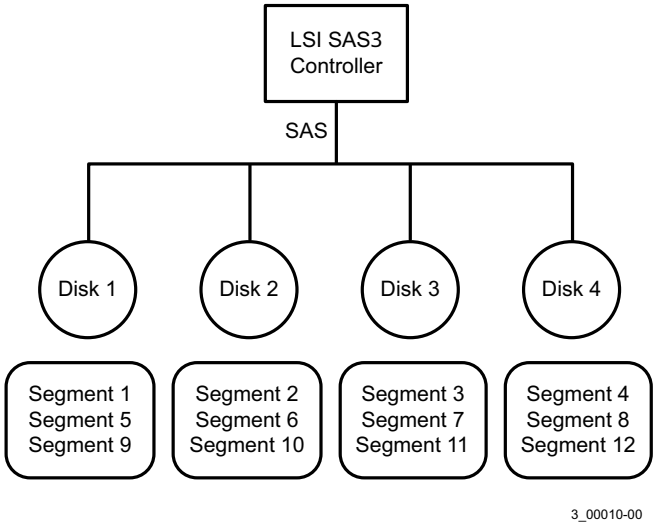

Figure 8: Integrated Striping Example

The following figure shows a logical view and a physical view of an Integrated Striping volume with three disks.

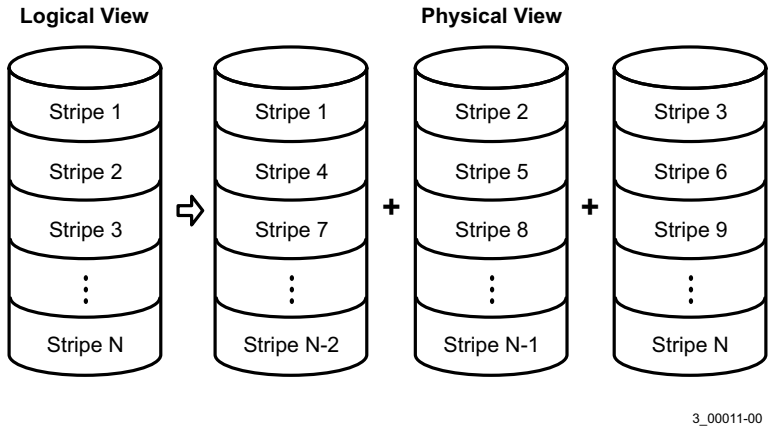

Figure 9: Integrated Striping – Logical and Physical Views

Speed is the primary advantage of the Integrated Striping solution because it transfers data to or from multiple disks simultaneously. However, there is no data redundancy. Back the data up on other media to avoid losing unsaved data if one disk fails.

Chapter 5

Creating Integrated Striping Volumes

This chapter explains how to create Integrated Striping volumes using the LSI SAS3 BIOS Configuration Utility (SAS3 BIOS CU).

5.1 Integrated Striping Configuration Overview

The LSI SAS3 BIOS CU is a menu-driven utility program that enables you to easily configure and manage Integrated RAID volumes. You can use the SAS3 BIOS CU to create one or two Integrated Striping volumes on each LSI SAS3 controller. Each volume can have from two-to-ten drives. All disks in an Integrated Striping volume must be connected to the same LSI SAS3 controller.

Although you can use disks of different size 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 disk(s). 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 kilobytes.

Refer to Chapter 4 for more information about Integrated Striping volumes.

5.2 Creating Integrated Striping Volumes

The SAS3 BIOS CU is part of the Fusion-MPT BIOS. When the BIOS loads during boot and you see the message about the LSI Configuration Utility, press **Ctrl-C** to start the CU. After you do this, the message changes to:

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

After a brief pause, the main menu of the SAS3 BIOS CU appears. On some systems, however, the following message appears next:

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

In this case, the SAS3 BIOS CU loads after the system completes its power-on self-test.

You can configure one or two Integrated RAID volumes on each LSI SAS3 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.

Follow these steps to configure an Integrated Striping volume with the SAS3 BIOS CU, after. The steps begin with the Adapter List window that appears when the SAS3 BIOS CU starts.

1. On the Adapter List window, select an LSI SAS adapter, and press **Enter**.

   The Adapter Properties window appears, as the following figure shows.

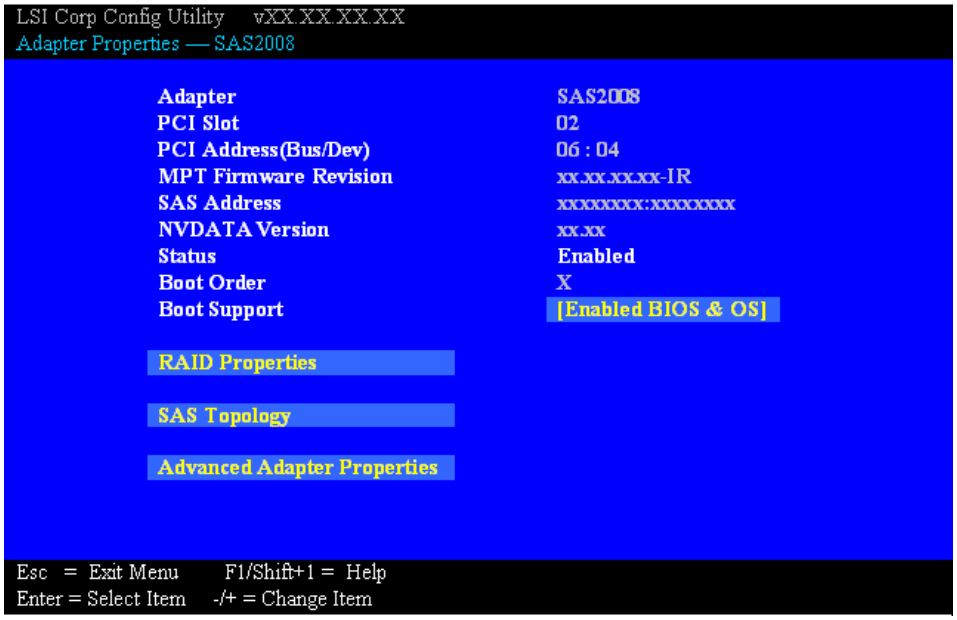

Figure 10: Adapter Properties Window

2. Select **RAID Properties**, and press **Enter**.

   The Create Array window appears.

3. Select **Create RAID 0 Volume**.

   The Create New Array window appears.

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 desired number of disks.
7. Press **C** to create the array.

   A menu appears.

8. From the menu options, select **Save changes then exit this menu**.

   A Processing message appears briefly, and then the SAS3 BIOS CU 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 desired, and if enough additional disks are available.

5.3 Other Configuration Tasks

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

5.3.1 Viewing Volume Properties

Follow these steps to view the RAID properties of a volume:

1. In the SAS3 BIOS CU, select an LSI SAS3 adapter from the Adapter List.

   The Adapter Properties window appears.

2. Select **RAID Properties**.

   The Select New Array Type window appears.

3. Select **View Existing Array**.

   The View Array window appears, 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.

5.3.2 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 allows you to reactivate an inactive volume. This option is available only when the selected volume is currently inactive.

Follow these steps to activate a selected volume:

1. In the Adapter List window, use the arrow keys to select an LSI SAS adapter and press **Enter**.

   The Adapter Properties window appears.

2. Select **RAID Properties**, and then press **Enter**.

   The Select New Array Type window appears.

3. Select **View Existing Array**.

   The View Array window appears. If necessary, press **Alt + N** to switch to another array on this adapter.

4. Select **Manage Array**.

   The Manage Array window appears.

5. Select **Activate Array** on the Manage Array window.

   A menu window appears.

6. Press **Y** to activate the array.

   The array becomes active after a pause.

5.3.3 Deleting an Array

CAUTION: Before you delete an array, be sure to back up the data.

Follow these steps to delete a selected volume (array):

1. In the Adapter List window, use the arrow keys to select an LSI SAS adapter.

   The Adapter Properties window appears.

2. Use the arrow keys to select **RAID Properties**, and then press **Enter**.

   The Select New Array Type window appears.

3. Select **View Existing Array**.

   The View Array window appears. If necessary, press **Alt + N** to switch to another array on this adapter.

4. Select **Manage Array**.

   The Manage Array window appears.

5. Select **Delete Array**.

   A menu window appears.

6. Either press **Y** to delete the array, or press **N** to cancel the deletion process.

   After a pause, the utility deletes the array.

5.3.4 Locating Disk Drives in a Volume

You can use the SAS3 BIOS CU to locate and identify a specific physical disk drive in a disk enclosure by flashing the drive's 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, follow these steps:

1. Select the desired SAS3 controller on the Adapter List window and press **Enter**.

   The Adapter Properties window appears.

2. Highlight *SAS Topology*, and press **Enter**.

   The SAS Topology window appears.

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.

5.3.5 Selecting a Boot Disk

You can select a boot disk in the SAS Topology window. The next time you boot 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 boot from the alternate device.

Follow these steps to select a boot disk:

1. In the SAS3 BIOS CU, select an adapter 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 the following figure shows.

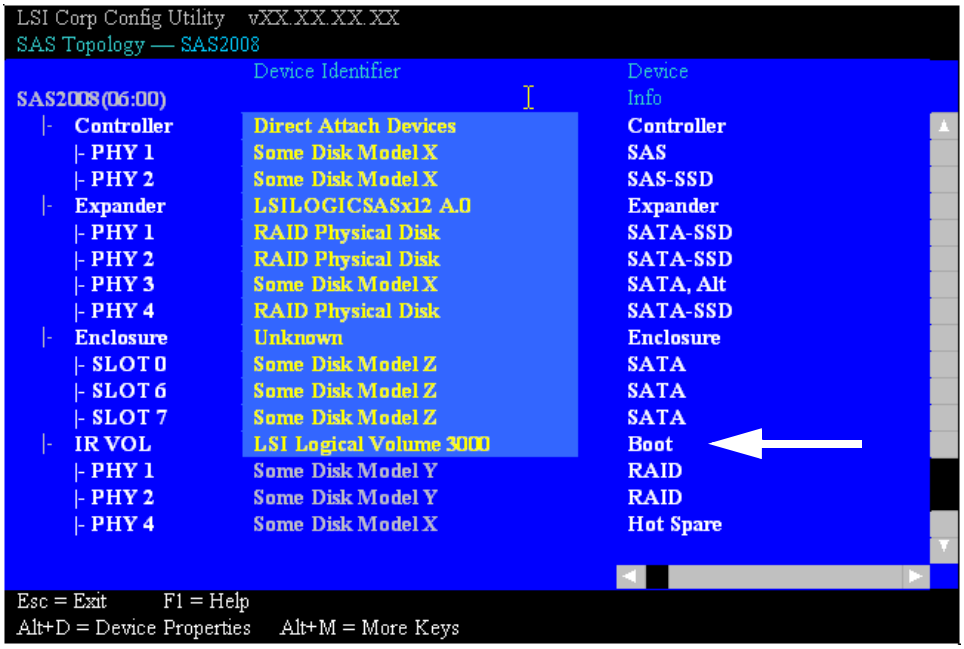

Figure 11: Boot Device on SAS Topology Window

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, follow steps 4 and 5 in this procedure, but use **Alt + A** instead of **Alt + B**.

Appendix A

Using the SAS3 Integrated RAID Configuration Utility

This appendix explains how to use the command-line-driven SAS3 Integrated RAID configuration utility (SAS3IRCU) to create Integrated RAID volumes on LSI SAS3 controllers in the manufacturing environment.

SAS3IRCU is a command-line utility that you can use to configure the Integrated RAID functions of LSI SAS3 controllers. SAS3IRCU is a minimally interactive program that you can execute from a command-line prompt or a shell script. When you use a SAS3IRCU command, the program returns a status value to the operating system when it exits.

OEMs can use SAS3IRCU to configure Integrated RAID devices on the LSI family of MPT2.0-based SAS3 controllers. You typically use this utility for system configuration on the manufacturing floor.

NOTE: End users should not use the SAS3IRCU utility. Instead, they should use the LSI SAS3 BIOS Configuration Utility (SAS3 BIOS CU) to create and manage Integrated RAID volumes. For more information, see Chapter 3 and Chapter 5.

A.1 Hardware and Software Requirements

SAS3IRCU runs on the following platforms.

- X86 or X64-compatible
- United Extensible Firmware Interface (UEFI) 2
- EM64T/AMD64
- Sun SPARC® (v9)

SAS3IRCU works with storage devices that are compliant with existing SCSI standards.

A.1.1 Controller Support

SAS3IRCU supports the following LSI SAS3 controllers and the host bus adapters based on these controllers:

- LSISAS2004
- LSISAS2008
- LSISAS2108
- LSISAS2208
- LSISAS2304
- LSISAS2308

A.1.2 Operating System and Software Support

SAS3IRCU requires PCI™ 2.x or PCI 3.0 firmware and MPI v2.0. SAS3IRCU supports the following operating systems:

- WinPE 1.x (Server 2003/XP), WinPE 2.0 (Vista), WinPE 2.1 (Server 2008)

  Requires Windows® driver v2.00.00.17 or greater.

- UEFI 2.1
- Linux® 2.6 Kernel - Red Hat® Enterprise Linux (RHEL) 5, SUSE® Linux Enterprise Server (SLES) 10

  Requires Linux driver v00.255.04.00 or greater.

- MS-DOS® 6.22 and FreeDOS 1.0

  SAS3IRCU runs on DOS only if the system BIOS supports 32-bit BIOS services, including the PCI BIOS services. SAS3IRCU uses these services to locate the controller and its interface registers because it must directly access the controller chip's interface registers.

A.2 Interface Description

Format commands as follows for the SAS3IRCU command-line interface:

```
sas2ircu <controller_#> <command> <parameters>
```

Use a space to separate the program name, the controller number, the command, and the parameters fields. The format of *<parameters>* is command specific.

Information passes between the user environment and the SAS3IRCU through the command line, the standard output and standard error interfaces, and the program return value. You can redirect the output streams as permitted by the operating system. When the program exits, it returns a value of 0 if the command is successful. Otherwise, it returns a value of 1.

If a RAID command fails, the SAS3IRCU prints the IOCStatus and IOCLogInfo on the console. You can use this information to analyze the cause of the failure.

A.3 Commands

The following table shows which commands the SAS3IRCU supports on each operating system.

Table 1: SASIRCU Commands

SAS3IRCU Command	Operating System			
	DOS	Linux	EFI	WinPE
CREATE	X	X	X	X
DELETE	X	X	X	X
DISPLAY	X	X	X	X
HOTSPARE	X	X	X	X
LIST	X	X	X	X
STATUS	X	X	X	X
MFGPAGE	X	—	—	—

Table 1: SASIRCU Commands (Continued)

SAS3IRCU Command	Operating System			
	DOS	Linux	EFI	WinPE
CONSTCHK	X	X	X	X
ACTIVATE	X	X	X	X
LOCATE	X	X	X	X
LOGIR	X	X	X	X

The commands are not case sensitive. The command descriptions use the following conventions:

- Enter the text in *italic* exactly as shown on the command line.
- Replace text enclosed in < > with a required parameter.
- Replace text enclosed in [ ] with an optional parameter.
- Enter parameters enclosed in { } one or more times, as required for the command being executed.
- Do not enter the command-line definition characters < >, [ ], and { } on the command line.

A.3.1 Common Command-Line Parameters

This section describes command-line parameters that are common to more than one command.

- *<controller_#>*

  The unique controller number that the program assigns to each *PCI function* found on supported controller chips in the system, starting with controller # 0. For example, in a system containing two LSISAS2008 controllers, controller # 0 references the first controller and controller # 1 references the other controller.

  Valid controller number values are 0 to 255 (decimal).

- *<Enclosure:Bay>*

  The enclosure and bay/slot of a peripheral device attached to the bus. The argument must use a colon (:) as a separator and must follow the *enclosure:bay* format. *Enclosure* is a 16-bit EnclosureHandle value set by the I/O controller (IOC). A value of 0 is invalid. *Bay/Slot* is a 16-bit slot value set by the IOC. Use the DISPLAY command to get the enclosure and slot numbers of a drive.

A.3.2 CREATE Command

The CREATE command creates Integrated RAID volumes on LSI SAS3 controllers.

When you add a disk to an Integrated RAID volume, the volume might not use all of the disk's storage capacity. For example, if you add a 300-GB disk drive to a volume that only uses 200 GB of capacity on each disk drive, the volume does not use the remaining 100 GB of capacity on the disk drive.

The disk identified by the first *Enclosure:Bay* on the command line becomes the *primary disk* drive when you create an Integrated Mirroring (RAID 1) volume. If the controller resynchronizes the disk drives, the data on the primary disk drive becomes available when you access the newly created volume.

When the IR firmware creates a RAID 1 volume, it starts a background initialization of the volume. You can use the STATUS command to monitor the status of the initialization.

Observe the following rules when creating Integrated RAID volumes and hot spare disks:

- All disks that are part of a volume, including hot spares for that volume, must be on the same SAS3 controller.
- You can create RAID 0, RAID 1, RAID 1E, and RAID 10 Integrated RAID volumes.
- You can create a maximum of two Integrated RAID volumes per controller.
- The configuration of the Integrated RAID firmware determines the maximum and minimum number of drives that you can use in Integrated RAID volumes. The following fields of IOC Page 6 specify the configuration:

  MaxDrivesRAID0, MaxDrivesRAID1, MaxDrivesRAID10, MaxDrivesRAID1E MinDrivesRAID0, MinDrivesRAID1, MinDrivesRAID10, MinDrivesRAID1E, MaxVolumes, MaxPhysDisks, MaxGlobalHotSpares, MaxPhysDisks (maximum number of physical drives combined in *all* volumes on the controller)

  For more information, refer to the description of the IOC configuration pages in the *Fusion MPT 2.0 MPI Specification Guide*.
- SAS3IRCU does not allow you to create an Integrated RAID volume that combines SAS and SATA hard disk drives.
- SAS3IRCU does not allow you to create an Integrated RAID volume that combines SSDs (solid-state drives) and hard disk drives.
- SAS3IRCU *does* allow you to use both SATA and SAS solid-state drives in a single Integrated RAID volume, if the Integrated RAID firmware supports it. Support for such a mixing is specified by values in static fields in Manufacturing Page 4 in the MPI2 specification and is specific for SSD drives only.

Command Line

```
sas2ircu <controller_#> create <volume_type> <size>
{<Enclosure:Bay>} [VolumeName] [noprompt]
```

Parameters

- *<controller_#>* – The index of the controller for the newly created volume.
- *<volume_type>* – Volume type for the new volume. Valid values are RAID0, RAID1, RAID10, or RAID1E.
- *<size>* – Size of the RAID volume in Mbytes, or `MAX` for the maximum size available.
- *<Enclosure:Bay>* – The Enclosure:Bay value of the disk drive for the new RAID volume. You can get these values from the output of the DISPLAY command. DOS does not support addressing by Enclosure:Bay.
- *VolumeName* – A user-specified string to identify the volume.
- `noprompt` – This optional parameter prevents warnings and prompts from appearing while the command is running.

Program Return Value

0x00 SUCCESS: Command completed successfully.

0x01 FAILURE: Bad command-line arguments or operational failure.

0x02 ADAPTER_NOT_FOUND: Cannot find specified adapter.

A.3.3 DELETE Command

The DELETE command deletes all of the Integrated RAID volumes and hot spare drives from the specified LSI SAS3 controller. The command does not change any other controller configuration parameters.

Command Line

`sas2ircu <controller_#> delete [noprompt]`

Parameters

- `<controller_#>` – The index of the controller with the volume(s) that you want to delete.
- `noprompt` – This optional parameter prevents warnings and prompts from appearing while the command is running.

Program Return Value

0x00 SUCCESS: Command completed successfully.

0x01 FAILURE: Bad command-line arguments or operational failure.

0x02 ADAPTER_NOT_FOUND: Cannot find specified adapter.

A.3.4 DISPLAY Command

The DISPLAY command displays information about LSI SAS3 controller configurations, including controller type, firmware version, BIOS version, volume information, physical drive information, and enclosure. See the following Sample Output example.

The physical device information section displays the duplicate device of a dual-port SAS drive.

Command Line

`sas2ircu <controller_#> display [filename]`

Parameters

- `<controller_#>` – The index of the controller for which you want to display information.
- `[filename]` – An optional valid filename to store the command output to a file.

Program Return Value

0x00 SUCCESS: Command completed successfully.

0x01 FAILURE: Bad command-line arguments or operational failure.

0x02 ADAPTER_NOT_FOUND: Cannot find specified adapter.

Sample Output Following is a sample of the information that the DISPLAY command returns.

```
Read configuration has been initiated for controller 0
------------------------------------------------------------
Controller information
------------------------------------------------------------
   Controller type                          : SAS2008
   BIOS version                             : 7.00.02.00
   Firmware version                         : 00.250.19.0
   Channel description                      : 1 Serial Attached
SCSI
   Initiator ID                             : 112
   Maximum physical devices                 : 62
   Concurrent commands supported            : 266
   Slot                                     : 3
   Segment                                  : 0
   Bus                                      : 64
   Device                                   : 1
   Function                                 : 0
   RAID Support                             : Yes
------------------------------------------------------------

IR Volume information
------------------------------------------------------------
------------------------------------------------------------
Physical device information
------------------------------------------------------------

Initiator at ID #112
Device at ID #335524
  Device is a Hard disk
  Enclosure #                              : 2
  Slot #                                   : 2
  Connector ID                             : 4
  State                                    : Ready (RDY)
  Size (in MB)/(in sectors)                : 70007/143374738
  Manufacturer                             : HP
  Model Number                             : DG072A9BB7
  Firmware Revision                        : HPD0
  Serial No                                : B365P720H7330709
  Protocol                                 : SAS
  Drive Type                               : SAS
------------------------------------------------------------
Enclosure information
------------------------------------------------------------
Enclosure#                                 : 1
Logical ID                                 : 51234567:89012345
Numslots                                   : 8
StartSlot                                  : 0
```

Logical drive status values are as follows:

- `Okay (OKY)` – The volume is active and drives are functioning properly. User data is protected if the current RAID level provides data protection.
- `Degraded (DGD)` – The volume is active. User data is not fully protected because the configuration has changed or a drive has failed.
- `Failed (FLD)` – The volume has failed.
- `Missing (MIS)` – The volume is missing.
- `Initializing (INIT)` – The volume is initializing.
- `Online (ONL)` – The volume is online.

Physical device status values are as follows:

- `Online (ONL)` – The drive is operational and is part of a logical drive.
- `Hot Spare (HSP)` – The drive is a hot spare that is available to replace a failed drive in an array.
- `Ready (RDY)` – The drive is ready for use as a normal disk drive, or it is ready to be assigned to a disk array or a hot spare pool.
- `Available (AVL)` – The drive may or may not be ready, and it is not suitable for use in an array or a hot spare pool.
- `Failed (FLD)` – The drive failed and is now offline.
- `Missing (MIS)` – The drive has been removed or is not responding.
- `Standby (SBY)` – The device is not a hard-disk device.
- `Out of Sync (OSY)` – The drive, which is part of a logical drive, is not in sync with other drives that are part of the logical drive.
- `Degraded (DGD)` – The drive is part of a logical drive and is in degraded state.
- `Rebuilding (RBLD)` – The drive is part of a logical drive and is currently rebuilding.
- `Optimal (OPT)` – The drive is optimal and is part of a logical drive.

Physical device Drive Type values are as follows:

- `SAS_HDD` – The drive is a SAS HDD.
- `SATA_HDD` – The drive is a SATA HDD.
- `SAS_SSD` – The drive is a SAS SSD.
- `SATA_SSD` – The drive is a SATA SSD.

Physical device Protocol values are as follows:

- `SAS` – The drive supports SAS protocol.
- `SATA` – The drive supports SATA protocol.

A.3.5 HOTSPARE Command

The HOTSPARE command adds a hot spare drive to spare pool 0 or deletes a hot spare drive. The capacity of the hot spare drive must be greater than or equal to the capacity of the smallest drive in the RAID volume. You can verify this by using the DISPLAY command on the drive.

Observe the following rules when creating hot spare disks:

- You cannot create a hot spare disk unless at least one RAID1, RAID10, or RAID1E volume already exists.
- You cannot create a hot spare and add it to an inactive Integrated RAID volume.
- For hard-disk drives, you cannot add a SAS hot spare disk if the existing volumes on the controller use SATA disks. You cannot add a SATA hot spare disk if the existing volumes on the controller use SAS disks.
- For solid-state drives, you can add a SAS hot spare SSD to a volume with SATA SSDs and you can add a SATA hot spare SSD to a volume with SAS SSDs, if the Integrated RAID firmware allows it. This depends on the values in the static fields in Manufacturing Page 4. For more information, see the *Fusion-MPT 2.0 MPI Specification Guide*.
- The maximum allowable number of hot spare drives depends on the value of the MaxGlobalHotSpares field in IOC Page 6. (Normally, the maximum is two global hot spares per controller.)
- You cannot add an SSD hot spare to a volume that has HDDs, or vice versa.

Command Line `sas2ircu <controller_#> hotspare [delete] <Enclosure:Bay>`

Parameters

- `<controller_#>` – The index of the controller on which you want to create the hot spare disk.
- `<Enclosure:Bay>` – The Enclosure:Bay value for the hot spare disk drive. You can get these values from the output of the DISPLAY command. DOS does not support addressing by Enclosure:Bay.
- `delete` – This optional command deletes the hot spare disk at *`enclosure:bay`*.

Program Return Value

0x00	SUCCESS: Command completed successfully.
0x01	FAILURE: Bad command-line arguments or operational failure.
0x02	ADAPTER_NOT_FOUND: Cannot find specified adapter.

A.3.6 STATUS Command

The STATUS command displays the current status of any existing Integrated RAID volumes and the status of any operation that is currently in progress on the selected controller. If an operation is not in progress, the SAS3IRCU prints a message indicating this condition before it exits.

Command Line `sas2ircu <controller_#> status`

Parameters

- `<controller_#>` – The index of the controller with the volumes whose status you want to display.

Program Return Value

0x00	SUCCESS: Command completed successfully.
0x01	FAILURE: Bad command-line arguments or operational failure.
0x02	ADAPTER_NOT_FOUND: Cannot find specified adapter.

Sample Output

Following is an example of the information that the STATUS command returns when a volume resynchronization is in progress:

```
Background command progress status for controller 0...
IR Volume 1
  Volume ID                              : 6
  Current operation                      : Synchronize
  Volume status                          : Enabled
  Volume state                           : Degraded
  Physical disk I/Os                     : Not quiesced
  Volume size (in sectors)               : 70311936
  Number of remaining sectors            : 68250624
  Percentage complete                    : 2.93%
```

Following is an example of the status information that the STATUS command returns if a background volume operation is not in progress:

```
Background command progress status for controller 0...
IR Volume 1
  Current operation                      : None
  Volume ID                              : 6
  Volume status                          : Enabled
  Volume state                           : Optimal
  Physical disk I/Os                     : Not quiesced
```

The possible values for the fields in the status data are as follows:

- Current operation: *Synchronize, Consistency Check, OCE, Background Init,* or *None*
- Volume status: *Enabled* or *Disabled*
- Volume state: *[Inactive] Optimal*, *Degraded, Missing*, or *Failed*
- Physical disk I/Os: *Quiesced* or *Not quiesced*

A.3.7 LIST Command

The LIST command displays a listing of all controllers present in system, along with each corresponding controller index. You use the controller index as an input parameter for other SAS3IRCU commands.

Command Line

```
sas2ircu list
```

Parameters

None

Program Return Value

0x00 SUCCESS: Command completed successfully.

0x01 FAILURE: Command failed.

0x02 ADAPTER_NOT_FOUND: Cannot find specified adapter.

Sample Output

Following is an example of the output of the LIST command. The format and fields in the output may vary depending on the types of installed controllers.

```
          Adapter  Vendor Device                     SubSys  SubSys
 Index     Type      ID     ID      Pci Address       Ven ID  Dev ID
 -----  ---------  ------ ------ -----------------  -------  ------
   0     SAS2008   1000h   72h    00h:01h:00h:00h   1000h    00dah
   1     SAS2008   1000h   72h    00h:05h:00h:00h   1000h    00dah
```

A.3.8 MFGPAGE Command

The MFGPAGE command updates information on manufacturing pages. Only DOS and EFI support this command.

Command Line

```
sas2ircu  <controller_#> mfgpage <passcode> <mfgpage_#>
<offset> <value>
```

Parameters

- *<controller_#>* – The index of the controller with the manufacturing pages you want to update.
- *<passcode>* – The passcode required for DOS access.
- *<mfgpage_#>* – The manufacturing page (4 or 10) that requires an update.
- *<offset>* – The DWord offset of the specified manufacturing page that requires an update, in hexadecimal format.
- *<value>* – The value for the offset to be modified, in hexadecimal format.

Program Return Value

0x00	SUCCESS: Command completed successfully.
0x01	FAILURE: Bad command-line arguments or operational failure.
0x02	ADAPTER_NOT_FOUND: Cannot find specified adapter.

A.3.9 CONSTCHK Command

The CONSTCHK command sends requests to the Integrated RAID firmware to start a consistency check operation on the specified volume.

Command Line

```
sas2ircu <controller_#> constchk <volumeId> [noprompt]
```

Parameters

- *<controller_#>* – The index of the controller on which the consistency check operation will run.
- *<volumeId>* – The volume ID of an Integrated RAID volume, as listed in the DISPLAY command, on which the consistency check operation will run.
- `noprompt` – This optional parameter prevents warnings and prompts from appearing while the command is running.

Program Return Value

0x00	SUCCESS: Command completed successfully.
0x01	FAILURE: Bad command-line arguments or operational failure.
0x02	ADAPTER_NOT_FOUND: Cannot find specified adapter.

A.3.10 ACTIVATE Command

The ACTIVATE command activates an inactive Integrated RAID volume.

Command Line

```
sas2ircu  <controller_#>  activate <volumeId>
```

Parameters

- *<controller_#>* – The index of the controller with the volume that requires activation.
- *<volumeId>* – The volume ID of an Integrated RAID volume currently in the Inactive state.

Program Return Value

0x00	SUCCESS: Command completed successfully.
0x01	FAILURE: Bad command-line arguments or operational failure.
0x02	ADAPTER_NOT_FOUND: Cannot find specified adapter.

A.3.11 LOCATE Command

The LOCATE command locates a specific drive in a volume by turning on its location indicator and flashing its LED.

Command Line

```
sas2ircu <controller_#> locate <Enclosure:Bay> <action>
```

Parameters

- *<controller_#>* – The index of the controller with the drives that you need to locate.
- *<Enclosure:Bay>* – The enclosure and bay number of the drive.
- *<action>* – The possible actions are as follows:
  - ON – Turn on the location indicator of the drive.
  - OFF – Turn off the location indicator of the drive.

Program Return Value

0x00	SUCCESS: Command completed successfully.
0x01	FAILURE: Bad command-line arguments or operational failure.
0x02	ADAPTER_NOT_FOUND: Cannot find specified adapter.

A.3.12 LOGIR Command

The LOGIR command uploads or clears the Integrated RAID log information.

Command Line

```
sas2ircu <controller_#> logir <action> [filename] [noprompt]
```

Parameters

- *<controller_#>* – The index of the controller with the logs that you need to upload or clear.
- *<action>* – The possible actions are as follows:
  - UPLOAD – Upload the controller logs to a file.
  - CLEAR – Clear the controller logs.
- *filename* – This optional parameter specifies the filename where the logs must be uploaded. The default filename is LOGIR.LOG.
- noprompt – This optional parameter prevents warnings and prompts from appearing while the command is running.

Program Return Value

0x00	SUCCESS: Command completed successfully.
0x01	FAILURE: Bad command-line arguments or operational failure.
0x02	ADAPTER_NOT_FOUND: Cannot find specified adapter.

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