# Intel® IT/IR RAID Software User's Guide

Revision 2.0

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# 1 Overview

The Intel® IT/IR RAID Software User's Guide explains how to configure and use the components of the Intel® IT/IR RAID Software with the Intel® IT/IR RAID Controllers. The features and benefits of each controller are also provided.

## Supported Hardware

The Intel® IT/IR RAID Solution can be used with the following Intel® IT/IR RAID Controllers:

- Intel® RAID Controller SASWT4I
- Intel® RAID Controller SASUC8I
- Intel® RAID SAS Controller FALSASMP2 without Intel® SAS RAID Activation Key AXXRAKSAS2 installed.
- Intel® RAID SAS Riser Controller AFCSASRISER in Intel® Server System S7000FC4UR without Intel® SAS RAID Activation Key AXXRAKSAS2 installed.
- Intel® SAS Entry RAID Module AXX4SASMOD

## Software

The Intel® IT/IR RAID Controller can be managed in the following operating systems using Intel® RAID Web Console 2:

- Microsoft Windows Server 2008*, Microsoft Windows Server 2003*, and Microsoft Windows XP*
- Red Hat* Enterprise Linux 4.0 and 5.0
- SuSE* Linux Enterprise Server 9 and 10

> *Note:* The operating systems listed here may not be supported by your server board. See the tested operating system list for your server board at http://support.intel.com/support/motherboards/server/.

# Introduction

The Intel® IT/IR RAID Solution provides cost benefits for the server or workstation market where the extra performance, storage capacity, and redundancy of a RAID configuration are required. The components of Intel® IT/IR RAID are:

- IT Mode: Native SAS mode without RAID function. Supports up to 122 physical devices.

- IR Mode: This mode includes the following components:

    — Integrated Mirroring (IM): Supports two-disk mirrored arrays and hot-spare disks.

    — Integrated Mirroring Enhanced (IME): Supports mirrored arrays with three to ten disks, plus hot-spare disks.

    — Integrated Striping (IS): Supports striped arrays with two to ten disks.

By simplyfying the configuration options and providing firmware RAID support for its host adapters, Intel can offer the Intel® IT/IR RAID solution at a lower cost.

Fusion-MPT* firmware supports IM, IME, and IS volumes. You can create up to two Intel® IT/IR RAID storage volumes on the same Intel® IT/IR RAID Controller.

# Intel® IT/IR RAID Benefits and Features

Intel® IT/IR RAID has the following benefits and features:

- Support for up to ten disks per IME or IS volume, with one or two storage volumes per Intel® IT/IR RAID Controller. Each controller can support up to 12 volume disks, plus one or two hot-spare disks, for a maximum of 14 disks per controller

    *Note:* *Support for this number of disks requires IT/IR RAID firmware v1.20.00 or above.*

- Support for two-disk IM mirrored volumes

- Low cost RAID volume creation meets the needs of most internal RAID installations

- Easy to use installation and configuration

- System can boot from an IM, IME, or IS volume

- No special OS-specific software is required

- High reliability and data integrity

    — Non-volatile write journaling

    — Physical disks not visible to the OS or to the application software

- Low host CPU and PCI bus utilization

- Fusion-MPT* architecture provides processing power
  - — Shared memory architecture minimizes external memory requests
  - — Functionality is contained in device hardware and firmware

# Using this Manual

- Chapters 2 and 3 of this User's Guide list IM and IME features and explain how to create IM and IME volumes and optional hot-spare disks.
- Chapters 4 and 5 list Integrated Striping features and explain how to create Integrated Striping (IS) volumes.
- Chapter 6 introduces the RAID management utility for Intel® IT/IR RAID under different operating systems.

# 2 Integrated Mirroring and Integrated Mirroring Enhanced Features

This chapter provides an overview of the Intel® IT/IR RAID Software's Integrated Mirroring (IM) and Integrated Mirroring Enhanced (IME) features.

## Introduction

The Intel® IT/IR RAID Software's Integrated Mirroring (IM) and Integrated Mirroring Enhanced (IME) features provide data protection for the system boot volume to safeguard critical information such as the operating system on servers and high performance workstations. The IM and IME features provide a robust, high-performance, fault-tolerant solution for data storage needs, at a lower cost.

The IM and IME features support one or two mirrored volumes per Intel® IT/IR RAID Controller, to provide fault-tolerant protection for critical data. The two volumes can have up to a total of twelve disk drives, plus one or two hot-spare disks.

If a disk in an Integrated Mirroring volume fails, the hot-swap capability allows you to restore the volume by simply swapping disks. The firmware then automatically re-mirrors the swapped disk. Additionally, each Intel® IT/IR RAID Controller can have one or two global hot-spare disks available to automatically replace a failed disk in the IM or IME storage volumes on the controller. Hot spares make the IM/IME volume even more fault tolerant.

*Note:* *You can also configure one IM or IME volume and one Integrated Striping (IS) volume on the same Intel® IT/IR RAID Controller.*

The IM/IME feature uses the same device drivers as the IT (non-RAID) mode controllers, providing seamless and transparent fault tolerance. This eliminates the need for complex backup software or expensive RAID hardware. The IM/IME feature operates independently from the operating system, in order to conserve system resources. The BIOS-based configuration utility makes it easy to configure IM and IME volumes.

# Features

Integrated Mirroring and Integrated Mirroring Enhanced support the following featurs:

- Configurations of one or two IM or IME volumes on the same Intel® IT/IR RAID Controller. IM volumes have two mirrored disks; IME volumes have three to ten mirrored disks. Two volumes can have up to a total of 12 disks.

  *Note:   This feature requires IR RAID firmware v1.20.00 or above to be installed.*

- One or two global hot-spare disks per controller, to automatically replace failed disks in IM/IME volumes. The hot-spare drivess are in addition to the 12-disk maximum for two volumes per Intel® IT/IR RAID Controller.

  *Note:   Support for two hot-spare disks requires IR RAID firmware v1.20.00 or above.*

- Mirrored volumes run in optimal mode or in degraded mode (if one mirrored disk fails).
- Hot-swap capability.
- Presents a single virtual drive to the OS for each IM/IME volume.
- Supports both SAS and SATA disks. The two types of disks cannot be combined in the same volume. However, a Intel® IT/IR RAID Controller can support one volume with SATA disks and a second volume with SAS disks.
- Fusion-MPT* architecture.
- Easy-to-use BIOS-based configuration utility.
- Error notification: The drivers update an OS-specific event log.
- LED status support.
- Write journaling, which allows automatic synchronization of potentially inconsistent data after unexpected power-down situations.
- Metadata used to store volume configuration on mirrored disks.
- Automatic background resynchronization while the host continues to process inputs/outputs (I/Os).
- Background media verification ensures that data on IM/IME volumes is always accessible.

# Description

The Intel® IT/IR RAID solution supports one or two IM/IME volumes on each Intel® IT/IR RAID Controller (or one IM/IME volume and one Integrated Striping volume). Typically, one of these volumes is the boot volume, as shown in Figure 1. Boot support is available through the firmware of the Intel® IT/IR RAID Controller that supports the standard Fusion-MPT* interface. The runtime mirroring of the boot disk is transparent to

the BIOS, drivers, and operating system. Host-based status software monitors the state of the mirrored disks and reports any error conditions. Figure 1 shows an IM implementation with a second disk as a mirror of the first (primary) disk.
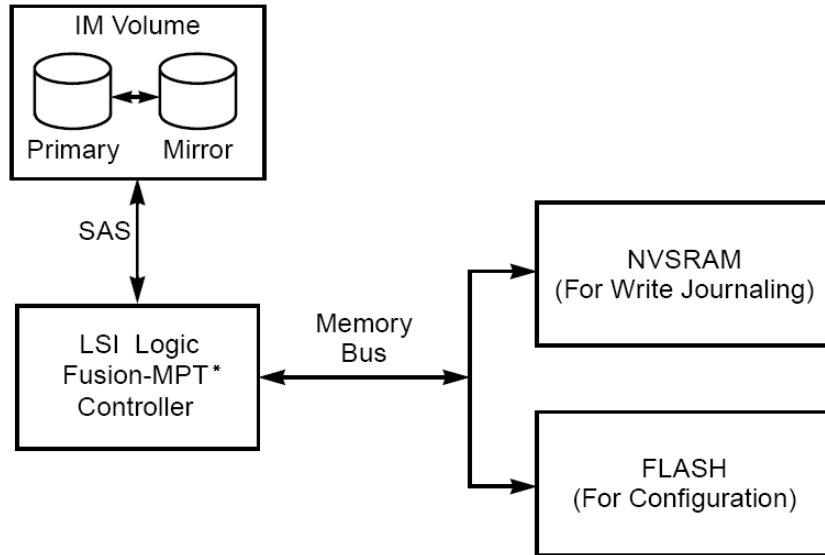


**Figure 1. Typical Integrated Mirroring Implementation**

The advantage of an IM/IME volume is that there is always a second, mirrored copy of the data. While writes take longer because data must be written twice, performance is actually improved during reads.

Figure 2 shows the logical view and physical view of an IM volume.
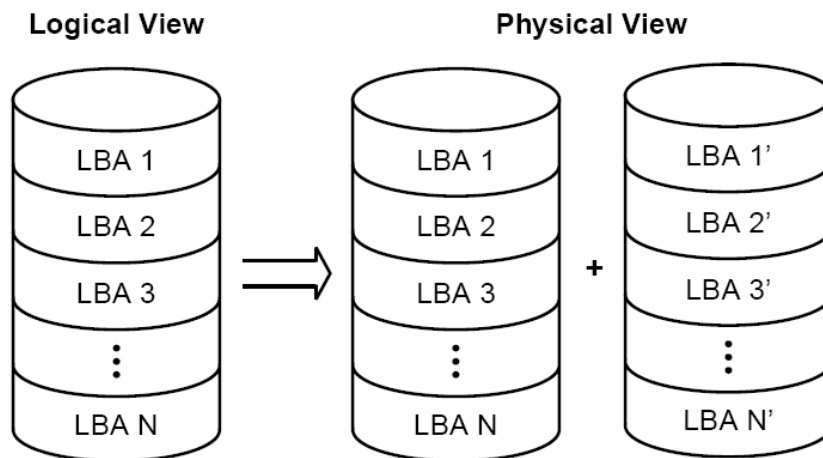


**Figure 2. Integrated Mirroring Volume**

An IME volume can be configured with up to ten mirrored disks (one or two global hot spares can also be added). Figure 3 shows the logical view and physical view of an Integrated Mirroring Enhanced (IME) volume with three mirrored disks. Each mirrored stripe is written to a disk and mirrored to an adjacent disk. This type of configuration is also called RAID 1E.
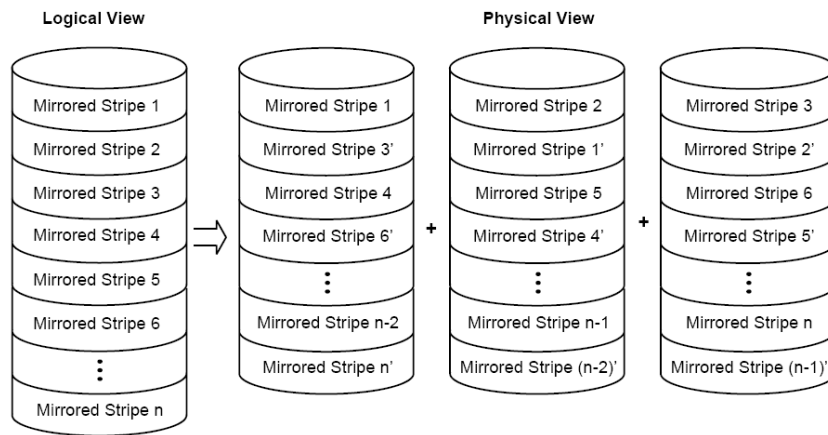
**Figure 3. Integrated Mirroring Enhanced with Three Disks**

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

# IR RAID Firmware

## Resynchronization with Concurrent Host I/O Operation

The IR RAID firmware allows host I/Os to continue on an IM or IME volume while the volume is being re-synchronized in the background. Resynchronization is attempted after a hot spare is activated due to a physical device failure, or after a hot swap has occurred to a physical disk in the volume.

## Metadata Support

The firmware supports metadata, which describes the IM/IME logical drive configuration stored on each member disk. When the firmware is initialized, each member disk is queried to read the stored metadata in order to verify the configuration. The usable disk space for each member disk is adjusted down to a lower value when the configuration is created, in order to leave room for this data.

## Hot Swapping

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

Following a hot-swap event, the firmware readies the new physical disk by spinning it up and verifying that it has enough capacity for the mirrored volume. The firmware resynchronizes all hot-swapped disks that have been removed, even if the same disk is re-inserted. In a two-disk mirrored volume, the firmware marks the hot-swapped disk as the secondary disk and marks the other mirrored disk as the primary disk. The firmware resynchronizes all data from the primary disk onto the new secondary disk.

## SMART Support

SMART is a technology that monitors hard disk drives for signs of future disk failure and generates an alert if such signs are detected. The 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 IM/IME volume, it processes the SMART data and stores it in nonvolatile memory. The IM/IME volume does not support SMART directly, since it is just a logical representation of the physical disks in the volume.

## Hot-Spare Disk

One or two disk drives per controller can be configured as global hot-spare disks, to protect data on the IM/IME volumes that are configured on the controller. If the 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 is automatically notified when the failed disk has been replaced, and it then designates the failed disk as the new hot spare.

## Media Verification

The firmware supports a background media verification feature that runs at regular intervals when the IM/IME volume is in optimal state. If the verification command fails for any reason, the other disk's data for this segment is read and written to the failing disk in an attempt to refresh the data. The current Media Verification Logical Block Address is written to nonvolatile memory occasionally to allow media verification to continue approximately where it left off prior to a power-cycle.

## Disk Write Caching

The firmware disables disk write caching by default for IM/IME volumes. This is done to increase data integrity, so that the disk write log stored in NVSRAM is always valid. If disk write caching were enabled (not recommended), the disk write log could be invalid.

## NVSRAM Usage

The IR RAID firmware requires at least a 32 KB NVSRAM in order to perform write journaling. Write journaling is used to verify that the disks in the IM/IME volume are synchronized with each other.

# Fusion-MPT* Support

The BIOS uses the Fusion-MPT* interface to communicate to the Intel® IT/IR RAID Controller and firmware to enable IM and IME volumes. This includes reading the Fusion-MPT* configuration to access the parameters that are used to define behavior between the controller and the devices connected to it. The Fusion-MPT* drivers for all supported operating systems implement the Fusion-MPT* interface to communicate with the controller and firmware.

# 3 Creating IM and IME Volumes

This chapter explains how to create Integrated Mirroring (IM) and Integrated Mirroring Enhanced (IME) volumes using the LSI MPT* SAS BIOS Configuration Utility.

## IM and IME Configuration Overview

You can use the LSI MPT* SAS BIOS Configuration Utility to create one or two IM/IME volumes on each Intel® IT/IR RAID Controller, with one or two optional global hot-spare disks. All disks in an IM/IME volume must be connected to the same Intel® IT/IR RAID Controller.

Although you can use disks of different size in IM and IME volumes, the smallest disk in the volume will determine the logical size of all disks in the volume. In other words, the excess space of the larger member disk(s) will not be used. For example, if you create an IME volume with two 100 GB disks and two 120 GB disks, only 100 GB of the larger disks will be used for the volume.

For more information about Integrated Mirroring volumes, see "Features" on page 6.

## Creating IM and IME Volumes

The LSI MPT* SAS BIOS Configuration Utility is part of the Fusion-MPT* BIOS. When the BIOS loads during boot and you see the message about the LSI MPT* SAS BIOS Configuration Utility, press <Ctrl> + <C> to start the utility. The message then changes to:

    Please wait, invoking LSI SAS Configuration Utility...

After a brief pause, the main menu appears. On some systems, however, the following message appears:

    Configuration Utility will load following initialization!

In this case, the LSI MPT* SAS BIOS Configuration Utility loads after the system has completed a power-on self test. You can configure one or two IM or IME volumes per Fusion-MPT* controller. You can also configure one IM/IME and one Integrated Striping (IS) volume on the same controller, up to a maximum of 12 physical disk drives for the two volumes. In addition, you can create one or two hot spares for the IM/IME array(s).

The following guidelines also apply when creating an IM or IME volume:

- All physical disks in a volume must be either SATA (with extended command set support) or SAS (with SMART support). SAS and SATA disks cannot be combined 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.

- An IM volume must have two drives. An IME volume can have three to ten drives. In addition, one or two hot spares can be created for the IM/IME volume(s).

*Note:* *If a disk in an IM/IME volume fails, it is rebuilt on the global hot spare if one is available. Intel recommends that you always use hot spares with IM/IME volumes.*

# Creating an IM Volume

To create an IM volume with the LSI MPT* SAS BIOS Configuration Utility, follow these steps:

1. On the Adapter List screen, use the arrow keys to select an adapter.

2. Press <Enter> to go to the Adapter Properties screen, shown in Figure 4.

```
LSI Corp Config Utility    v6.24.00.00 (2008.07.01)
Adapter Properties -- SAS1064E

        Adapter                     SASWT4I
        PCI Slot                    06
        PCI Address(Bus/Dev)        0A:00
        MPT Firmware Revision       1.26.00.00-IR
        SAS Address                 500605B0:000C9B64
        NVDATA Version              2D.00
        Status                      Enabled
        Boot Order                  0
        Boot Support                [Enabled BIOS & OS]

        RAID Properties

        SAS Topology

        Advanced Adapter Properties


Esc = Exit Menu       F1/Shift+1 = Help
Enter = Select Item   -/+/Enter = Change Item
```

**Figure 4. Adapter Properties Screen**

3. On the Adapter Properties screen, use the arrow keys to select **RAID Properties** on the screen and press <Enter>.

4. When prompted to select a volume type, select **Create IM Volume**.

    The Create New Array screen shows a list of disks available to be added to a volume.

5. Move the cursor to the RAID Disk column and select a disk. To add the disk to the volume, change the No to Yes by pressing the <+> or <-> keys, or the space bar.

    When the first disk is added, the utility prompts you to either keep existing data or overwrite existing data.

6. Press <M> to keep the existing data on the first disk or press <D> to overwrite it.

    If you keep the existing data, this is called a data migration. The first disk will be mirrored onto the second disk, so any data you want to keep must be on the first disk selected for the volume. Data on the second disk is overwritten. The first disk must have 512 KB available for metadata after the last partition.

As disks are added, the Array Size field changes to reflect the size of the new volume.

7. [Optional] Add one or two global hot spares by moving the cursor to the hot spare column and pressing the <+> or <-> keys, or the space bar.

Figure 5 shows an IM volume configured with one global hot-spare disk.

```
LSI Corp Config Utility     v6.24.00.00 (2008.07.01)
Create New Array -- SAS1064E
  Array Type:                      IM
  Array Size(MB):                  75340

Slot  Device  Identifier             RAID   Hot   Drive      Pred   Size
Num                                  Disk   Spr   Status     Fail   (MB)
  0    ATA     ST3808110AS      D    [Yes]  [No]  Primary    ---    76319
  1    ATA     ST3808110AS      D    [Yes]  [No]  Secondary  ---    76319
  2    ATA     ST3808110AS      D    [No]   [Yes] Hot Spare  ---    76319
  3    ATA     ST3808110AS      D    [No]   [No]  Max Dsks   ---    76319




Esc = Exit Menu        F1/Shift+1 = Help
Space/+/- = Select disk for array or hot spare     C = Create array
```

**Figure 5. Create New Array Screen**

8. When the volume has been fully configured, press <C> and select **Save Changes**. Then exit this menu to commit the changes.

The LSI MPT SAS BIOS Configuration Utility* pauses while the array is created.

# Creating an IME Volume

To create an IME volume with the LSI MPT* SAS BIOS Configuration Utility, follow these steps:

1. On the Adapter List screen, use the arrow keys to select an Intel® IT/IR RAID Controller.

2. Press <Enter> to load the Adapter Properties screen, shown in Figure 4.

3. On the Adapter Properties screen, use the arrow keys to select **RAID Properties** on the screen and press <Enter>.

4. When prompted to select a volume type, choose **Create IME Volume**.

The Create New Array screen shows a list of disks that can be added to a volume.

5. Move the cursor to the RAID Disk column and select a disk. To add the disk to the volume, change the No to Yes by pressing the <+> or <-> keys, or the space bar.

6. Repeat this step to select a total of three to ten disks for the volume.

All existing data on all the disks you select will be overwritten. As you add disks, the Array Size field changes to reflect the size of the new volume.

7. [Optional] Add one or two global hot spares to the volume by moving the cursor to the hot spare column and pressing the <+> or <-> keys, or the space bar.

8. When the volume has been fully configured, press <C> and then select **Save changes**. Exit the menu to commit the changes.

   The utility pauses while the array is created.

# Creating a Second IM or IME Volume

Intel® IT/IR RAID Controllers allow you to configure two IM or IME volumes per controller. If one volume is already configured, and if there are available disk drives, there are two ways to add a second volume.

**Option 1**:

1. In the configuration utility, select an adapter from the Adapter List.

2. Select the **RAID Properties** option to display the current volume.

3. Press <C> to create a new volume.

4. Continue with either step 4 in "Creating an IM Volume" on page 12 or step 4 in "Creating an IME Volume" on page 13 to create a second volume.

**Option 2**:

1. On the Adapter List screen, use the arrow keys to select an Intel® IT/IR RAID Controller.

2. Press <Enter> to go to the **Adapter Properties** screen, shown in Figure 4.

3. On the Adapter Properties screen, use the arrow keys to select **RAID Properties** and press <Enter>.

4. Continue with either step 4 in "Creating an IM Volume" on page 12 or step 4 in "Creating an IME Volume" on page 13to create a second volume.

# Managing Hot Spares

You can create one or two global hot-spare disks to protect the IM or IME volumes on an Intel® IT/IR RAID controller. Usually, you create global hot spares at the same time you create the IM/IME volume.

To add global hot-spare disks after an IM/IME volume has been created, follow these steps:

1. On the View Array screen, select **Manage Array**.

2. In the Manage Array screen select **Manage Hot Spares**, as shown in Figure 6.

**Figure 6. Manage Array Screen**

3. Select a disk from the list by pressing the <+> or <-> key, or the space bar.

4. After you select the global hot-spare disk, press <C>.

   An error message appears if the selected disk is not at least as large as the smallest disk used in the IM/IME volume(s). The global hot-spare disk must have 512 byte blocks, it cannot have removable media, and the disk type must be either SATA with extended command set support or SAS with SMART support.

   If SATA disks are used for the IM/IME volume(s), the hot-spare disk must also be a SATA disk. If SAS disks are used, the hot-spare disk must also be a SAS disk. An error message appears if the selected disk is not the same type as the disks used in the IM/IME volumes.

5. [Optional] Select a second hot-spare disk.

6. Select **Save changes** then exit this menu to commit the changes.

   The configuration utility pauses while the global hot spares are added.

To delete a global hot spare, follow these steps:

1. Select **Manage Hot Spare** on the Manage Array screen.

2. Select **Delete Hot Spare** and then press <C>.

   If there are two hot spares, select one to delete.

3. Select **Save changes** then exit this menu to commit the changes.

   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 IM and IME volumes.

## Viewing Volume Properties

To view the properties of volumes, follow these steps:

1. In theLSI MPT* SAS BIOS Configuration Utility, select an adapter from the Adapter List.

2. Select the **RAID Properties** option.

   The properties of the current volume are displayed. If global hot spares are defined, they are also listed.

   *Note:* *If you create one volume using SAS disks, another volume using SATA disks, and another using global hot-spare disks, the hot-spare disks will only appear when you view the volume that has the same type of disks as the hot-spare disks.*

3. If two volumes are configured, press <Alt> + <N> to view the other array.

4. To manage the current array, select **Manage Array** and press < Enter>.

## Synchronizing an Array

The Synchronize Array command forces the firmware to resynchronize the data on the mirrored disks in the array. It is seldom necessary to use this command, because the firmware automatically keeps the mirrored data synchronized during normal operation. When you use this command, one disk of the array is placed in a degraded state until the data on the mirrored disks has been resynchronized.

To force the synchronization of a selected array, follow these steps:

1. Select **Synchronize Array** on the Manage Array screen.

2. Press <Y> to start the synchronization, or <N> to cancel it.

## Activating an Array

An array can become inactive if it is removed from one controller or computer and moved to another one. The Activate Array option allows you to reactivate an inactive array that has been added to a system. This option is only available when the selected array is currently inactive.

To activate a selected array, follow these steps:

1. Select **Activate Array** on the Manage Array screen.

2.  Press <Y> to proceed with the activation, or press <N> to abandon it.

    After a pause, the array will be active.

> *Note:*  *If there is a global hot-spare disk on the controller to which you have moved the array, the BIOS checks when you activate the array to determine if the hot spare is compatible with the new array. An error message appears if the disks in the activated array are larger than the hot-spare disk or if the disks in the activated array are not the same type as the hot-spare disk (SATA versus SAS).*

## Deleting an Array

> *Caution:*  *If a volume has been deleted, it cannot be recovered. Before deleting an array, be sure to back up all data on the array that you want to keep.*

To delete a selected array, follow these steps:

1.  Select **Delete Array** on the Manage Array screen.

2.  Press <Y> to delete the array.

    After a pause, the array is deleted. If there is a 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 array. If they are not compatible (i.e., they are too small or the wrong disk type), the firmware deletes them as well.

> *Note:*  *When an IM volume is deleted, the data is preserved on the primary disk. When an IME volume is deleted, the master boot records of all disks are deleted.*

## Locating a Drive or Multiple Drives in a Volume

You can use the LSI MPT* SAS BIOS Configuration Utility to locate and identify a specific physical disk drive by flashing the drive's LED. You can also use the utility to flash the LEDs of all the disk drives in a RAID volume. There are several ways to do this:

- When you are creating an IM or IME volume, and a disk drive is set to Yes as part of the volume, the LED on the disk drive is flashing. The LED is turned off when you have finished creating the volume.

- You can locate individual disk drives from the SAS Topology screen. To do this, move the cursor to the name of the disk in the Device Identifier column and press <Enter>. The LED on the disk flashes until the next key is pressed.

- You can locate all the disk drives in a volume by selecting the volume on the SAS Topology screen. The LEDs flash on all disk drives in the volume.

> *Note:*  *The LEDs on the disk drives will flash as described above if the firmware is correctly configured and the drives or the disk enclosure supports disk location.*

# Selecting a Boot Disk

You can select a boot disk in the SAS Topology screen. The selected disk is moved to scan ID 0 on the next boot, and remains at this position. This makes it easier to set the BIOS boot device options and to keep the boot device constant during device additions and removals. There can only be one boot disk.

To select a boot disk, follow these steps:

1. In the LSI MPT* SAS BIOS Configuration Utility, select an adapter from the Adapter List.

2. Select the **SAS Topology** option.

   The current topology is displayed. If the selection of a boot device is supported, the bottom of the screen lists the <Alt> + <B> option. This is the key for toggling the boot device. If a device is currently configured as the boot device, the Device Info column on the Topology screen will show the word "Boot."

3. To select a boot disk, move the cursor to the disk and press <Alt> + <B>.

4. To remove the boot designator, move the cursor down to the current boot disk and press <Alt> + <B>.

   This controller will no longer have 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 will move to this disk.

   *Note:* *The firmware must be configured correctly in order for the <Alt> + <B> feature to work.*

# 4      Overview of Integrated Striping

This chapter provides an overview of the Intel® IT/IR RAID Integrated Striping (IS) feature.

## Introduction

The Intel® IT/IR RAID Integrated Striping (IS) feature is useful for applications that require the faster performance and increased storage capacity of striping. The low-cost IS feature has many of the advantages of a more expensive RAID striping solution. A single IS logical drive may be configured as the boot disk or as a data disk.

The IS feature is implemented with controller firmware that supports the Fusion-MPT* Interface. IS provides better performance and more capacity than individual disks, without burdening the host CPU. The firmware splits host I/Os 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.

The LSI MPT* SAS BIOS Configuration Utility is used to configure IS volumes, which can consist of two to ten disks.

## Features

Integrated Striping includes the following features:
- Support for volumes with two to ten disks
- Support for two IS volumes (or one IS volume and one IM/IME volume) on a controller, with up to a total of 12 disks

  *Note:*    *This option requires IR RAID firmware v1.20.00 or above to be installed.*

  *Note:*    *All physical disks in a volume must be connected to the same SAS controller.*
- Presents a single virtual drive to the OS for each configured volume
- Support for both SAS and SATA drives, although the two types of drives cannot be combined in one volume
- Fusion-MPT* architecture
- Easy-to-use LSI MPT* SAS BIOS Configuration Utility
- Error notification
- Use of metadata to store volume configuration on disks

- OS-specific event log
- Error display inside the Fusion-MPT* BIOS
- LED support for drives used in IS volumes

# Description

The IS feature writes data across multiple disks instead of onto one disk. This is accomplished by partitioning each disk's storage space into 64 KB stripes. These stripes are interleaved round-robin, so that the combined storage space is composed alternately of stripes from each disk.

For example, as shown in Figure 7, segment 1 is written to disk 1, segment 2 is written to disk 2, segment 3 is written to disk 3, and so on. When the system reaches the end of the disk list, it continues writing data at the next available segment of disk 1.
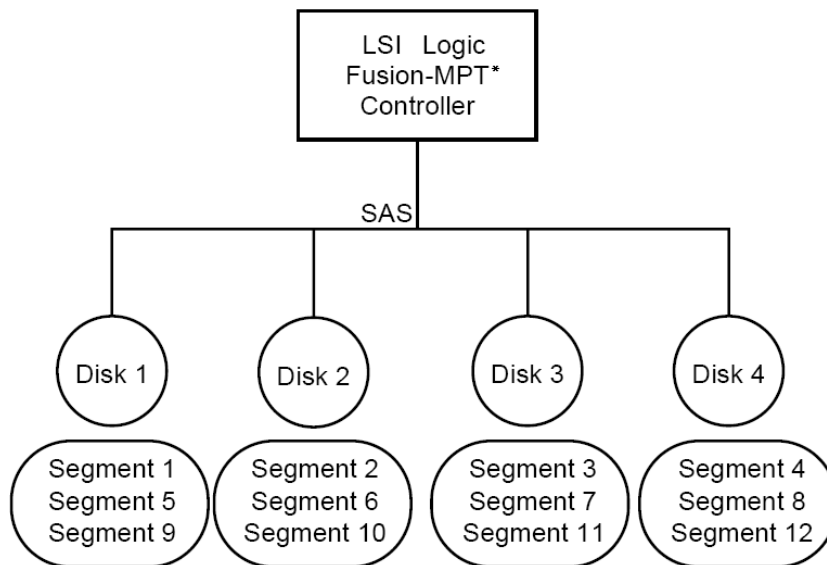


**Figure 7. Integrated Striping Example**

Figure 8 shows a logical view and a physical view of Integrated Striping configuration.
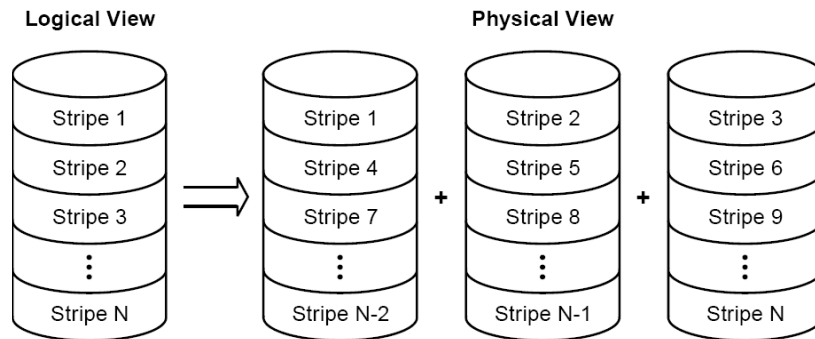
**Figure 8. Integrated Striping - Logical and Physical Views**

The primary advantage of IS is speed, because it transfers data to or from multiple disks at once. However, there is no data redundancy; therefore, if one disk fails, that data is lost.

# Integrated Striping Firmware

This section describes features of the Intel® IT/IR RAID firmware.

## Metadata Support

The firmware supports metadata, which describes the IS logical drive configuration stored on each member disk. When the firmware is initialized, each member disk is queried to read the stored metadata to verify the configuration. The usable disk space for each IS member disk is adjusted down to a lower value when the configuration is created, in order to leave room for this data.

## SMART Support

SMART is a technology that monitors hard disk drives for signs of future disk failure and generates an alert if such signs are detected. The 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 IS volume, it processes the SMART data and stores it in nonvolatile memory. The IS volume does not support SMART directly, since it is just a logical representation of the physical disks in the volume.

## Disk Write Caching

Disk write caching is enabled by default on all IS volumes.

# Fusion-MPT* Support

The BIOS uses the Fusion-MPT* interface to communicate to the SAS controller and firmware to enable IS. This includes reading the Fusion-MPT* configuration to gain access to the parameters that are used to define behavior between the SAS controller and the devices connected to it. The Fusion-MPT* drivers for all supported operating systems implement the Fusion-MPT* interface to communicate with the controller and firmware.

# 5 Creating Integrated Striping Volumes

This chapter explains how to create Integrated Striping (IS) volumes using the LSI MPT* SAS BIOS Configuration Utility.

## IS Configuration Overview

You can use the LSI MPT* SAS BIOS Configuration Utility to create one or two IS volumes, with up to a total of 12 drives, on an Intel® IT/IR RAID Controller. Each volume can have from two to ten drives. Disks in an IS volume must be connected to the same Intel® IT/IR RAID Controller, and the controller must be in the BIOS boot order.

Although you can use disks of different size in IS volumes, the smallest disk determines the "logical" size of each disk in the volume. In other words, the excess space of the larger member disk(s) is not used. Usable disk space for each disk in an IS volume is adjusted down to a lower value in order to leave room for metadata. Usable disk space may be further reduced to maximize the ability to interchange disks in the same size classification. The supported stripe size is 64 kbytes.

For more information about Integrated Striping volumes, see "Features" on page 19.

## Creating IS Volumes

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

```
Please wait, Invoking Configuration Utility...
```

After a brief pause, the main menu of the LSI MPT* SAS BIOS Configuration Utility appears. On some systems, however, the following message appears next:

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

In this case, the utility will load after the system has completed its power-on self test.

Follow the steps below to configure an Integrated Striping (IS) volume with the LSI MPT* SAS BIOS Configuration Utility. The procedure assumes that the required controller(s) and disks are already installed in the computer system. You can configure an IM/IME volume and an IS volume on the same Intel® IT/IR RAID Controller.

1. On the Adapter List screen of the LSI MPT* SAS BIOS Configuration Utility, use the arrow keys to select a RAID adapter.

2. Press <Enter> to go to the Adapter Properties screen, as shown in Figure 9.

```
LSI Corp Config Utility     v6.24.00.00 (2008.07.01)
Adapter Properties -- SAS1064E

        Adapter                     SASWT4I
        PCI Slot                    06
        PCI Address(Bus/Dev)        0A:00
        MPT Firmware Revision       1.26.00.00-IR
        SAS Address                 500605B0:000C9B64
        NVDATA Version              2D.00
        Status                      Enabled
        Boot Order                  0
        Boot Support                [Enabled BIOS & OS]

        RAID Properties

        SAS Topology

        Advanced Adapter Properties


Esc = Exit Menu        F1/Shift+1 = Help
Enter = Select Item    -/+/Enter = Change Item
```

**Figure 9. Adapter Properties Screen**

3. On the Adapter Properties screen, use the arrow keys to select **RAID Properties** and press <Enter>.

4. When you are prompted to select a volume type, select **Create IS Volume**.

   The Create New Array screen shows a list of disks that can be added to a volume.

5. Move the cursor to the RAID Disk column. To add a disk to the volume, change the No to Yes by pressing the <+> or <-> key, or the space bar. As disks are added, the Array Size field changes to reflect the size of the new volume.

   There are several limitations when creating an IS (RAID 0) volume:

   — All disks must be either SATA (with extended command set support) or SAS (with SMART support).

   — Disks must have 512 byte blocks and must not have removable media.

   — There must be at least two and no more than ten drives in a valid IS volume. Hot-spare drives are not allowed.
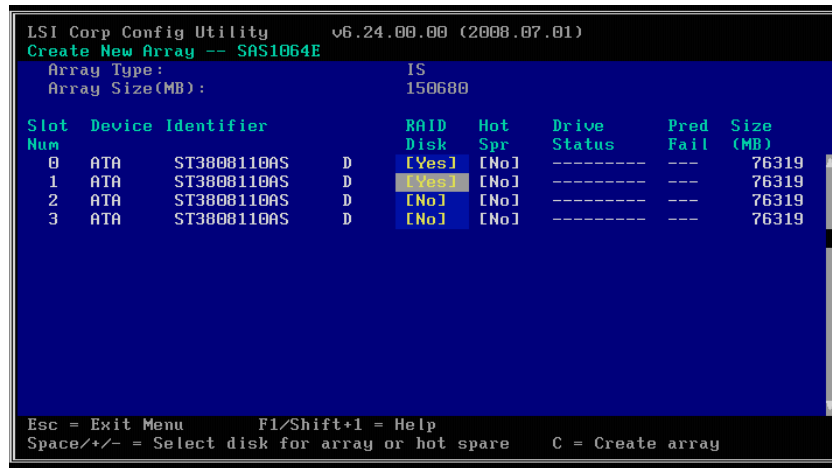
**Figure 10. Create New Array Screen**

6. When you have added the desired number of disks to the array, press <C> and then select **Save changes**. Then exit the menu to commit the changes. The configuration utility pauses while the array is created.

# Creating a Second IS Volume

The Intel® IT/IR RAID Controllers allow you to configure two IS volumes, or an IS volume and an IM/IME volume. If one volume is already configured, and if there are available disk drives, there are two ways to add a second volume.

**Option 1:** Perform the following steps:

1. In the LSI MPT* SAS BIOS Configuration Utility select an adapter from the Adapter List. Select the **RAID Properties** option.

   The current volume will be displayed.

2. Press <C> to create a new volume.

3. Continue with Step 4 of "Creating IS Volumes," to create a second IS volume.

**Option 2:** Perform the following steps:

1. On the Adapter List screen, use the arrow keys to select an Intel® IT/IR RAID Controller.

2. Press <Enter> to go to the Adapter Properties screen, shown in Figure 9.

3. On the Adapter Properties screen, use the arrow keys to select **RAID Properties** and press <Enter>.

4. Continue with step 4 in "Creating IS Volumes" on page 23 to create a second IS volume.

# Other Configuration Tasks

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

## Viewing IS Volume Properties

To view the properties of IS volumes, follow these steps:

1. In the configuration utility, select an adapter from the Adapter List.

2. Select the **RAID Properties** option.

   The properties of the current volume are displayed.

3. If more than one volume is configured, press <Alt> + <N> to view the next array.

4. To manage the current array, press <Enter> when the Manage Array item is selected.

## Activating an Array

An array can become inactive if, for example, it is removed from one controller or computer and moved to another one. The "Activate Array" option allows you to reactivate an inactive array that has been added to a system. This option is only available when the selected array is currently inactive.

To activate an array once it has been selected, follow these steps:

1. Choose **Activate Array** on the Manage Array screen.

2. Press <Y> to proceed with the activation, or press <N> to abandon it. After a pause, the array will be active.

## Deleting an Array

*Caution:* *Once a volume has been deleted, it cannot be recovered. Before deleting an array, be sure to back up all data on the array that you want to keep.*

To delete a selected array, follow these steps:

1. Select **Delete Array** on the Manage Array screen.

2. Press <Y> to delete the array, or press <N> to abandon the deletion. After a pause, the firmware deletes the array.

   *Note:* *The master boot records of all disks are deleted and data cannot be recovered.*

# Locating a Disk Drive, or Multiple Disk Drives in a Volume

You can use the LSI MPT* SAS BIOS Configuration Utility to locate and identify a specific physical disk drive by flashing the drive's LED. You can also use the utility to flash the LEDs of all the disk drives in a RAID volume. There are several ways to do this:

- When you are creating an IS volume, and a disk drive is set to Yes as part of the volume, the LED on the disk drive is flashing. The LED is turned off when you are finished creating the volume.

- You can locate individual disk drives from the SAS Topology screen. To do this, move the cursor to the name of the disk in the Device Identifier column and press <Enter>. The LED on the disk flashes until the next key is pressed.

- You can locate all the disk drives in a volume by selecting the volume on the SAS Topology screen. The LEDs flash on all disk drives in the volume.

*Note:* *The LEDs on the disk drives will flash as described above if the firmware is correctly configured and the drives or the disk enclosure supports disk location.*

# Selecting a Boot Disk

You can select a boot disk in the SAS Topology screen. This disk is then moved to scan ID 0 on the next boot, and remains at this position. This makes it easier to set BIOS boot device options and to keep the boot device constant during device additions and removals. There can be only one boot disk.

To select a boot disk, follow these steps:

1. In the LSI MPT* SAS BIOS Configuration Utility, select an adapter from the Adapter List.

2. Select the **SAS Topology** option.

   The current topology is displayed. If the selection of a boot device is supported, the bottom of the screen lists the <Alt> + <B> option. This is the key for toggling the boot device. If a device is currently configured as the boot device, the Device Info column on the SAS Topology screen will show the word "Boot."

3. To select a boot disk, move the cursor to the disk and press <Alt> + <B>.

4. To remove the boot designator, move the cursor down to the current boot disk and press <Alt> + <B>.

   This controller will no longer have 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 will move to this disk.

   *Note:* *The firmware must be configured correctly for the <Alt> + <B> feature to work.*

# 6 Intel® IT/IR RAID Management Under Operating Systems

This chapter introduces the RAID management utility for Intel® IT/IR RAID under operating systems.

## Operating System Installation

For information about installing operating systems on Intel® IT/IR RAID, refer to the "Intel® RAID Drivers" section in the *Intel® RAID Software User's Guide*.

## Using Intel® RAID Web Console 2 to Manage Intel® IT/IR RAID

For information about using this utility to manage RAID under various operating systems, refer to the "Intel® RAID Web Console 2" section in the *Intel® RAID Software User's Guide*.

*Warning:* *For hard drives that are in IT (non-RAID) mode under operating systems, data will be lost if using Intel® RAID Web Console 2 to create Intel® IT/IR RAID. This happens even if partitions have already been made to the IT mode drives under operating systems.*