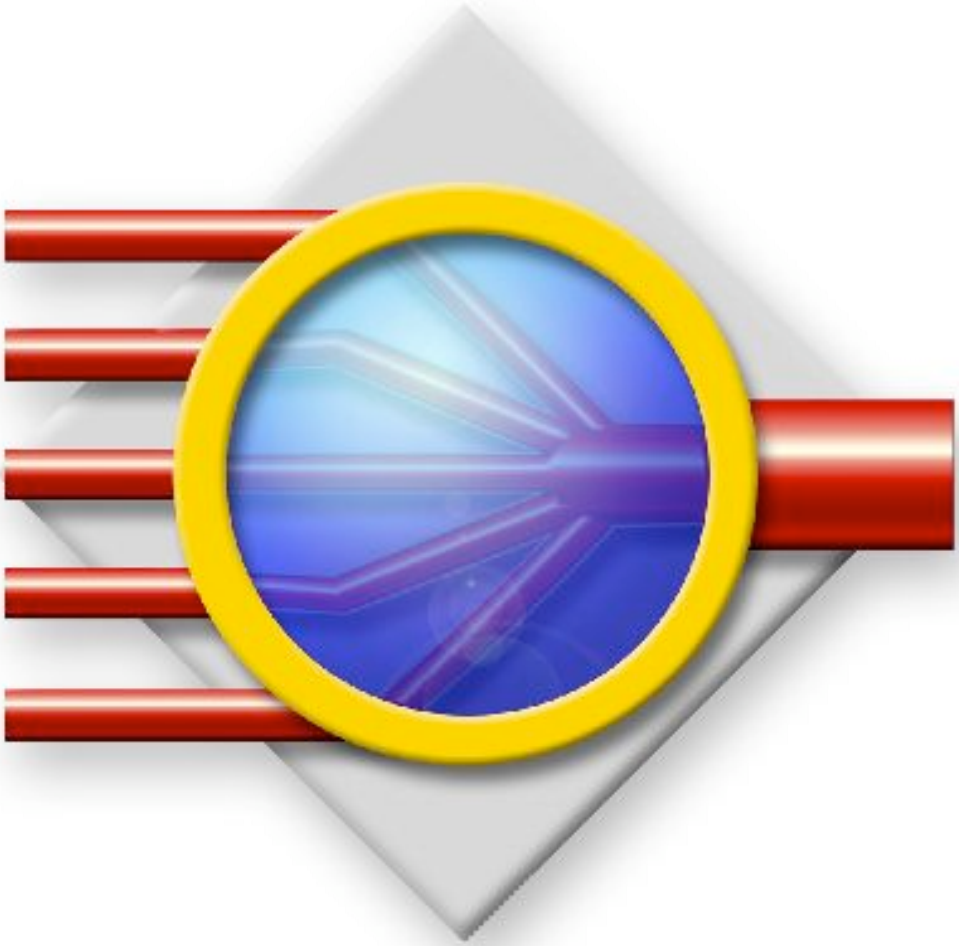


SoftRAID 3
Manual

v.3.6.7

Table of Contents

Understanding SoftRAID 3

SoftRAID 3 is an application and disk driver which allows you to maximize the performance of your hard disks to meet your computing needs. It is a software implementation of **RAID**. RAID stands for **Redundant Array of Independent Disks**. It describes a way of arranging data on multiple disk drives so they can be used as one volume. In the past, RAID has only been available as a separate external box which contained an array of disks and the software to run them. **SoftRAID 3** gives you the benefits of RAID for your existing disks without the need for any other supplemental hardware or software.

Disks and Buses

SoftRAID 3 works with several types of hard drives or disks: **FireWire**, **USB**, **SCSI**, **ATA**, **S-ATA** and **Fibre Channel**. These disks connect and communicate with the Mac via **buses**. Buses are made up of: a) the cables which attach the disk to the Mac, b) the chips which send signals along the cables, and c) the software which controls the chips. FireWire, USB, SCSI and ATA are the types of storage buses supported by SoftRAID 3. Fibre Channel is a speedy implementation of the SCSI bus.

Disks differ in their performance, their portability, and their cost. Most Macs come with ATA disks built in. SCSI is a higher performance and more expensive disk; a FireWire disk is slower but much more portable. Fibre Channel is very fast, very expensive, and not very portable.

	Speed	Cost	Portability
USB	✓	✓✓	✓✓✓✓
FireWire	✓✓✓	✓✓	✓✓✓✓
ATA	✓✓✓	✓	✓
SCSI	✓✓✓	✓✓✓	✓✓
Fibre Channel	✓✓✓✓	✓✓✓✓	✓

Drivers, Volumes and Partitions

Mac OS X communicates with hard disks using **drivers**. The driver gives instructions to the disks on how to distribute data coming from the Mac onto the disks. Disk management software, such as SoftRAID 3, installs drivers into systems and then uses the drivers to create **volumes** on disks. Volumes are discrete entities made up of one or more **partitions** from one or more disks. Partitions are blocks of sectors on a disk assigned by the driver to a specific volume.

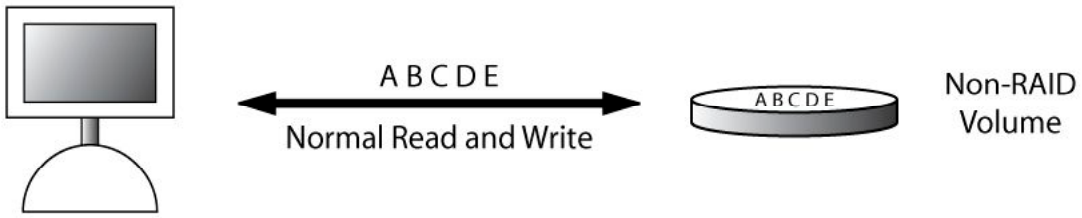
Before a volume can be created on a hard disk, the disk must first be **initialized**. Initializing a disk involves writing information to the beginning of the disk so a Macintosh can recognize it. Internal disks which come with the Macintosh are initialized with Apple's Disk Utility application. Disks which are purchased from vendors other than Apple are often uninitialized or have been initialized to work on a PC. Disks must first be initialized with the SoftRAID application before SoftRAID can recognize them.

Understanding RAID (cont.)

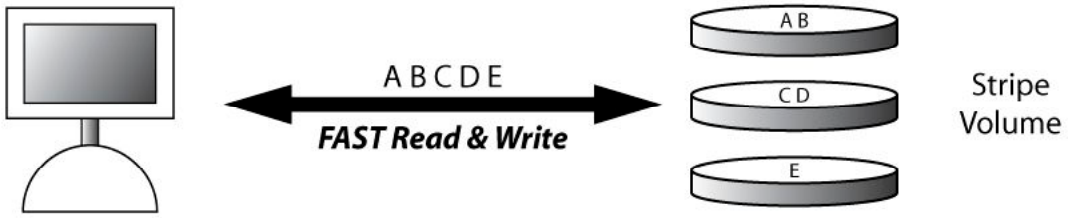
SOFTRAID 3 can create **non-RAID**, **Stripe** (**RAID 0**) and **Mirror** (**RAID 1**) volumes. The advantages of combining disks into RAID volumes are:

Increased speed when reading data off the disks and/or
Increased security from having ongoing data backup.

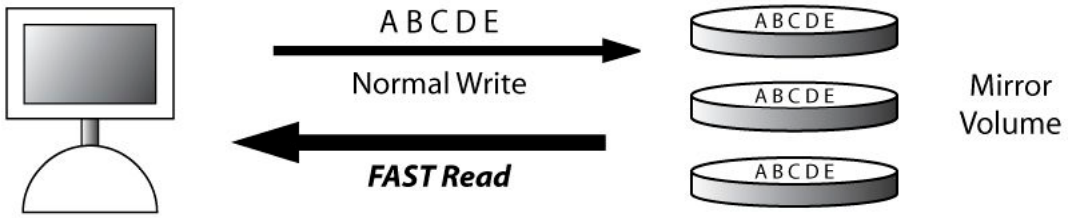
Non-RAID A non-RAID or standard volume consists of one disk drive. The speed of reading data off of a disk is physically constrained by how fast the reading mechanism, or disk head, can read data from the spinning disk.



Stripe (RAID 0) If the data, instead of being clustered on one disk, is evenly distributed over two or more disks, each disk head can be reading or writing a part of the data simultaneously. A Stripe volume distributes the data across all the disks. The more disks used in a volume, the faster the reading and writing.



Mirror (RAID 1) When all of the data is written to each of the disks, a Mirror volume is created. This makes the backup of data an ongoing process. If one disk fails, the data is intact on the other disks in the volume. SoftRAID 3 enhances RAID 1 by allowing more than two disks in a Mirror volume and by making reads as fast as those from a RAID 0 Stripe volume.



Planning Your SoftRAID Volumes

SoftRAID 3 gives you great flexibility in configuring different types of volumes over numerous combinations of disks. Planning your volume strategy ahead of time can assure you the maximum effective use of disk space and bus performance.

When planning your strategy you will need to decide:

1. **What types of volumes you want to create or convert,**
2. **What the bus speeds and capacities are of your disks, and**
3. **Where on the disks your volumes will reside.**

1. Types of Volumes

RAID and non-RAID Volumes - The types of volumes you choose to create are based on the main use of your Macintosh. If you are a Server Administrator or a user needing instantaneous backup you will create **Mirror volumes** and possibly **read-only secondary volumes**. If you are a Video or Graphics professional or need fast data access, you will create **Stripe volumes**. **Non-RAID** (standard) **volumes** are used by anyone needing a SoftRAID volume on just one disk. Many users will create a combination of volumes to meet their needs.

Like Apple volumes, the size and volume type of SoftRAID volumes cannot be changed without eliminating the data written to them, so it is important to decide ahead of time which **type** and **size** of volume you want. Apple volumes which already reside on your disks can, however, be converted to SoftRAID volumes without eliminating data with the ***Convert to SoftRAID 3*** command in the **Volume** menu (see page 12). Converting standard Apple volumes gives you the added error reporting protection of SoftRAID volumes. SoftRAID volumes, like Apple volumes can be accessed by Disk Utility to access First Aid.

Startup ("Boot") Volumes - Since Mirror volumes and non-RAID volumes can contain Mac OS X, you can use these as your **startup** ("boot") **volumes** just as you would use a standard Apple volume. (Stripe volumes cannot be used as startup volumes.) We recommend having your system in a Mirror volume so you always have a functioning copy of your system and data even if one of your disks stops working.

Some users may have situations where they know they will benefit from having their system in a non-RAID volume. Mac OS X may be more difficult to configure if it resides on a different volume than your data depending on the applications you use. See the **Organizing your Volumes on your Disks** section below.

2. Types of Disks

When you are designing your volume strategy you will want to have an idea of how much disk space you need and what the speeds are of your disks. **Mirror and Stripe Volumes will only perform as fast as the slowest disk in the volume.** It is always best to choose disks similar in speed and bus for any given volume.

Types of Disks (cont.)

Each bus has a performance standard measured in Megabytes per second. Each of the buses in your Macintosh can accommodate a certain number of disks. If the speeds of all the disks on the bus exceeds the speed of the bus, the performance of any volumes on those disks will be less than optimal. For information on which buses your Macintosh contains, consult the specification page of your owner's manuals for the Mac as well as any PCI cards which have been added.

The following is a list of SoftRAID's recommendations for the number of disks per volume on any one bus:

ATA - Can accommodate up to 2 disks per bus;
recommended use: 1 disk per bus for each volume. Plug one disk in to your built-in ATA bus and additional ATA disks into third party PCI cards.

S-ATA- Like ATA but can accommodate more than 2 disks per bus;
recommended use: 1 or 2 disks per bus for each volume. S-ATA is similar to ATA but more efficient when there are 2 devices on a bus

SCSI - Can accommodate up to 15 disks per bus;
recommended use: up to 4 disks on each bus for a each volume.

FireWire - Can accommodate up to 63 disks per bus;
recommended use: up to 1 disks per bus for a each volume.

FireWire 800 - Can accommodate up to 63 disks per bus;
recommended use: up to 2 disks per bus for a each volume.

Fibre Channel - Can accommodate nearly unlimited disks per bus;
recommended use: up to 8 disks per bus for each volume.

USB 1 and 2 - Can accommodate up to 125 disks per bus,
Due to performance limitations, USB disks are not recommended for use in RAID volumes.

After you choose your type of storage we recommend you read the Keeping RAID Volumes Healthy section on page 45 of this manual.

3. Organizing your Volumes on your Disks

Once the disks and volumes have been chosen, you will want to decide where each volume resides. Placement of volumes can affect their performance. SoftRAID will place volumes in order of creation from the outside of the disk inward. The further out on a disk a volume is, the faster its data is accessed. Stripe volumes which are designed for high performance such as for Digital Video capture, should always be the first created on a disk and we also suggest that they do not take up more than half of the disk capacity.

Volume placement (cont.)
The placement of the startup volume also has implications for different uses.

For Server Administrators and all Mirror volume users:

As mentioned above, Mirror volume users have the option of placing their system in the Mirror volume or in a separate non-RAID volume. We recommend placing the startup system in a Mirror volume because, in the event of a disk error on your Primary disk, SoftRAID will automatically convert one of the secondary disks to the Primary and your Mirror volume will keep running.

For in-depth information on Backup Strategies with Mirror volumes, see the next chapter in this Manual.

For Video and Graphics Professionals and all Stripe volume users:

> **For video capture - dedicated disks**
> Video professionals rely on Stripe volumes to provide a performance level which eliminates the dropping of frames. It is recommended that the Stripe volume(s) be on separate disks from the startup volume. It is also recommended that the Stripe volume only occupy the first half of the disk for maximum performance.

> **For scratch disk users - scratch volume first**
> Graphics professionals also rely on Stripe volume for high performance for their scratch disks, but generally the performance will be at a high enough level even if the volume shares the disk with the startup volume. The Stripe scratch volume should be the first volume created on the disks with Mirror and startup volumes created afterwards.

Video and Graphics Professionals will often also create Mirror volumes to move their footage onto to safeguard completed projects from data loss due to disk failure.

Volumes Sharing Disks

When you create, delete, or convert a volume which is a startup volume or shares the same disk as your startup volume, you need to startup the Mac from a system on a separate disk. This is because disks need to be unmounted during those operations, and a disk which is part of the startup volume cannot be unmounted. You may have a dedicated FireWire disk for this purpose or you can create a **SoftRAID Startup CD-ROM or DVD** with the SoftRAID application. The ***Create SoftRAID Startup CD-ROM or DVD*** command is located in the **Utilities** menu and when selected will instruct you to use your original Mac OS X installer CDs and a blank CD-ROM or DVD for the disk creation. This disk will contain the SoftRAID application, as well as a Mac OS X system with the SoftRAID driver installed.

Backup Strategies with Mirror Volumes

SoftRAID Mirror volumes give you speed and reliability while they are giving instantaneous backup. Depending on what protection you are seeking, there is a Mirror volume solution for you.

If You Need :

Protection From Catastrophic Disk Failure
A catastrophic disk failure is when one disk can no longer read or write data. If you have your system and data in a Mirror volume of two or more disks, and one disk fails, your Mirror volume will still function correctly.

Offsite Backup
If you want to maintain an offsite backup of your volume to protect yourself from data loss due to fire, flood, theft, and other threats, you will want to create a Mirror volume with at least three disks. This will allow you to store one of the disks of the Mirror volume offsite in a secure location while the other two are used with the Mac. When you want to update your offsite backup, you can remove the secondary disk from your operating Mirror volume and replace it with the disk which was stored offsite. The disk you just removed is then placed offsite and becomes your updated offsite backup. SoftRAID will then rebuild the disk you just attached, in the background, while you continue to use the Mirror volume. See the **Mirror Essentials** section in this manual for information about creating a Mirror volume, starting and automating a Mirror volume rebuild, and identifying the secondary disks of a Mirror volume.

To Archive your Server
If you cannot easily backup your server volume because it needs to be available 24 hours a day and 7 days a week, you can create archives using a SoftRAID Mirror volume. Depending on how many archives you want to store offsite, you can choose disks or tape as your archive medium.

Short-term archiving to Disks
If you want to maintain a short-term offsite archive and store your backup data on disks, you can create a Mirror volume and rebuild it to a new disk every time you want to create a new offsite backup copy. When your oldest offsite disk is so old that its data is irrelevant, you can recycle the disk by rebuilding your Mirror volume to it again. This will give you a fresh copy of your volume's data and you can continue to recycle the oldest disks in your offsite storage in this manner. See the **Mirror Essentials** section in this manual for additional information on maintaining your Mirror volumes.

Long-term Archiving to Tape
If you need a long history of archives, you will want to use tape as your archive medium. To archive to tape using a SoftRAID Mirror volume, you will create a read-only secondary disk which can be removed from the server and mounted on another Mac with a tape backup. The data on the disk will be backed up onto tape and then the disk is returned to the Mirror volume. For more information on read-only secondary disks, see the **Mirror Essentials** section in this manual.

SoftRAID and Intel

Two Types of Disks

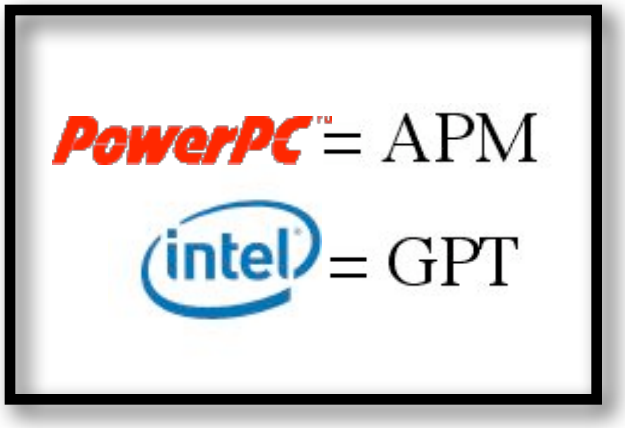
With the introduction of the new Intel architecture on the Mac, Apple has changed the way it maps out data onto hard disks. Previously, on PowerPC machines, disks would be written with an Apple Partition Map, or **APM**. In Intel, Apple uses the GUID Partition Table or **GPT**. GPT disks are readable on both Intel and Power PC machines, but can be used as startup disks only on Intel machines. Likewise, Intel and PowerPC machines both recognize APM disks, but these disks can only be used as startup disks on Power PC.

SoftRAID volumes can exist on either GPT or APM disks but all of the disks in the volume need to be the same designation. If you are starting from scratch with your new Intel Machine, this is not a problem because you will be creating GPT disks and using these for SoftRAID volumes.

You can also bring over non-startup SoftRAID volumes which you created on your Power PC machines and use these on your Intel Machines. SoftRAID's disk tiles will indicate what type of Apple Partition scheme was used when the volume was created.

GPT Startup Disks.- SoftRAID Mirror and Non-RAID volumes created on SoftRAID initialized GPT format disks can be startup volumes for Intel Machines as long as the startup system is 10.4.8 or later. To create a SoftRAID startup volume from GPT formatted disks, the disks must be initialized with SoftRAID while booted from a disk **OS X 10.4.8 or later**, and the resulting Startup Volume must be selected as the boot volume using the Startup Disk window of the 10.4.8 System Preferences under the Apple Menu.

When you are initializing disks with the SoftRAID driver, you can choose the type of partition scheme you would like.



SoftRAID volumes can reside on either type of disk.

Using SoftRAID 3

SoftRAID 3 consists of:

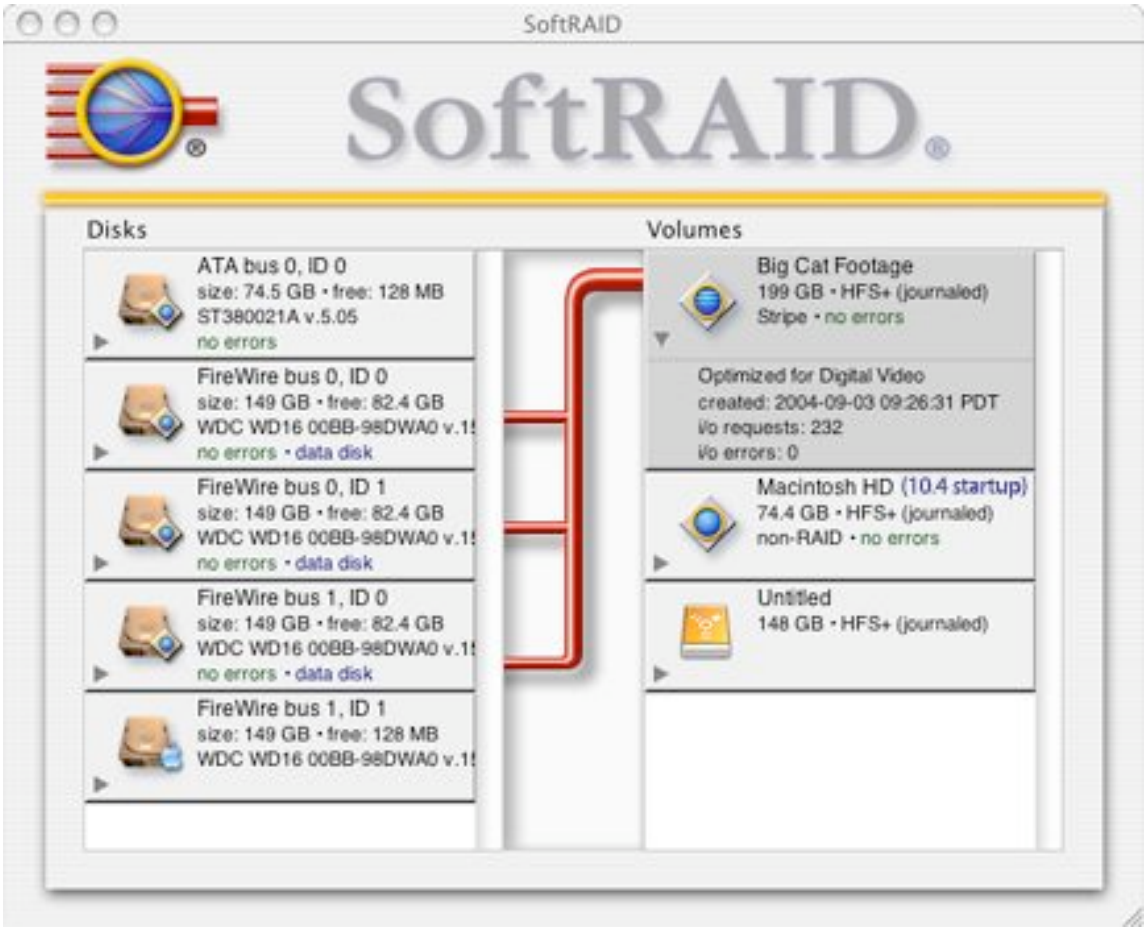
the **SoftRAID Application,** used to create and manage SoftRAID volumes,

the **SoftRAID Monitor,** used to alert you to changes in volume states when the Application is not running, and

the **SoftRAID Driver,** which does the actual work of reading and writing data and handling error conditions.

The SoftRAID Application

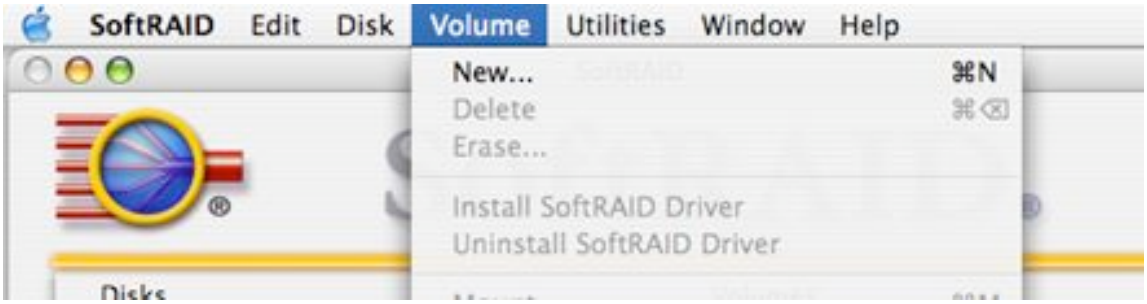
The SoftRAID application window consists of a list of **disks** on the left, a list of **volumes** on the right, and **connection pipes** in the middle which appear when a single disk or volume is selected. This window is used to keep track of and maintain the volumes you create.



This window shows 5 disks attached to the Mac:

• 1 **ATA boot** disk initialized with the SoftRAID driver. This is the disk that this particular machine boots from,
• 3 **FireWire** disks joined together in a Mirror volume called Big Cat Footage,
• 1 **FireWire** disk initialized with the Apple driver, containing an untitled non-RAID volume.

The SoftRAID application (cont.)



The menus in the SoftRAID application contain all the commands and utilities you will need for the creation and maintenance of your SoftRAID volumes. The menu items are discussed in this section and in the **Mirror Essentials**, **Stripe Essentials** and **Glossary** sections of this manual.

The SoftRAID Monitor

The SoftRAID Monitor is a part of SoftRAID 3 which runs invisibly, but gives you alerts when errors and changes in volume states occur. The SoftRAID application does not need to be launched for the Monitor to work. Through the **Monitor Preferences** in the application, you can select what types of alerts you will receive.

This is the type of alert that the Monitor can display.

The SoftRAID Driver

The SoftRAID driver is the real workhorse of SoftRAID 3 and is in charge of performing all read/write operations to SoftRAID volumes. It also keeps track of volumes and reports any changes in states to the Monitor and the Application. The SoftRAID driver must be installed in the startup system to recognize SoftRAID volumes. SoftRAID automatically asks a user if they want to install the driver if it detects that it is missing from the system. A user can access driver functions only through the Application window or the Monitor dialog boxes.

Creating and Using SoftRAID Volumes

SoftRAID volumes, like Apple Disk Utility volumes, are accessed using a driver installed in the System folder of your startup volume. SoftRAID volumes can only be created on SoftRAID initialized disks .

Once a disk has been initialized with the SoftRAID driver, it will only appear on the desktop of machines with systems containing the SoftRAID driver. The SoftRAID driver has been preinstalled on all Macs running OS X 10.4 and greater.

Preparing Disks for SoftRAID Volumes

The first step in creating a SoftRAID volume is to initialize the disk(s) with the SoftRAID application. This can happen in two ways:

Initialize

Uninitialized disks, or Apple initialized disks with volumes and data that you **don't** want to keep, can be initialized using the ***Initialize*** command under the **Disk** menu. Since this overwrites your access to any existing data on the disk, you will be asked for your system password.

To Initialize a disk:

1. Highlight a disk tile in the Application window (see note below about Startup disks)

2. Select the ***Initialize*** command under the **Disk** menu. You will be asked for your password.

3. A dialog will appear asking you to choose the format of the disk. Choosing **Default** tells SoftRAID to format the disks according to the type of processor in the Mac i.e., GPT for Intel or APM for PowerPC. Choosing **Custom** allows you to choose which of these you need. All disks in a SoftRAID volume need to have the same format. See page 9 for more information.

4. Once SoftRAID has finished the Initialization procedure, you will see that the disk icon has changed in the Application window as well as on the Desktop. The disk is now ready for the creation of SoftRAID volumes.

Convert to SoftRAID 3

Disks initialized with Apple Disk Utility or SoftRAID 2.x which have volumes with data that you want to keep can be converted to SoftRAID 3 volumes, with the ***Convert to SoftRAID 3*** command in the **Disk** menu. If you wish to retain the data, but change the volume size you will first need to back up your data, reinitialize the disk(s) with the SoftRAID driver, create a new volume and then add back your data.

Note: If you want to create, delete, convert, or initialize a volume which is the startup volume or which shares a disk with the startup volume, you will need

Convert to SoftRAID 3 (cont.)

to start up your Mac from a different startup volume on another disk,or from a SoftRAID Startup CD-ROM or DVD. Volumes undergoing these changes need to be unmounted and the volume from which the Mac is booted cannot be unmounted. To create a CD-ROM or DVD startup disk, you use the Create SoftRAID Startup CD-ROM or DVD command under the Utilities menu. For more details, see page 33 of this manual.

To Convert Disks to SoftRAID 3:

1. Back up all the volumes on the disks you are about to convert.

2. If you are converting a disk containing the Startup volume or one that shares a disk with the startup volume, start up from a **SoftRAID Startup CD-ROM or DVD**, or a separate FireWire disk. For all other volumes, start up as usual.

3. If you are converting a disk containing a **Mirror volume** select the **Preferences** item under the **SoftRAID** menu. Go to the Driver tab and change the "Mirror volume Secondary disk time-out" Preference to 2 minutes. Since the disks of AppleRAID and SoftRAID 2.x volumes are converted one-at-a-time, and the SoftRAID driver looks for those disks to appear in a certain amount of time, (see **Mirror Essentials** in the Manual for more details), this procedure allows you enough time to convert the entire volume. **It is also important not to use the volume until all of the disks in that volume are converted.**

4. Make sure that Apple Disk Utility is not running.

5. Highlight the disks you wish to convert in the Disk column of the Application window. If you are not sure which disks are in the Volume, first highlight the volume in the Volume column.

6. Select the menu item ***Convert to SoftRAID 3*** under the **Disk** menu. The following dialog box appears:

7. Select the **Convert** button. You may be asked for your password before SoftRAID will complete the operation. A progress indicator will appear, showing the time in which all of the disks must be converted.

Convert to SoftRAID 3 (cont.)

Converted Apple disks will show a new SoftRAID volume of the same size as the original volume. For non-RAID volumes, this will be almost the entire disk capacity with just 128 MB of free space left over. This size is regardless of how much data is stored in the volume.

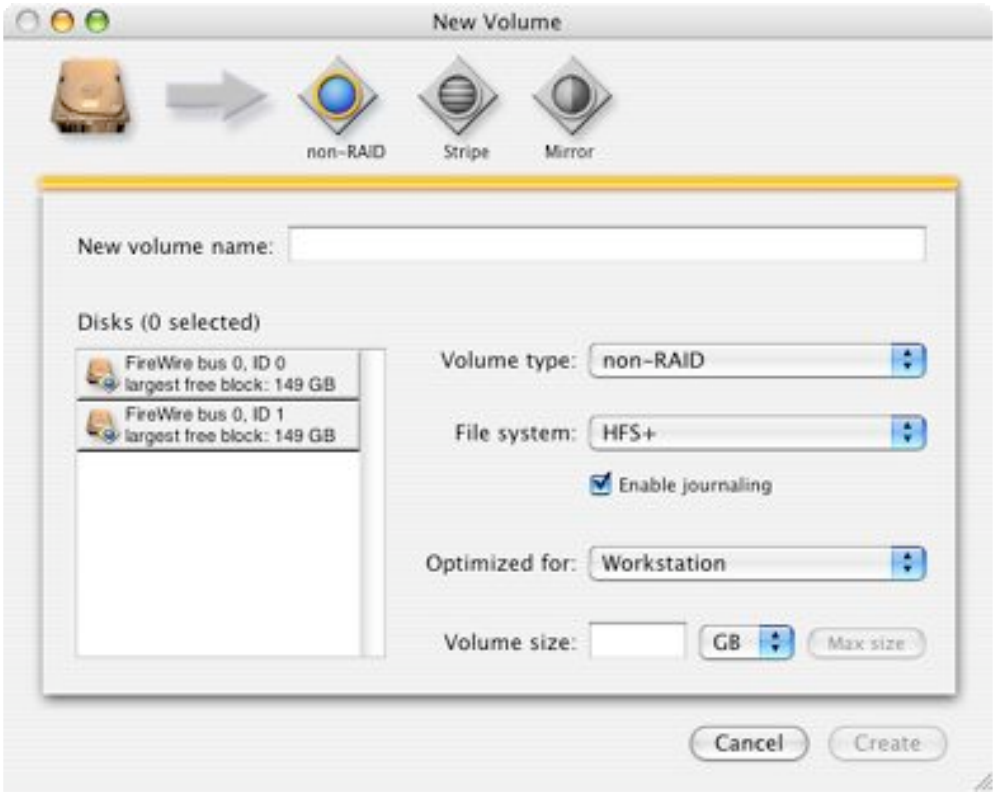
If you have converted a Startup volume you will need to select it in the System Preferences Startup Disk window in order to boot your Mac from it. On an Intel machine the system on the converted disk must be 10.4.8 or later to be bootable.

Note: SoftRAID will not convert an AppleRAID Mirror volume which has failed. To fix the failed state you must correct it in AppleRAID. You can either rebuild the disks in AppleRAID or disconnect the failed disk and convert just the working disk. To detect which disk has failed, you can try copying a large file to or from the volume and seeing which disk is blinking (working) and which disk isn't (failed).

Creating SoftRAID Volumes

Disks which have been initialized with the SoftRAID application which have free space available can be selected to contain SoftRAID volumes. SoftRAID volumes can be created with the ***New...*** command under the **Volume** menu or a SoftRAID Mirror volume can be created using a converted Apple non-RAID volume and using the ***Convert to Mirror...*** command under the **Volume** menu. Step-by step instructions for creating new Mirror and Stripe volumes can be found in the **Mirror Essentials** and **Stripe Essentials** sections of this manual.

New... - This command in the **Volume** menu, brings up the New Volume window which is used to create **non-RAID**, **Stripe**, or **Mirror** volumes.



New... (cont.)

The type of volume can be selected using the icons at the top of the window or the pull-down menu by the **Volume type** text. After a Volume type is selected and disks are selected, the **maximum volume size** will be displayed. A smaller size can be entered. After the **volume name** is entered and the **file system**, **optimization** and **journaling option** chosen, the volume can be created. If the volume is either a Stripe or a Mirror, SoftRAID will show a window asking for further information. (These windows are discussed in the **Mirror Essentials** and **Stripe Essentials** sections of this manual.) After the volume is created, a Volume tile will appear in the application window and a Volume icon with the same name will appear on the desktop.

Types of volumes:

Non-RAID volumes
Non-RAID volumes reside on a single disk and are used like any other volume for reading and writing data. Non-RAID volumes can contain a Mac OS X system and be used as a startup volume.

Stripe volumes
A Stripe volume will increase the speed with which your data is written and read from the disks. To obtain optimal performance from a Stripe volume, you will want to carefully consider the the bus speed and bus combinations mentioned in the **Choosing the Right Bus** section on page 6 of this manual. To find out more about maintaining Stripe volumes, read **Stripe Essentials** later in this manual. **Note: Although a Stripe volume can contain a Mac OS X system, it cannot be used as a startup volume.**

Mirror Volumes
A Mirror volume always consists of a Primary disk and one or more secondary disks. Secondary disks are identical copies of the Primary disk. In the process of creating a Mirror volume, you will choose which disk will be your Primary disk. **If, at any time, the Primary disk is missing from the volume or encounters a read or write error, SoftRAID will automatically convert one of the secondary disks to be the Primary disk.** The Primary disk should always be the fastest, most reliable disk. Mirror volumes can contain a Mac OS X system and be used as a startup volume.

Convert to Mirror...
If you have converted an Apple non-RAID volume to a SoftRAID volume or have created a SoftRAID non-RAID volume that you want to make into a Mirror volume, you can use the SoftRAID ***Convert to Mirror...*** command to create your new volume.

To Convert a Non-RAID volume:

1. Highlight the non-RAID volume in the Application window which you will be converting to a Mirror.

Convert to Mirror (cont.)

2. Select the ***Convert to Mirror...*** menu item in the **Volume** menu. SoftRAID will display the available disks which can be added to the volume. If a disk which you want to use does not appear, it is because it does not have enough available space, is part of another startup volume, or has not yet been initialized with the SoftRAID driver. If the disk is a converted Apple disk, it will show only 128 MB of available space, even if there is no data in the volume. **You must reinitialize this disk with SoftRAID if you want to add it to a SoftRAID volume with a capacity of more than 128 MB.**

3. Select a disk and click the Convert button. A progress indicator will appear which tracks the rebuild process.

Creating a SoftRAID Startup ("Boot") Volume

As discussed in the **Planning your SoftRAID Volumes** section of this manual, you can decide to have your startup system reside in a non-RAID or Mirror SoftRAID volume, or in a standard Apple volume. To create a SoftRAID boot volume, you can either convert an existing Apple boot volume with the ***Convert to SoftRAID 3*** command described previously or you can add Mac OS X to a new or existing SoftRAID Mirror or non-RAID volume.

To add Mac OS X to a new or existing SoftRAID non-RAID or Mirror volume you will need to create a modified Mac OS X install CD-ROM or DVD which contains the SoftRAID driver. The **SoftRAID CDs and DVDs** section, starting on page 32 of this manual, gives you a detailed description of this process.

To create a new SoftRAID Startup Volume

1. Startup your Mac from a startup volume which does not share a disk with the volume you are about to create. If you are creating an Intel startup volume, you must be started up from a volume containing OS X 10.4.8. Use a SoftRAID Startup CD-ROM or DVD as described on page 35 of this manual, or a separate FireWire startup disk.

2. Create a new SoftRAID non-RAID or Mirror volume with the ***New...*** command under the **Volume** menu.

3. Restart your Mac with the **Modified Mac OS X Install CD-ROM or DVD**. To do this, insert it into your CD slot and startup or restart your machine while holding down the "c" key. Once your Mac has started up, you will open into the standard Mac OS X installer window. Follow the instructions for selecting the appropriate volumes for installation.

The disks will work the same as they do when they are used to install a system on an Apple volume. A SoftRAID volume may appear as a folder instead of a volume icon during the install process. This will not affect your

Creating a SoftRAID Startup Volume (cont.)

ability to install Mac OS X onto it.

When the Install process is finished, the Mac will restart using your newly created SoftRAID startup volume.

Changing your Volumes

This section will describe some of the items under the **Volume** and **Utilities** menus which are used to change Volumes. For the Mirror volume and Stripe volume specific commands, please read the **Mirror Essentials** and/or **Stripe Essentials** sections of this manual.

Delete - Deleting a volume wipes away all partitions for that volume as well as all the data in that volume. SoftRAID will ask you for password authentication to initiate this procedure. The Volume tile will disappear and the Volume icon will vanish from the desktop. If SoftRAID is unable to unmount the volume because the volume is shared or another application is using it, you will receive an error message.
Note: If you are creating, deleting, or converting a volume which is the boot volume or which shares the same disk as the boot volume, you will need to start up your Mac from a different system disk or a SoftRAID Startup CD-ROM or DVD. To create a SoftRAID Startup CD-ROM or DVD startup disk, you use the ***Create SoftRAID Startup CD-ROM or DVD*** command under the **Utilities** menu.

Erase - Erasing a volume saves the volume and its partition map but removes all data files from it. You will be prompted to rename the volume and be able to change its optimization and journaling if desired.

Install/Reinstall/Update SoftRAID Driver - The SoftRAID driver needs to be installed on any startup volume which will be connected to SoftRAID volumes. Installing the driver does not change the startup volume into a SoftRAID volume. When the application starts up for the first time it looks to see if a driver is installed in any systems on any volumes connected to the Mac and gives you the opportunity to install it. The driver has to be installed on the startup volume for SoftRAID to operate but it does not need to be on the other systems unless they will be used at some later date as the startup volumes. This option allows you to install the driver at times other than when SoftRAID detects the absence of the driver. If the SoftRAID driver is already installed, the command changes to ***Reinstall***. You may want to reinstall the driver if you thought it had become corrupted. If SoftRAID detects an older driver, the command changes to ***Update***.

Uninstall SoftRAID Driver - If, at some time, you want to troubleshoot a disk or volume situation without the presence of the SoftRAID driver, you can use this command to uninstall it. Once the driver is gone, the system will no longer be able to see any SoftRAID volumes connected to the Mac.

Mount - A volume which does not appear on the desktop is considered unmounted. A volume can be unmounted by dragging its **Volume icon** to the trash/eject icon on the

dock. The Volume tile will continue to appear in the Application window but the volume icon will not appear on the desktop. To make the volume remount, highlight the Volume tile and choose the ***Mount*** command.

Enable/Disable Journaling - When Journaling is enabled, the file system will create an area on the volume where changes to the volume's file system are recorded before the changes are actually made. When rebooting after a crash, the Mac uses this information to rebuild the volume's file system. This item can be selected when the volume is being created in the New volume window and then can be changed at a later date with this menu command. It is recommended to always use journaling unless the application being used suggests that it be disabled.

Clear I/O counters - SoftRAID tracks I/O counts and errors by volume, and by disk. This menu item will clear all I/O Counters on the selected volume(s) or disk(s).

Optimize for.... - When creating a SoftRAID volume you are asked how you would like SoftRAID to optimize the volume for the best performance for your use. If you decide to change the use of the volume, you can go and change the optimization with this command.

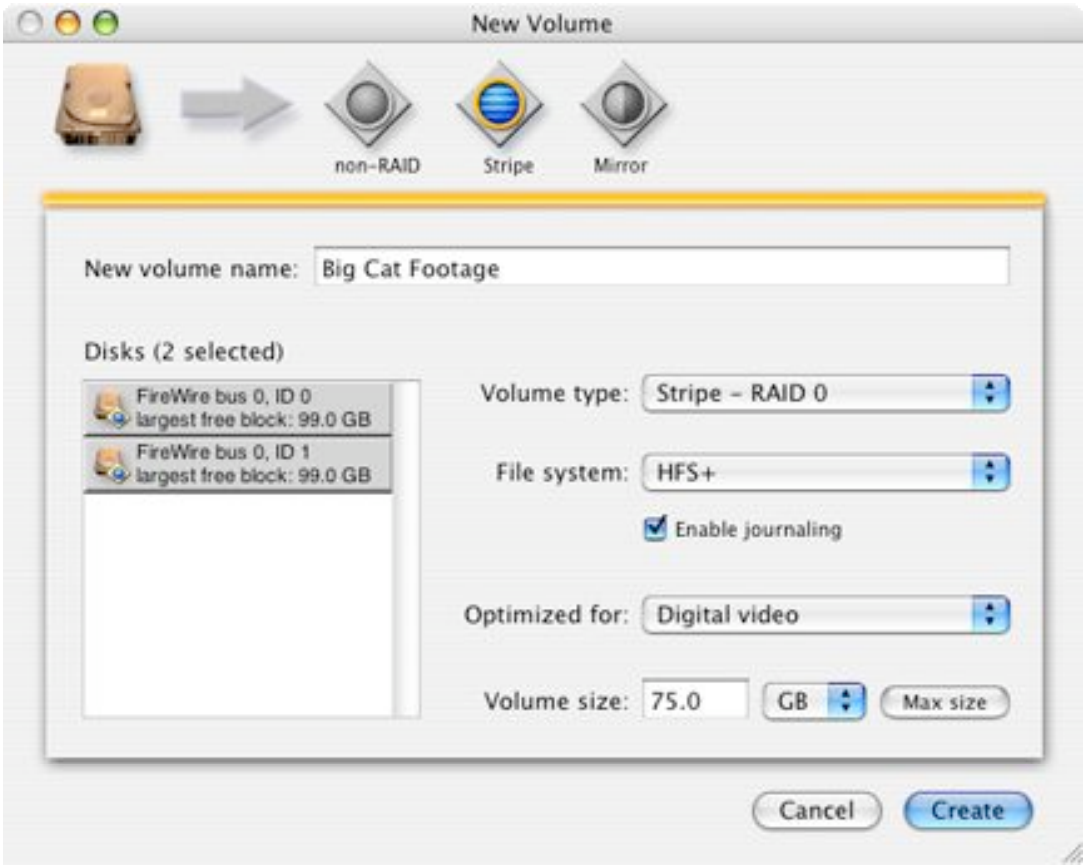
Stripe Essentials

SoftRAID 3 Stripe *volumes* bring flexibility and speed to users requiring the fastest data access. This section will describe the creation and maintenance of Stripe volumes.

Creating a Stripe Volume

Creating a Stripe volume is straightforward and simple. As noted in the **Planning Your SoftRAID Volume** section of this manual, the placement of your Stripe volumes on disks can affect their performance. For the highest performance needs, we recommend creating Stripe volumes on dedicated disks and that the volume size be half of the maximum volume size. For more detailed recommendations see page 7 of this manual.

1. Select *New...* This command is located under the **Volume** Menu. The **New Volume** window will appear:



2. Select the Disks - Disks can be chosen from the New Volume window, or from the Application window before the ***New..*** command is selected. If disks are chosen from the Application window, they will appear highlighted in the New Volume window. Disks can be selected by clicking, shift-clicking, command-clicking, or dragging through the list of disks. Disks which have no free space, or which aren't controlled by SoftRAID will not appear in this window. Disks which contain the

Creating a Stripe Volume (cont.)

startup volume will also not be available for a new volume unless you first startup from another system. See the section on the ***Create SoftRAID Startup CD-ROM or DVD*** command on page 33 of this manual.

3. Select the Volume type - The Stripe volume type can be chosen from the pull-down menu or by clicking the icons at the top of the window.

4. Select the File System - Choose **HFS+** unless the application to be used on the volume specifies **UFS** (Unix File System) or **Case Sensitive HFS+** in its documentation.

5. Enable Journaling - When Journaling is enabled, the file system will create an area on the volume where changes to the volume's file system are recorded before the changes are actually made. When rebooting after a crash, the Mac uses this information to rebuild the volume's file system. This should remain enabled unless the application in use specifies that journaling should be turned off.

6. Select the Optimization - SoftRAID 3 gives you four choices for optimization: Workstation, Server, Digital Video and Digital Audio. Choose the setting which best describes how you will use the volume. SoftRAID will then adjust transfer parameters for each setting. If you are unsure of the which setting you need, choose Workstation.

7. Select the Volume Size - This box will, by default, display the maximum size Stripe volume which you can create with the disks you have selected. Type in the desired volume size. If after selecting a volume size you wish to change to the Maximum size again, use the **Max size** button.

8. Type in the New volume name - This name will appear in a Volume tile in the Application window and under the Volume icon on the desktop. Volumes names should be less than 28 characters and cannot include colon (:) or forward slash (/) characters.

9. Click the Create Button - The **Stripe Unit Size** dialog box appears. SoftRAID 3 creates a Stripe volume by segmenting data into chunks and sending them to each subsequent disk in the array. The size of the chunk is called the stripe unit size.

Stripe Unit Size (cont.)
SoftRAID's recommended stripe unit size for a Workstation is 64k, a Server is 32k and the Digital Audio or Video is 128k. This window lets you modify or confirm this setting. This setting cannot be changed once a volume is created unless a new volume is created with the ***Erase*** command under the Volume menu. Advanced users can experiment with alternative stripe unit sizes to increase performance of their Stripe volume for custom applications like Digital Video, Digital Audio, etc.

Maintaining a Stripe Volume

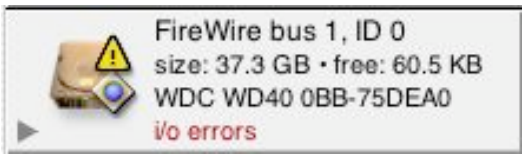
Once a Stripe volume is mounted, it can be used like any other volume on the desktop. Like any other volume, it is subject to any performance changes of the hard disk. SoftRAID 3 is continually monitoring the state of the volume and reports these changes in the Application window and the Monitor dialog boxes which appear on the Desktop.

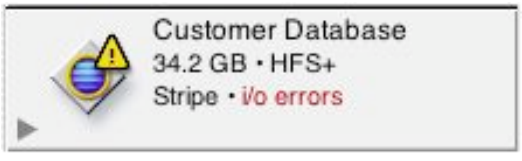
Stripe Volume and Disk States

The Volume tile for a Stripe volume will display information about the volume, such as the number i/o requests, i/o errors and whether the volume is missing disks. The following tiles show the different states detected by SoftRAID:

No errors
A Stripe volume in which all the disks are available and which hasn't experienced any i/o errors will have a Volume tile with the text **no errors** in Green.

I/O Errors
If any of the disks used in a Stripe volume encounter errors during operation, a **caution sign** will appear on the volume tile and the number of errors will show up in the expanded tile. The disk tile of the disk experiencing the i/o errors will also have a caution sign on it. This Stripe volume can still be used but should be





investigated for **data loss**. You should back up this volume, and replace the error causing disk(s) if necessary. I/O errors can occur because a single disk is damaged or can occur if there is an interruption in power.

If more than one disk tile shows a caution sign, it may indicate a brownout or a

I/O errors (cont.)

cable problem. To diagnose an error, see the **System Log** section on the next page.

Failed Stripe Volume

If any disk used in a striped volume fails during operation or fails to mount, the entire volume becomes unusable, and all data in that volume becomes inaccessible. If this occurs, a stop sign will appear on the volume tile in the SoftRAID application with

the text **missing stripe disks**. If the missing disk cannot be restarted, all data on the volume will be lost and the volume will be unrecoverable.

Using the System Log

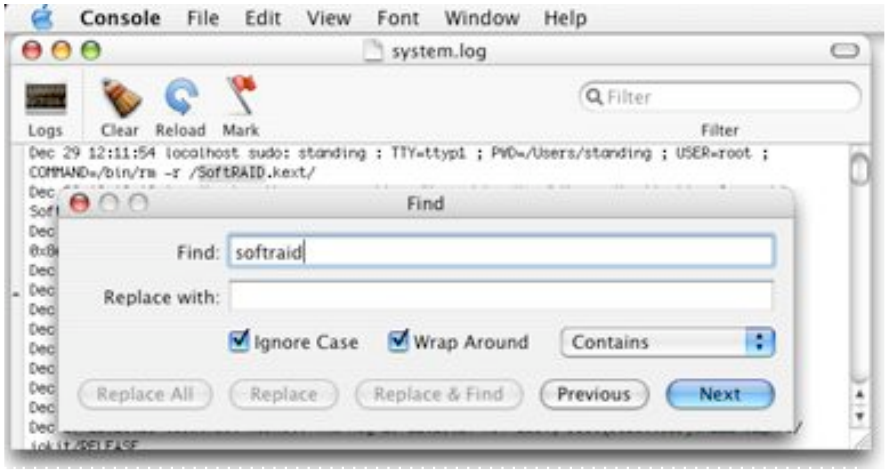
The System Log is a part of OS X. It allows a driver to write events to it with a time stamp. This is useful information if you are trying to investigate when a disk error may have occurred. If the Driver Preference in SoftRAID is set to “Write volume errors to system log,” SoftRAID will record all i/o errors to the Log. To search the Log:

1. Select Show System Log in the **Utilities** Menu. The Console Application will launch.

2. Choose Find under the **Edit** Menu of the Console Application

3. Search for “SoftRAID” or “SoftRAID driver log:” if you are looking specifically for I/O errors.

4. When finished, quit the Console Application and return to SoftRAID .

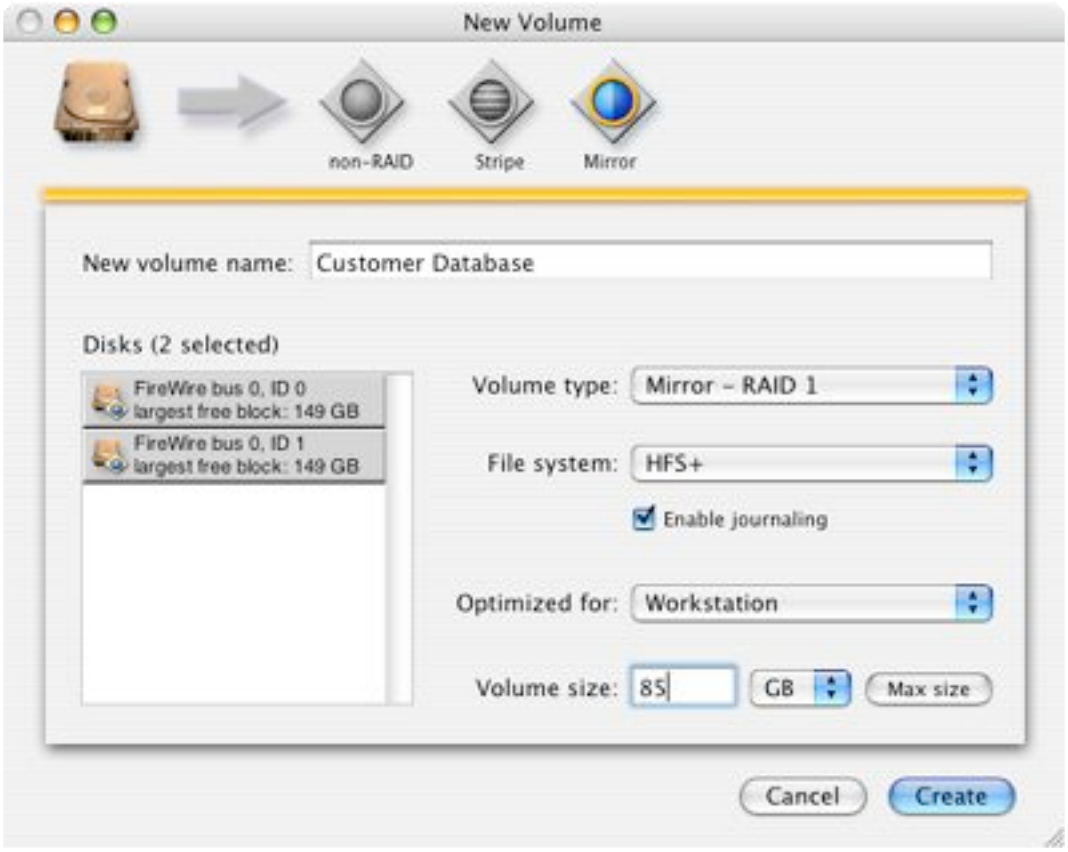


Mirror Essentials

SoftRAID's unique strategy for creating Mirror volumes lets you increase the power and flexibility of your backup scenarios. SoftRAID allows more than two disks in a Mirror volume and its Mirror volumes offer the same high performance reads as its Stripe volumes with the same number of disks. Mirror volumes can also be used as startup volumes on both PowerPC and Intel Macs. This section will give a more detailed explanation of how you create and manage Mirror volumes with SoftRAID.

Creating a Mirror Volume

1. Select *New...* This command is located under the **Volume** menu. The **New Volume** window will appear:



2. Select the Disks - Disks can be chosen from the New Volume window, or from the Application window before the ***New..*** command is selected. If disks are chosen from the Application window, they will appear highlighted in the New Volume window. Disks can be selected by clicking, shift-clicking, command-clicking, or dragging through the list of disks. Disks which have no free space, or which aren't controlled by SoftRAID will not appear in this window. Disks which contain the startup volume will also not be available for a new volume unless you first startup from another system. See the section on the ***Create SoftRAID Startup CD-ROM or DVD*** command on page 33.

Creating a Mirror volume (cont.)

3. Select the Volume type - The Mirror volume type can be chosen from the pull-down menu or by clicking on the icons at the top of the window.

4. Select the File System - Choose **HFS+** unless the application to be used on the volume specifies **UFS** (Unix File System) or **Case Sensitive HFS+** in its documentation.

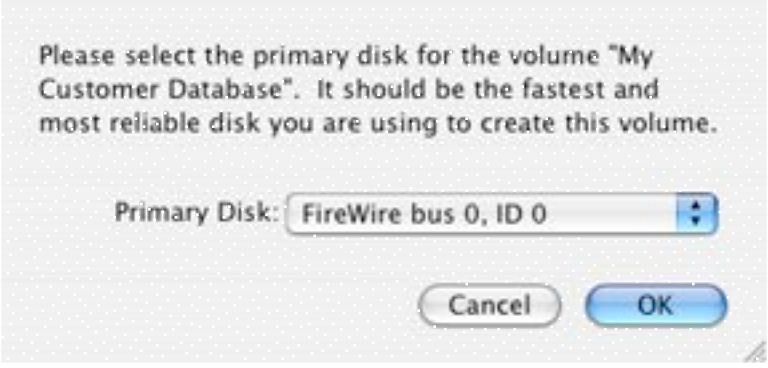
5. Enable Journaling - When Journaling is enabled, the file system will create an area on the volume where changes to the volume's file system are recorded before the changes are actually made. When rebooting after a crash, the Mac uses this information to rebuild the volume's file system. This should remain enabled unless the application in use specifies that journaling should be turned off.

6. Select the Optimization - SoftRAID 3 gives you four choices for optimization: Workstation, Server, Digital Video and Digital Audio. Choose the setting which best describes how you will use the volume. SoftRAID will then adjust transfer parameters for each setting. If you are unsure of the which setting you need, choose Workstation.

7. Select the Volume Size - This box will, by default, display the Maximum size Mirror volume which you can create with the disks you have selected. Type in the desired volume size. If after selecting a volume size you wish to change to the Maximum size again, use the **Max size** button.

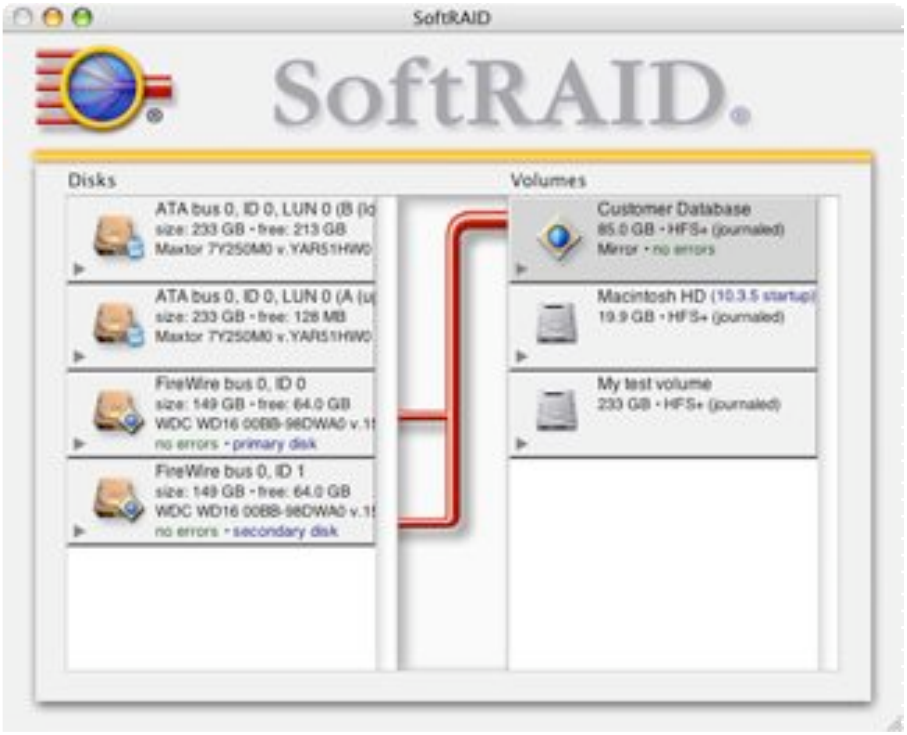
8. Type in the New volume name - This name will appear in a Volume tile in the Application window and under the Volume icon on the desktop. Volumes names should be less than 28 characters and cannot include colons (:) or forward slash (/) characters.

9. Click the Create Button - The **Primary Disk** dialog box will appear. The Primary disk contains the original data and the secondary disks are identical copies of it. When you create a new Mirror volume, SoftRAID asks which disk you prefer as your Primary disk and then designates all others in the volume as secondary disks. The Primary which appears as the first selection is the one which SoftRAID suggests based on its analysis of the buses of the possible Primary disks.



Creating a Mirror volume (cont.)

SoftRAID always requires one Primary disk in a volume. If SoftRAID does not detect a Primary disk, it will automatically convert one of the volume's secondary disks into the Primary disk. If a Primary disk fails during Mirror operations, SoftRAID will automatically convert a secondary disk to become the new Primary to ensure the data integrity.



A Mirror Volume and its disks

Adding a System to a Mirror volume

A new or existing SoftRAID Mirror volume can be transformed into a startup disk by installing Mac OS X on it. You will need to create a modified Mac OS X install CD which contains the SoftRAID driver for a successful installation. The ***Create Modify Mac OS X Install CD-ROM or DVD*** command located in the **Utilities** menu is explained on page 35 of this manual.

Taking Care of Mirror Volumes

SoftRAID is always taking steps to insure the integrity of a Mirror volume. If all of the Mirror volume disks are not present at startup or if an i/o error occurs in a read or write operation, SoftRAID will change the volume's state.

This information will either be reported in the disk and volume tiles in the SoftRAID application or be displayed in a dialog box by the Monitor when the application is not running. The following section will describe the different states that may happen to a Mirror volume and the ways of changing those states.

Volume and Disk States

SoftRAID displays information about the state of volumes and disks in the volume and disk tiles of the Application window. Text in **Green** indicates that everything is operational, **Red** indicates an error state which should be addressed, and **Blue** indicates procedural information provided by the application.

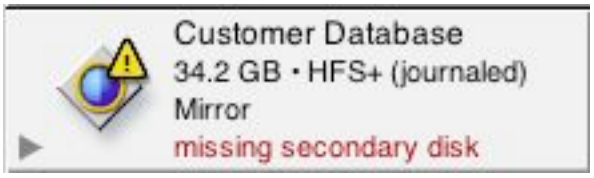
Volume and Disk States (cont.)

No errors - This is the optimal state for an operational Mirror volume.

Missing secondary disk - A missing secondary disk state can occur:

at startup - if one or more of the disks in the mirror volumes did not get connected correctly, or did not get turned on correctly, or malfunctioned.

after startup - if one or more of the disks is turned off or disconnected while the volume is in use.



Whenever a Mirror volume is detected, the SoftRAID driver waits for **15 seconds** for all disks to appear. This value can be changed in the **Driver panel** of the Preference dialog if the Mirror volume has disks which take longer to spin up. If, after 15 seconds, SoftRAID detects that any disks are missing, it will mount the volume and change the state in the volume tile to **missing secondary disk. The Mirror volume can still be used in this state.**

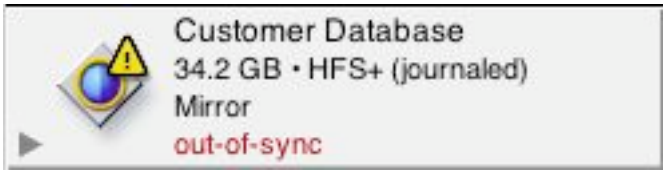
This volume state can be **cleared** in several ways depending on the cause of the missing secondary disk:

• If the **missing secondary disk** state is the result of a dead disk and the disk is removed, the ***Remove Missing Secondary Disk*** command in the **Volume** menu can be used to set the state back to **no errors**. If it is desirable to keep the Mirror volume with the same number of disks as before, another functioning disk can be added back to the volume with the ***Add Secondary Disk...*** command under the **Volume** menu.

• If the **missing secondary** state is the result of a disconnected secondary disk, the disk may be reconnected and the Mac rebooted if necessary, (FireWire, Fibre Channel and USB do not require rebooting.) If any writes have occurred to the volume while the disk was missing, the volume tile will indicate an **out-of-sync** state and the disk tile will also indicate out-of-sync**.** The ***Rebuild Mirror*** command is necessary to clear this state as described below. If no i/o requests have been made, the secondary will be added back to the volume and the **missing secondary disk** state will disappear.

Volume and Disk States (cont.)

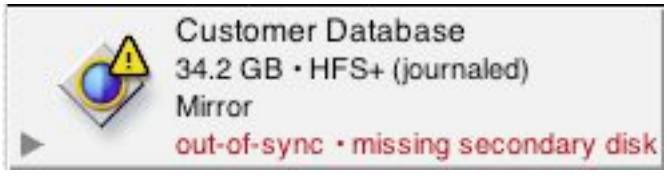
Out-of-sync - An out-of-sync mirror state indicates that one or more of the secondary disks do not match the Primary disk. This state occurs if SoftRAID did not detect all of the disks at startup, if a disk has been turned off while the volume was being used, or if one or more of the disks has experienced an **i/o error.**



Although SoftRAID will continue writing to an out-of-sync Mirror volume, it is highly recommended that the volume be rebuilt using the ***Rebuild Mirror*** command in the **Volume** menu. If the "**Automatically Start Mirror Rebuilds"** option is set in the Driver Preferences dialog, the SoftRAID driver will immediately start the process as soon as the out-of-sync state is detected. **The volume can still be used while the Rebuild proceeds.**

An **out-of-sync** state can also occur if the Mac crashed while the Volume was in use. Use the ***Rebuild Mirror*** command to copy all the data from the Primary disk to the out-of-sync secondary disk(s).

Out-of-sync, missing secondary - This state would occur if a Mirror volume is out-of-sync AND if one of the secondary disks was missing.



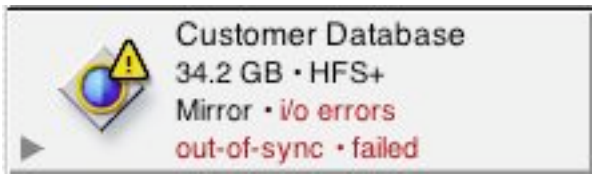
No secondary disk - This state occurs if there is only one disk available for the a Mirror volume. This volume can have up to 15 secondary disks added to it with the ***Add Secondary Disk...*** command in the **Volume** menu.

Volume and Disk States (cont.)

Failed - The failed state can occur in a Mirror volume or a disk and is the result of an error in writing data to disks - an **i/o error**. A **disk** is marked failed when it experiences an i/o error. The disk will still be written to but its tile will show the failed state.

If the disk with the errors is a Primary disk and there is an intact secondary disk available, SoftRAID will turn that secondary into a Primary and mark the volume **out-of-sync**.

A **volume** is marked failed if i/o errors occur on all of the disks. A failed mirror can still be used but data integrity is no longer assured.



The failed state of a Mirror volume or a secondary disk is often indicative of a hardware failure and the defective hardware should be eliminated or replaced to ensure intact Mirror volumes.

Note: To determine when a failure happened (which may help you determine the cause), you can consult the System Log. Read the section **Using the System Log** in the **Stripe Essentials** section of this Manual for more information on this feature.

To clear a failed disk state: Remove the failed secondary disk and the volume tile will change to **missing secondary disk.** This state can then be cleared with the ***Remove Missing Secondary Disks*** command described later in this section. The failed disk can then be replaced and the new disk can be initialized and added to the Mirror volume using the ***Add Secondary Disk...*** command in the **Volume** menu.

To clear a failed Mirror: A failed Mirror volume may indicate that a cable or card is malfunctioning or may be caused by a crash or brownout. To troubleshoot this state, the ***Recover Failed Mirror*** command may be used. This rebuilds the Mirror and clears the **failed** state from the Volume tile. If the cause is malfunctioning hardware, I/O errors are likely to recur, and the hardware should be replaced. If a failed Mirror is caused by a crash or power brownout, then the errors are not likely to recur after the Mirror is recovered.

Making Changes to Mirror Volumes

SoftRAID allows you to make changes to your Mirror volumes either to change your configurations or to mitigate state changes, such as failed secondary disks. This section describes the commands under the **Volume** menu which are used to change Mirror volumes.
Mirror volumes which contain Mac OS X can be changed in the same fashion as those without a system. Any volume which is going to be **deleted** or **created** on the same disk as the boot volume requires that the Mac be started from an alternate boot volume such as a FireWire drive or CD-ROM or DVD. Instructions for creating a **SoftRAID Startup CD-ROM or DVD** for this purpose can be found on page 34 of this manual.

Rebuild - Rebuilding a Mirror volume copies all of the data from the Primary disk to any out-of-sync or failed secondary disks. Rebuilding will occur automatically in an out-of-sync situation if the Driver preference "**Automatically Start Mirror Rebuilds"** has been selected. The Mirror volume **is available** while the rebuild is in progress. To stop a rebuild, select the Volume tile and select ***Cancel*** (command-period) in the **Utilities** Menu.

Set Primary Disk - The Primary disk designation, originally selected the volume is created, can be changed to another disk using this menu command. Highlight the volume tile anc check which secondary disks are not out-of-sync. Select the command and a window will show the choices for the new Primary. Choose one of the disks that was not out-of sync.

Split Mirror - Splitting a Mirror allows you to change your Mirror volume configuration either to remove failing disks or to optimize your back-up strategies. Splitting off more than one disk at a time allows you to create new, identical Mirror volumes. Splitting off single disks allows you to create a **non-RAID** volume or a **read-only secondary** volume.

To Split a Mirror:

1. Choose the disk(s) - Select the secondary disks you wish to split off.

2. Choose the volume type:

non-RAID - This allows you to take a copy of the Primary volume off of the Mirror to another machine and use it. SoftRAID must be installed on the new machine. Other disks can be added to it with the ***Convert to Mirror*** command.

Mirror- This allows you to split off a Mirror volume to take to another Mac which has SoftRAID installed.

Read-only secondary - A read-only secondary volume is used for archival purposes and to ensure that an accurate write-protected copy of data is available. It can only be mounted on a computer which has the SoftRAID driver installed. Read only secondary volumes are a safe way to split off a secondary from a Mirror and keep it intact until it is added back to the original Mirror volume with the ***Convert Read-only secondary*** command. **Read-only secondary volumes can only be created from Mirror volumes which are unmountable.**

Some Mirror volume scenarios may involve removing a **Primary** disk for copying or changing offsite. In this case, it is important that the secondary disk not be mounted while the Primary is gone. If the disk is mounted, the SoftRAID driver will change it to a Primary disk since it will detect that the Primary disk is missing. A read-only secondary volume prevents this from happening.

3. Choose the name - The name of the original volume appears in this box. Changing the name of the new volume can help avoid confusion.

4. Click on Create - If you have selected a new Mirror, the **Primary Disk** window will appear asking you to confirm your selection.

The Volume tiles in the Application window will change to show the new split off volume.

Note: If the original volume has been reduced down to just the Primary disk, the state of the volume will be changed to **Mirror • no secondary disk** unless a read-only secondary volume was split off in which case it will say **Mirror • missing secondary.**

Recover Failed Mirror - A Mirror volume is considered failed if all of its disks received i/o errors. This is a serious condition and may indicate a hardware failure, such as a bad cable or SCSI-PCI card. This command can be used to troubleshoot the situation by rebuilding the failed Mirror. If the cause of the failure is hardware related,

Recovered Failed Mirror (cont.)

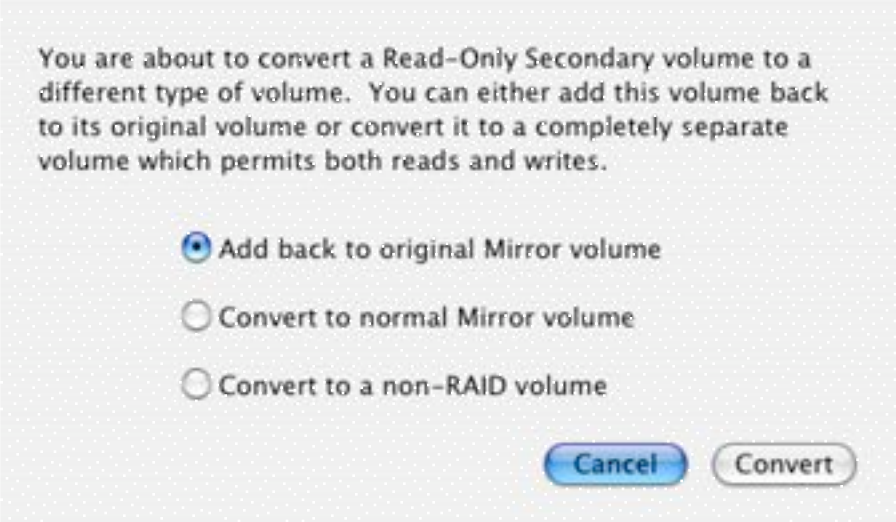
then the errors will occur again after the recovery. Malfunctioning hardware should be replaced before creating new Mirror volumes. If the cause of the failure is a crash or brownout, the errors will not recur after the recovery. Recovering a failed Mirror with this command is no guarantee of data integrity.

Add Secondary Disk... - If you wish to increase the number of disks in a Mirror volume, you can highlight the Mirror volume you wish to add to and choose this menu item. A list of all available disks will appear and you can select the additional secondary disk(s). A **Rebuild** procedure will be initiated immediately. The volume will show that it is out-of-sync and is being rebuilt until the process is complete.

Remove Missing Secondary Disks - A Mirror volume tile may show a state of **missing secondary disk** if 1) any secondary disks for that Mirror volume have been disconnected or malfunctioned, or 2) a read-only secondary volume has been split off using the ***Split Mirror*** command. If you wish to continue using the Mirror volume without the missing secondary disks, they can be removed and no longer associate with the volume. Highlight the volume with the missing secondary disk and select **Remove Missing Secondary Disks** from the **Volume** menu. An alert will appear asking you to confirm the operation.

If a disk has been removed as a secondary and is mounted at a later date, it will have its status changed to a Primary and its Volume tile will indicate that it is missing a secondary disk.

Convert Read-Only Secondary Volume - A read-only secondary volume can be added back to its original Mirror volume, or it can be converted to a new non-RAID or Mirror volume. Highlight the volume and select this item. The window will display the conversion options.



Add to original Mirror volume is the the only way a read-only secondary can be reintegrated with its original Primary disk.

Convert to normal Mirror volume will result in a volume which has no secondary disks. The ***Add Secondary Disk...*** command described above can be used to make a complete Mirror volume.

Convert to a non-RAID volume removes the read-only designation and the connection to the original Mirror volume.

Convert to Mirror - A non-RAID volume can be converted to a Mirror volume by highlighting the volume and selecting this item. A window will list all available disks which can then be added as secondary disks. Once the secondary disks are selected, the non-RAID volume will be unmounted and changed to be the Primary of the Mirror volume. The volume will be added to the Volume column and a Mirror rebuild operation will start automatically.

The Speed of the Read

SoftRAID mirrors have the ability to perform reads from all disks. This operation is called which is called a **stripe read**. This results in a Mirror volume with identical read performance as a Stripe volume with the same number of disks. Stripe reads are enabled by default in the SoftRAID preferences. This option is located by selecting the "**Driver**" tab and finding the option "**Use all disks for mirror reads**".

Note: If very different speeds of disks are used, read performance of the Mirror volume will be reduced by the presence of slower disks. In this case it would be best to deselect this option allowing the driver to read just from the Primary disk.

Volume States and Stripe Reads

If a Mirror volume was performing stripe reads and one of the secondary disks received an i/o error, SoftRAID will change the Disk tile to say **i/o errors** and **failed secondary disk** and the Volume tile will change to **i/o errors out-of-sync**. If there are at least two "in-sync" disks available, SoftRAID will continue to perform stripe reads using the remaining disks. The SoftRAID driver will only use the Primary and the in-sync secondary disks for Stripe reads.

SoftRAID CDs and DVDs

SoftRAID 3 has developed four CD or DVD commands to help you create and manage your SoftRAID volumes. These are located in the **Utilities** menu**.**

Create SoftRAID Startup CD-ROM or DVD

This command allows you to create a SoftRAID Startup CD-ROM or DVD which you can use to start up Mac. You will want this CD-ROM or DVD if you need to create, delete, or convert any startup volumes or any volumes which share a disk with your startup volume. (You also can use any other startup volume as long as it has the SoftRAID driver installed.) Without the SoftRAID driver, the Mac OS X will not recognize the SoftRAID volumes and they will not appear on your desktop.

What You Will Need

To create a SoftRAID Startup CD-ROM or DVD you will need your original Mac OS X installer CDs or DVDs, version 10.4 or later, and a blank CD-R, CD-RW, DVD-R or DVD-RW.

> **Note: Some versions of 10.4 Tiger are shipped on dual layer DVDs. If you have one of these, you must use a blank dual layer DVDs to create a SoftRAID Startup DVD.**
>
> Intel Users: In order to create a Startup DVD which allows you to create and modify SoftRAID Startup Volumes, you will need to start with **Mac OS X 10.4.8** or later Install Disks. SoftRAID Startup DVDs created with earlier versions will not allow you to install the most current SoftRAID driver into the system. If you do not have 10.4.8 install disks, you will need to create a Startup system on a USB2 or Firewire drive with 10.4.8 to start up your Mac.

Creating the CD or DVD

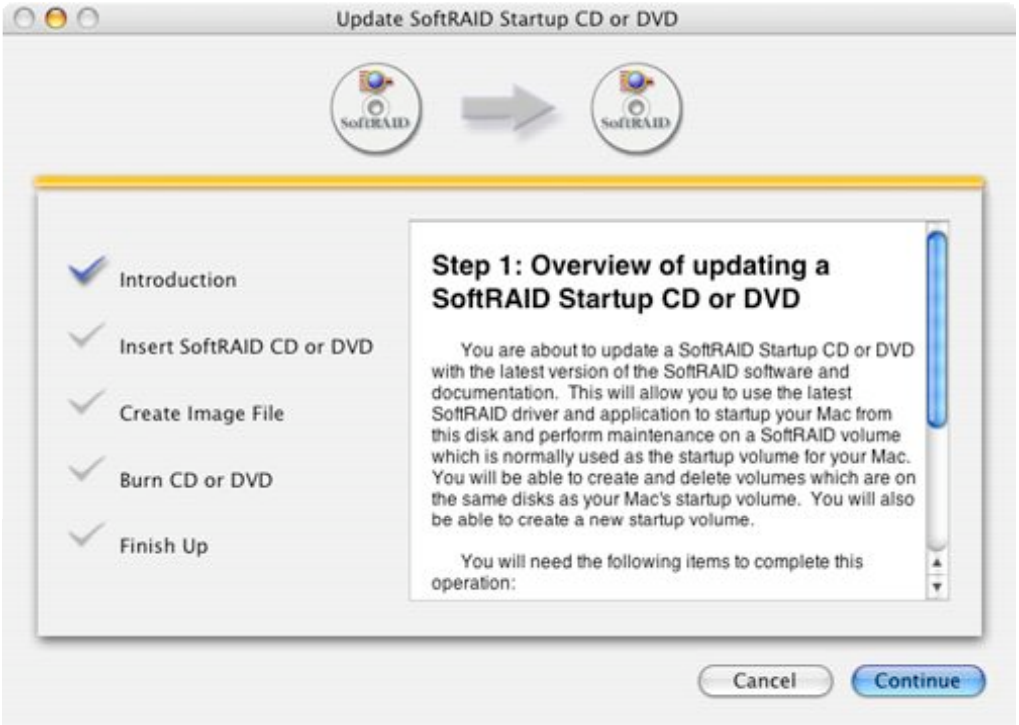
Select the ***Create SoftRAID Startup CD-ROM or DVD*** from the **Utilities** menu.

You will be guided through a step-by-step CD-ROM or DVD creation process. This procedure can take up to 45 minutes and can proceed in the background. You will need to be on hand to insert the correct CDs or DVDs at the appropriate time.

Using the CD or DVD
Once you have created your CD or DVD, you can use it to start up your Mac. To do this, insert it into your CD or DVD slot and start up or restart your machine while holding down the “c” key. Your desktop will look the same but you will see that you are booted off of the CD or DVD and the SoftRAID application will be open and ready to do the volume changes you need. When you are done with the SoftRAID application, you can choose ***Quit*** from the **SoftRAID** menu and your Mac will restart. If you added a disk to a SoftRAID Startup volume, you will want to hold down the Option key during your restart in order to select the correct startup volume.

Update SoftRAID Startup CD-ROM or DVD

Over the course of time, SoftRAID, LLC will update the SoftRAID driver and application. When you receive an update, you may want to update your previously created SoftRAID Startup CD-ROM or DVD or your SoftRAID retail CD or DVD. The



Update SoftRAID Startup CD-ROM or DVD command under the **Utilities** Menu allows you to create an image of your Startup CD or DVD, adds the new SoftRAID driver to it and then burns a new disk. The process takes approximately as long as it did to create your original CD or DVD.

Modify Mac OS X Install CD-ROM or DVD

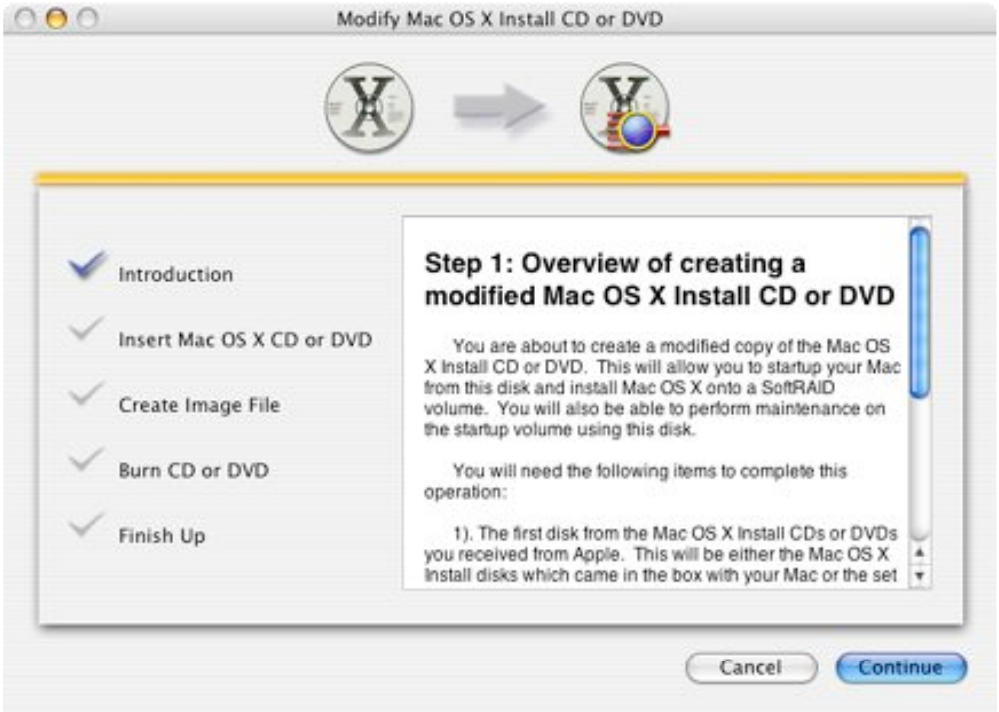
This command lets you create a modified Mac OS X Install CD-ROM or DVD for the purposes of installing Mac OS X version 10.4.x with the most current SoftRAID driver onto SoftRAID volumes. All OS X 10.4.x Install disks ship with the SoftRAID driver, but it may not be the most current and so you may not have the full functionality of SoftRAID. This command can also be used to update the SoftRAID driver on a previously Modified Mac OS X Install CD-ROM or DVD.

What You Will Need

To create a Modified Mac OS X Install CD-ROM or DVD you will need your original Mac OS X installer CDs or DVDs, version 10.4.x, and a blank, minimum 700 MB capacity CD-R, CD-RW, DVD-R or DVD-RW.

Creating the CD or DVD

Select the ***Modify Mac OS X Install CD-ROM or DVD*** from the **Utilities** menu. You will be guided through a step-by-step CD-ROM or DVD creation process. This procedure can take up to 45 minutes and can proceed in the background. You will be only modifying the first disk of your installer CD or DVD set. You will need to be on hand to insert the correct CD or DVD at the appropriate time.



Using the CD

Once you have created your CD or DVD, you can use it to start up your Mac. To do this, insert it into your CD or DVD slot and start up or restart your machine while holding down the “c” key. Once your Mac has started up, you will open into the standard Mac OS X installer window. Follow the instructions for selecting the appropriate volumes for installation.

The disks will work the same as they do when they are used to install a system on an Apple volume. A SoftRAID volume may appear as a folder instead of as a volume icon during the install process. This will not affect your ability to install Mac OS X onto it.

Modify Utility CD-ROM or DVD

This command allows you to modify a Utility CD-ROM or DVD such as DiskWarrior and TechTool Pro so they can recognize SoftRAID volume. This command can also be used to update the SoftRAID driver on a previously Modified Utility CD-ROM or DVD. Since Utility disks are in a constant state of change, we can't always guarantee compatibility with SoftRAID. Check our website at www.softraid.com for a list of compatible Utility disks.

What You Will Need

You will need to have a blank CD-R, CD-RW, DVD-R or DVD-RW.

Creating the CD or DVD

If you have checked the compatibility and wish to create a modified Utility CD-ROM or DVD,select the ***Modify Utility CD-ROM or DVD*** from the **Utilities** menu. You will be guided through a step-by-step procedure which includes the creation of an image file and the burning of a modified CD or DVD. The procedure can take up to 45 minutes and can occur in the background. You will need to be available to insert the appropriate CD or DVD at the appropriate time.

Using the CD-ROM or DVD

Use this CD or DVD according to the manufacturer's instructions for your original utility disk.

Note: In order to start up an Intel Mac from a Modified Utility CD-ROM or DVD you must first start with a CD or DVD which is designed for Intel Macs. Contact the manufacturer of your Utility software for more information.

Glossary of Menu Items

SoftRAID 3 has four SoftRAID specific Menu headers: **SoftRAID**, **Disk**, **Volume** and **Utilities**.

SOFTRAID

About **SoftRAID** and **Preferences** are the SoftRAID specific items in this menu.

About SoftRAID - This window tells you which version of SoftRAID 3 you have and credits our brilliant programmer. The version is also displayed in the lower right-hand corner of the Application window. Our website and technical support can also be accessed from this window by clicking on the addresses displayed.

Preferences - These are the preferences for the Application, Monitor and Driver.

Application

Require Administrator Password (default setting is **Off)**
If checked, an Administrator Password will be required to launch SoftRAID. If unchecked, SoftRAID will launch without a password but will ask for one before completing privileged operations, i.e., those which can change data or the configuration of disks or volumes. Once you have entered a password you can continue to perform privileged operations for up to five minutes before being prompted for it again.

Remember window positions (default setting is **On**)
When checked, SoftRAID will remember window positions between launches. This is useful if the same monitor is always used. Turn the preference **Off** if the Mac will be using different monitors.

Display completion dialogs (default setting is **On**)
After an operation such as rebuilding a volume or zeroing a disk is completed, a dialog confirming this will be displayed by the Monitor. Turn this setting **Off** if you need an uninterrupted work session.

Open Disk Tiles as Standard or Expanded (default setting is **Standard**)
and
Open Volume Tiles as Standard or Expanded (default setting is **Standard**)
The disk and volume tiles consist of two tiles of information for each disk or tile.

The **Standard** view opens with just the upper tile in view. The upper tile of the Disk tile contains the bus type and ID, disk size and available space, the disk manufacturer, model number and the version of its firmware, and SoftRAID state information. The upper tile of the Volume tile contains the volume name, the selected file system, the Volume size and type, and SoftRAID state information.

The **Expanded** view for both tiles shows the upper and lower tiles. The lower

Preferences (cont.)

tile displays counters with the total number of i/o requests and the total number of errors. The lower Disk tile also includes the serial number of the disk. Each tile can be expanded manually.

Driver

Write volume errors to system log (default setting is **On**)
SoftRAID can write volume errors to the System log file which is part of OS X. Accessing this log and viewing the volume errors is useful in diagnosing disk failure. Turn this setting to **Off** if you are performing operations where you don't want any interruptions such as Digital Video capture. This log can be displayed by choosing ***Show System Log File*** under the **Utilities** menu.

Record Recoverable errors (default setting is **Off**)
When the driver performs a read/write operation, it may encounter a problem due to some minor malfunction of the disk which gets corrected by retrying the read/write a second time. These errors are called **recoverable errors** and are not normally reported to the user. Repeated recoverable errors may be an indication of future disk failure. If you are starting to see a decrease in performance, or are experiencing occasional non-recoverable errors which are reported by SoftRAID, you will want to turn this setting to **On**. A disk which generates recurring recoverable errors is prone to a catastrophic failure.

Use all disks for Mirror reads (default setting is **On**)
This setting allows the driver to read data from each disk of the Mirror volume simultaneously in order to increase read performance. The read speed of a mirror volume, with this setting enabled, is the same as that of a Stripe volume with the same number of disks. Stripe reads will only be as fast as the slowest disk in the volume. If the Mirror volume contains a slow disk you will want to change this setting to **Off** so all of the reads originate from the Primary disk.

Automatically rebuild out-of-sync Mirror (default setting is **On**)
A Mirror volume consists of a Primary disk and one or more secondary disks which are exact copies of the Primary disk. If one or more of the secondary disks is no longer an exact copy the Primary disk the Volume will be labeled out-of-sync. To recover the Mirror, SoftRAID will need to rebuild it so that all secondary disks have identical copies of the data on the Primary disk. This procedure can either be done manually using the ***Rebuild*** command in the **Volume** menu or can be initiated automatically by the driver when this setting is on. **The Mirror volume can be used while the rebuild proceeds.** Change this setting to **Off** if you want more control over your system.

Save i/o counts to disk - default setting is **at system shutdown or restart**
It is recommended that Server administrators select **at system shutdown** and **every hour.** If you are capturing or editing video and want to minimize dropped frames, use the default setting.

Driver(cont.)

Mirror volume Secondary disk time-out (default setting is 15 seconds)
SoftRAID waits, for this set interval, for all the disks in a Mirror volume to become available. If after this time-out, a disk has not appeared SoftRAID will display a **missing secondary disk** state in the Volume tile.

Set to a longer duration when:

• Using the ***Convert to SoftRAID 3*** command. Changing this setting to 2 minutes ensures that there is enough time to convert all SoftRAID 2.x and AppleRAID Mirror volumes to SoftRAID 3 disks. The disks in these volumes are converted one at a time. Once the Primary disk has been converted, SoftRAID 3 will start looking for the secondary disks of that volume.

• Using disks which take longer than 15 seconds to spin up, such as Fibre Channel disks or disk arrays in enclosures.

Monitor

Display Dialog when:

Mirror volume is out-of-sync (default setting is **On**)
A Mirror volume is marked **out-of-sync** if SoftRAID detects that one or more of the disks in the volume is not identical to the primary disk. If this setting is enabled, the SoftRAID Monitor will display a dialog box every time this state is detected. This setting should be turned **Off** if there are times you don't want a dialog box appearing on the desktop such as when using presentation software or running a film clip.

Mirror volume rebuild is done (default setting is **On**)
If a Mirror volume has become out-of-sync, the **Rebuild** operation will ensure that all of the secondary disks in a Mirror volume are identical to the Primary disk. If this setting is On, a dialog box will appear when the rebuild operation is complete. Change this to **Off** if you don't want your work session to be interrupted with the appearance of a dialog box.

Mirror volume is missing secondary (default setting is **Off**)
If one of the secondary disks in a Mirror volume does not start up correctly or becomes disconnected from the Macintosh, the Volume state is changed to **missing secondary disk.** The Mirror volume will continue to operate with the remaining disks. If you want to be notified of this state change, change this setting to **On**.

Disk has an error (default setting is **On**)
SoftRAID counts all i/o errors and keeps track of which disk and which volumes they occurred on. This information is normally displayed in the Application window. With this setting enabled, the Monitor will display a dialog whenever an error occurs. Change this setting to **Off** if you are using presentation software or displaying a movie.

Monitor (cont.)

Disk has a recoverable error (default setting is **Off**)
A recoverable error occurs if an i/o request to a disk results in an error, but a subsequent retry of the same i/o succeeds. In most cases this will not indicate a future problem. If you are suspicious of a disk you may want to turn this setting to **On**. Repeated recoverable errors may be an indication of future disk failure.

DISK

These are items specific to Disk operations. **Note:** Initialize, Convert, and Zero Disk can only be performed on a boot volume or a volume sharing a disk with a boot volume if the Mac is started from a separate system, such as the **SoftRAID Startup CD-ROM or DVD**.

Initialize - Selecting this item brings up the Initialize Disk window. This operation will delete all existing data, including volumes or disk partitions on the disk. The ***Initialize*** command automatically installs a SoftRAID 3 partition map on the disk. You will be asked for your system password.

Convert to SoftRAID Format - If a disk which has been selected has been previously initialized with either Apple Disk Utility or SoftRAID 2.x and has data on it, it can be converted to a SoftRAID disk without losing any data. Each disk of a volume must be converted individually. Changing the Driver Preference for the Mirror time-out to two minutes should give you ample time to convert all of the disks for each volume. You will be asked to authenticate with your password. Converted disks will **only** be available on Macs running OS X and SoftRAID 3.

Convert to Apple Disk Utility Format - If a disk has been previously initialized with SoftRAID 3.x and has data on it, it can be converted to Apple Disk Utility format without losing any data. Each disk of a volume must be converted individually. Once converted, non-RAID volumes will appear as standard Apple volumes and stripe and mirror volumes will appear as AppleRAID volumes. After conversion, these disks and volumes can be managed using the Disk Utility application found in the Utilities folder of your startup volume.

Zero Disk - Zeroing disks effectively erases all data on a disk. Writing Zeros to the entire disk is a time intensive operation. 26 GB takes approximately 30 minutes on a fast disk. Zeroing an entire disk changes all bits on a disk to zeros. Zeroing a disk assures that no one will be able to read any of the data on the disk without disassembling the disk drive. The “Zero first hundred sectors” option is a quick way to delete all driver partition information from a disk to make it appear “new” to SoftRAID, Apple’s Disk Utility, or other Disk management software.

Blink Disk Light - Highlighting a disk and selecting this option makes the disk light blink, if the disk has a light. This is a handy way to identify which physical disks match up to which Disk tiles in the Application window. This is especially useful if you need to remove any disks from the Mac. To turn off Blink Disk Light, click anywhere in the Disks or Volumes columns.

VOLUME

These items are for operations involving Volume creation and management. Some are useful for both Stripe and Mirror operations and some are specific to the type of volume.

New... - This menu command is used to create all new volumes.

New...(cont.)
The available disks are listed on the left of the window. Select which disks you want by clicking, shift clicking, command clicking or dragging. To deselect, click on another disk or use command click. If a disk appears in the Application window but not in the New volume window, it may have no available free space or may initialized with a driver other than SoftRAID 3, or may be used in the startup volume.

Enter a name -Volumes names should be less than 28 characters and may include any characters except a colon (:) or a forward slash (/).

Volume type - you can choose the volume type from the icons at the top of the window or from the Volume type pull-down window.

File system - you are offered the following choices: **HFS+**, **UFS** (Unix File System) and **Case Sensitive HFS+** . HFS+ is recommended unless the documentation for the application you are using specifies a UFS volume or Case Sensitive HFS+.

Enable Journaling - This option should remain enabled unless the application in use specifies that journaling should be turned off. See explanation of **Enable Journaling** menu item on the next page.

Optimized for - Workstation, Server, Digital video or Digital audio are the choices tell SoftRAID how you will use this volume.

Workstation - This is the default optimization setting and is best for general purpose use, including Photoshop, editing, scanning and day to day operations.
Server - This setting optimizes a volume to handle many small i/o operation simultaneously.

Digital Video - A DV-optimized volume allows for very large or sustained i/o transfers. This setting works well with video capture and video effects editing, especially applications with dedicated capture/display cards.

Digital Audio - This makes a volume optimized for many small transfers. This setting artificially slows down the transfer rate to provide compatibility with PCI cards which support audio capture, output or video effects.

Volume size - SoftRAID will, by default show you the Maximum size available for the volume depending on the type of volume and the disks you have selected.

Units - You may select a volume size in MB (Megabytes), GB (Gigabytes), TB (Terabytes) or PB(Petabytes). A TB is 1024 GB, a PB is 1024 TB.

Max size - Clicking on the Max size button will clear the manually entered number in the Volume size text window, and replace it with the maximum size available for the disks and volume type selected.

New... (cont.)

Create - After all of the parameters have been chosen for the New volume, the Create button is clicked. Depending on the type of volume created, a new window will appear:

If a Stripe volume is being created, a window will appear allowing for customization of Stripe Unit Size. SoftRAID will display what it thinks is the optimal Stripe Unit Size for the volume use you are creating. Once a Stripe volume is created, the stripe unit size cannot be changed without erasing or deleting the volume. Changing this setting will not change the volume optimization you have selected.

When a Mirror volume is being created, a window will appear asking you to choose the Primary disk. The Primary disk will be the disk whose data is copied to all of the secondary disks. Choose your fastest, most reliable disk for this function. The Primary disk is also the disk which data will be read from unless the Driver preference “Use all disks for Mirror reads” is set to On.

Delete - Deleting a volume wipes away all partitions for that volume as well as all the data in that volume. SoftRAID will ask for password authentication before completing this operation. If a volume is deleted, its volume tile will disappear from the Application window and the volume icon will vanish from the desktop. If SoftRAID is unable to unmount the volume because the volume is shared or another application is using it, an error message will be displayed. You cannot delete a boot volume or a volume which shares a disk with a boot volume unless you are booted from a separate volume such as the **SoftRAID Startup CD**.

Erase - Erasing a volume saves the volume and its partition map but removes all data files from it. SoftRAID will ask for password authentication before completing this operation. You will be prompted to rename the volume and have the option of changing its optimization and journaling option. You can erase your startup volume, if you are started from another system.

Install/Reinstall/Update SoftRAID Driver - When SoftRAID is launched, it automatically searches all systems on all volumes connected to the Mac for the presence of its driver and gives you the opportunity to install it into those systems which don’t have it. The SoftRAID driver needs to be installed on any boot volume which will be connected to SoftRAID volumes if those volumes are to be recognized by the system. This command allows you the opportunity to install the driver at times other than when SoftRAID detects the absence of the driver and asks you if you want to install. If SoftRAID detects that its driver is already present, the command changes to ***Reinstall***. If SoftRAID detects an older driver, the command becomes Update.

Uninstall SoftRAID Driver - Uninstalling the SoftRAID driver allows you to have the driver removed from your startup system. This would be used if, at some time, you want to troubleshoot a disk or volume situation without the presence of the SoftRAID driver. Once the driver is gone, the system will no longer be able to see any SoftRAID volumes connected to the Mac.

Mount - A volume which does not appear on the desktop is considered unmounted. A volume can be unmounted by going to the Finder and dragging its **Volume icon** to the trash/eject icon on the dock. The Volume tile will continue to appear in the Application window but the volume icon will not appear on the desktop. To make the volume remount, highlight the Volume tile and select this command.

Enable/Disable Journaling - When Journaling is enabled, the file system will create an area on the volume where changes to the volume's file system are recorded before the changes are actually made. When rebooting after a crash, the Mac uses this information to rebuild the volume's file system.

Optimize for.... - When creating a SoftRAID volume you are asked how you would like SoftRAID to optimize the volume for the best performance for your use. If you decide to change the use of the volume, you can go and change the optimization with this command. For more information see the **Optimized for...** option in the ***New...*** command, Glossary Section, page 41.

Rebuild - A Mirror volume needs to be rebuilt if the driver detects that the data on any Mirror secondary disk is not identical to that on the Primary disk. Rebuilding will occur automatically in an **out-of-sync** situation if the "Automatically rebuild out-of-sync Mirror" Driver preference has been selected. A progress thermometer will appear on the Volume tiles while the rebuild operation is taking place. The volume **is available** for reading and writing during the rebuild. To stop a rebuild, select the Volume tile and select ***Cancel*** (command-period) in the **Utilities** menu.

Set Primary Disk - The Primary disk designation, originally selected when the volume was created, can be changed to another disk using this menu command. Highlight the volume tile and check which secondary disks are not out-of-sync. Select the command and a window will show the choices for the new Primary. Choose one of the disks that is not out-of-sync.

Split Mirror - This command allows you to split disks off of a Mirror volume to form another **Mirror volume**, a **non-RAID** volume or a **read-only secondary** volume. Highlighting a volume and selecting this menu item displays a window allowing you to select the disks that are to be split off.

A read-only secondary volume is used for archival purposes and to ensure that an accurate write-protected copy of data is available. A read-only secondary volume, like all other. SoftRAID volumes, can only be mounted on a computer which has the SoftRAID driver installed. Read-only secondary volumes are a safe way to split off a secondary from a Mirror and keep it intact until it is added back to the Mirror volume with the ***Convert Read-only secondary*** command.

If multiple disks are selected, another Mirror volume can be created. You should enter an new name for the new Volume to avoid confusion in the Application window, and then designate the new Primary disk.

Recover Failed Mirror - This command rebuilds a failed Mirror based on the data on the Primary disk. Recovering a failed Mirror with this command is no guarantee of data integrity. A Mirror volume is considered failed if **all** of its disks received i/o errors. This state can occur because of a crash or brownout or may indicate a hardware failure, such as a bad cable or malfunctioning SCSI-PCI card. This command can be used to troubleshoot the situation by rebuilding the failed Mirror. If the cause of the failure is hardware-related, then the errors will occur again after the recovery. Malfunctioning hardware should be replaced before creating new Mirror volumes. If the cause of the failure is a crash or brownout, the errors will not recur after the recovery.

Add Secondary Disk... - If you wish to increase the number of disks in a Mirror volume, you can highlight the volume and choose this menu item. A list of all available disks will appear and you can select the new secondary disk(s). A **Rebuild** will be initiated immediately. The volume will show that it is out-of-sync and is being rebuilt until the process is complete.

Remove Missing Secondary Disks - A Mirror volume tile may show a state of **missing secondary disk** if 1) any secondary disks for that Mirror volume have been disconnected or malfunctioned, or 2) the Mirror volume has had a read-only secondary volume split off using the ***Split Mirror*** command,

If you wish to continue using the Mirror volume without the missing secondary disks, they can be removed and no longer associate with the volume. Highlight the volume with the missing secondary disk and select this item. If a disk has been removed as a secondary and is mounted at a later date, it will have its status changed to Primary and its Volume tile will indicate that it is missing a secondary disk.

Convert Read-Only Secondary Volume - A read-only secondary volume can be added back to being part of its original Mirror volume, converted into a non-RAID volume, or converted to a normal Mirror volume. Highlight the volume and select this item. Converting the read-only secondary to normal Mirror volume or non-RAID volume removes its read-only designation and disconnects it from its original Mirror volume.

Convert to Mirror - A non-RAID volume can be converted to a Mirror volume by highlighting the volume and selecting this item. A window will list all available disks which can then be added as secondary disks. Once the secondary disks are selected, the non-RAID volume changed to be the Primary disk of the new Mirror volume. The volume will be added to the Volume column and a rebuild operation will start automatically.

UTILITIES
These are additional menu items to help you maintain your disks and volumes.

Clear I/O counters - SoftRAID tracks I/O counts and errors by volume, and by disk. This menu item will clear all I/O Counters on the selected volume(s) or disk(s). Click on either one or more disks, or one or more volumes, and select this menu item. All i/o counts of those disks or volumes will be set to zero.

Rebuild Boot Cache - Sometimes during the creation of an Intel startup volume with OS X 10.4.8 and up, the boot cache files for a particular volume, do not get written correctly. If this occurs, the system cannot recognize the volume as a startup volume. The Rebuild Boot Cache command will repair the volume whose tile is highlighted in the Volume column so it can then be selected in the Startup Disk System Preference panel as a startup volume.

Show System Log - The System log is a part of OS X. It allows any driver to write events to it with a time stamp. This is useful information if you are trying to investigate when a disk error may have occurred. If the Driver Preference in SoftRAID is set to "Write volume errors to system log", SoftRAID will record all i/o errors to the System Log. To search the Log:

1. Select ***Show System Log*** in the **Utilities** Menu. The Console Application will launch.
2. Choose ***Find*** under the **Edit** Menu of the Console Application
3. Search for "SoftRAID" or "SoftRAID driver log:" if you are looking specifically for I/O errors.
4. When finished, Quit the Console Application and return to SoftRAID 3.

Create SoftRAID Startup CD-ROM or DVD - If you are creating, deleting or converting any volumes which share a disk with the boot volume, you will need to start up the computer from a different disk. You can create a SoftRAID Startup CD-ROM or DVD with this command. After creating this CD or DVD, you can start up your Mac from the CD or DVD, hold down the "c" key during startup and perform any of the SoftRAID volume modifications you need to.

Update SoftRAID Startup CD-ROM or DVD - If you own a retail SoftRAID CD-ROM or a Startup CD-ROM or DVD which you created with a previous version of SoftRAID, this command will allow you to create a new Startup disk with the updated SoftRAID driver. The process takes approximately as long as it did to create the original CD or DVD.

Modify Mac OS X Install CD-ROM or DVD - This command allows you to modify your Mac OS X Install CD-ROM or DVD to include the most current SoftRAID driver. The first CD or DVD of the set is modified and then this new CD or DVD plus the remainder of the Install set are used to install Mac OS X onto SoftRAID volumes. This command can also be used to update the SoftRAID driver of a previously created Modified Mac OS X Install CD-ROM or DVD.

Modify Utility CD-ROM or DVD - Utility CD-ROMs or DVDs such as DiskWarrior and TechTool Pro need to be modified to identify SoftRAID volumes. This command lets you add a SoftRAID driver to the Utility CDs or DVDs, so they can then be used to

diagnose SoftRAID volumes. This command can also be used to update the SoftRAID driver of a previously created Modified Utility CD-ROM or DVD.

Uninstall SoftRAID - This menu command allows you to completely remove the SoftRAID driver and the application from your startup volume. You may want to do this to move SoftRAID to another machine, test the machine without the SoftRAID driver present, or to use Apple's Disk Utility. Once you remove the driver, SoftRAID volumes will not mount, or be available to users. If you run the SoftRAID Application again, it will reinstall the driver. If you install SoftRAID onto another machine, and move those volumes over to that machine, all volumes and data will be available as normal.

Cancel - This item, also enabled by the key combination command-period, allows you to stop an ongoing procedure such as Zero disk or Mirror rebuild.

Keeping RAID Volumes Healthy

RAID volumes are designed to give you speed and/or backup, and you depend on them for reliability. SoftRAID volumes can only be as reliable as the disks and buses they are created on. One of SoftRAID's benefits is that it has excellent error reporting which allow you to recognize the early signs of disk failure so you don't lose any data. Here are additional steps you can take to ensure the correct operation of your RAID volumes.

1. Confirm that the Write volume errors to system log option in the SoftRAID Driver Preferences is enabled. This ensures that all errors will be reported which will aid you in troubleshooting. See page 38 for more information.

2. Periodically launch SoftRAID and check the error counts in both your SoftRAID volumes and the disks which are used for those volumes. A disk which contains disk errors should be replaced.

3. Keep track of why your Mirror volumes go out-of-sync. If your Mirror volume goes out-of-sync, it means that either your Mac crashed, lost power, or that one of the secondary disks is unreliable. If you know that your out-of-sync Mirror was not caused by either of the first two reasons, then you will want to investigate the unreliable secondary disk. One way of determining which disk is causing problems is to consult the Disk tile in the Application window. If one of the secondary disks gets an i/o error, its status on its disk tile will change to "i/o error, failed secondary." The Mac will continue to write data to the disk, but the volume will not rebuild and will continue to be out-of-sync.

There are two conditions, however, when the Disk tile will not indicate a failing secondary disk. If one of the secondary disks has a catastrophic failure and no longer spins up, its tile will not even record the failure since the error information is recorded on the disk. Another type of failure can occur which does not get recorded and this happens when the disk is starting to become unreliable and fails to respond for 10-20 seconds at a time. When this happens, the Mirror volume will start to rebuild even though the Disk tile for the failing disk does not indicate any errors. You can check the System Log file (see page 44) for a SoftRAID driver entry indicating an error occurrence.

4. Watch for Mirror volumes which split into two. If this occurs it indicates that your Mirror's Primary disk became unavailable for at least 10-20 seconds. This is usually indicative of a failing Mirror disk and this disk should be replaced.

Specific recommendations for maintaining data integrity on FireWire disks.

1. Make sure that all of your consumer electronics devices (iSights, web

cameras, scanners and video cameras) are connected to a separate FireWire bus. These devices are not built to the same standards as storage devices and are known for introducing errors onto a FireWire bus.
Note: All of the FireWire connectors on your Mac actually share the same FireWire bus. If you wish to connect a consumer electronics device to a separate bus, you will have to install a FireWire PCI card in your Mac. Each of these cards also adds a single FireWire bus, even if they have two or more FireWire connectors.

2. Do not use FireWire hubs on the same bus as your disks. FireWire hubs are notorious for introducing errors and instability onto the bus.

3. Use only quality cables. While most cables work fine with a single device connected to a FireWire bus, many cables will introduce errors when 2 or more disks are connected to the bus.

4. Make sure your FireWire disks have adequate cooling. If they are stacked together and the middle one gets hot, it will have a shorter life span. Use cases with fans. **Note:** If the outside of the feels hotter than lukewarm, the disk inside is too hot.

5. Test all FireWire disks for hot-plugging capabilities before using. Hot-plugging is the ability to connect a FireWire disk cable and have the device mount on the desktop without needing to reboot. Not all FireWire disks do this reliably.

To test your disks, create a daisy chain of at least two FireWire disks and decide which is your test disk. Copy a large file onto the non-test disk while you plug and unplug the test disk five times. If the copy is not able to proceed correctly then the test FireWire disk is not reliable for any situations where you may want to hot-plug.

RAID Scenarios

The following are scenarios for solving data storage challenges using SoftRAID 3's powerful new features.

Challenge 1: Large Database Manager needs backup and speed.

Joan manages a large FileMaker Pro database server used for online transactions for a mail-order company. She has a G5 X-Serve. She needs to always have a backup available in case of drive failure and she needs to provide quick data access to the Sales Reps on the phones.

Solution: Three Disk Mirror Volume

Joan sets up a three disk Mirror with the disks in bay 1, 2 and 3, and installs a Mac OS X system onto the Mirror volume. When she is setting it up, she confirms that the "Use all disks for Mirror reads" in the Driver Preferences is turned on. This allows SoftRAID to read data off of the disks as if they were part of a Stripe volume. At the end of each day, she uses the ***Split Mirror*** command to split off a read-only secondary disk. She then pulls this disk out of the X-Serve, takes it to another X-Serve and makes a tape backup which is then stored off site. She takes the disk and reconnects it to her server. The disk is added back to the Volume with the ***Convert Read-only Secondary Volume*** command. SoftRAID performs an automatic rebuild while the volume is in use. Once a week, Joan takes the drive in bay 3 and rotates it with a spare drive she keeps off line, so that she always has a one week old drive with all her Filemaker data on it.

Challenge 2: Commuter needs to safely take disk from work to office.

Emil works as an art director, three days in the office and two days at home. He has a desktop Mac with 2 internal ATA drives at both locations and takes his FireWire drive with him from home to office. He needs to be able to have ongoing backup at each site and be able to take his projects home to work on them and bring the changes back to the office.

Solution: One Mirror, One traveling disk, two read-only secondary disks

Emil used SoftRAID 3 to make a two disk mirror with his portable FireWire drive as his Primary disk and one of his ATA disks as his secondary disk at his office. At the end of the day, he turned his secondary disk into a read-only drive with the ***Split Mirror*** command. This protects him or someone else in his company from mistakenly booting up without the Primary disk. If a SoftRAID Mirror volume secondary disk boots up without the Primary, SoftRAID automatically turns it into a Primary disk that won't recognize the original volume. Because Emil's disk is read-only it can't be turned into a Primary disk
At the end of the first day, he takes his Primary disk home and plugs it in with a second FireWire drive which will become his home backup. The SoftRAID application, after

Solution 2 (cont.)

launching, will indicate that his mirror volume is missing a secondary i.e., his office disk. Using the ***Add Secondary Disk...*** command he adds his second FireWire disk to the mirror volume. SoftRAID will automatically begin to rebuild that disk into a mirror as he uses the volume. SoftRAID indicates that there is a secondary disk missing but will still create a Mirror volume as Emil works. At the end of his session Emil uses the ***Split Mirror*** command again to make his home disk read-only, just in case.

The next day he takes the Primary drive back to the office. He plugs the disk in and boots up the machine. Again, the SoftRAID Application window will indicate that the volume is missing a secondary. Emil will selects the original secondary which was converted into a read-only secondary and the ***Convert Read-only Secondary Volume*** command under the Volume menu. This will rejoin and rebuild the Mirror volume. SoftRAID will rebuild a 10 GB disk in approximately 20 minutes in the background. The missing secondary state will remain in the SoftRAID volume tile, but the Mirror volume will operate correctly, ensuring him a backup at both locations. At the end of his time in the office, he will repeat the Split Mirror procedure and when he returns home he will repeat the ***Convert Read-only Secondary Volume*** operation.

He now is able to always have an intact backup from the site that he just left and an archive of his previous work at the site he is going to!

Challenge 3: Video Producer needs fast digitizing and editing on a PowerBook

Adele is a video producer who uses her Macbook Pro, Final Cut Pro and two 1TB FireWire drives. She needs to be able to digitize when she is on the go and have fast access for editing. She also needs backup, but prefers to do that overnight.

Solution: Two FireWire Disks in a Stripe Volume

She sets up a two drive stripe and optimizes it for digital video. She uses this volume whenever she is digitizing and editing. At the end of each day, when she is back at her office, she copies the volume over to her internal ATA disk ensuring that she has a backup on another hard drive

Challenge 4: Backup for a large hard drive

Yoshi was given an iMac by her children with an internal 80 Gig ATA disk. She was going to use this for storing pictures and iMovies of her grandchildren sent to her on e-mail. Her children told her she needed to back these up but she didn't know how to.

Solution: A two drive Mirror Volume

First, Yoshi's daughter bought her one external 80 MB FireWire drive. She created a SoftRAID Startup CD, started up the iMac from it and converted her ATA Apple volume to a SoftRAID volume. Then using the ***Convert to Mirror*** command, she made the two disks into one Mirror volume of 80 gigs where Yoshi could put all of her iMovies and

pictures. Since she had instantaneous backup, everyone was happy, and Yoshi never worried again about losing her data.

Challenge 5: Power traveler with no time to backup

Quinn is constantly traveling and brings his PowerBook with him wherever he goes. One week he is in the office, the next in New York for a presentation. His busy schedule doesn't give him time to do backups as often as he would like, and he feels exposed should his laptop ever get lost or fail.

Solution: 2 disk Mirror of Laptop disk with a FireWire disk

Quinn uses SoftRAID to create a SoftRAID Startup CD to startup his PowerBook. He then converts his PowerBook's startup volume to a SoftRAID volume. Next, he plugs in a External FireWire disk, and uses the ***Convert to Mirror*** command and makes his laptop a mirrored system. The FireWire disk will remain at his office as his backup disk. Whenever he returns to the office, he plugs in his FireWire disk, and this rebuilds, ensuring he has an identical copy of his data backed up. When he leaves, he simply puts his laptop to sleep, disconnects the FireWire cable, and packs his PowerBook in his carrying case. Any time he is back at the office, and plugs in his FireWire drive to his PowerBook, SoftRAID automatically rebuilds the Mirror in the background.

Troubleshooting

SoftRAID 3 is designed as an easy-to-use application. Occasionally, you may come up with a situation where SoftRAID doesn't perform as you think it should. In this section we will suggest some troubleshooting techniques and detail some known bugs with SoftRAID 3. We suggest you try troubleshooting before contacting our Technical Support. Technical Support can be emailed from the "About SoftRAID" dialog box in the **SoftRAID** menu or by sending email to **support@softraid.com**.

Troubleshooting Topics

- If you experience a hang or a "kernel panic"
- If you want to uninstall SoftRAID.
- If you experience SoftRAID tiles not changing correctly
- If you see the message, "SoftRAID encountered an error when trying to create a file system, no file system was placed on the volume"
- If your Mirror volumes frequently become out-of-sync
- If you start a rebuild and don't want to continue
- If the progress thermometer stops working
- If you get a stop sign icon on your volume
- If you can't see all your disks in the New Volume dialog box
- If a disk is on, but its volumes are not appearing on the Desktop
- If a disk shows up in the disk column but its volumes don't appear
- If the Mac says it can't recognize a disk
- If you created a UFS volume, and can't write to it
- If your Mirror volume becomes two volumes, each with a Primary disk
- If your SoftRAID startup volume fails to boot your machine
- If you are booted from a SoftRAID volume but the volume icon on the desktop is an Apple or a FireWire icon
- If after a restart, your volumes are sometimes out-of-sync when they were fine at shutdown
- If your trackpad on your PowerBook doesn't work after starting up from the SoftRAID Startup CD
- If you want to perform a System upgrade from the Mac OS X updater and you are mirrored to an external FireWire Disk and the updater wants you to disconnect all FireWire disks
- If you want to repair permissions on a SoftRAID volume
- If you want to convert your SoftRAID volume to AppleRAID
- If you cannot create a new Mirror Volume, or use the Convert to Mirror command with your brand new disk
- If while creating a SoftRAID Startup DVD or Modified Mac OS X DVD you experience an error

Troubleshooting Tips

If you experience a hang or "kernel panic":
There are two types of hangs in OS X - an application hang and a "kernel panic".

> An application hang is indicated with the endlessly spinning beach ball. Try clicking on

the desktop background, and then hit the key combination "command-option-escape".
This is a feature of Mac OS X which allows you to force quit an application. If the SoftRAID application hangs, it could be because a disk reached a state where it is not responding to the system.

A "kernel panic" is where the computer stops running, and a sign appears in 5 languages saying you need to restart your computer. Your only option is to hold the power button down for several seconds until your Mac turns itself off. You will then be able to turn it on again. When your machine restarts (it may take a little longer, as Mac OS X checks all the directory structures after a panic) you can run SoftRAID and make sure all your volumes are OK. You may want to run a disk utility like Disk First Aid (available inside Apple's Disk Utility Application in the Application/Utility folder), or a third party product, such as DiskWarrior, TechTool Pro, or DataRescue.

If either of these situations happens repeatedly and you can reproduce the hang or kernel panic please contact Technical Support (**support@softraid.com**) so we can investigate further.

If you want to unistall SoftRAID:
You can uninstall all the software which the SoftRAID application installs in you system by selecting ***Uninstall SoftRAID*** from the ***Utilities*** menu. This may require you to restart your Mac. After uninstalling SoftRAID, you will no longer be able to access the data on any SoftRAID volumes attached to your Mac.

If you experience the SoftRAID tiles not changing correctly:
Try quitting SoftRAID, and relaunching it. If this does not correct the problem, you can log out and log in from the **Apple** menu, or restart. If a problem still occurs, you can send an e-mail to SoftRAID support and we will help you determine whether you have something wrong with your configuration.

If you see the message, "SoftRAID encountered an error when trying to create a file system, no file system was placed on the volume":
Delete the volume, and try again.

If your Mirror volumes frequently become out-of-sync:
An out-of-sync state occurs to a Mirror volume if A) your machine crashes, or B) when one or more disks belonging to a Mirror volume is unavailable at startup, or when Mac OS X tried to write to the volume.

Any crash will cause Mirror volumes to become out-of-sync. This is normal, and a necessary protection for your Mirror volumes. SoftRAID will automatically rebuild Mirrors if the auto-rebuild option is set.

If you are not crashing, and not moving disks and the out-of sync state is happening, check to see if there are I/O errors on any of the disks. I/o errors can indicate that a disk is failing and needs to be replaced. Otherwise, it is possible there is a defective/loose cable, or the power to your system is very poor, causing the disks to lose contact with

the computer for brief moments. Try replacing cables, especially if the problem is happening with FireWire drives. We have tested cables from Molex and Granite Digital, and both improve or eliminate these kind of problems.

If you start a rebuild and don't want to continue:
SoftRAID allows you to stop a rebuild at any time. Just click on the volume tile, and use the ***Cancel*** command from the **Utility** menu or the key combination “command-period”.

If your rebuild progress thermometer stops working:
Check that the I/O counts are increasing. Note: An unmounted volume will not continue to rebuild until it is mounted again. Try quitting and restarting SoftRAID, or restarting the machine. If this continues, contact us at **support@softraid**.com for more help.

If you get a stop sign on a volume:
A stop sign icon is only displayed when a volume is in danger of losing data.

> **Stripe volume** - If you have a Stripe volume, this means a disk is missing or has failed. If the disk is missing, you can shut down the machine, plug in the disk and restart. If the disk has failed, you have lost the data on your volume. End user data recovery is not possible with a failed Stripe volume.
>
> **Mirror volume** - If you have a failed Mirror volume, it means that all of the disks have failed. This is most likely caused by a faulty cable or a faulty card which all the disks are connected to. If the volume still mounts, back it up immediately onto a reliable disk on a different bus. If the volume doesn’t mount, you may be able to use a disk utility such as DiskWarrior 3, TechTool Pro or DataRescue to recover some of your data.

If you can’t see all your disks in the New Volume dialog box:
If you are using the New Volume dialog box and a disk is not appearing that you would expect to appear, check that the disk is initialized with the SoftRAID application and that it
has free space. If the disk is used for the startup volume, it will not appear in the New volume dialog.

If a disk is connected, but its volumes are not appearing on the desktop:
Run the SoftRAID application and see if the disk appears in the Disk column. If you are uncertain which disk is which, select a disk, and use the ***Blink Disk Light*** command to help you see if it is the correct disk. If the volume appears in the Volumes column of the application, but not on the Desktop, click on the volume, and hit command M to attempt to mount the volume manually. If this is unsuccessful there may be a problem with the volume. Try running Disk Utility’s repair volume, or DiskWarrior to repair it. If this does not help, contact us at **support@softraid.com** and we will try to assist you further.

If the disk is connected and powered on, but not showing up in either SoftRAID or Disk Utility, then there is a connection problem. Check the cables and/or restart your Mac. **Note:** SCSI drives do not automatically show up when turned on after startup; the Mac must be restarted.

If a disk shows up in the Disk column but its volumes don't appear:
The disk partition map may be damaged. Contact Technical Support and supply the following information: Is the SoftRAID icon is still on the Disk tile? Was the disk accidentally initialized, or the volume accidentally deleted? Is there a link to a volume, with a name like "converted volume"? Are the i/o counters on the disk and its volume(s) still showing with valid numbers?

If you get a message saying "you have inserted a disk that has no volumes that Mac OS X can recognize":
This will happen any time you insert a disk that either has no volumes that Mac OS X can easily
recognize, or a partition map structure that Mac OS X does not recognize. Just click on the Ignore button. This is a problem with the way Mac OS was designed to handle disk events, and doesn't mean that your drive has failed. If you are concerned, you can run SoftRAID, and verify that all your volumes are OK.

If you created a UFS volume, and can't write to it:
Restart the machine, or "get info" on the volume. You will then be able to write to it.

If your Mirror volume becomes two volumes, each with a Primary disk:
This happens if there is a catastrophic failure of the Primary disk and it stopped responding to requests from the Mac or was not available during startup. This failure can be intermittent and may only last 10 to 20 seconds. The volume with the older creation date is the failed disk. Take the following steps to insure you save the correct volume.

1. Rename one of the disks.
2. Go into the Finder and Get Info (command I) on each of the volumes. You will want to make sure these match the volumes SoftRAID has identified.
3. Check each of the volumes for your important files and make sure that the most up-to-date ones are on the disk with the newest creation date.
4. Remove the disk which you have confirmed has the oldest creation date and the oldest version of your data from the Mac.
5. Remove the Missing Secondary disk(s) from the newer, remaining volume with the ***Remove Missing Secondary Disks*** command and then add a new disk to it with the ***Add Secondary Disk... command***.
6. You may want to check your system to determine why the Primary failed. One frequent cause is cabling. Check the cable to the failed disk to see if it was the reason for the failure.

If your SoftRAID startup volume fails to boot your machine and you see a gray circle with a diagonal line:
This icon indicates that the Mac cannot determine the proper Startup volume. This may have happened because SoftRAID changed Primary disks or the boot volume's ID changed. To remedy this, highlight the volume tile and select the ***Rebuild Boot Cache*** command under the **Utility** menu and then try a restart. If that does not take care of it, start up your machine holding down the Option key and select the icon for the volume. If it is a Mirror volume select one of the icons bearing the correct volume name and see

if the machine starts up. If not, restart and try the next. Continue until you get the new Primary. You will know when you reach the new Primary because the Mac will start up.

Once the Mac has booted, go into the Startup disk preferences in the System preferences under the **Apple** Menu. Select this disk as the startup disk and Mac OS X will now recognize it correctly.

If you are booted from a SoftRAID volume but the volume icon on the desktop is Apple or a FireWire icon:
This means that the SoftRAID driver was removed from your startup system, possibly with the ***Uninstall SoftRAID Driver*** command. Start up the application, install the driver when the application asks and restart. The correct icon will appear.

If you cannot create a new Mirror volume, or use the *Convert to Mirror* command with your brand new disk:
The main problem new users experience in converting their disks to SoftRAID is understanding the difference between empty volumes and “free space”. SoftRAID works by segmenting disks into partitions, which then are used to make volumes. If your new disk already has a volume on it, then you may need to delete that volume to create enough “free space” to add that disk to an existing volume. So if you have a disk you want to add to an existing volume to make a mirror, make sure you delete all volumes on it before starting.

If you want to repair permissions on a SoftRAID volume:
Permissions are repaired on a SoftRAID volume using Disk Utility in the same manner as for an Apple volume. Click on the Volume icon in Disk Utility of the volume you want to repair. You can only repair permissions on a bootable volume.

If you want to convert your SoftRAID volume to AppleRAID:
SoftRAID can convert SoftRAID volumes to AppleRAID ones. This allows you to use utilities which may not support SoftRAID volumes. To convert your SoftRAID volume to AppleRAID, select all of the disks which are used for the volume you want to convert. Then select ***Convert to Apple Disk Utility Format*** under the ***Disk*** menu.

If you want to perform a System upgrade from the Mac OS X updater and you are mirrored to an external FireWire Disk and the updater wants you to disconnect all FireWire disks:
A small percentage of FireWire disks are damaged when upgrading Mac OS X and so Apple
gives this warning. There are two choices with your SoftRAID boot volume,

1. Disconnect the FireWire disk, perform the upgrade, then reconnect the disk, whereupon SoftRAID will perform a rebuild;

or,

2. Perform the update leaving the FireWire disk attached. The volume should be okay, but for extra caution disconnect the disk temporarily as suggested above.

If your trackpad on your PowerBook doesn't work after starting up from the SoftRAID Startup CD
When you boot from a SoftRAID Startup CD, connect a USB mouse to the PowerBook while you are managing your system. We are currently investigating the cause of this action.

If after a restart, your volumes are sometimes out-of-sync when they were fine at shutdown
This often happens with FireWire disks that are not fully unmounted before the Mac shuts down. You can try several approaches:

- If your drives were sleeping, give them plenty of time to wake up before shutting down.
- If these are FireWire drives, try different (higher quality) cables.
- If you are using a utility application such as Tech Tool Pro, try disabling it temporarily, and see if that changes the behavior.
- If your disks don't have a power switch and you shut them down from a power strip, make sure that the Mac is fully shut down, i.e. its power indicator light is off, before you shut down the disks.
- Unmount your volumes wait 30 seconds before shutting down
- Disconnect your iPod/iSight before shutting down.

Please contact **support@softraid.com** if you are continuing to have this problem

If while creating a SoftRAID Startup DVD or Modified Mac OS X DVD you experience an error
Some versions of 10.4 Tiger are shipped on dual layer DVDs. If you have one of these, you must use a blank dual layer DVDs to create a SoftRAID Startup DVD.