RAID Utility
User Guide

Instructions for setting up RAID volumes on a computer with a Mac Pro RAID Card or Xserve RAID Card

Contents

RAID Utility User Guide

This guide shows you how to set up RAID volumes using the RAID Utility application on a computer with a Mac Pro RAID Card or Xserve RAID Card.

With a Mac Pro RAID Card or Xserve RAID Card installed in your computer, you can use RAID Utility to turn your computer's internal disks into storage volumes based on RAID (redundant array of independent disks) schemes that improve performance and protect your data.

The RAID Utility Window

Click to see overall RAID status

Components of your RAID configuration

RAID battery status

Items belonging to the selected component

Running RAID Utility

The RAID Utility application is in /Applications/Utilities/. You can open it from there anytime you want to reconfigure or check the status of the RAID components in your computer.

You can also run RAID Utility from the Installer when you start up your computer using the Mac OS X or Mac OS X Server installation disc that comes with the computer. Choose Utilities > RAID Utility while you're in the Installer.

Note: If you plan to perform a task that affect the computer's startup disk (for example, reusing the startup disk to create new RAID sets or volumes), you need to start up the computer from the installation disc that comes with your computer or from an external disk on which you've installed Mac OS X or Mac OS X Server.

About Battery Status

The battery on your RAID card supplies the power needed to save data that's still in the card's write caches at the time of a power failure. The status of the battery is reflected in the overall status of the RAID card as shown in RAID Utility. Conditioning and charging are the most common causes of battery status changes.

Battery Conditioning

To ensure the maximum charge, the battery on your RAID card is periodically conditioned (fully discharged and recharged). Conditioning takes place the first time you start the computer after installing the RAID card and every three months thereafter. (If you purchase a computer with the RAID card already installed, the first conditioning cycle is already finished.) Conditioning can last up to 12 hours, and until the battery returns to full charge, RAID Utility displays a yellow battery warning status and alerts you that the write caches are disabled. This is normal, and you can continue to set up and use RAID volumes while the battery is conditioning. The warning indicators return to normal and the caches are reenabled as soon as the battery reaches full charge.

Important: Don't restart or shut down your computer during conditioning. Doing so interrupts the charging cycle and delays the use of the write caches. Repeated interruptions can prevent the battery from accepting or delivering a full charge.
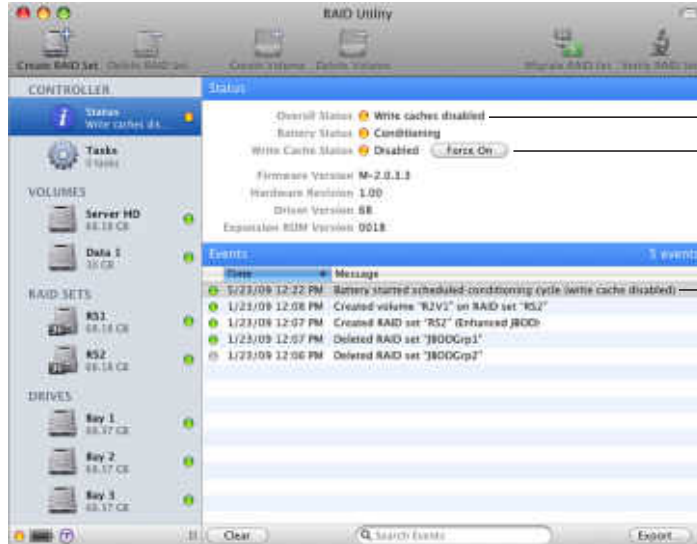
Amber status warns that write caches are disabled during battery conditioning

Click to force caches on during conditioning (risk of data loss if there is a power failure)

The start and finish of conditioning are recorded in the log

Battery Charging
During normal operation, the battery is kept fully charged. However, the battery discharges during a power failure, when the computer is unplugged, and during shipment of a new computer with a RAID card installed. If the battery loses enough charge that it can't provide roughly 72 hours of cache backup, the write caches are disabled and RAID Utility displays a battery warning status until the battery is recharged.

Setting Up RAID Volumes

There are two basic ways to set up RAID volumes:

- Migrate your existing startup volume
- Set up RAID sets and volumes manually

For examples of some typical setups, see "Setup Examples" on page 18.

Migrating your Existing Startup Volume

If you purchased your computer with a RAID card already installed and no solid-state drive (SSD), a simple way to set up a RAID volume is to use the Migrate RAID Set command to convert the existing startup volume, together with other empty disks in the computer, to a new RAID volume in a single step. When you migrate your existing startup volume, you don't need to reinstall the operating system.

If your computer came with a solid-state drive, it's set up as the startup drive and there's nothing to migrate. All of your disk modules are available for creating RAID sets and volumes manually.

To migrate your disks to a RAID volume:

- Follow the instructions under "Migrating an Existing Volume to a RAID Volume" on page 7.

Setting Up RAID Sets and Volumes Manually

If you want more control over RAID set and volume setup, and you don't mind reinstalling Mac OS X or Mac OS X Server, you can use the Create RAID Set command and the Create Volume command to set up your RAID storage.
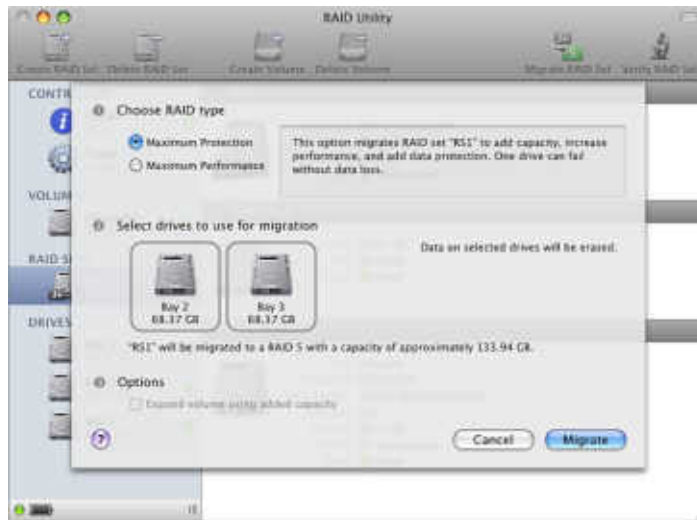
To set up RAID sets and volumes manually:

1 Start up the computer using the Mac OS X or Mac OS X Server installation disc that comes with the computer.

2 When the Installer opens, choose your language and click the Next button to see the Utilities menu in the menu bar at the top of the screen.

3 Choose Utilities > RAID Utility.

4 In RAID Utility, use the Create RAID Set command and the Create Volume command to create your RAID volumes.

For information, see "Creating a RAID Set" on page 8, and "Creating a Volume" on page 9.

5 When you've created your volumes, quit RAID Utility.

6 Follow the Installer onscreen instructions to install Mac OS X or Mac OS X Server on one of the new RAID volumes and restart the computer.

Migrating an Existing Volume to a RAID Volume

When you purchase a computer with the RAID card installed but no solid-state drive, the startup disk is already configured as a single-drive Enhanced JBOD RAID set. You can convert this RAID set, along with one, two, or three other drives, to a RAID volume using the Migrate RAID Set command. All files on the original disk are retained in the new RAID volume. Any data on the additional drives is erased.

To migrate to a RAID volume:

1 Start up your computer using the Mac OS X or Mac OS X Server installation disc that comes with the computer.

2 When the Installer opens, choose your language and click the Next button to see the Utilities menu at the top of the screen.

3 Choose Utilities > RAID Utility.

4 Select the existing RAID set, which supports your current startup volume, in the left column of the RAID Utility window.

5 Click Migrate RAID Set in the toolbar or choose RAID > Migrate RAID Set.

6 Choose the type of RAID volume you want to create.

   Maximum Protection: Migrates your system to a RAID volume based on either the RAID 1 or RAID 5 level, depending on the number of drives available.

   Maximum Performance: Creates a volume based on the RAID 0 level.

   To see the type of RAID set that will be created, look below the drive icons.

7 Choose the additional drives you want to include in the volume.

8 Under Options, choose whether you want to use space from the additional drives to expand the existing volume or leave the extra space free for creating other volumes later.

Expand volume using added capacity: Expands the original startup volume to use all available space on the new RAID set.

If you don't select this option, RAID Utility retains the original startup volume on the new RAID set and leaves the remaining space on the RAID set free for you to create other volumes when you want.

9 Click Migrate.

10 When the migration process is finished, quit RAID Utility.

11 Quit the Installer and restart the computer.

Creating a RAID Set

Before you can create a RAID volume, you need to combine physical drives into a logical disk called a RAID set.

The number of drives needed to create a RAID set depends on the RAID level you want to use. You can use a single drive to create an Enhanced JBOD set, two drives to create a RAID 0 or RAID 1 set, three or four drives to create a RAID 0 or RAID 5 set, or four drives to create a RAID 0+1 set.

To create a RAID set:

1 Open RAID Utility and click Create RAID Set.

2 In the dialog that appears, select the RAID level you want to use.

   The RAID levels you can select depend on the number of drives you select. If the RAID level you want to use isn't enabled, try selecting a different number of drives.

3 Select the drives you want to include in the set.

4 Select the options that you want to apply to the set.

   Use unassigned drives as spares: Reserves any drive not selected for the RAID set as a spare that will be used if a drive in the set fails. You can't assign a spare to a RAID 0 or Enhanced JBOD set.

5 Click Create.

   For information about RAID levels, see "About RAID Levels" on page 16.

Creating a Volume

To create a RAID volume, you use RAID Utility to format space available on a RAID set.

To create a volume:

1 In RAID Utility, select a RAID set in the left column and click Create Volume.

2 Type a name for the volume.

3 Choose a volume format from the pop-up menu.

   If you're not sure which format to use, choose Mac OS X Extended (Journaled).

4 Enter a size for the volume.

This is initially set to the size of the underlying RAID set, but you can enter a smaller size and save the remaining space to create other volumes.

5   Click Create Volume.

You can start using the volume as soon as its icon appears in the Finder, but maximum read and write performance isn't available until the volume is completely initialized. Until then, the volume status icon in RAID Utility is yellow. Initialization time depends on the RAID level of the underlying RAID set. To check progress, click Tasks in the left column of the RAID Utility window.

Expanding a Volume

You can use the command line to expand (add space to) an existing volume from the available space on the RAID set that hosts it. Expanding a volume doesn't affect data already on the volume.

To expand a volume:

- Open Terminal and enter the following command:

```
$ sudo raidutil modify volume --expand -n volume -s size
```

where *volume* is the name of the volume as shown by the `raidutil list volumeinfo` command and *size* is the amount of space you want to add to the volume.

For more information, see the `raidutil` man page.

Moving a Volume

If you have more than one RAID set, you can move a volume from one RAID set to another.

To move a volume to a different RAID set:

- Open RAID Utility, select the volume in the left column, and choose RAID > Move Volume.

Setting Up a Spare Drive

You can set aside an unassigned drive as a global spare. Then, if any drive in a RAID set fails, the spare is automatically integrated into the set to take the place of the failed drive. Only RAID 1, RAID 0+1, and RAID 5 sets can take advantage of spare drives.

To set up a spare drive:

1 Open RAID Utility.

2 Select the drive you want to use as a spare in the left column.

3 Choose RAID > Make Spare.

You can also assign unused drives as spares by selecting the "Use unassigned drives as spares" option when you create a set using the Create RAID Set command.

Reverting a Spare Drive

You can use the Revert Spare command to return a spare drive to general availability so you can use the drive to create RAID sets.

To revert a spare drive:

1 Open RAID Utility.

2 Select the drive in the left column.

3 Choose RAID > Revert Spare.

Deleting a Volume or RAID Set

As a first step in modifying your RAID configuration, you can delete an existing volume or RAID set to free up the drives needed to create a new volume or RAID set.

To delete the computer's startup volume or the RAID set that the startup volume is based on, you must first start up the computer from a different disk that has the RAID software installed, such as:

- The Mac OS X or Mac OS X Server installation disc that comes with your computer
- An external disk on which you've installed Mac OS X or Mac OS X Server using the installation disc that comes with your computer

Important: When you delete a RAID set, all volumes based on that RAID set are also deleted.

To delete a RAID set or a volume:

1 Open RAID Utility and choose the volume or RAID set in the left column.

2 Click Delete Volume or Delete RAID Set.

Solving Problems

The following paragraphs may help you identify or solve a problem you're having with your RAID volumes.

If the Battery Isn't Fully Charged

If you just installed the RAID card, the battery might not have finished conditioning. Conditioning can take up to 12 hours and starts when you first turn on the computer after installing the card.

If you've been using the card for more than three months, the battery might be in a reconditioning cycle. Every 90 days, the battery is completely discharged and recharged to keep it in good condition.

If you have a new computer that came with the RAID card already installed, the battery might not have reached full charge. Charging may take a few hours.

In any case, RAID Utility alerts you that the battery is charging or conditioning, and that write caches are disabled. Performance may be slightly degraded during this time, but will return to normal when the battery is recharged.

To see if your battery is charging or reconditioning:
- Open RAID Utility and click Status in the left column.

  You can also check the battery status using System Profiler. Choose About This Mac from the Apple menu and click More Info. Then select Hardware RAID under Hardware in the Contents list. System Profiler is also available in /Applications/Utilities/.

If the Write Caches are Disabled

The RAID card battery may be conditioning or not fully charged. To protect your data, the RAID card automatically disables write caching whenever the battery isn't fully charged. When the card is new, and again every three months, the RAID card conditions the battery by completely discharging and then recharging it.

If you accept the risk of a power failure and possible data loss, you can force the write caches on when the battery is not fully charged.

> *WARNING:* If you enable the write caches when the battery is not fully charged, you might lose data if the power to your computer fails.

To force write caching on:
- Open RAID Utility, click Status, and then click the Force On button next to Write Cache Status.

Checking the Status of RAID Components

You can use RAID Utility to check the status of the RAID card, its battery, your RAID volumes, and the drives and RAID sets they're built on.

Overall status

List of events
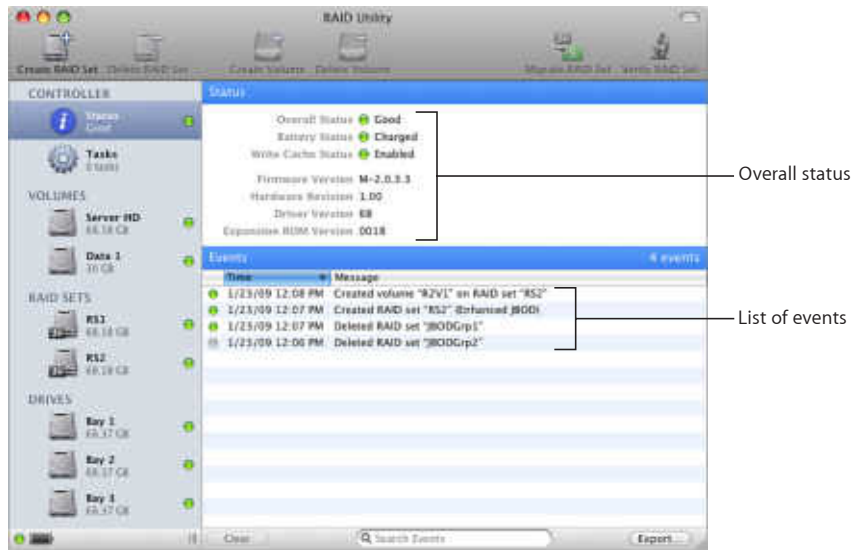
To check the status of a component:

1 Open RAID Utility.

2 Click an item in the left column.

You can also check RAID component status using System Profiler. Choose About This Mac from the Apple menu and click More Info. Then select Hardware RAID under Hardware in the Contents list. System Profiler is also available in /Applications/Utilities/.

Self-Monitoring, Analysis, and Reporting Technology (SMART) status information is available only for SATA drives.

Reviewing Event Messages

RAID Utility keeps a list of events related to the current state of the RAID card, RAID volumes, and their components.

To view events:

1 Open RAID Utility.

2 Click Status in the left column.

To erase an event, click the button in the Clear column.

Verifying a RAID Set

You can use the Verify RAID Set command to confirm that data stored on a RAID 1, RAID 0+1, or RAID 5 volume is protected.

The performance of the RAID set and any volume based on it is degraded during verification.

To verify a RAID set:

1 Open RAID Utility.

2 Select the RAID set in the left column.

3 Click Verify RAID Set.

If the verification process reports problems, you can use the command

```
$ raidutil modify volume --rewrite
```

in Terminal to recreate the volume's data protection information. For information, see the `raidutil` man page or enter `raidutil` at the command-line prompt.

If a Volume is Degraded

A degraded volume is either not providing full performance or has lost its ability to guarantee data protection. All data on a degraded volume is available, but data will be lost if a drive fails. A volume's status is listed as degraded:

• While the volume is being created. This is normal, and the volume's status changes from degraded to good as soon as initialization is finished.

• When a drive fails in the RAID 1, RAID 5, or RAID 0+1 set that the volume is based on. The volume remains in a degraded state until you replace the faulty drive or until an available spare is integrated into the RAID set.

• While the RAID set that the volume is based on is recovering from a loss of data redundancy. The volume's status changes from degraded to good as soon as the recovery process in finished.

If a Drive Fails

If a RAID set or volume becomes degraded because a drive has failed, you can use RAID Utility to identify the drive that needs to be replaced.

Note: If your RAID setup includes a spare drive, it is automatically incorporated into the RAID set, and the set switches from degraded to good as soon as the recovery process finishes. If there is no spare, the set remains degraded until you replace the failed drive, and if a second drive fails before you replace the first, you could lose data.

To replace a failed drive:

1 Open RAID Utility, select the RAID set or volume that is displaying a problem status indicator, and look for a drive bay with a red status indicator.

   The bay numbers in RAID Utility correspond to the numbered drive bays in your Mac Pro or Xserve.

2 Replace the bad drive module.

3 Use the Make Spare command to set up the new drive as a global spare.

   If no spare was available when the original drive failed, the RAID card uses the new spare immediately to rebuild the affected RAID set and volumes. If a spare was available at the time of the failure, it is already incorporated into the affected RAID set, and the new spare remains available until it's needed.

If SMART Status is Listed as Unsupported

Self-Monitoring, Analysis, and Reporting Technology (SMART) status information is available only for SATA drives. If you are using SAS drives, SMART is listed as unsupported in the drive information in RAID Utility.

Using the Command Line

You can also set up and manage your RAID card from the command line using the `raidutil` command. For information, see the `raidutil` man page or enter `raidutil` at the command-line prompt.

About RAID Levels

RAID Utility lets you set up RAID sets based on the following RAID levels:

- Enhanced JBOD
- RAID 0 (striping)
- RAID 1 (mirroring)
- RAID 0+1 (mirroring a striped pair)
- RAID 5 (striping with distributed parity)

Enhanced JBOD

Using Enhanced JBOD, you can create a RAID set using a single drive. The resulting RAID set doesn't gain the performance or data protection of the other RAID levels, but it does benefit from the data caching and battery backup provided by the RAID card. An enhanced JBOD set can also be migrated to other RAID sets or moved to another computer that has a Mac Pro or Xserve RAID Card installed.

RAID 0

RAID 0 offers improved performance but no data protection. Blocks of data are spread across all of the drives in the RAID set in a process called striping. This allows better performance, because file contents move in parallel to and from the individual drives in the set. RAID 0 also provides the greatest amount of usable disk space; nearly all space on all drives is available for user data. You can create a RAID 0 set using two, three, or four drives.

RAID 1

RAID 1 protects data against a drive failure and provides some increase in read performance. Data is protected by duplicating the contents of each drive on a second drive in the set, a process called mirroring. Because of the duplication, a volume based on a RAID 1 set can't be larger than half of the total space available on the drives in the set. You can create a RAID 1 set using either two or four drives.

RAID 0+1

RAID 0+1 combines the performance of RAID 0 with the data protection of RAID 1, by mirroring a striped set on a second pair of drives. Because mirroring duplicates all data, this level offers less usable disk space than RAID 5. Usable space is half of the total space available on the drives in the set. You need four drives to create a RAID 0+1 set.

RAID 5

RAID 5 is a compromise between the performance of RAID 0 and the data protection of RAID 1. Performance is improved by striping data across the drives in the set. Data protection is provided by parity information that's distributed across the drives. Data can be recovered if any single drive fails. RAID 5 leaves you with a greater amount of usable space than RAID 1. RAID 5 needs only the equivalent of one drive's worth of disk space to store the parity information. You can create a RAID 5 set using either three or four drives.

Using Non-RAID JBOD Drives

Drives that aren't part of the RAID environment are called JBOD disks (just a bunch of disks). If you install a new drive or a drive taken from a computer without a RAID card, it's treated as a JBOD disk. If you install an unformatted drive, you see a dialog that asks you how you want to proceed.

Open Disk Utility: Opens Disk Utility so you can erase or partition the drive and then use it in the Finder like any other disk. The resulting JBOD disk can also be read on a computer that doesn't have a RAID card installed.

Ignore: Leaves the drive unformatted.

Open RAID Utility: Opens RAID Utility so you can use the disk to create a RAID set or a spare drive. The disk is shown in RAID Utility with the state JBOD.

A non-RAID disk has the state JBOD

Setup Examples

The following examples show some common ways to set up RAID volumes.

Migrating to a Single RAID Volume

This is the easiest way to set up a RAID volume on a new computer. There's no need to reinstall the operating system or restore existing files on the computer's startup disk. However, the migration process does take some time and you can't use the new volume until the process is finished.

The example assumes that you've purchased a computer with a RAID card and four 500 GB disk drives. The computer is shipped with the operating system on the first disk.

With four disks, you can choose to migrate the existing startup volume to a RAID volume based on a RAID 0, RAID 1, RAID 5, or RAID 0+1 scheme. For the best combination of performance, protection, and volume size, let's choose RAID 5 for this example. With RAID 5, roughly one drive's worth of the space is dedicated to parity data, so the usable space on the volume in this example will be roughly equivalent to the total capacity of the three remaining disks.

To set up this example:
Start up the computer using the Mac OS X or Mac OS X Server installation disc that comes with the computer. When the first Installer pane appears, choose your language and click Next. When the menu bar appears, choose Utilities > RAID Utility and then choose the Migrate RAID Set command. Finally, in the dialog that appears, you choose Maximum Protection, make sure all three remaining drives are selected, select "Expand volume using added capacity," and then click Migrate.

When the migration process finishes, you'll have a single, RAID-protected startup volume with additional space for storing data.

Creating a Separate High Performance Data Volume

As in the previous example, we'll assume that you've purchased a computer with a RAID card and four 500 GB disk drives. In this example, you want to take advantage of RAID to create a fast data volume (for video editing, perhaps) and aren't worried about data protection. You'll leave the current startup disk as is, and use a RAID 0 scheme to create a separate volume on the remaining disks. RAID 0, which stripes data across the drives in the RAID set, usually offers the highest performance. However, neither the startup disk nor the data volume benefit from any data protection.

To set up this example:

First, because you're leaving the original startup disk untouched, there's no need to restart the computer from a different disc; just open RAID Utility and use the Create RAID Set command to create a RAID 0 set using the three remaining disks. When the RAID set appears in the left column of the RAID Utility window, select it and use the Create Volume command to create the volume. The result is a fast 1,500 GB data volume that's independent of the computer's startup disk.

Creating a New Startup Volume and Several Data Volumes

In this example, you'll recreate a startup volume, add several data volumes, and save some space for a future volume, all on a protected RAID set that has a spare drive available. As in the previous examples, we'll assume that you've purchased a computer with a RAID card and four 500 GB disk drives.

To set up this example:

Because you're going to recreate the current startup disk, you need to restart the computer using the installation disc that comes with your computer and open RAID Utility from the Utilities menu. Next, for the protection of the new startup disk and the data volumes, you create a single RAID 5 set. To do so, choose the Create RAID Set command, then choose RAID 5, select three of the four available disks, select the "Use unassigned drives as spares" option, and click Create. Then, select the RAID set and use the Create Volume command to create a 20 GB startup volume by changing the default size in the volume creation dialog. Repeat the volume creation process to add other data volumes with sizes that suit your needs. Finally, install Mac OS X or Mac OS X Server on the new startup volume using the installation disc that comes with your computer.