User's Guide

for

NVIDIA RAID

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1. ABOUT NVIDIA RAID

NVIDIA brings Redundant Array of Independent Disks (RAID) technology—which is used by the world's leading businesses—to the common PC desktop. This technology uses multiple drives to either increase total disk space or to offer data protection.

RAID techniques were first published in 1988 by a multivendor consortium—the RAID Advisory Board. RAID techniques were divided into different categories or levels.

Originally, RAID levels focused on improving resiliency or data availability. As additional RAID levels were defined, one was introduced for improving performance. For all levels, RAID techniques optimize storage solutions by using multiple disks grouped together and treating them as a single storage resource.

This chapter describes NVRAID in the following sections:

1.1 System Requirements

Operating System Support

NVRAID supports the following operating systems:

- Windows® XP Home Edition
- Windows XP Professional Edition
- Windows 2000 Professional
- Windows 2003 Server

1.2 RAID Arrays

This section describes the following types of RAID arrays that NVRAID supports:

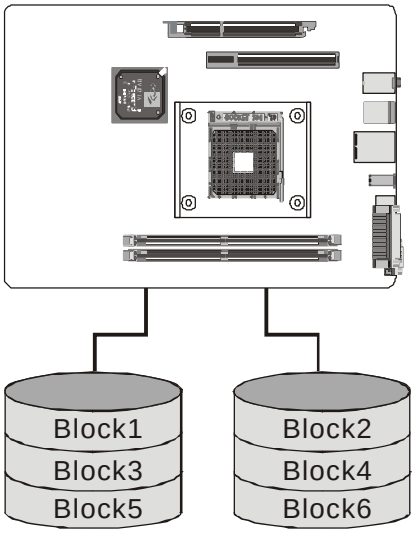
- **RAID 0** : RAID 0 defines a disk striping scheme that improves the disk read and write times for many applications.
- **RAID 1** : RAID 1 defines techniques for mirroring data.
- **RAID 0+1** : RAID 0+1 combines the techniques used in RAID 0 and RAID 1 arrays.(Note: Only support P Serial Case).
- **RAID 5**[1]: RAID 5 provides fault tolerance and better utilization of disk capacity.(Note: Only support P Serial Case).
- **Spanning (JBOD)**: JBOD provides a method for combining drives of different sizes into one large disk.

RAID 0

How RAID 0 Works

RAID 0 involves no parity calulations to complicate the write operation. This makes RAID 0 ideal for applications that require high bandwidth but do not require fault tolerance. RAID 0 has the best performance and capacity of any RAID level, but the lowest availability (no fault tolerance). If one drive fails, the entire array fails because part of the data is missing with no way to recover it other than restoring from a backup.

Figure 1.1 RAID 0 Array Diagram



Summary of Features and Benefits

Benefits	Provides increased data throughput, especially for large files. No capacity loss penalty for parity.
Drawbacks	Does not deliver any fault tolerance. If any drive in the array fails, all data is lost.
Uses	Intended for non-critical data requiring high data throughput, or any environment that does not require fault tolerance.
Drives	Minimum: 1. Maximum: Up to 6 or 8, depending on the platform.
Fault Tolerance	No.

RAID 1

How RAID 1 Works

In a RAID 1 array, every read and write is actually carried out in parallel across two disk drives. The mirrored—or backup—copy of the data can reside on the same disk or on a second redundant drive in the array. RAID 1 provides a hot-standby copy of data if the active volume or drive is corrupted or becomes unavailable because of a hardware failure. RAID 1 techniques can be applied for high-availability solutions, or as a form of automatic backup that eliminates tedious manual backups to more expensive and less reliable media.

RAID 1 provides complete data redundancy, but at the cost of doubling the required data storage capacity, resulting in 50% capacity utilization. Performance is roughly the same as for a single drive, although in some instances the dual write may be somewhat slower.

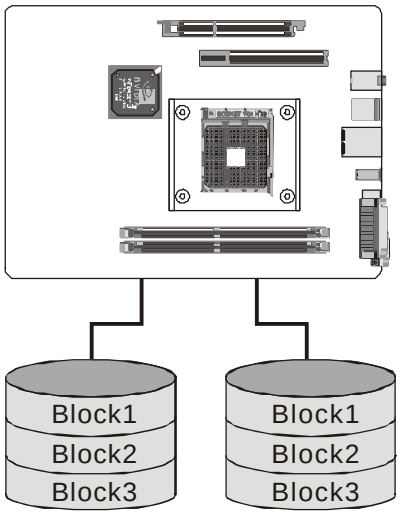


Figure 1.2 RAID 1 Array Diagram

Summary of Features and Benefits

Benefits	Provides 100% data redundancy. Should one drive fail, the controller switches to the other drive.
Drawbacks	Requires two drives for the storage space of one drive. Performance is impaired during drive rebuilds.
Uses	RAID 1 is ideal for small databases or any other application that requires fault tolerance and minimal capacity.
Drives	Minimum, 2. Maximum, 2.
Fault Tolerance	Yes.

RAID 0+1

How RAID 0+1 Works

RAID 0 drives can be mirrored using RAID 1 techniques, resulting in a RAID 0+1 solution for improved performance plus resiliency.

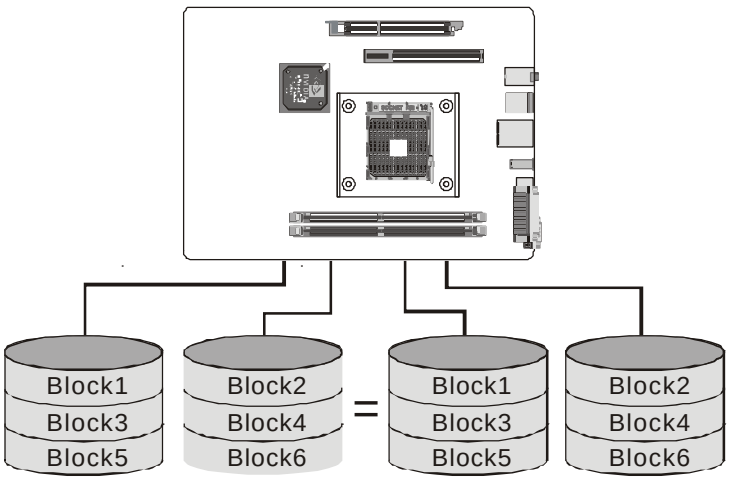


Figure 1.3 RAID 0+1 Array Diagram

The controller combines the performance of data striping (RAID 0) and the fault tolerance of disk mirroring (RAID 1). Data is striped across multiple drives and duplicated on another set of drives.

Summary of Features and Benefits

Benefits	Optimizes for both fault tolerance and performance, allowing for automatic redundancy. May be simultaneously used with other RAID levels in an array, and allows for spare disks.
Drawbacks	Requires twice the available disk space for data redundancy, the same as RAID level 1.
Drives	Minimum: 4. Maximum: 6 or 8, depending on the platform.
Fault Tolerance	Yes.

Spanning (JBOD)

How JBOD Works

JBOD stands for “Just a Bunch of Disks”. Each drive is accessed as if it were on a standard SCSI host bus adapter. This is useful when a single drive configuration is needed, but it offers no speed improvement or fault tolerance.

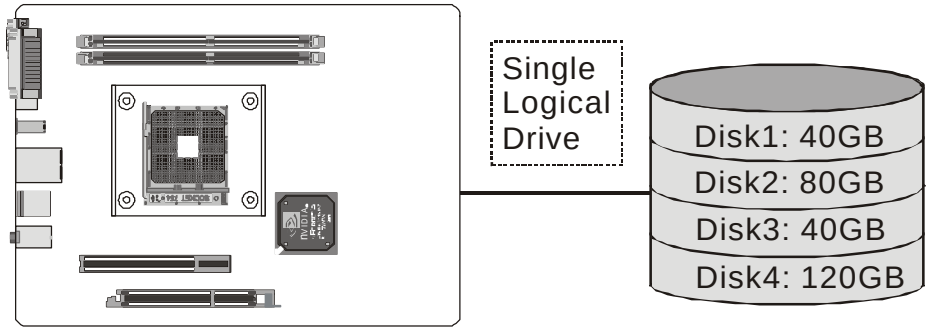


Figure 1.4 JBOD Array Diagram

Summary of Features and Benefits

Benefits	JBOD provides the ability to combine odd size drives using all of the capacity of the drives.
Drawbacks	Decreases performance because of the difficulty in using drives concurrently.
Uses	JBOD works best if you have odd sized drives and you want to combine them to make one big drive.
Fault Tolerance	No.

RAID 5

How RAID 5 Works

RAID 5 stripes both data and parity information across three or more drives. It writes data and parity blocks across all the drives in the array. Fault tolerance is maintained by ensuring that the parity information for any given block of data is placed on a different drive from those used to store the data itself.

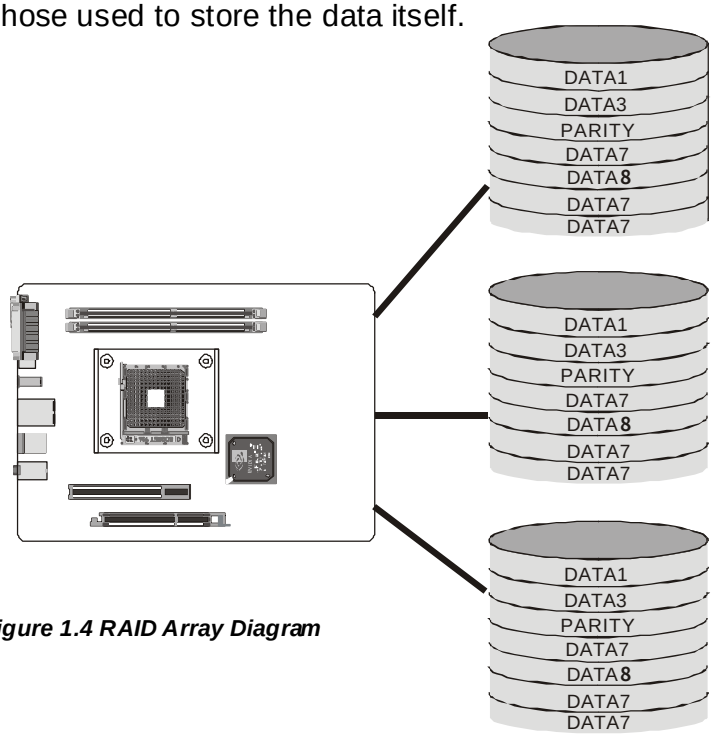


Figure 1.4 RAID Array Diagram

Summary of Features and Benefits

Benefits	An ideal combination of good performance, good fault tolerance, and high capacity and storage effciency.
Drawbacks	Individual bolck data transfer rate same as a single disk. Wtire performance can be CPU intensive.
Uses	RAID 5 is recommended for transaction processing and general purpose service.
Drives	Minimum, 3
Fault Tolerance	Yes.

Summary of RAID Configurations

Table 1.1 RAID Configuration Summary

Array	RAID 0	RAID 1	RAID 0+1	JBOD	RAID 5
Uses	Non-critical data requiring high performance.	Small databases or any other small capacity environment requiring fault tolerance.	Critical data requiring high performance.	Combining odd size drives into one big drive.	Critical data and reasonable level of performance.
Advantages	High data throughput.	100% data redundancy.	Optimized for both 100% data redund-ancy and performance. Allows spare disks.	Combines and uses the capacity of odd size drives.	Fault tolerance and better utilization of disk space.
Drawbacks	No fault tolerance.	Requires two drives for the storage space of one drive.	Requires two drives for the storage space of one drive —the same as RAID level 1.	Decreases performance because of the difficulty in using drives concurrently or to optimize drives for different uses.	Decreased write performance due to parity calculations.
# Hard Disks	multiple	2	4+	multiple	3+
Fault Tolerance	None	Yes	Yes	No	Yes

1.3 NVIDIA RAID Features

- **Free Disk and Dedicated Spare Disk**

A Free Disk or Dedicated Disk can be automatically used in case one drive of a faulttolerant array fails. NVIDIA MediaShield drfines a fault-tolerant array as either RAID 1,RAID 0+1, or RAID5. A free disk can be used by any available fault-tolerant array,while a dedicated disk can be used only by the array to which it is assigned.

- **Bootable RAID**

This allows you to install the operating system onto the RAID volume.

- **Migrating**

Migrating is the ability to convert from one RAID mode to another RAID mode. This allows the user to upgrade their current disk or array for better performance, higher security, and increased capacity. More importantly, this is a accomplished without having to go through multiple steps. The migrating feature gives the user an upgradeable option to manage storage easily.

- **Hot Plug Array**

A nice flexibility feature is the ability to move MediaShield RAID arrays from one nForce system to another. Since most nForce systems support SATA hot plug capability, you can add/remove a RAID array even shile the system is running. This is done using the Hot Plug Array wizard.

2. SETTING UP YOUR RAID CONFIGURATION

2.1 Basic Configuration Instructions

The following are the basic steps for configuring NVRAID:

Non-Bootable RAID Array

1. Choose the hard disks that are to be RAID enabled in the system BIOS.
2. Specify the RAID level, either Mirroring (RAID 1), Striping (RAID 0), Striping and Mirroring (RAID 0+1), RAID 5, or Spanning (JBOD) and create the desired RAID array.
3. Run the Windows nForce Setup application and install the RAID software.
4. Initialize the NVRAID Array Disks

See “Initializing and Using the Disk Array” on page 29.

Bootable RAID Array

1. Choose the hard disks that are to be RAID enabled in the system BIOS.
2. Specify the RAID level, either Mirroring (RAID 1), Striping (RAID 0), Striping and Mirroring (RAID 0+1), RAID 5,or Spanning (JBOD) and create the desired RAID array.
3. Boot from the Windows CD and install the nForce RAID software.
4. Initialize the NVRAID Array Disks

See “Initializing and Using the Disk Array” on page 29.

2.2 Setting Up a Non-Bootable NVRAID Array

Setup Used in This Section

This section assumes the following setup:

RAID arrays can be created/deleted using both MediaShield RAID BIOS and the MediaShield RAID Manager from Windows. This section only covers basic BIOS setup required for non-bootable array.

Setting Up the BIOS

1. Start your computer, then press **Delete** to enter the BIOS setup. The BIOS CMOS Setup Utility window appears.

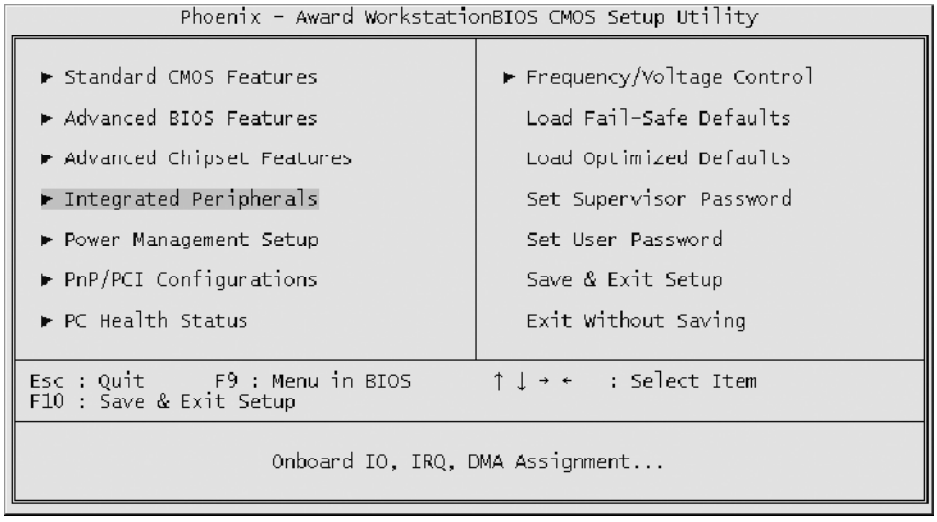


Figure 2.1 BIOS CMOS Setup Utility Main Window

2. Use the arrow keys to select **Integrated Peripherals** (see Figure 2.1), then press **Enter**.

3. Use the arrow keys to select **IDE function Setup**, then press **Enter**. (See figure 2.2)

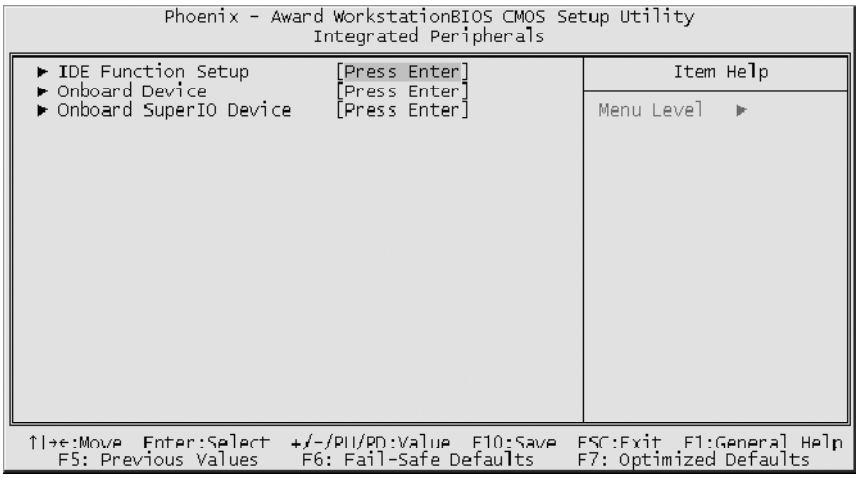


Figure 2.2 Integrated Peripherals Window

4. Use the arrow keys to select the **RAID Function Setup** (see Figure 2.3), then press Enter. The RAID Config window appears.

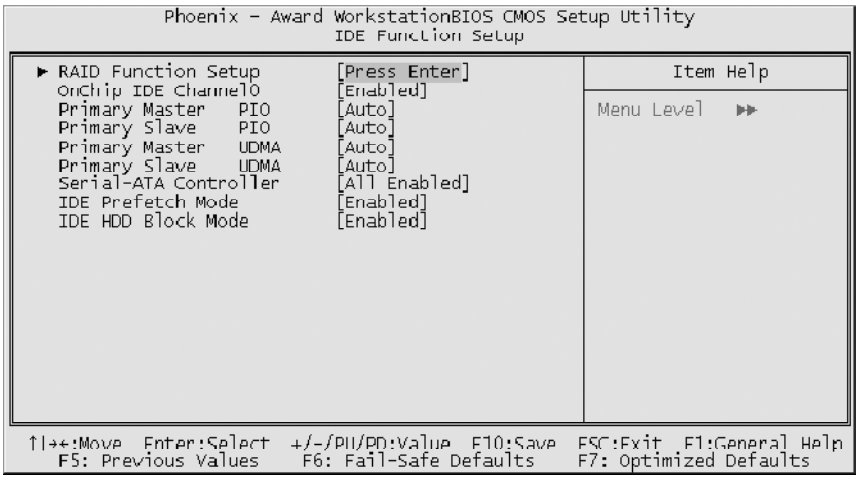
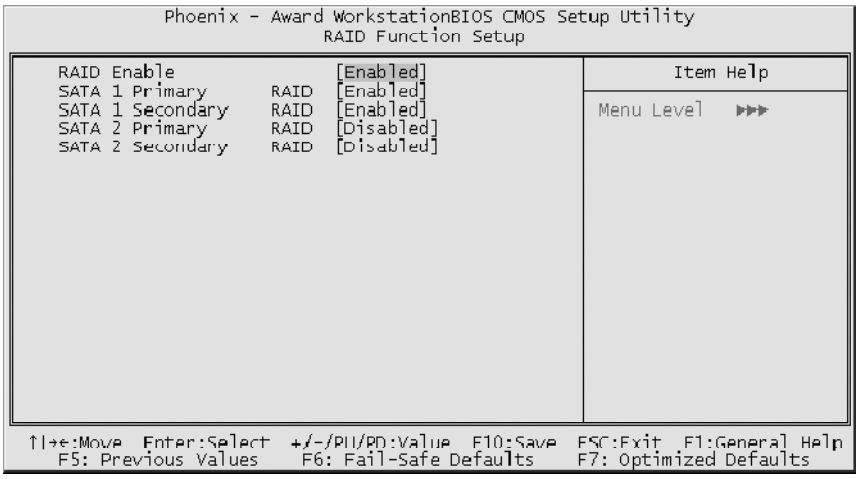


Figure 2.3 RAID Function Setup Window

5. From the RAID Config window, globally enable RAID, then en able the SATA ports with disks that you want to use for RAID.

   If RAID is enabled globally but not enabled on the individual SATA port, disks on that port can only be used for non-RAID applications.

   In the example in figure 2.4, two SATA ports are enabled, so the non-bootable RAID array can include up to two SATA disks. If there is a disk connected to “SATA 2 Primary” or “SATA 2 Secondary”, it can not be used for RAID.



6. Press **F10** to save the configuration and exit.

Configuring the NVRAID BIOS

The NVRAID BIOS setup lets you choose the RAID array type and which hard drives you want to make part of the array.

- **Entering the RAID BIOS Setup**

1. After rebooting your computer, wait until you see the RAID software prompting you to press **F10**.

   The RAID prompt appears as part of the system POST and boot process prior to loading the OS. You have a few seconds to press **F10** before the window disappears.

2. Press **F10**.

   The NVIDIA RAID Utility—**Define a New Array** window appears (Figure 2.4).

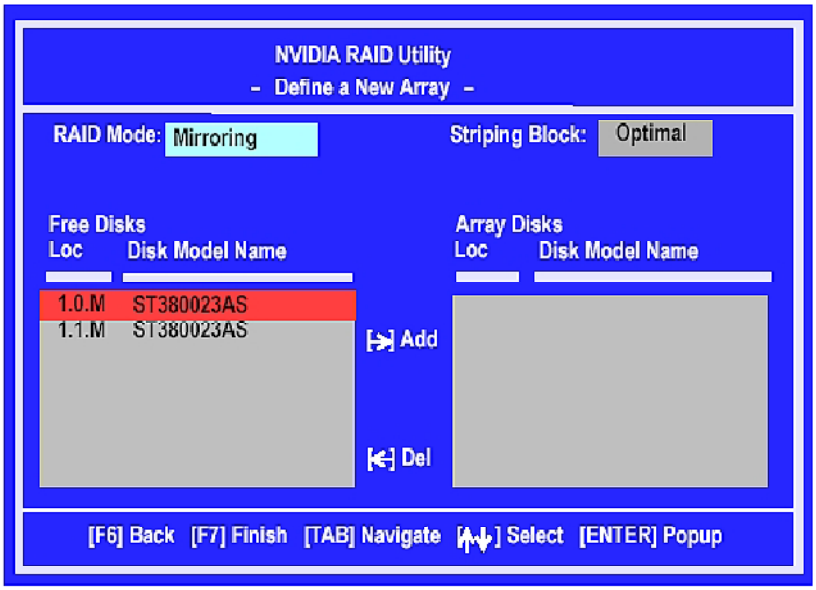


Figure 2.4 NVIDIA RAID Utility

By default, RAID Mode is set to Mirroring and Striping Block is set to Optimal.

◆ Understanding the Define a New Array Window

Use the Define a New Array window to

- **Select the RAID Mode**
- **Set up the Striping Block**
- **Specify which disks to use for the RAID Array**

  The SATA ports are called channels and they are associated with adapters. The first digit in the Location field defines the adapter that the port is associated with. The 2nd diigit defines the channel. (The “M” field, which used to specify Master or Slave, is obsolete.)

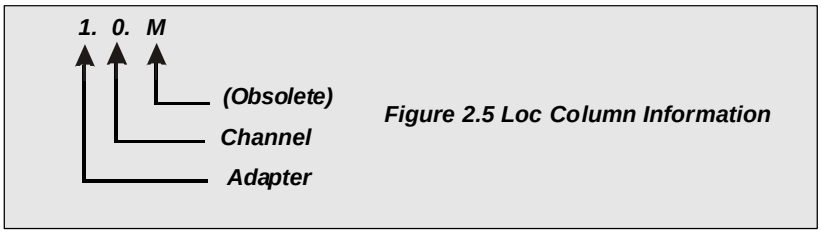


Figure 2.5 Loc Column Information

◆ Using the Define a New Array Window

If necessary, press the tab key to move from field to field until the appropriate field is highlighted.

- **Selecting the RAID Mode**

  By default, this is set to Mirroring. To change to a different RAID mode, press the down arrow key until the mode that you want appears in the RAID Mode box—either Mirroring, Striping, Spanning, Stripe Mirroring or RAID 5.

- **Selecting the Striping Block Size**

  Striping block size is given in kilobytes, and affects how data is arranged on the disk. It is recommended to leave this value at the default Optimal, which is 64KB, but the values can be between 4 KB and 128 KB (4,8,16,32,64, and 128KB).

- **Assigning the Disks**

  The disks that you enabled from the RAID Config BIOS setup page appear in the Free Disks block. These are the drives that are available for use as RAID array disks.

  To designate a free disk to be used as a RAID array disk.

  1. Tab to the Free Disks section.
     The first disk in the list is selected.

  2. Move it from the Free Disks block to the Array Disks block by pressing the rightarrow key (→).

     The first disk in the list is moved, and the next disk in the list is selected and ready to be moved.

  3. Continue pressing the right-arrow key (→) until all the disks that you want to use as RAID array disks appear in the Array Disks block.

     Figure 2.6 illustrates the Define a New Array window after two disks have been assigned as RAID1 array disks.

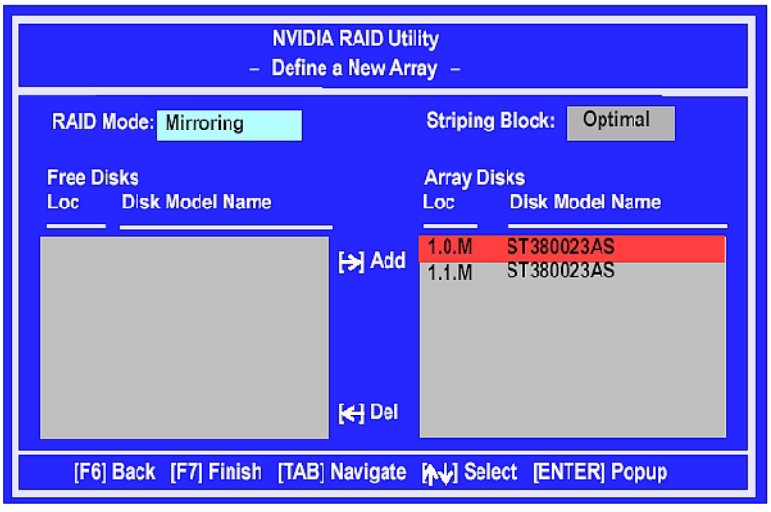


Figure 2.6 NVIDIA RAID Utility—Array Disks Assigned

◆ Completing the RAID BIOS Setup

1. After assigning your RAID array disks, press **F7**.

   The Clear disk data prompt appears.

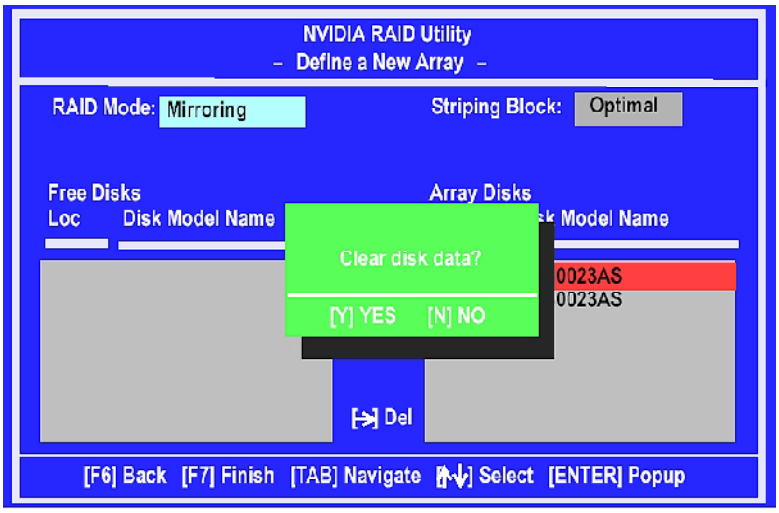


Figure 2.7 Clear Disk Data Prompt

2. Press **Y** if you want to wipe out all the data from the RAID array, otherwise press **N**. You must choose **Yes** if the drives were previously used as RAID drives.

   The **Array List** window appears, where you can review the RAID arrays that you have set up.

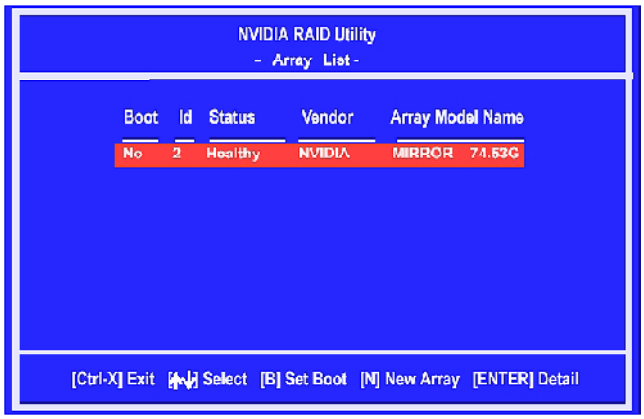


Figure 2.8 Array List Window

3. Use the arrow keys to select the array that you want to set up,then press **Enter** The **Array Detail** window appears.

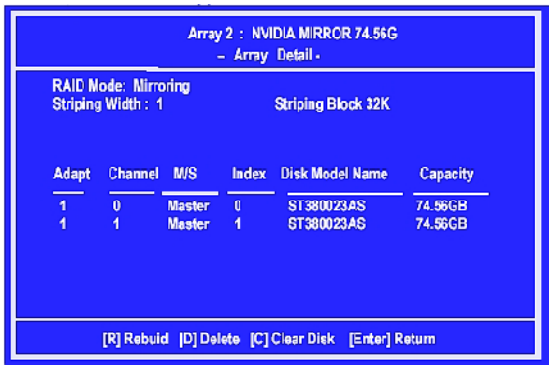


Figure 2.9 Array Detail Window

The Array Detail window shows information about the array that you selected, such as Striping Block used, RAID Mode, Striping Width, Disk Model Name, and disk capacity.

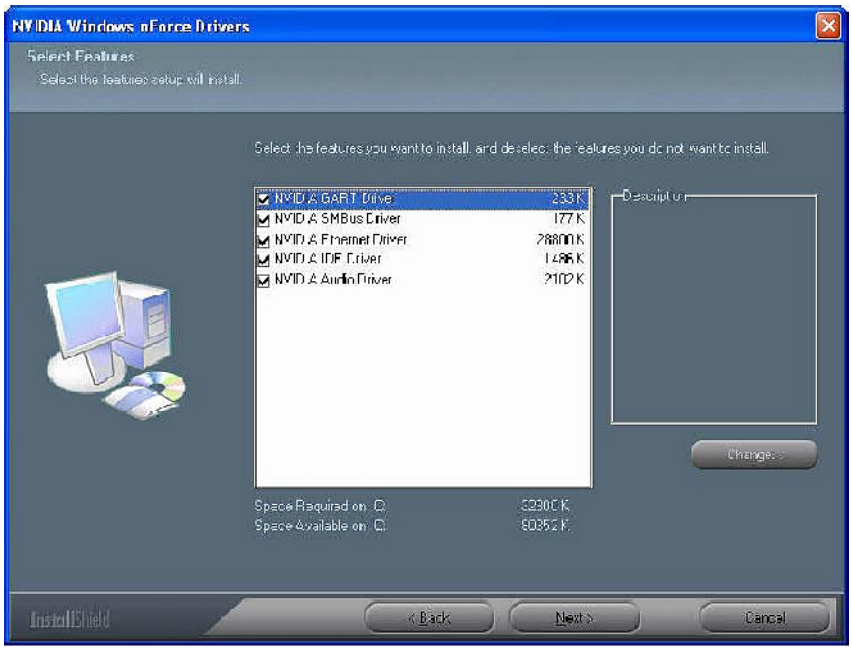
4. If you want to mark this disk as empty and wipe out all its contents then press **C**.
5. At the prompt, press **Y** to wipe out all the data, otherwise press **N**.
6. Press **Enter** again to go back to the previous window and then press **[Ctrl+X]** to exit the RAID setup.

Now that the RAID setup has been configured from the RAID BIOS, the next step is to configure and load NVRAID drivers under Windows, as explained in “Installing the NVIDIA RAID Software Under Windows” on page 19.

Installing the NVIDIA RAID Software Under Windows

This section describes how to run the setup application and install the RAID software[1].

1. Start the nForce Setup program to open the NVIDIA Windows nForce Drivers page.



2. Select the modules that you want to install.

   Make sure that the "NVIDIA IDE Driver" is selected.

   You must install the NVIDIA IDE driver in order to enable NVIDIA MediaShield. If you do not install the NVIDIA IDE driver, NVIDIA MediaShield will not be enabled.

3. Click **Next** and then follow the instructions.
4. After the installation is completed, be sure to reboot the PC.
5. After the reboot, initialize the newly created array.

   See "Initializing and Using the Disk Array" on page 29.

2.3 Setting Up a Bootable NVRAID Array

This section explains how to configure a bootable NVIDIA RAID array.

Setting Up the BIOS

1. Start your computer, then press Delete to enter the BIOS setup. The BIOS CMOS Setup Utility screen appears.

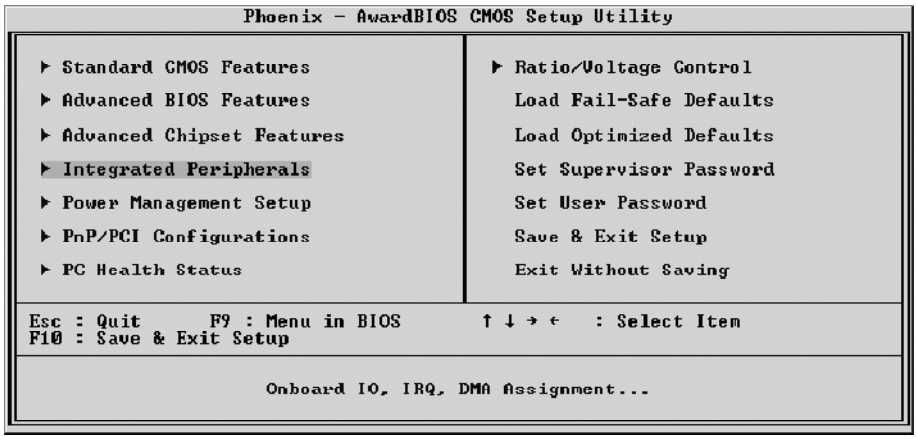


Figure 2.10 BIOS CMOS Setup Utility Main Screen

2. Use the arrow keys to select **Integrated Peripherals** (see Figure 2.10), then press **Enter**.

3. Use the arrow keys to select **Onboard IDE Device**, then press **Enter**. The Integrated Peripherals window appears.

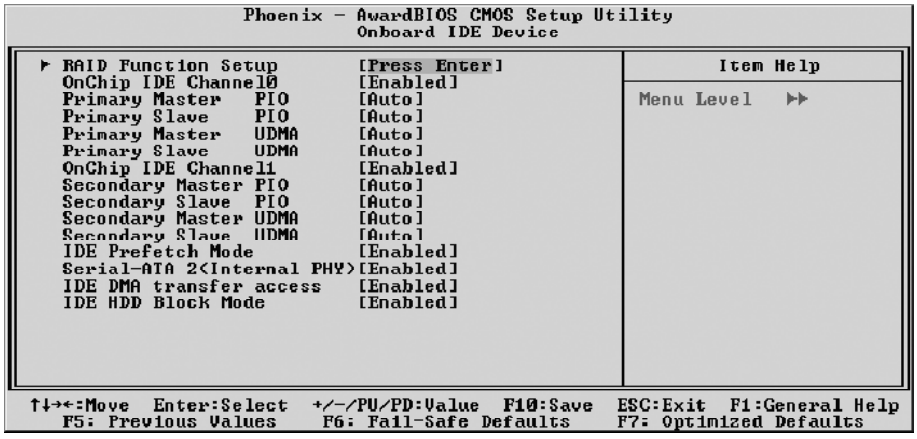


Figure 2.11 Integrated Peripherals Screen

4. Use the arrow keys to select the **RAID Function Setup** (see Figure 2.11).

5. Press Enter.

   The RAID Function Setup screen appears.

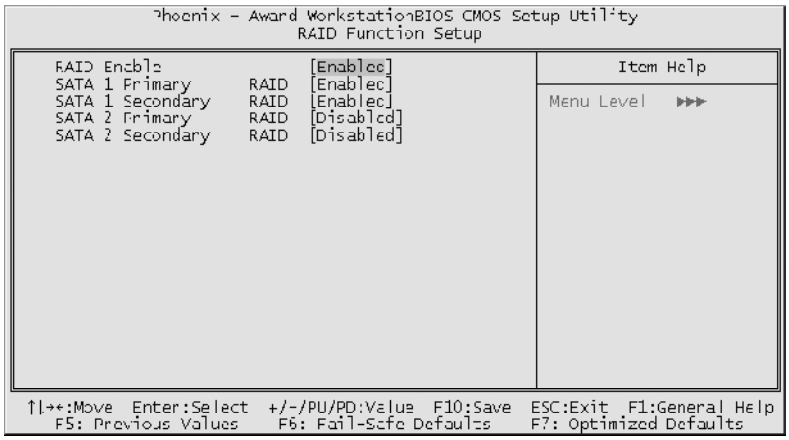


Figure 2.12 RAID Function Setup Screen

6. From the RAID Config window, globally enable RAID, then en able the SATA ports with disks that you want to use for RAID.

   If RAID is enabled globally but not enabled on the individual SATA port, disks on that port can only be used for non-RAID applications.

   In the example in figure 2.4, two SATA ports are enabled, so the non-bootable RAID array can include up to two SATA disks. If there is a disk connected to “SATA 2 Primary” or “SATA 2 Secondary”, it can not be used for RAID.

7. Press **F10** to save the configuration and exit.

8. Enter the RAID BIOS Setup by pressing **F10** when prompted, and proceed to set up the NVRAID BIOS as described in the next section.

Configuring the NVRAID BIOS

The NVRAID BIOS set up lets you choose the RAID type and which hard drives you want to make part of the array.

- **Entering the RAID BIOS Setup**

1. Wait until you see the RAID software prompting you to press **F10**. The RAID prompt appears as part of the system POST and boot process prior to loading of the OS. You have a few seconds to press **F10** before the screen disappears.

2. Press **F10**.

   The NVIDIA RAID Utility—**Define a New Array** screen ap pears (Figure 2.13).

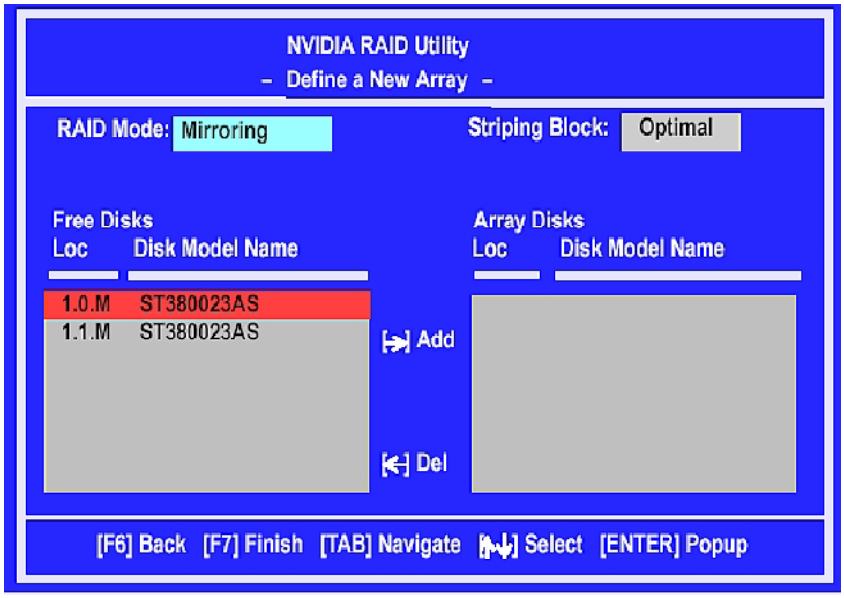


Figure 2.13 NVIDIA RAID Utility

By default, RAID Mode is set to Mirroring and Striping Block is set to Optimal.

◆ Understanding the Define a New Array Window

Use the Define a New Array window to

- **Select the RAID Mode**
- **Set up the Striping Block**
- **Specify which disks to use for the RAID Array**

  The SATA ports are called channels and they are associated with adapters. The first digit in the Location field defines the adapter that the port is associated with. The 2nd diigit defines the channel. (The “M” field, which used to specify Master or Slave, is obsolete.)

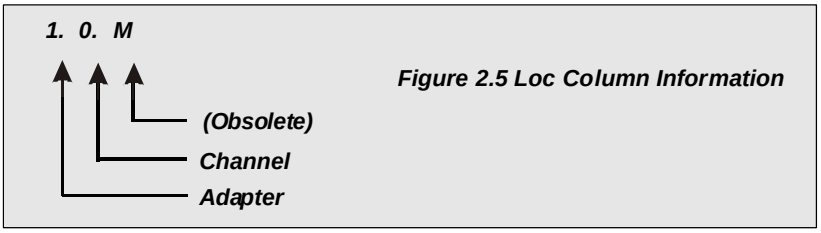


Figure 2.5 Loc Column Information

◆ Using the Define a New Array Window

If necessary, press the tab key to move from field to field until the appropriate field is highlighted.

- **Selecting the RAID Mode**

  By default, this is set to Mirroring. To change to a different RAID mode, press the down arrow key until the mode that you want appears in the RAID Mode box—either Mirroring, Striping, Spanning, Stripe Mirroring or RAID 5.

- **Selecting the Striping Block Size**

  Striping block size is given in kilobytes, and affects how data is arranged on the disk. It is recommended to leave this value at the default Optimal, which is 64KB, but the values can be between 4 KB and 128 KB (4,8,16,32,64, and 128KB).

◆ Using the Define a New Array Window

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- **Assigning the Disks**

  The disks that you enabled from the RAID Config BIOS setup page appear in the Free Disks block. These are the drives that are available for use as RAID array disks.

  To designate a free disk to be used as a RAID array disk.

  1. Tab to the Free Disks section.
     The first disk in the list is selected.

  2. Move it from the Free Disks block to the Array Disks block by pressing the rightarrow key (→).

     The first disk in the list is moved, and the next disk in the list is selected and ready to be moved.

  3. Continue pressing the right-arrow key (→) until all the disks that you want to use as RAID array disks appear in the Array Disks block.

     Figure 2.6 illustrates the Define a New Array window after two disks have been assigned as RAID1 array disks.

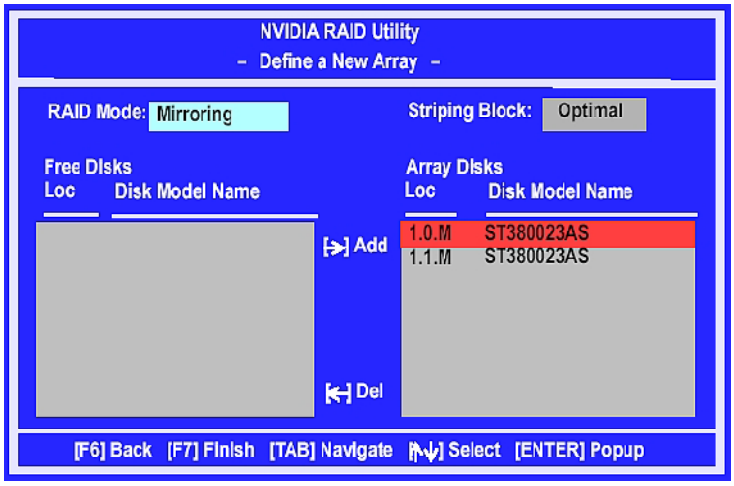


Figure 2.15 NVIDIA RAID Utility—Array Disks Assigned

◆ Completing the RAID BIOS Setup

1. After assigning your RAID array disks, press **F7**.
   The Clear disk data prompt appears.

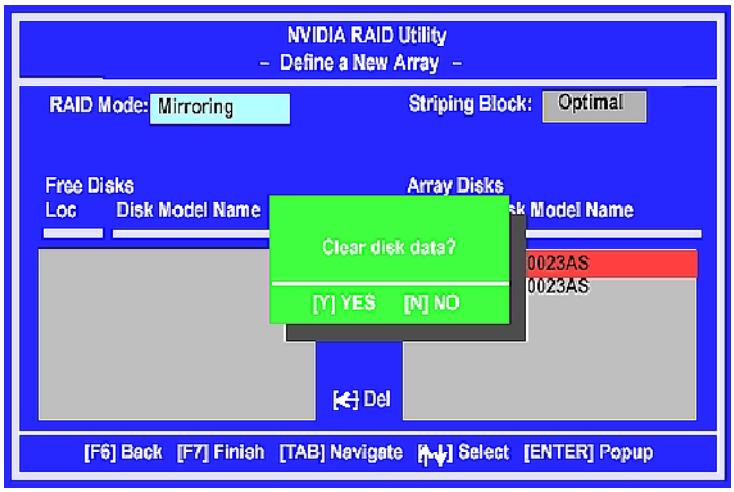


Figure 2.16 Clear Disk Data Prompt

2. Press **Y** if you want to wipe out all the data from the RAID array, otherwise press **N**. The **Array List** screen appears, where you can review the RAID arrays that you have set up.

3. Use the arrow keys to select the array that you want to set up, then press **B** to specify the array as bootable.

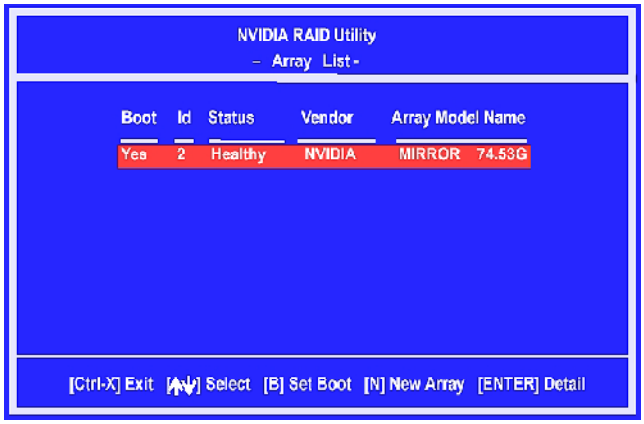


Figure 2.17 Array List Screen

3. ***Press* Enter** to view and verify details.
   The **Array Detail** screen appears.

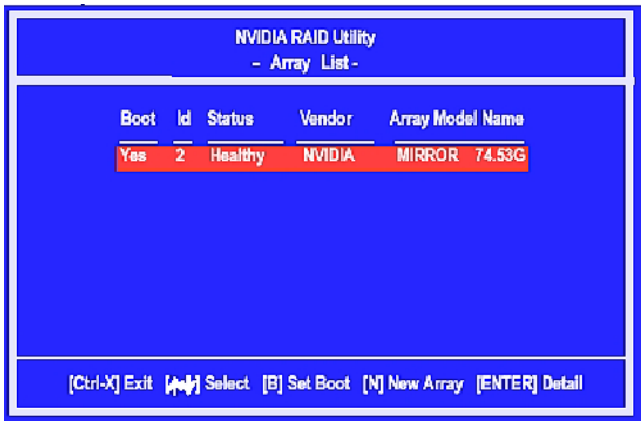


Figure 2.18 Array Detail Screen

The Array Detail screen shows various information about the array that you selected, such as Striping Block used, RAID Mode, Striping Width, Disk Model Name, and disk capacity.

4. If you want to mark this disk as empty and wipe out all its contents then press **C**.
5. At the prompt, press **Y** to wipe out all the data, otherwise press **N**.
6. Press **Enter** again to go back to the previous window and then press **[Ctrl+X]** to exit the RAID setup.

Installing the RAID Drivers

1. After you complete the RAID BIOS setup, boot from the Windows CD. The Windows Setup program starts.
2. Press **F6** and wait a few moments for the Windows Setup screen to appear.

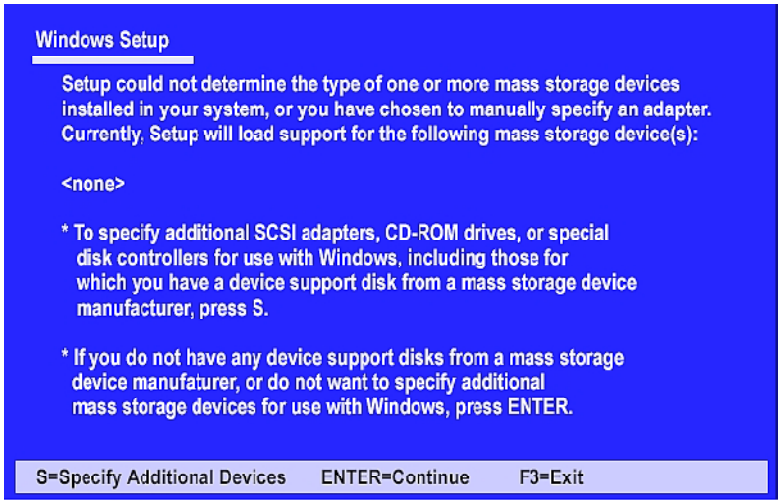


Figure 2.19 Windows Setup—Specify Devices

3. Specify the NVIDIA drivers.
   a. Insert the floppy that has the RAID driver, press **S**, then press Enter. The following Windows Setup screen appears:

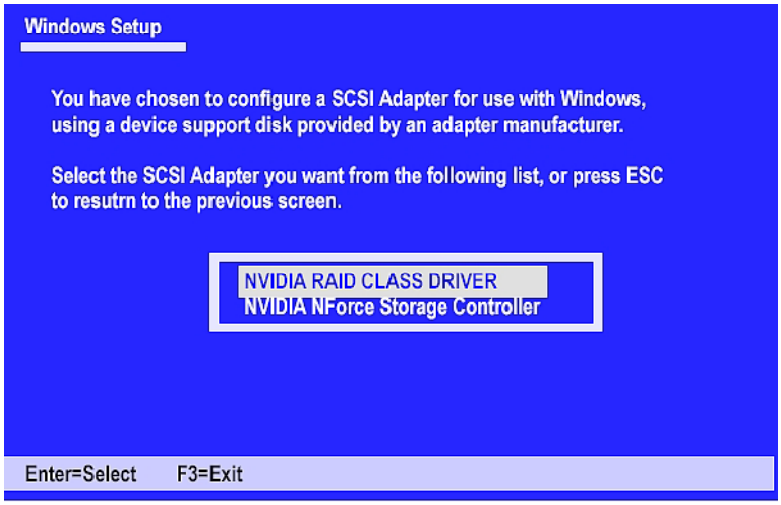


Figure 2.20 Windows Setup—Select SCSI Adapter

b. Select “NVIDIA RAID CLASS DRIVER”, then press **Enter**.

c. Press **S** again at the Specify Devices screen, then press **Enter**.

d. Select “NVIDIA NForce Storage Controller”, then press **Enter**.

The following Windows Setup screen appears listing both drivers:

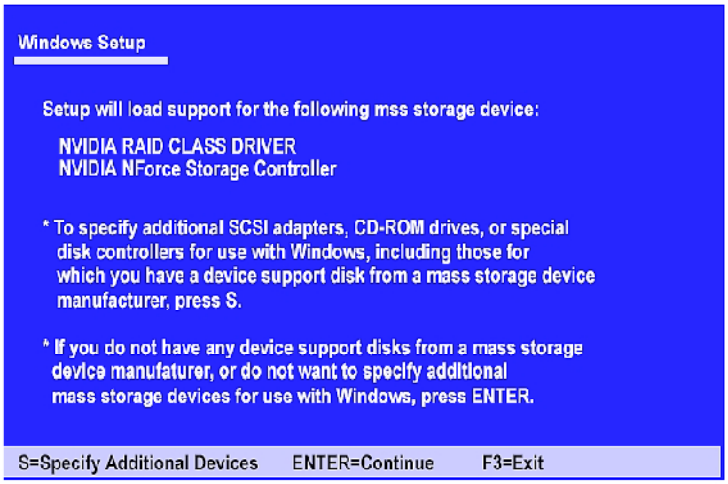


Figure 2.21 Windows Setup—NVIDIA drivers listed

4. Press **Enter** to continue with Windows XP Installation.

   Be sure to leave the floppy disk inserted in the floppy drive until the blue screen portion of Windows XP installation is completed, then take out the floppy.

5. Follow the instructions on how to install Windows XP.

   After Windows XP is completely installed, it its recommended that you install the ForceWare software in order to access the MediaShield RAID Management tool.

Note : *Each time you add a new hard drive to a RAID array, the RAID driver will have to be installed under Windows once for that hard drive. After that, the driver will not have to be installed.*

2.4 Initializing and Using the Disk Array

The RAID array is now ready to be initialized under Windows.

1. Launch Computer Management by clicking Start → Settings → Control Panel then open the Administrative Tools folder and double click on Computer Management.

2. Click Disk Management (under the Storage section).

   The Initialize and Convert Disk Wizards appears.

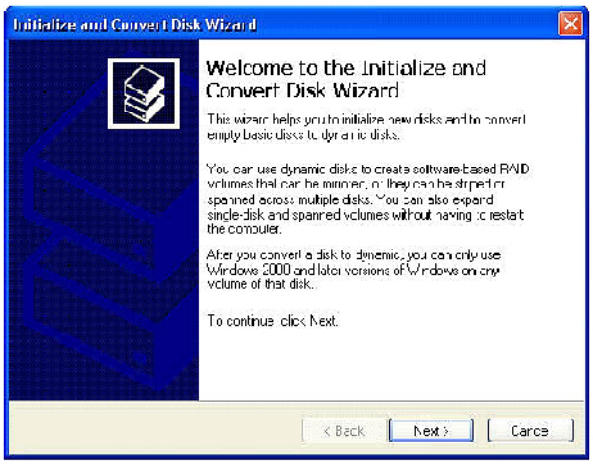


Figure 2.22 Initialize and Convet Wizard

3. Click **Next**.

   The Select Disks to Initialize window appears.

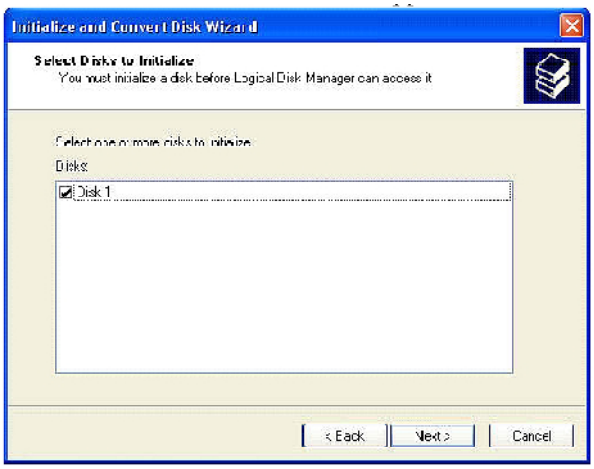


Figure 2.23 Select Disks to Initialize Page

The disks listed depend on how many arrays you have configured.

4. Click **Next**.

   The Select Disks to Convert window appears.

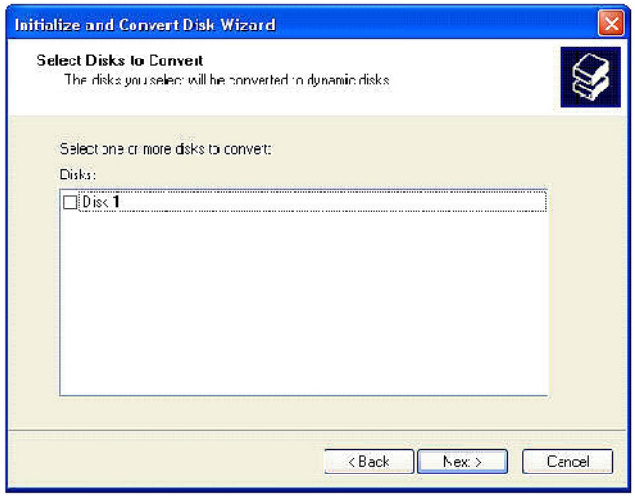


Figure 2.24 Select Disks to Convert Page

5. Check the disk in the list if you want to make the array a dynamic disk, then click **Next**. The Completing the Initialize and Convert Disk Wizard window appears.

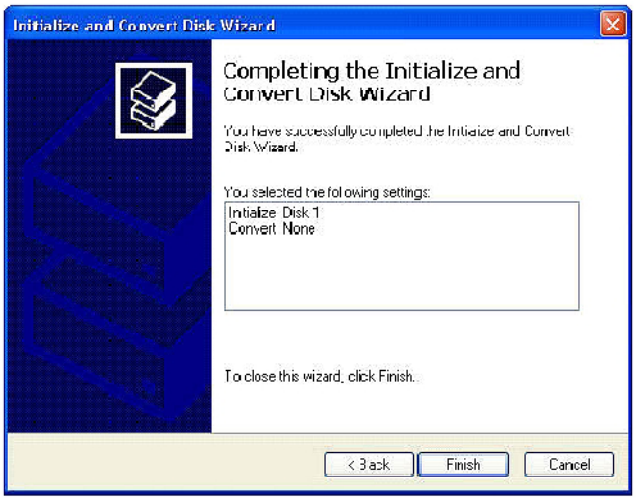


Figure 2.25 Completing the Initialize and Convert Disk Wizard Page

6. Click **Finish**.

   The Computer Management window appears.

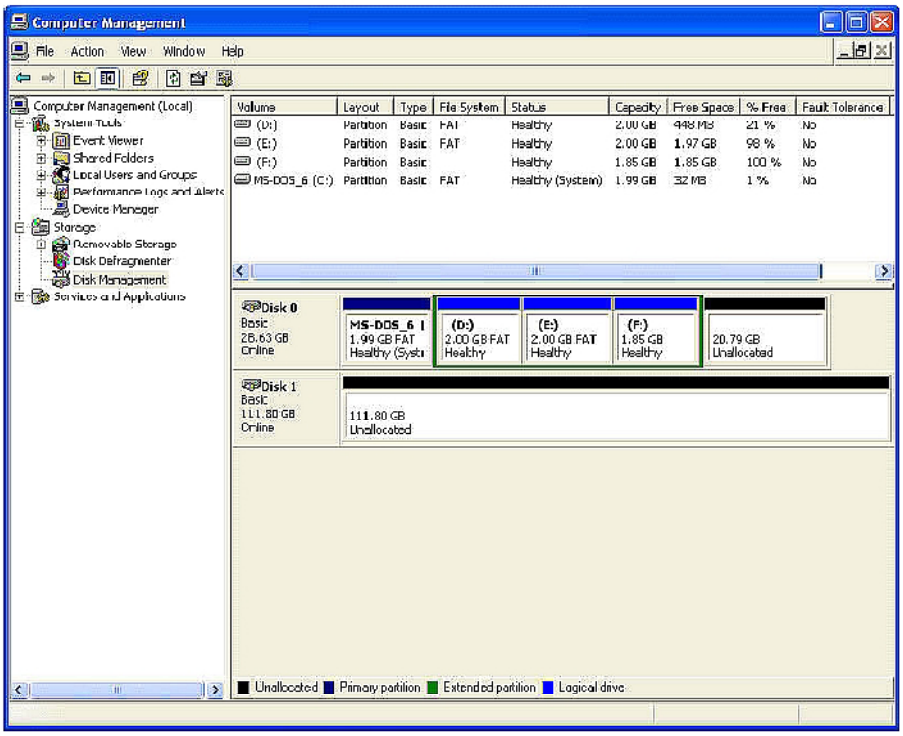


Figure 2.26 Computer Management Window

The actual disks listed will depend on your system. In Figure 2.26, there is a 111 GB unallocated partition (which is the total combined storage of two 60 GB HD). You must format the unallocated disk space in order to use it.

7. Format the unallocated disk space.

   Right click “Unallocated space”, select “New Partition…” and follow the wizard.

   After the drive has been formatted, it is ready for use.

3. MANAGING YOUR RAID DRIVES

3.1 About the NVRAID Utility

The NVRAID software ships with an application called NVRAIDMAN. With this application you can perform the following tasks:

- ***Viewing RAID Array Configurations***

  View an array configuration (mirrored, striped, mirror-striped, JBOD, or any supported combination)

- ***Setting Up a Spare RAID Disk***

  • View free and/or dedicated free disks

  • Designate a free disk to a particular array

- ***Rebuilding a RAID Mirrored Array***

  • Rebuild a broken mirrored array

  • Watch the progress of rebuilding of an array

3.2 Viewing RAID Array Configurations

To view your RAID configuration from Windows, launch the MediaShield RAID Management utility by double-clicking MediaShield.
The RAID configuration information appears in the right-side pane, as shown in Figure 3.1.

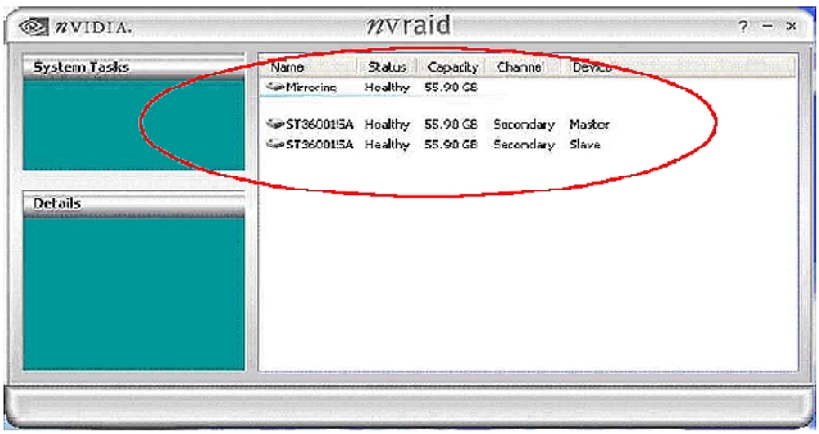


Figure 3.1 NVRAID Management Utility Window

The following are examples of the information displayed for the various RAID levels. While the details of your own configuration will likely vary from what is shown, the examples serve to illustrate the basic differences between the RAID levels.

- ***NVRAID Mirrored Array***

  Figure 3.2 shows an example of a two hard drive mirrored array using identical 55.90 GB[1] hard drives (ST360015A), where one drive is configured as Master and the other drive is configured as Slave.The total hard disk space used is 55.90 GB.

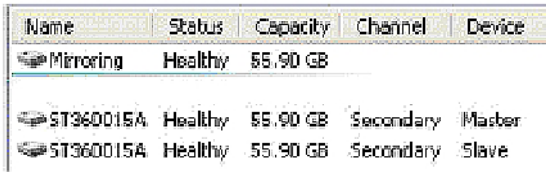
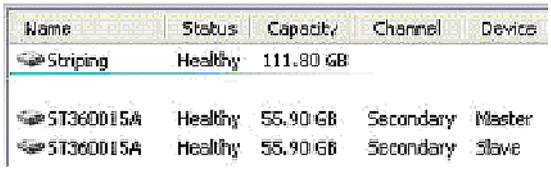


Figure 3.2 NVRAIDMAN Mirrored Array Information

- ***NVRAID Striped Array***

  Figure 3.3 shows an example of a two hard drive striped array using identical 55.90 GB hard drives (ST360015A), where one drive is configured as Master and the other drive is configured as Slave. The total disk space used is 111.80 GB.



- ***NVRAID Striped Mirror Array***

  Figure 3.4 shows an example of a four hard drive stripe-mirrored

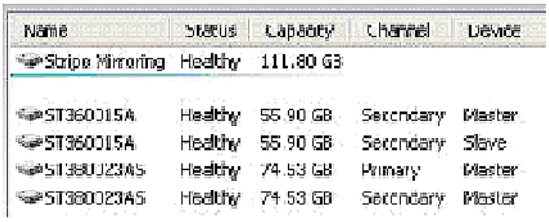


Figure 3.4 NVRAIDMAN Stripe Mirroring Array Information

array. The total disk space used is 111.80 GB.

- ***NVRAID Spanning (JBOD) Array***

Figure 3.5 shows an example of a two hard drive spanning array. The tot

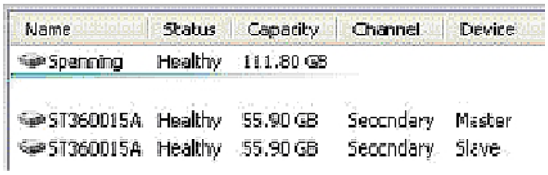


Figure 3.5 NVRAIDMAN Spanning Array Information

- ***NVRAID Mirrored Array and a Striped Array***

Figure 3.6 shows an example of a two hard drive mirrored array

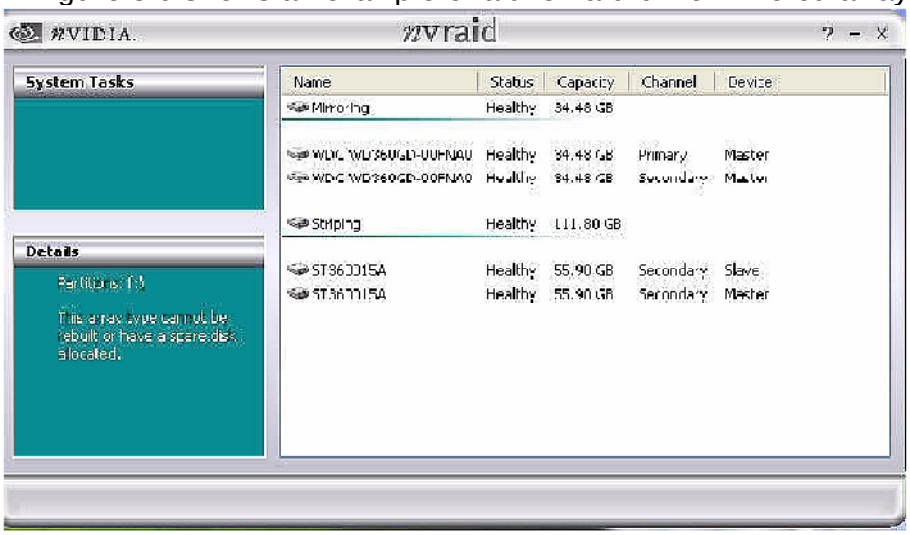


Figure 3.6 NVRAIDMAN Mirrored Array and Striped Array Information

3.3 Setting Up a Spare RAID Disk

You can designate a hard drive to be used as a spare drive for a RAID 1, RAID 0+1 or RAID 5 array[2]. The spare drive can take over for a failed disk. MediaShield RAID supports two types of spare drives:

- **Free Disk**

A free disk is a disk that is not part of any RAID array, but can be used by any available RAID 1, RAID 0+1, or RAID 5 array that requires a particular disk when one of its disks crashes or becomes unusable. The process is automatic and doesn't require any user interaction.

For example, if you have a system with four hard disks where one disk is used to boot the OS, two hard drives are set up in a mirrored array, and a fourth hard disk is set up as a free disk, then if one of the mirrored array drives fails, the free disk will be automatically assigned to the mirrored array to be used instead of the failed disk.

- **Dedicated Disk**

A dedicated free disk is a disk that is assigned to a RAID 1, RAID 0+1, or RAID 5 array and that disk is used by that array only when needed, for example during a system crash where a RAID mirrored drive is broken. The dedicated disk can be used only by the array that it is assigned to and not by any other array, unlike a free disk which can be used by any available RAID 1, RAID 0+1, or RAID 5 array.

Assigning a Free Disk

To mark a disk as free, or not a part of any array,

1. Enter the system BIOS setup and make sure that the drive that you want to mark as free is RAID enabled.
2. Enter the RAID BIOS and make sure that the drive is not part of any array (if one exists).
3. Boot into Windows and run the NVRAIDMAN program. The drive appears under the Free Disk section. Figure 3.7 shows an example of the NVRAIDMAN display if you have a mirror array and one free disk.

Note : *Spare disks cannot be used for RAID0 or JBOD arrays.*

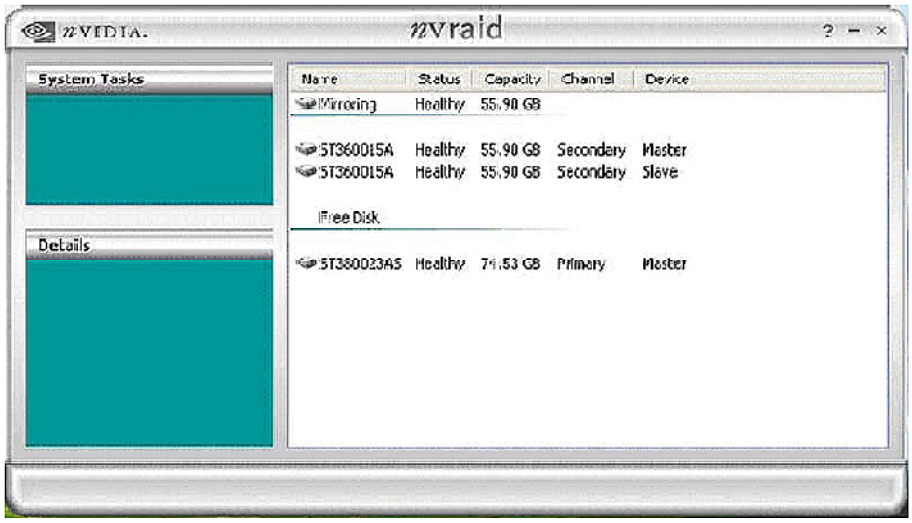


Figure 3.7 NVRAIDMAN Free Disk Information

Assigning a Dedicated Disk

To mark a disk as dedicated, or reserve it for use by a specific array,

Step 1: Mark the Disk as a Free Disk

1. Enter the system BIOS setup and make sure that the drive that you want to mark as free is RAID enabled.
2. Enter the RAID BIOS and make sure that the drive is not part of any array (if one exists).
3. Boot into Windows and run the NVRAIDMAN program. The drive appears under the Free Disk section.

Step 2: Dedicate the Free Disk to an Array

While running NVRAIDMAN, dedicate the free disk to an array using one of the following two methods:

- **Method 1: Select a free disk and then assign it to an array.**
- **Method 2: Select an array and then assign a free disk to it.**

Both methods are equally simple ways of accomplishing the same task.

Method 1: Select a free disk and then assign it to an array.

1. Right click one of the available disks under the Free Disk section. The pop-up menu appears.

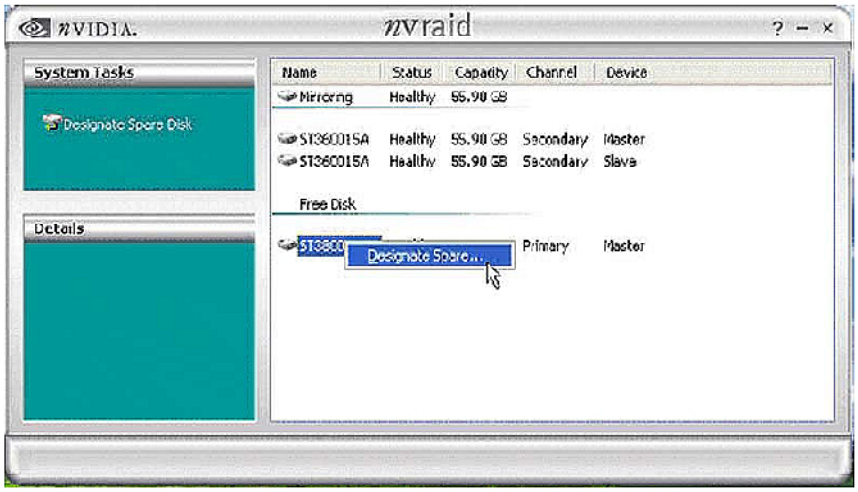


Figure 3.8 Free Disk Pop-up Menu

2. Select **Designate Spare** from the menu to launch the Spare Disk Allocation Wizard.

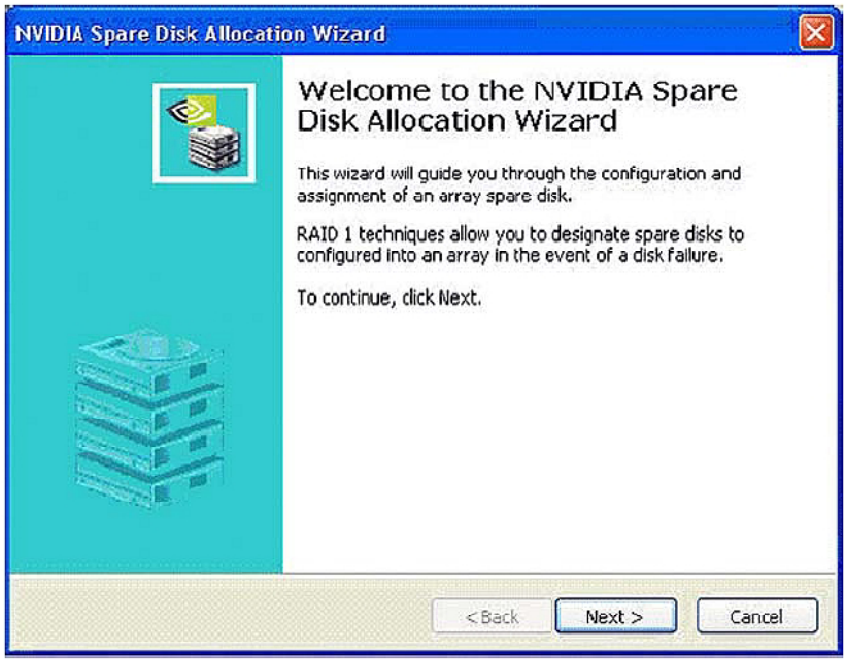


Figure 3.9 Spare Disk Allocation Wizard

3. Click **Next**.

   The RAID Array Selection page appears.

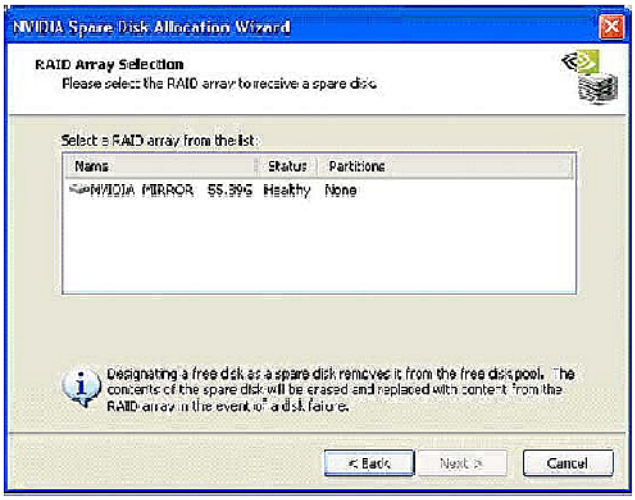


Figure 3.10 RAID Array Selection Page

4. From the RAID Array Selection page, select one of the arrays from the list. This is the array to which you want to allocate the dedicated free disk.

> ***Note: In Figure 3.10 there is only one array created on the system.***

5. Click **Next**. The Completing the NVIDIA Spare Disk Allocation page appears.

Figure 3.11 Completing Spare Disk Allocation Wizard Page

6. Click **Finish**.

   As shown in Figure 3.12, the ST380023AS drive is now a dedicated free disk in the mirrored array. If a system crash occurs that causes any of the two ST360015A drives to fail, the ST380023AS hard drive will take over and be used in the newly formed mirrored array.

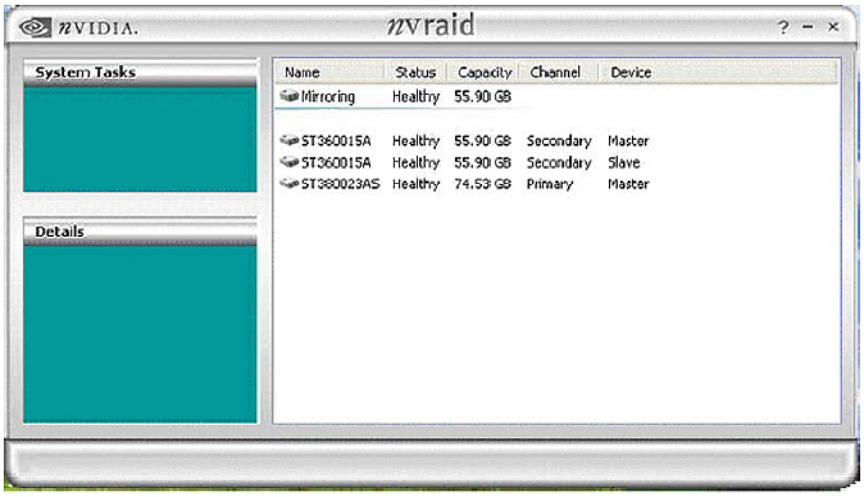


Figure 3.12 Designated Spare Disk

Once a dedicated disk has been assigned to a particular array, it can be removed at any time. To remove the disk, right click on the dedicated disk and select the option to remove it.

Method 2: Select an array and then assign a free disk to it.

1. Right click on the array to which you want to assign a dedicated free disk. The pop-up menu appears.

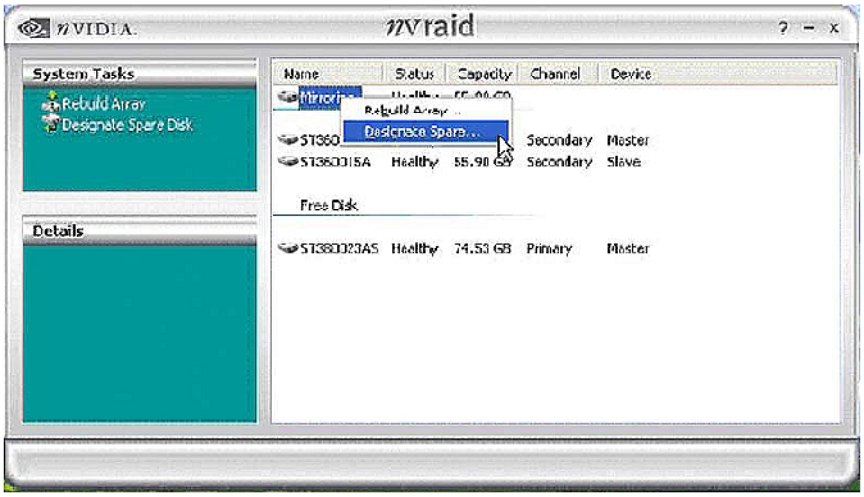


Figure 3.13 Array Pop-up Menu

2. Select Designate Spare from the menu to launch the Spare Disk Allocation Wizard.

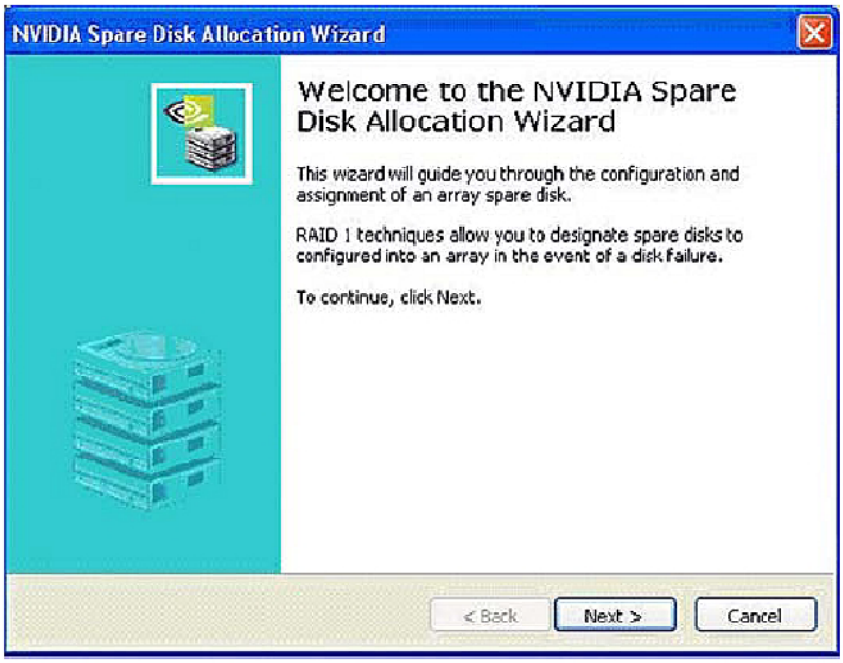


Figure 3.14 Spare Disk Allocation Wizard

3. Click **Next**.

   The Free Disk Selection page appears.

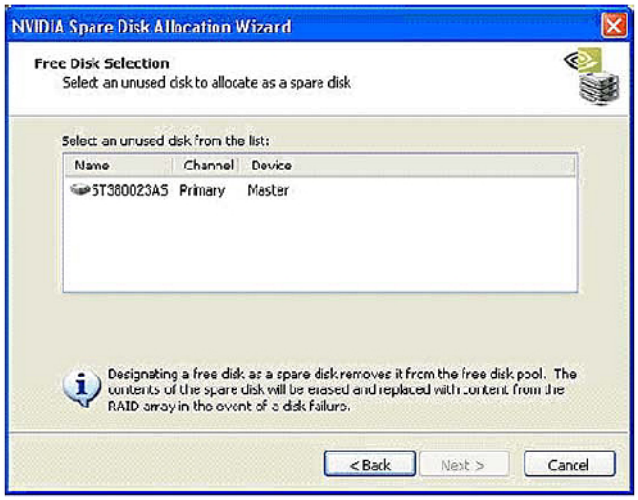


Figure 3.15 Free Disk Selection Page

4. From the Free Disk Selection page, select one of the disks from the list.

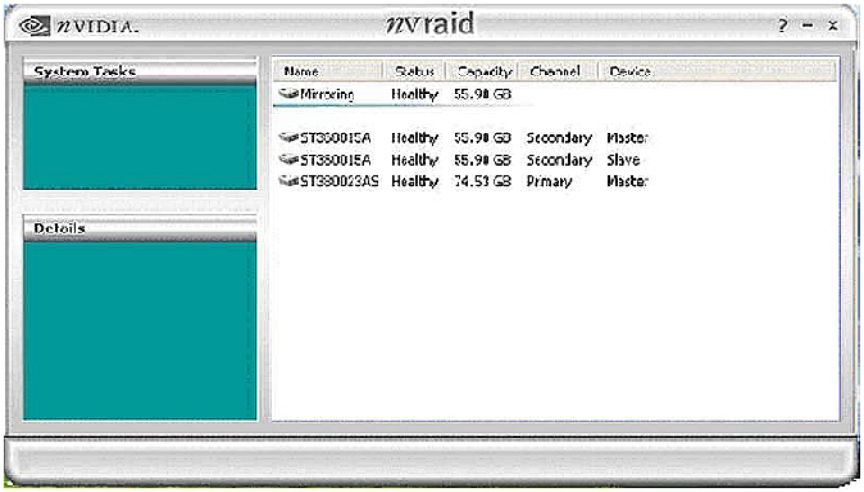
> ***Note: There can be more than one disk to choose from.***

5. Click **Next**. The Completing the NVIDIA Spare Disk Allocation page appears.

Figure 3.16 Completing the Spare Disk Allocation Wizard Page

6. Click **Finish**.

   You have now assigned a dedicated free disk to a mirrored array.



Once a dedicated disk has been assigned to a particular array, it can be removed at any time. To remove the disk, right click on the dedicated disk and select the option to remove it.

Example of Dedicating a Free Disk in a RAID 1 or RAID 0+1 Array

You can also assign a dedicated free disk to a RAID 1 or a RAID 0+1 array, using the same process.

1. Right-click either the free disk that you want to dedicate to an array, the array type, or the array drives as shown in Figure 3.17, Figure 3.18, and Figure 3.19. the then click Designate Spare to launch the Spare Disk Allocation Wizard.

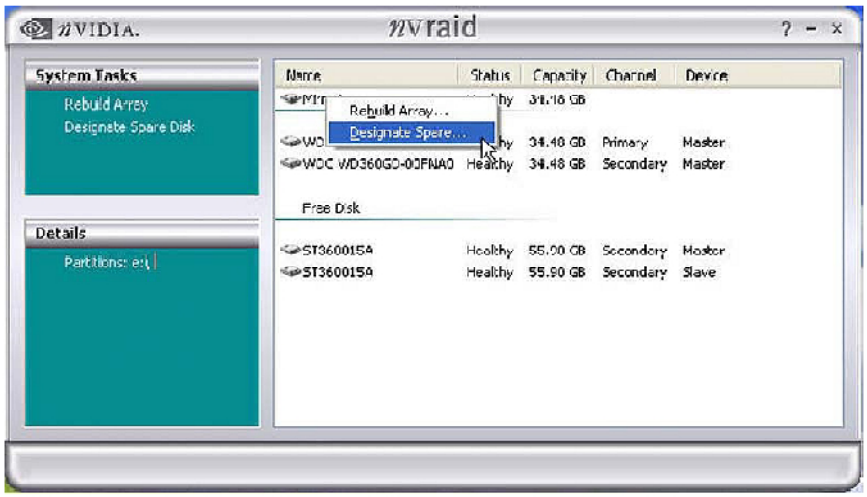


Figure 3.17 Right-clicking the Array Type

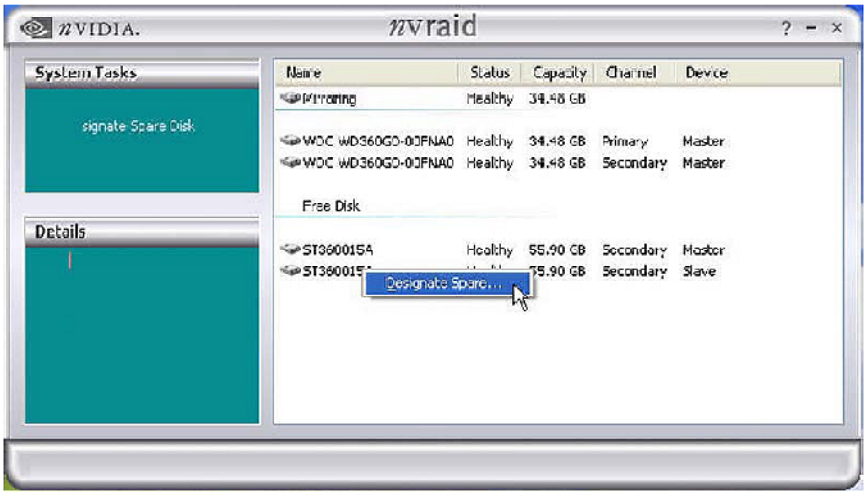


Figure 3.18 Right-clicking the Free Disk

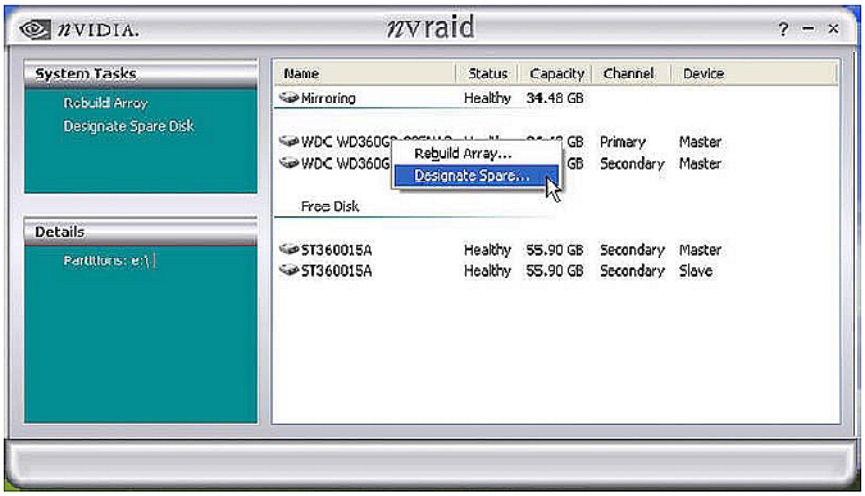


Figure 3.19 Right-clicking the RAID Drives

2. Click **Designate Spare** and then follow the instructions in the Wizard. Figure 3.20 shows an example of a RAID 1 array that has one spare disk dedicated to it.

Figure 3.20 NVRAIDMAN RAID 1 Spare Disk Information

Once a dedicated disk has been assigned to a particular array, it can be removed at any time. To remove the disk, right click on the dedicated disk and select the option to remove it.

3.4 Rebuilding a RAID Mirrored Array

Rebuilding is the process of recovering data from one hard drive to another. All data is copied from one hard drive to another and then the data is synchronized between the two hard drives. This only applies to RAID 1 array as well as a RAID 0+1 array.

Rebuilding Instructions

After creating a mirrored array, you can rebuild the array using the following steps:

1. Go to Windows and run the NVRAID Management utility.

   Figure 3.21 shows an example of a system with one mirrored array.

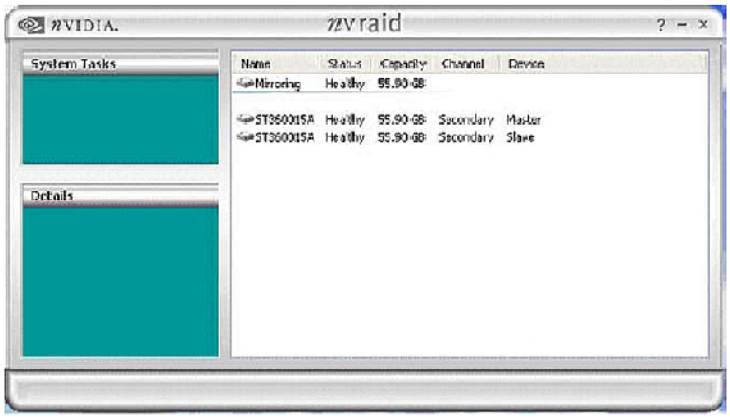


Figure 3.21 Mirrored Array

2. Right-click on Mirroring. The popup menu appears.

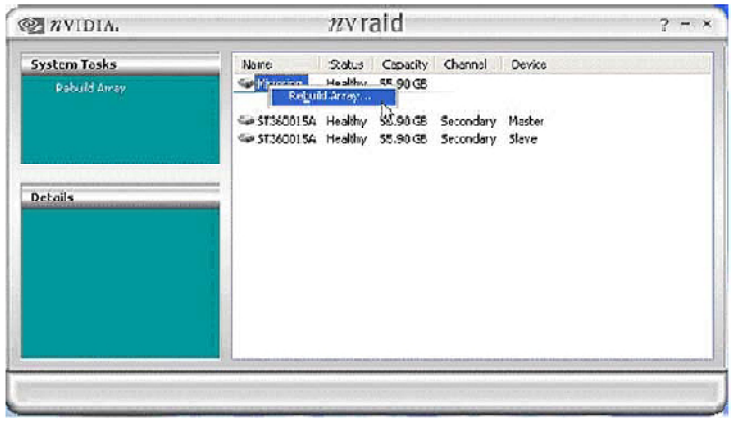


Figure 3.22 Array Pop-up Menu

3. From the popup menu, click **Rebuild Array**.

   The NVIDIA Rebuild Array Wizard appears.

Figure 3.23 NVIDIA Rebuild Array Wizard

4. Click **Next**. The Disk Selection page appears.

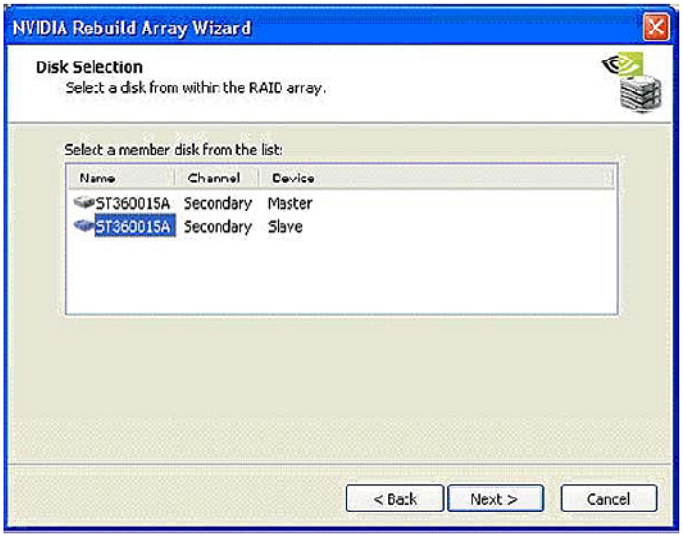


Figure 3.24 Disk Selection Page

5. Select the drive that you want to rebuild by clicking it from the list, then click **Next**.

   The Completing the NVIDIA Rebuild Array page appears.

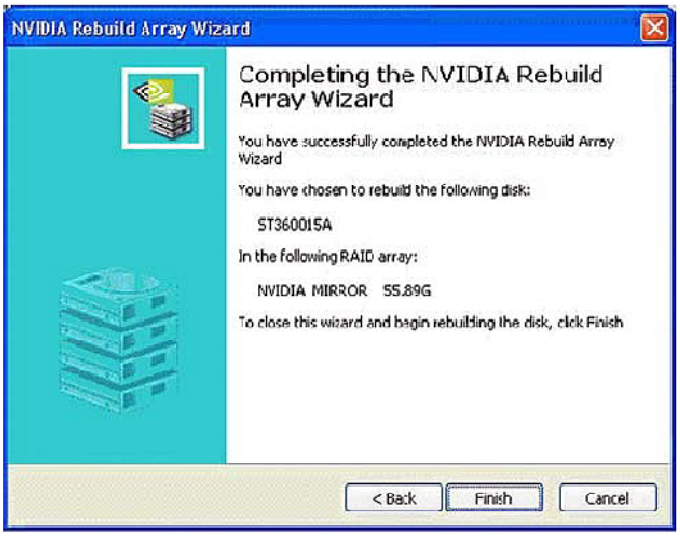


Figure 3.25 Completing the NVIDIA Rebuild Array Wizard Page

6. Click **Finish**.

The array rebuilding starts after a few seconds, and a small pop-up message appears towards the bottom right corner of the screen as shown in Figure 3.26.

Figure 3.26 Rebuild Bubble Message

During the rebuilding process, the NVRAID Management utility screen shows the status under the System Tasks and Details sections.

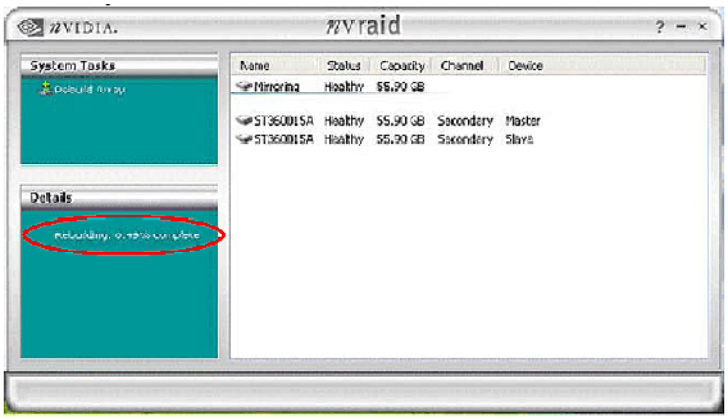


Figure 3.27 Array Rebuilding Status Detail

More About Rebuilding Arrays

- **Rebuilding Occurs in the Background**

  The rebuilding process is very slow (it can take up to a day) and occurs in the background so as not to affect the performance of the system.

- **Rebuilding Applies Only to RAID 1, RAID 0+1 or RAID 5 Arrays**

  Rebuilding an array works only when using RAID1, RAID 0+1 and/or RAID 5. Rebuilding does not apply to RAID 0 and JBOD arrays.

- **You Can Use Any Available Free Disk**

  You can rebuild a mirrored array using any available Free Disk or Dedicated Disk.

  For example, Figure 3.28 shows a mirrored array using 34.48 GB HD while having two Free Disks each 55.90 GB large.

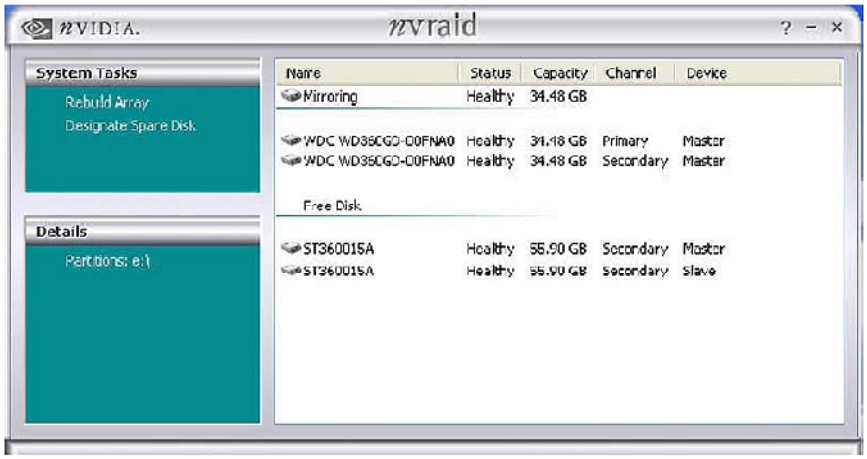


Figure 3.28 Free Disks Available for Rebuilding

To use one of these avialable free disks to rebuild your array, follow the same steps as explained in “Rebuilding a RAID Mirrored Array” on page 45, except when prompted to select a disk, choose one of the two available free disks.

4. NVRAID FREQUENTLY ASKED QUESTIONS

4.1 Basic RAID Questions

- ***What is RAID?***

  RAID stands for **R**edundant **A**rray of **I**ndependent **D**isks, and refers to the grouping of 2 or more disk drives that the system views as a single drive. Different groupings have difference advantages that include better performance and data fault tolerance.

  See "About NVIDIA RAID" on page 1 for detailed descriptions of the different types of RAID arrays.

- ***What type of RAID array is right for me?***

  In general, for better throughput of non-critical data, use RAID 0; for fault tolerance, use RAID1, and for better throughput as well as fault tolerance use RAID 0+1.

  See "About NVIDIA RAID" on page 1 for detailed descriptions of the different types of RAID arrays.

- ***What is the difference between a bootable and a non-bootable RAID array?***

  A system with a non-bootable RAID array includes a separate hard disk that contains the OS and is not part of the RAID array.

  See "Non-Bootable RAID Array" on page 10 for more information.

  In a bootable RAID array, the OS is installed on the RAID array disks.

  See "Bootable RAID Array" on page 10 for more information.

- ***I just configured a RAID 1 array—why is the array size one-half the total cumulative size of the drives?***

  RAID 1 uses one-half the total disk space for data redundancy.

  See "RAID 1" on page 4 for more information on RAID1 arrays.

- ***What is the optimal hard drive configuration for RAID 1 (mirror)?***

  In a mirrored array, a mirror is created using the maximum drive size of the smaller of the two drives. Ideal configuration is achieved using drives of identical size.

- ***How do I configure a multiple array system?***

  Two different arrays can be configured and active at the same time. For example, a mirrored array with two hard drives, as well as a striped array using three hard drives can exist at the same time. You need to configure each array separately in the RAID BIOS as well as initialize the arrays in Windows as described in “Setting Up Your RAID Configuration” on page 10.

- ***Why is the cumulative size of a RAID 0 (Stripe) or RAID 0+1 (Stripe-Mirror) not equal to the sum of the drives?***

  The drive size is controlled by stripe blocks. If you have mis-matched drive sizes, the size of the array is approximately the size of the smaller drive multiplied by two. This is done because there must be corresponding data locations between the drives in the array. Any space beyond the corresponding points is not usable.

- ***Why can I not get into Windows after adding a non-bootable array?***

  Possible cause would be adding the boot drive to the array and then clearing the array.

4.2 RAID ROM Setup Questions

- ***Why can I not get into the RAID ROM Setup?***

  You must enable RAID functionality in the system BIOS as explained in “Setting Up the BIOS” on page 12.

- ***Why do my hard drives not appear in the RAID ROM Setup?***

  From the RAID Config window, you must enable RAID and then enable the disks that you want to use as RAID disks. See “Setting Up the BIOS” on page 12 for more information.

- ***What is the Optimal Block Size in the RAID ROM Setup?***

  The default optimal block size is 32KB. NVIDIA recommends using the optimal block size.

- ***What does BBS stand for in the RAID ROM [F10] setup?***

  BBS stands for BIOS Boot Specification. This indicates that the boot device is defined in the BIOS.

- ***What does “Clear Disk” mean in the RAID ROM Setup?***

  Clear Disk clears the MBR (Master Boot Record). This is needed to prevent invalid data from appearing in the MBR space on any of the drives included in the array. Not doing so could render the system unstable.

4.3 Rebuilding Arrays Questions

- ***Why does the RAID rebuilding process take so long to complete?***

  In the rebuilding process, all data is copied from one hard drive to another and then the data is synchronized between the two hard drives. Because the rebuilding process occurs in the background in a way that does not affect system performance, the process can be very slow—taking up to a day or more to complete.

See “Rebuilding a RAID Mirrored Array” on page 45 for more information.

4.4 Dedicated Disk Questions

- ***Can I assign a dedicated disk to a striped array/JBOD or use a free disk withstriped array/JBOD?***

  No, free disks and dedicated disks can be only used with a mirrored array or a stripedmirrored array.

- ***Once a dedicated disk has been assigned to a RAID1 or RAID0+1 array can I remove it?***

  Yes, a dedicated disk can be removed from a RAID1 or a RAID 0+1 array.

4.5 Windows RAID Application

- ***What functions can be performed using the NVRAIDMAN application?***

  The following tasks can be performed:

  - View information about RAID0, 1, 0+1 and JBOD (as well as any supported configuration if you have more than one RAID array active)
  - Assigning a dedicated disk to RAID 1 and RAID 0+1
  - Removing a dedicated disk from a RAID 1 or RAID 0+1 array
  - Viewing Free Disks
  - Rebuilding a RAID 1 and RAID 0+1
  - Viewing the status of the rebuilding process

5. NVRAID APPLICATION NOTES

This chapter includes several application notes that address specific issues that may be encountered when trying to install the NVIDIA RAID software of other software required to run NVIDIA RAID.

- "installing NVIDIA RAID on a New Windows XP Operating System" on page 54 describes how to create a floppy disk to install NVIDIA RAID on a fresh Windows operating system.

- "Windows 2000 Limitation with Bootable RAID" on page 55 de scribes how to create a bootable RAID volume with Windows 2000 via the morphing method..

- "Installing the NVIDIA IDE Driver in Windows 2000" on page 57 describes how to instll Windows 2000 Service Pack 4, which required for instlling the NVIDIA IDE driver.

- "Using GHOST with NVIDIA RAID" on page 58 describes how to use disk cloning software with a RAID array.

Installing NVIDIA RAID on a New Windows XP Operating System

Problem

To install NVIDIA® RAID technology on a new Windows XP operating system, a floppy disk with the NVIDIA IDE drivers must be created to enable installation of NVIDIA RAID.

Solution

To create the NVIDIA IDE drivers floppy disk, the end user must:

1. Copy these files from the NVIDIA Nforce™ driver directory (IDE/WinXP or Win2K) onto a formatted floppy disk.
   • Disk1 • Txtsetup.oem • Nvraid.sys • NvAtaBus.sys
2. Go into the BIOS setup menu and enable RAID
   a. In the BIOS menu, specify which disks should be dedicated to RAID
   b. Exit the BIOS menu and reboot
3. At the RAID ROM screen, press F10 to enter RAID setup
   a. Create a RAID array and add disks to it
   b. Select “Yes” when asked to clear disk data
   c. Reboot system
4. Select F6 when prompted
5. Install the NVIDIA RAID drivers created on the floppy disk. Select both the RAID and IDE drivers from the floppy to enable RAID functionality.
6. Continue with the driver installation porcess

Windows 2000 Limition with Bootable RAID

Problem

In Windows 2000 (Service Pack 2 or previous versions), the end user cannot install this operating system to a bootable RAID volume.

Solution

There are two solutions to resolve this issue, described as follows:

Use the NVRAIDMAN Tool

Use the NVRAID Tool (nForce Driver Version 5.xx) to convert the boot volume to a RAID array. The following are step by step instructions.

1. Install Windows 2000 on a selected hard drive.
2. Download and install Windows 2000 Service Pack 4 from Microsoft's website.
3. Reboot the system.
4. Press the DEL key as the system is rebooting to enter into the system BIOS.
5. Select Integrated Peripherals menu.
6. Select the RAID Config menu.
7. Enable RAID for the selected drive (the one containing the Windows 2000 operating system).
8. Press F10 to exit and save settings in the system BIOS. This action reboots the System.
9. Press F10 as the system is rebooting to go into the RAID ROM. The system directs you into the NVIDIA RAID Utility.
10. Select Striping under RAID Mode.

11. Press TAB to go into the Free Disk menu.
12. Use the Right Arrow key to add the desired disk.
13. Press F7 to finish.
14. Select N(NO) when asked to Clear Disk Data.
15. Press Ctrl-X to exit. The system reboots into Windows 2000.
16. Install the NVIDIA nForce Driver Package while in Windows 2000.
17. Reboot the system.
18. Go to START>Programs>Nvidia Corporation and select NVRAID Manager. You should see the single disk RAID array (in striping mode) that was created from the boot disk.
19. Select the single boot disk RAID Array by clicking on it.
20. Select Convert Array under the System Tasks. The Convert Array wizard is displayed.
21. Select Next.
22. Select the desired type of RAID array you want to convert.
23. Select Nest. You are prompted to select the desired Free Disk(s) to add to the bootable RAID array.
24. Click Finish. At this point, NVRAID starts converting the single disk RAID array into a multi-disk RAID array in a bootable format.

Create a Combination CD

The user must create a combination installation CD that includes Windows 2000 and SP3 or SP4 fixes integrated in. To create the combination installation CD, refer to the following website.

http://www.microsoft.com/windows2000/downloads/servicepacks/sp4/HFdeploy.htm

Installing the NVIDIA IDE Driver in Windows 2000

Problem

In Windows 2000 (Service Pack 2 or previous versions), the end user cannot install the NVIDIA IDE Driver without upgrading Windows 2000 with Service Pack 4.

Solution

In order to upgrade Windows 2000 with Service Pack 4:

1. Install Windows 2000 on a selected hard drive.
2. Download and install Windows 2000 Service Pack 4 from Microsoft's website.
3. Reboot the system.
4. When in Windows 2000, install the NVIDIA nForce Driver Package. The user will have an option to install the NVIDIA IDE driver during the installation process..
5. Reboot the system.

Using GHOST with NVIDIA RAID

Problem

GHOST can interface with hard disk controllers by accessing the appropriate memory and hardware locations directly. However, in doing so, this can bypass the RAID enhancements that are provided by the system BIOS. The system BIOS understands the underlying disk and RAID array structures and formats. In order to properly use GHOST to interact with a RAID volume, the user should ensure that the tool is operating in a mode where it does not talk directly to the hardware resources, but rather communicates using the system BIOS.

Solution

In order to GHOST in a RAID volume, the user must:

- Disable the GHOST Direct Disk Access
- Force it to rely on Extended INT13 to access the disk

To set GHOST to use Extended Interrupt 13h(INT13)access-

a. Start GHOST from the DOS prompt. (Not the Windows Command Prompt session)

b. Select the “Options” (Alt+O) menu

c. Scroll to the “HDD ACCESS” Tab

d. Select the “Use Extended Interrupt 13h disk access”(Alt+E)

e. Select the “Disable direct IDE access support”(Alt+B)

f. Select the “Disable direct ASPI/SCSI access support”(Alt+B)

g. Press (Alt+A) to activate the “Accept” button to use the new settings

h. Proceed to run GHOST as normal

These steps will then allow the user to ue GHOST to copy the disk image through the RAID array.

Note: Typically, disk cloning software accelerates data transfer through direct disk access, which also allows for overlapping read and write calls, further accelerating the process. Because INT13 calls cannot “overlap”, read and write operations must be performed in series, which causes the disk cloning process to perform slower when RAID is enabled.