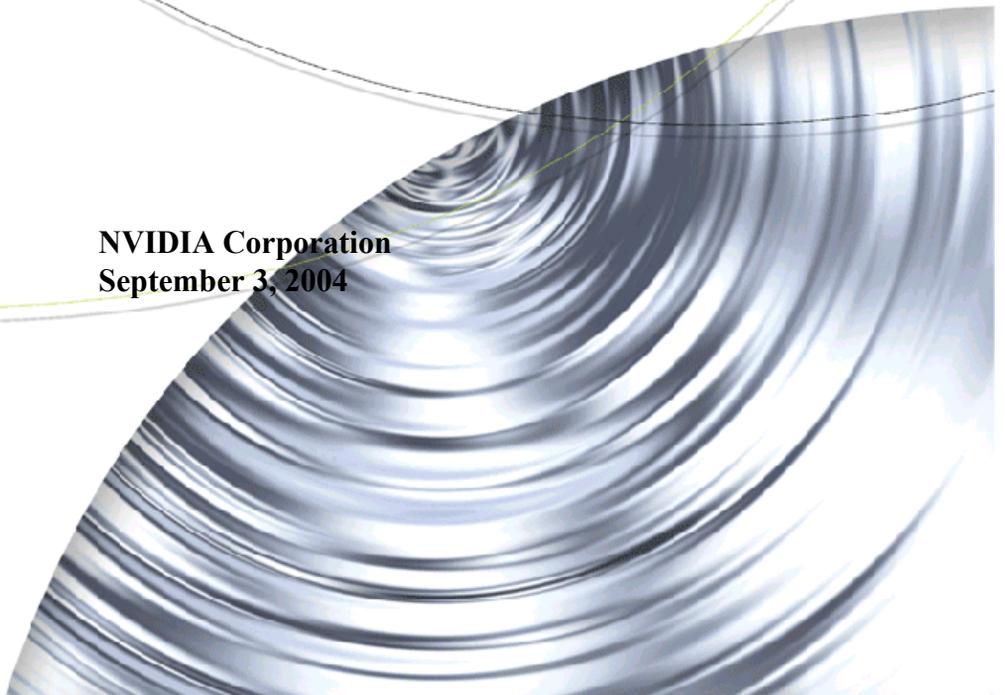ForceWare Software

NVIDIA RAID User's Guide

Version 2.0 A

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Table of Contents

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 NVIDIA RAID in the following sections:

- "System Requirements" on page 2.

- "RAID Arrays" on page 3 describes the RAID levels supported by NVIDIA RAID.

- "NVIDIA RAID Features" on page 9 describes additional features offered by NVIDIA RAID.

System Requirements

Hardware Support

NVIDIA RAID supports the following NVIDIA® nForce™ versions:

- nForce™4

- nForce4 Ultra

- nForce4 SLI

- nForce3 Pro250

- nForce3 250Gb

- nForce3 Ultra

- nForce3 250

- nForce3 150

- nForce2 MCP2S

Operating System Support

NVIDIA RAID supports the following operating systems:

- Windows® XP Home Edition

- Windows XP Professional Edition

- Windows 2000 Professional

- Windows 2003 Server

RAID Arrays

This section describes the following types of RAID arrays that NVIDIA RAID 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.

- Spanning (JBOD)

  JBOD provides a method for combining drives of different sizes into one large disk.

RAID 0

How RAID 0 Works

In a RAID 0 array, the controller "stripes" data across multiple drives in the RAID subsystem. RAID 0 breaks up a large file into smaller blocks and then performs disk reads and writes across multiple drives in parallel. The size of each block is determined by the stripe size parameter, which you set during the creation of the RAID set based on the system environment. This technique reduces overall disk access time and offers high bandwidth.
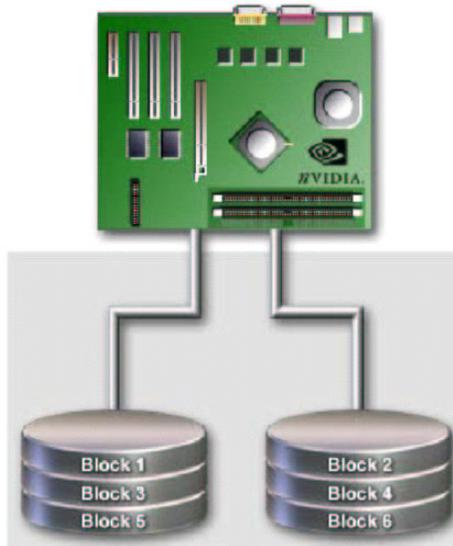
Figure 1.1   RAID 0 Array Diagram

RAID 0 involves no parity calculations 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.

Summary of Features and Benefits

- **Benefits:** Provides increased data throughput, especially for large files.
- **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 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 due to 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.
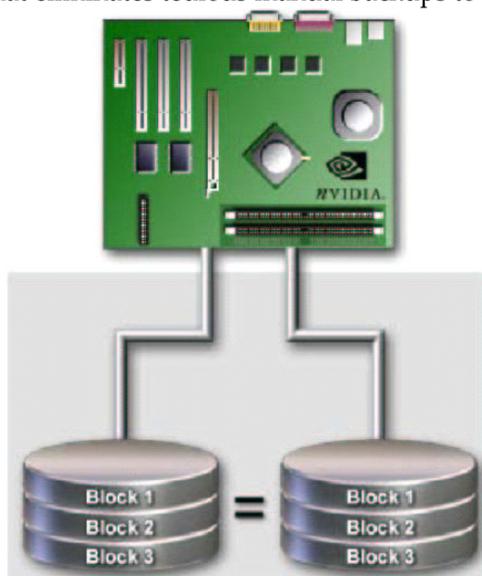
Figure 1.2   RAID 1 Array Diagram

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.

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.
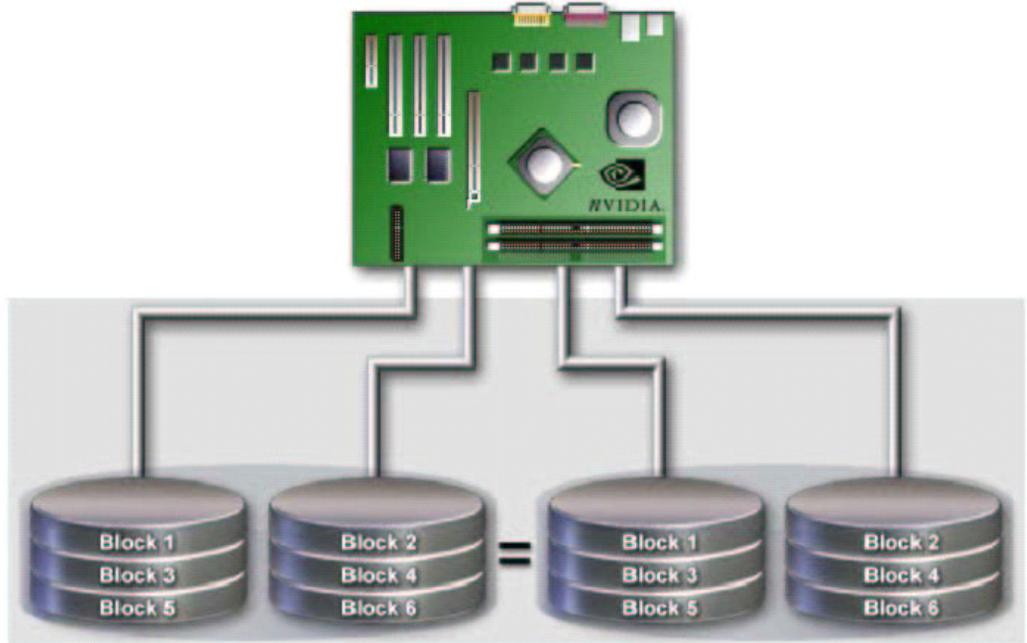
Figure 1.3 RAID 0+1 Array Diagram

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.
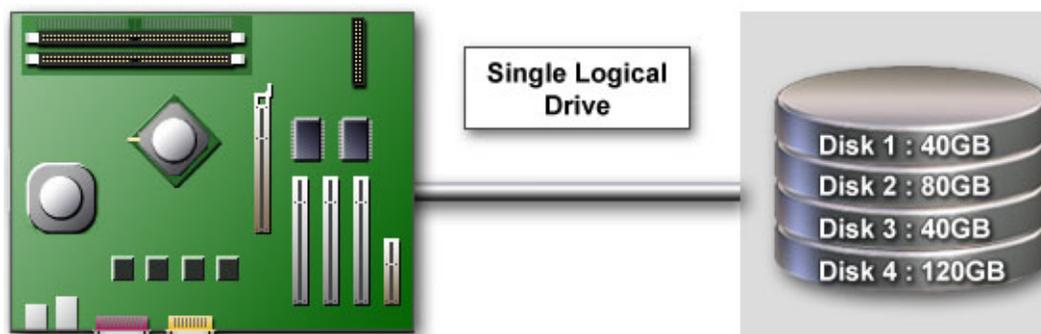
Figure 1.4 JBOD Array Diagram

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

Summary of RAID Configurations

Table 1.1   RAID Configuration Summary

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

NVIDIA RAID Features

Additional RAID Features

NVIDIA RAID offers the following additional features:

- **Free Disk and Dedicated Spare Disk**

  A Free Disk or Dedicated Disk can be automatically used in case one drive of a fault-tolerant array fails. NVIDIA RAID defines a fault-tolerant array as either RAID 1 or RAID 0+1. 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.

- **RAID Across PATA and SATA**

  NVIDIA RAID can span across both Parallel ATA as well as Serial ATA controllers. RAID operations can be performed on Parallel ATA hard drives, Serial ATA hard drives, or both Parallel and Serial ATA hard drives.

- **Bootable RAID**

  NVIDIA RAID can be configured in a way to make it bootable. For example, two hard drives can be configured as a bootable mirrored RAID array.

- **RAID on Multiple Disk Controllers**

  Unlike other RAID solutions that limits the user to a dedicated RAID controller, NVIDIA RAID software can use a drive on one RAID controller and another drive on a second RAID controller.

- **Morphing**

  Morphing 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 accomplished without having to go through multiple steps. The morphing feature gives the user an upgradeable option to manage storage easily.

- **Hot Plug Array**

  Hot plug, with respect to RAID, is the ability to add a disk to a system safely and without causing problems for the RAID software. For example, when a drive in a mirrored array fails, a user can launch the Hot Plug Array Wizard which instructs the user as to when a drive can be added safely to the system. As soon as the drive is added, the user can then finish running the RAID wizard and the drive becomes useable by the system.

Features and Benefits Summary

Features	Benefits
RAID across PATA and SATA	• Supports both Serial ATA and Parallel ATA disk devices within a single RAID Array. • Single set up procedure applies to all drives.
Spare Drive and Dedicated Drive Support	• Allows the user to dedicate a "spare" disk as a hot standby in the event of a array failure. • Offers additional protection in case of a failure in a mirrored array.
Bootable RAID	• Supports the use of a RAID drive for loading the operating system at power up for optimal performance
Morphing	• Allows the user to upgrade for more performance, security, and capacity. • Allows the user to change the current state of a disk/array to another array with a one step process called "morphing", without losing any data during the configuration change.
Disk Failure Identification	• Notifies the user when a disk fails and instructs you on which one to replace

SETTING UP YOUR RAID CONFIGURATION

Basic Configuration Instructions

The following are the basic steps for configuring NVIDIA RAID:

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), Mirrored Striping (RAID 0+1), 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 33.

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), Mirrored Striping (RAID 0+1), 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 33.

Setting Up a Non-Bootable NVIDIA RAID Array

All of the tasks that are related to a non-bootable NVIDIA RAID Array can be performed from Windows using the NVRAIDMAN utility.

Setup Used in This Section

This section assumes the following setup:

- **Boot Disk**

  One hard disk connected to the Primary IDE channel, and set to Master or Slave.

- **RAID Array Disks**

  - **RAID0**

    Two hard disks connected to the secondary IDE channel, where one is set to Master and the other set to Slave.

    This example shows how to enable RAID 0 on the two hard disks.

  - **RAID1**

    Two hard disks connected to the secondary IDE channel, where one is set to Master and the other set to Slave.

    This example shows how to enable RAID 1 on the two hard disks.

  - **JBOD/Spanning**

    Two hard disks connected to the secondary IDE channel, where one is set to Master and the other set to Slave.

    This example shows how to enable a JBOD/Spanning array on the two hard disks.

  - **RAID0+1**

    Two hard disks connected to the secondary IDE channel, where one is set to Master and the other set to Slave

    Two SATA hard disks

    Two hard disks will be used for striping and two hard disks will be used for mirroring.

Setting Up the BIOS

1 Start your computer, then press **Delete** to enter the BIOS setup.

The BIOS CMOS Setup Utility window appears.
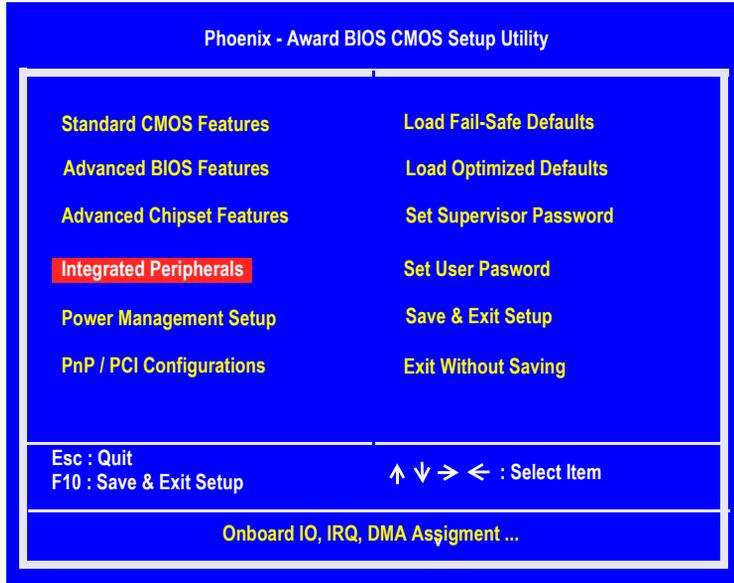
Figure 2.1 BIOS CMOS Setup Utility Main Window

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

The Integrated Peripherals window appears.

Figure 2.2 Integrated Peripherals Window

3 Use the arrow keys to select the RAID Config (see Figure 2.2), then press Enter.

The RAID Config window appears..

```
                Phoenix - Award BIOS CMOS Setup Utility
                            RAID Config

   RAID Enable              [Enable]              Item Help
   IDE Primary Master       RAID [Disabled]
   IDE Primary Slave        RAID [Disabled]
   IDE Secndry Master       RAID [Enabled]      Menu Level   ► ►
   IDE Secndry Slave        RAID [Enabled]
   Ext SATA Phy Primary     RAID [Disabled]
   Ext SATA Phy Secndry     RAID [Disabled]
   Int SATA Phy Primary     RAID [Disabled]
   Int SATA Phy Secndry     RAID [Disabled]




   ↑↓→← :Move  Enter:Select  +/-/PU/PD:Value  F10:Save  ESC:Exit  F1:General Help
         F5: Previous Values    F6: Fail-Safe Defaults    F7: Optimized Defaults
```
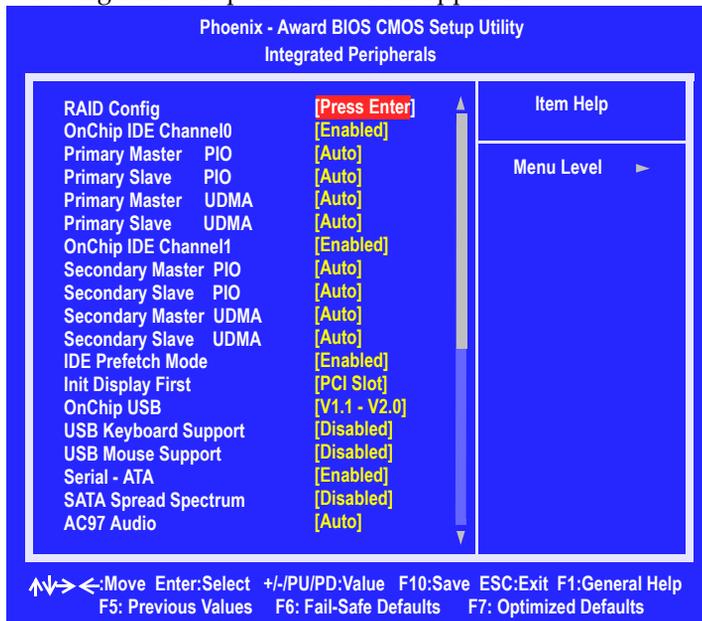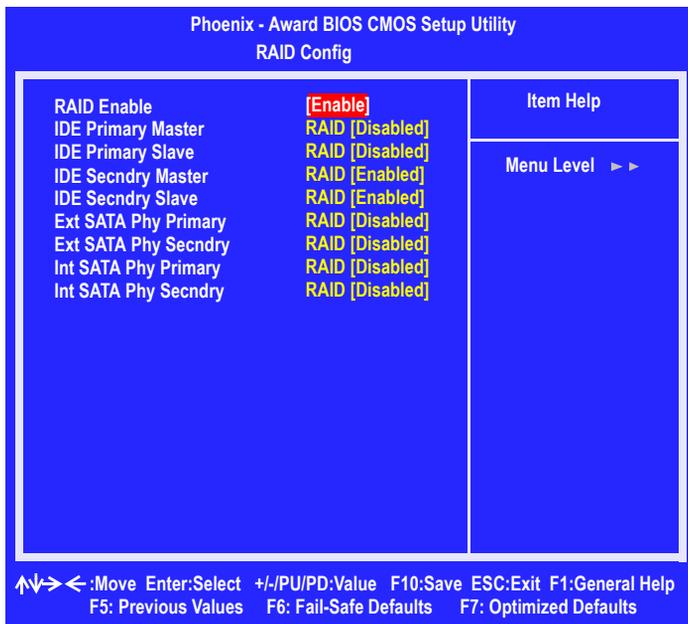
Figure 2.3   RAID Config Window

4 From the RAID Config window, enable RAID, then enable the disks that you want to use as RAID disks.

In Figure 2.3, the master and slave drives on the secondary IDE port are enabled as RAID disks.

Make sure to enable the SATA drives also if you are setting up a RAID 0+1 array.

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

The PC reboots.

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

Configuring the NVIDIA RAID BIOS

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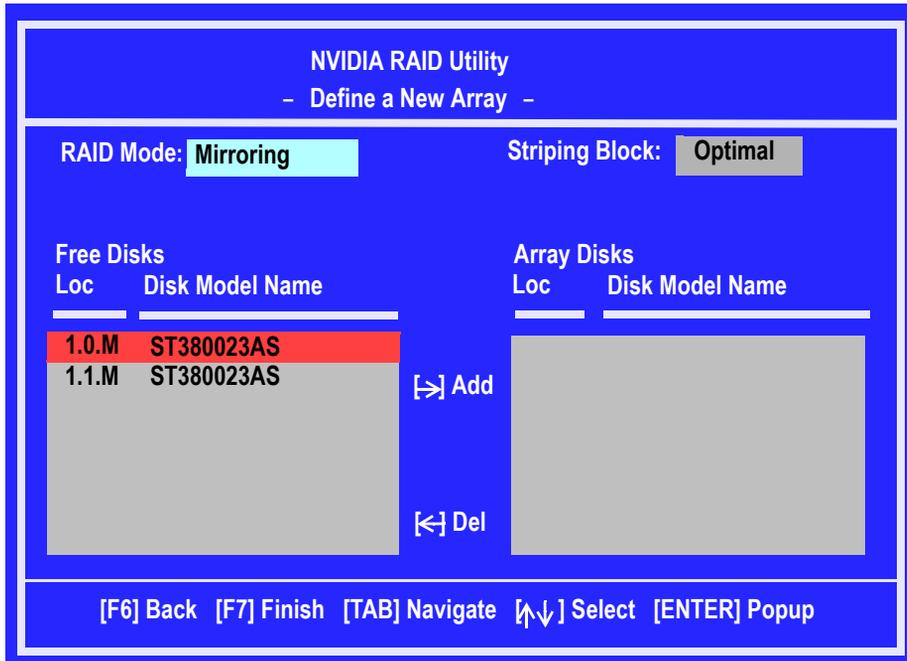
Entering the RAID BIOS Setup

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).

NVIDIA RAID Utility
– Define a New Array –

RAID Mode: **Mirroring**   Striping Block: **Optimal**

Free Disks   **Array Disks**
Loc   Disk Model Name   **Loc   Disk Model Name**

1.0.M   ST380023AS
1.1.M   ST380023AS   **[→] Add**

                                         [←] Del

[F6] Back   [F7] Finish   [TAB] Navigate   [↑↓] Select   [ENTER] Popup

Figure 2.4   NVIDIA RAID Utility

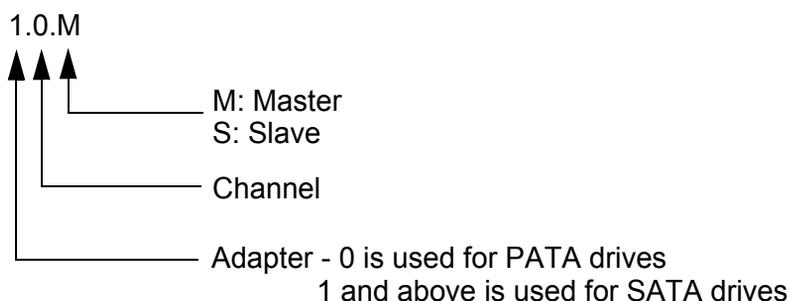By default, RAID Mode is set to Mirroring and Striping Block is set to Optimal.

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

  Depending on the platform used, the system can have one or more channels. In a typical system there is usually one adapter and multiple channels, and each channel has a slave and a master.

  The adapter/channel/master/slave status of each hard disk is given in the Loc (location) columns of the Free Disks and Array Disks lists.

1.0.M

M: Master
S: Slave

Channel

Adapter - 0 is used for PATA drives
        1 and above is used for SATA drives

Figure 2.5   Loc Column Information

In Figure 2.5, 1.0.M means the hard drive is attached to Adapter 1, Channel 0, and the drive is set to Master. The following is a list of all possible combinations:

Parallel ATA	
0.0.M	Adapter 0, Channel 0, Master
0.0.S	Adapter 0, Channel 0, Slave
0.1.M	Adapter 0, Channel 1, Master
0.1.S	Adapter 0, Channel 1, Slave

Serial ATA	
1.0.M	Adapter 1, Channel 0, Master
1.1.M	Adapter 1, Channel 1, Master
2.0.M	Adapter 2, Channel 0, Master
2.1.M	Adapter 2, Channel 1, Master

Note: There is no such thing as Slave drive in Serial ATA. All drives are considered to be Master since there is a one-to-one connection between the drive and the adapter.

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, or Stripe Mirroring.

- **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 128 KB).

- **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 right-arrow 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 RAID 1 array disks.
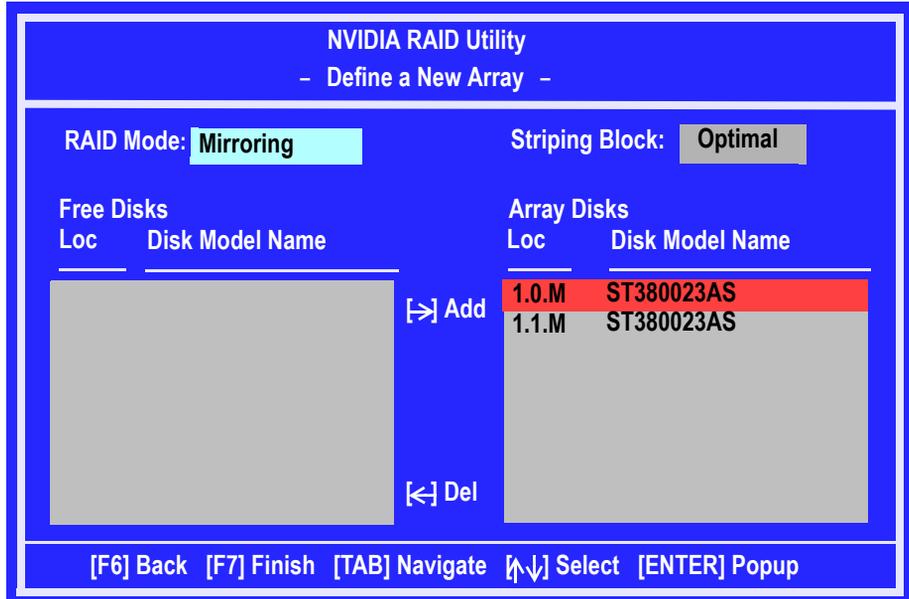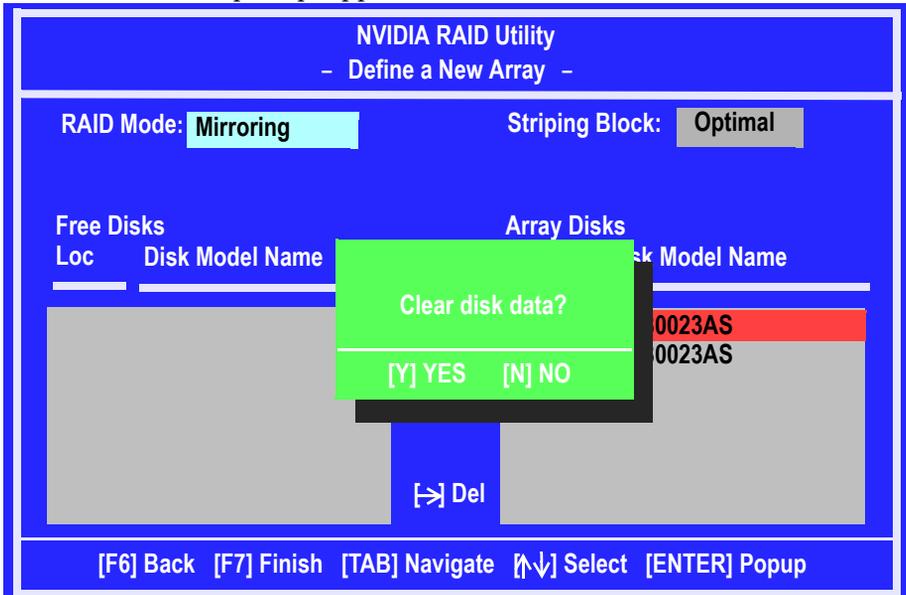

Figure 2.6   NVIDIA RAID Utility—Array Disks Assigned

Completing the RAID BIOS Setup

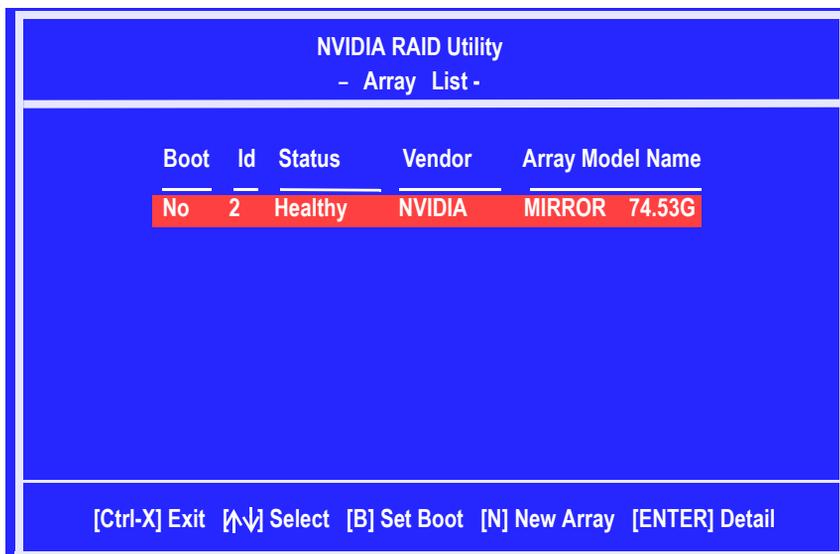**1** After assigning your RAID array disks, press **F7**.

The Clear disk data prompt appears.
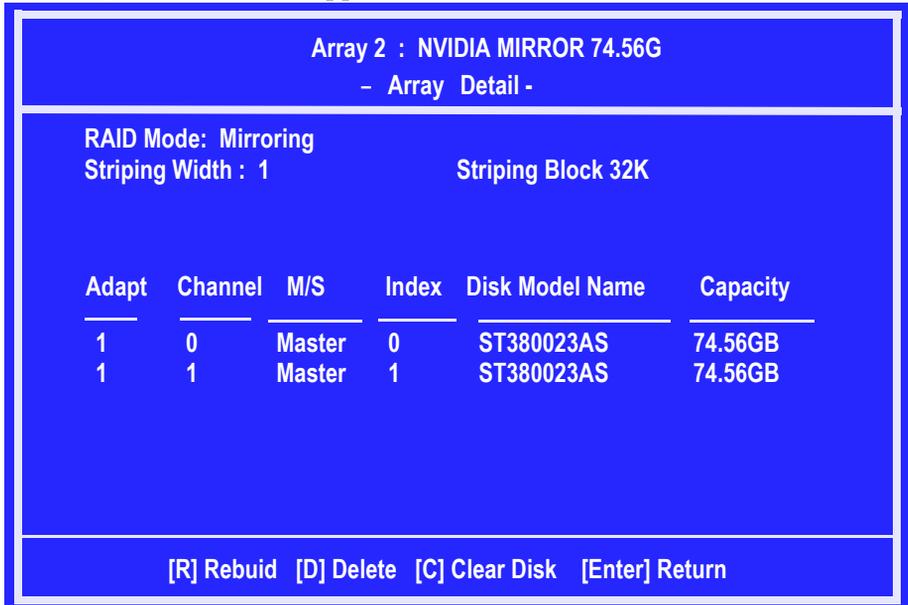

Figure 2.7   Clear Disk Data Prompt

2 Press **Y** to clear all drive data.

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.

```
┌─────────────────────────────────────────────────────────────────┐
│               Array 2 :  NVIDIA MIRROR 74.56G                     │
│                    –  Array   Detail -                            │
├─────────────────────────────────────────────────────────────────┤
│  RAID Mode:  Mirroring                                            │
│  Striping Width :  1                    Striping Block 32K        │
│                                                                   │
│                                                                   │
│   Adapt   Channel   M/S      Index   Disk Model Name    Capacity  │
│   ─────   ───────   ───      ─────   ───────────────    ──────    │
│    1        0       Master    0      ST380023AS         74.56GB   │
│    1        1       Master    1      ST380023AS         74.56GB   │
│                                                                   │
│                                                                   │
│                                                                   │
│                                                                   │
├─────────────────────────────────────────────────────────────────┤
│       [R] Rebuid  [D] Delete  [C] Clear Disk   [Enter] Return     │
└─────────────────────────────────────────────────────────────────┘
```

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 **F10** 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 NVIDIA RAID drivers under Windows, as explained in "Installing the NVIDIA RAID Software Under Windows" on page 21.

Installing the NVIDIA RAID Software Under Windows

The existing Windows IDE Parallel ATA driver (as well as the Serial ATA driver if SATA is enabled) must be upgraded to use the NVIDIA IDE Parallel ATA driver (as well as the NVIDIA Serial ATA driver if SATA is enabled).

This section describes how to run the setup application and install the RAID software which will upgrade the Windows IDE driver and install the RAID software[1].

1 Start the nForce Setup program to open the NVIDIA Windows nForce Drivers page.
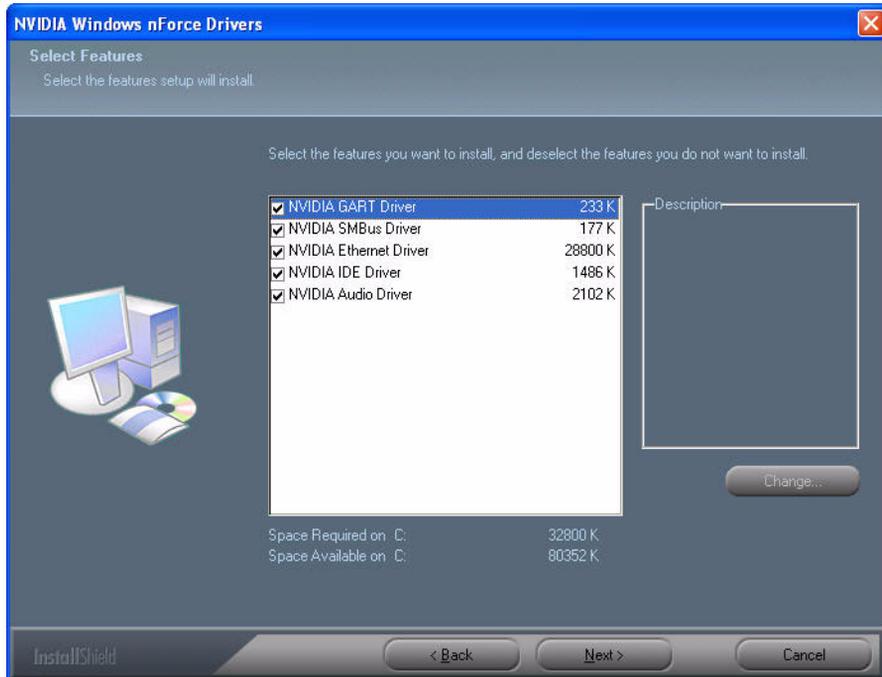
Figure 2.10 nForce Driver Installation Window

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 RAID. If you do not install the NVIDIA IDE driver, NVIDIA RAID 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 33.

---

1. See the application note "Installing the NVIDIA IDE Driver in Windows 2000" on page 115 for information on how to install the NVIDIA IDE Driver under Windows 2000.

Setting Up a Bootable NVIDIA RAID Array

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

Setup Used in This Section

This section assumes the following setup:

- **Boot Disk**

  An IDE CD-ROM is connected to the Primary IDE channel, and set to Master or Slave.

  Make sure to have a bootable Windows XP/Windows 2000[2] CD inserted into the CD-ROM so you can boot from it.

- **RAID Array Disks**

  - **RAID 0**

    Two hard disks connected to the secondary IDE channel, where one is set to Master and the other set to Slave.

    A fresh copy of Windows XP will be installed on the 2 striped hard disks.

  - **RAID 1**

    Two hard disks connected to the secondary IDE channel, where one is set to Master and the other set to Slave.

    A fresh copy of Windows XP will be installed on the 2 mirrored hard disks.

  - **RAID 0+1**

    Two hard disks connected to the secondary IDE channel, where one is set to Master and the other set to Slave

    Two SATA hard disks

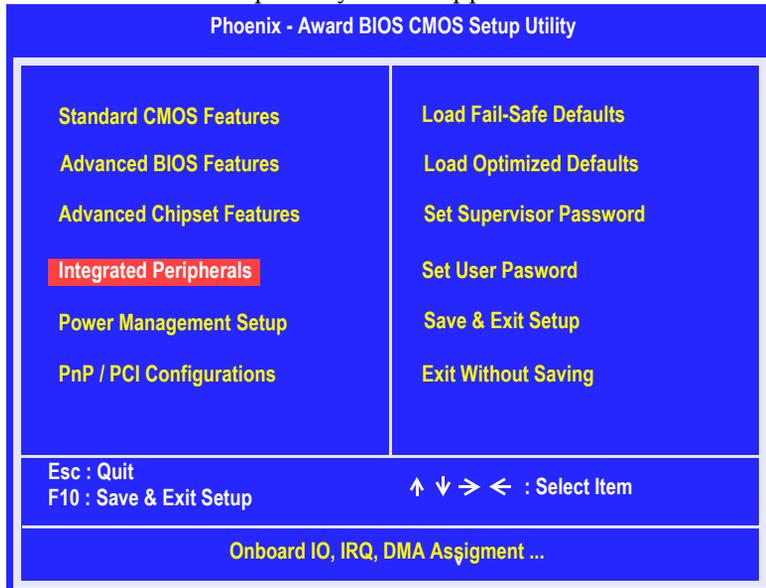   A fresh copy of Windows XP will be installed on the mirrored-striped hard disks.

---

2. For Windows 2000 bootable RAID installation, see the application note "Windows 2000 Limitation with Bootable RAID" on page 113.
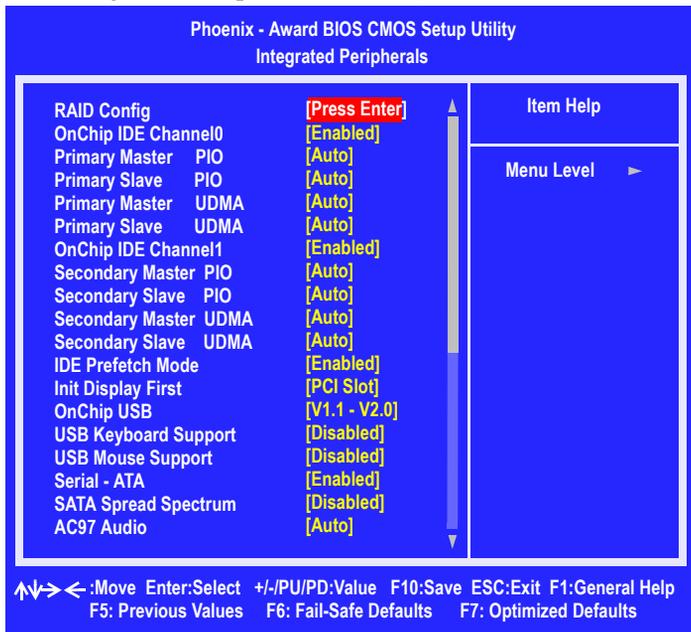
Setting Up the BIOS

1 Start your computer, then press **Delete** to enter the BIOS setup.

The BIOS CMOS Setup Utility screen appears.

Phoenix - Award BIOS CMOS Setup Utility	
Standard CMOS Features	Load Fail-Safe Defaults
Advanced BIOS Features	Load Optimized Defaults
Advanced Chipset Features	Set Supervisor Password
Integrated Peripherals	Set User Pasword
Power Management Setup	Save & Exit Setup
PnP / PCI Configurations	Exit Without Saving

```
Esc : Quit                          ↑ ↓ → ←  : Select Item
F10 : Save & Exit Setup
```
```
Onboard IO, IRQ, DMA Asşigment ...
```

Figure 2.11   BIOS CMOS Setup Utility Main Screen

2 Use the arrow keys to select **Integrated Peripherals** (see Figure 2.11), then press Enter.

The Integrated Peripherals screen (or a screen similar to it) appears.

```
                Phoenix - Award BIOS CMOS Setup Utility
                        Integrated Peripherals

  RAID Config                [Press Enter]          Item Help
  OnChip IDE Channel0        [Enabled]
  Primary Master    PIO      [Auto]
  Primary Slave     PIO      [Auto]              Menu Level    ►
  Primary Master    UDMA     [Auto]
  Primary Slave     UDMA     [Auto]
  OnChip IDE Channel1        [Enabled]
  Secondary Master  PIO      [Auto]
  Secondary Slave   PIO      [Auto]
  Secondary Master  UDMA     [Auto]
  Secondary Slave   UDMA     [Auto]
  IDE Prefetch Mode          [Enabled]
  Init Display First         [PCI Slot]
  OnChip USB                 [V1.1 - V2.0]
  USB Keyboard Support       [Disabled]
  USB Mouse Support          [Disabled]
  Serial - ATA               [Enabled]
  SATA Spread Spectrum       [Disabled]
  AC97 Audio                 [Auto]

  ↑↓→←:Move  Enter:Select  +/-/PU/PD:Value  F10:Save  ESC:Exit  F1:General Help
          F5: Previous Values    F6: Fail-Safe Defaults    F7: Optimized Defaults
```

Figure 2.12   Integrated Peripherals Screen

3 Use the arrow keys to select the RAID Config (see Figure 2.12).

4 Press Enter.

The RAID Config screen appears.

```
            Phoenix - Award BIOS CMOS Setup Utility
                        RAID Config

   RAID Enable              [Enable]              Item Help
   IDE Primary Master       RAID [Disabled]
   IDE Primary Slave        RAID [Disabled]
   IDE Secndry Master       RAID [Enabled]       Menu Level  ►  ►
   IDE Secndry Slave        RAID [Enabled]
   Ext SATA Phy Primary     RAID [Disabled]
   Ext SATA Phy Secndary    RAID [Disabled]
   Int SATA Phy Primary     RAID [Disabled]
   Int SATA Phy Secndry     RAID [Disabled]




 ↑↓→←:Move  Enter:Select  +/-/PU/PD:Value  F10:Save  ESC:Exit  F1:General Help
      F5: Previous Values    F6: Fail-Safe Defaults    F7: Optimized Defaults
```

Figure 2.13   RAID Config Screen

5 From the RAID Config screen, enable RAID, then enable any of the disks that you want to use as RAID disks.

In Figure 2.13, the master and slave drives on the secondary IDE port are enabled as RAID disks.

Make sure to enable the SATA drives also if you are setting up a RAID0+1 array.

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

The PC reboots.

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

Configuring the NVIDIA RAID BIOS

The NVIDIA RAID 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 appears (Figure 2.14).
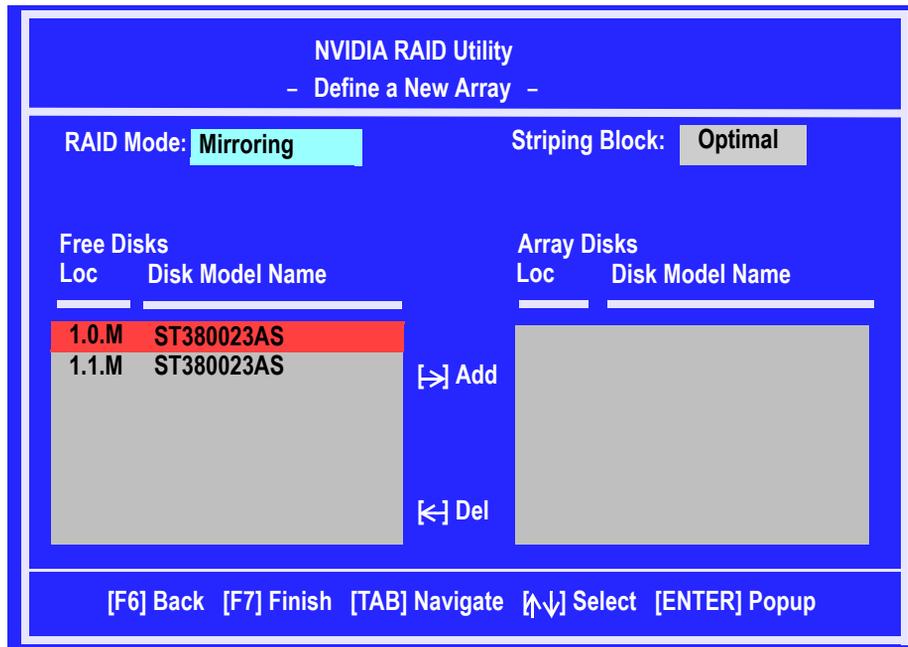
NVIDIA RAID Utility
– **Define a New Array** –

RAID Mode: **Mirroring**   Striping Block: **Optimal**

Free Disks
Loc   Disk Model Name

1.0.M ST380023AS
1.1.M ST380023AS   [→] Add

                               [←] Del

Array Disks
Loc   Disk Model Name

[F6] Back   [F7] Finish   [TAB] Navigate   [↑↓] Select   [ENTER] Popup

Figure 2.14   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

  Depending on the platform used, the system can have one or more channels. In a typical system there is usually one adapter and multiple channels, and each channel has a slave and a master.

  The adapter/channel/master/slave status of each hard disk is given in the Loc (location) columns of the Free Disks and Array Disks lists.

1.0.M

M: Master
S: Slave

Channel

Adapter 0 is used for PATA drives
    1 and above is used for SATA drives
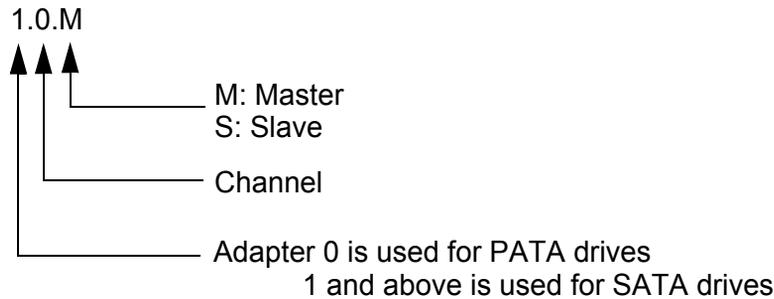
Figure 2.15   Loc Column Information

In Figure 2.15, 1.0.M means the hard drive is attached to Adapter 1, Channel 0, and the drive is set to Master. The following is a list of all possible combinations:

Parallel ATA	
0.0.M	Adapter 0, Channel 0, Master
0.0.S	Adapter 0, Channel 0, Slave
0.1.M	Adapter 0, Channel 1, Master
0.1.S	Adapter 0, Channel 1, Slave

Serial ATA	
1.0.M	Adapter 1, Channel 0, Master
1.1.M	Adapter 1, Channel 1, Master
2.0.M	Adapter 2, Channel 0, Master
2.1.M	Adapter 2, Channel 1, Master

Note: There is no such thing as Slave drive in Serial ATA. All drives are considered to be Master since there is a one to one connection between the drive and the adapter.

Using the Define a New Array Screen

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, or Stripe Mirroring.

- **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 128 KB)

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 right-arrow 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 2.16 illustrates the Define a New Array screen after two disks have been assigned as RAID1 array disks.

```
                        NVIDIA RAID Utility
                      –  Define a New Array  –

    RAID Mode: Mirroring              Striping Block:   Optimal

    Free Disks                        Array Disks
    Loc      Disk Model Name          Loc        Disk Model Name

                                      1.0.M    ST380023AS
                          [→] Add     1.1.M    ST380023AS




                          [←] Del


    [F6] Back   [F7] Finish   [TAB] Navigate   [↑↓] Select   [ENTER] Popup
```
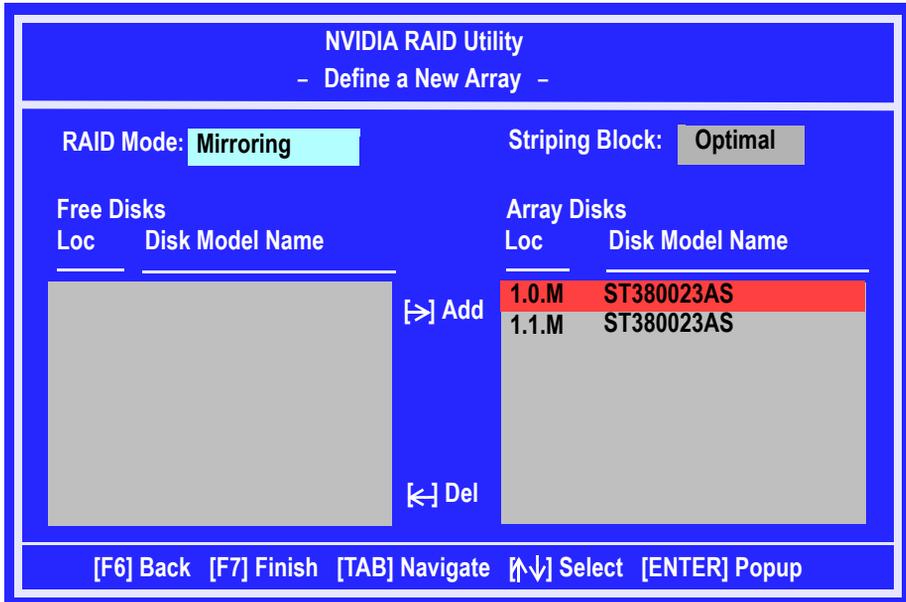
Figure 2.16   NVIDIA RAID Utility—Array Disks Assigned

Completing the RAID BIOS Setup

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

The Clear disk array prompt appears.
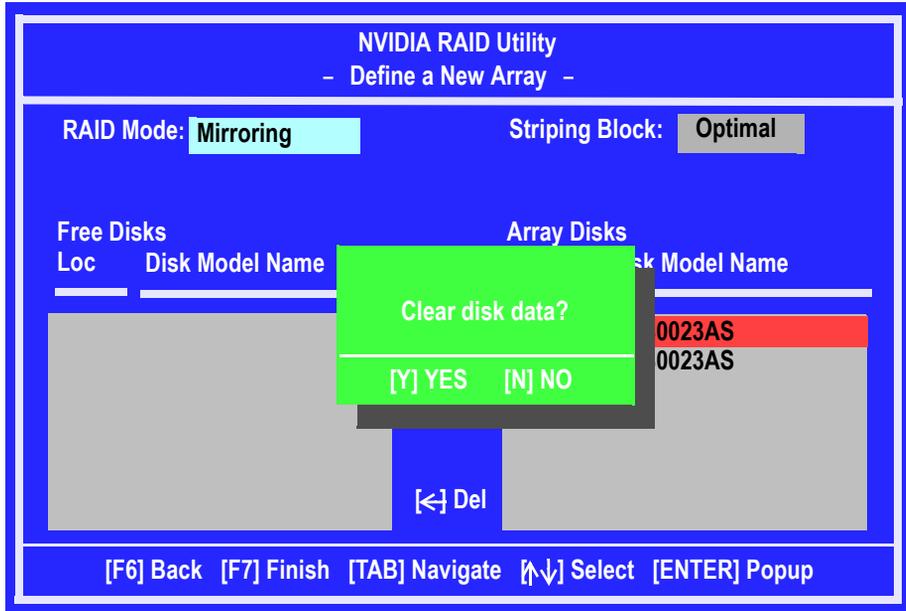
Figure 2.17   Clear Disk Data Prompt

2 Press **Y** to clear the disk data.

The **Array List** screen appears, where you can review the RAID arrays that you have set up.
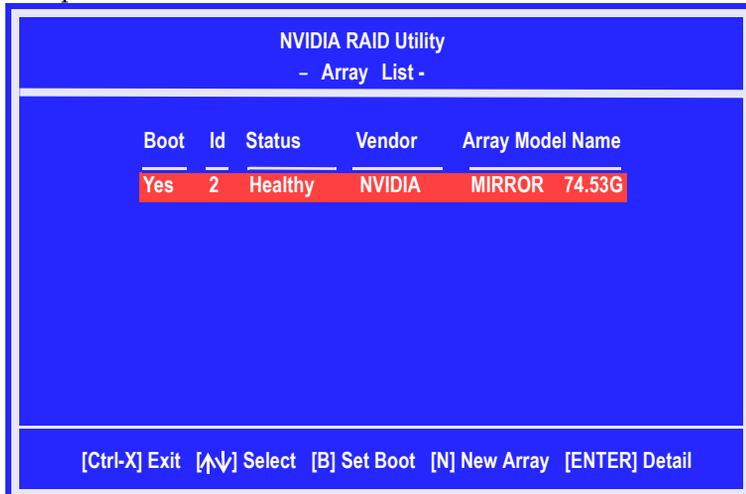
Figure 2.18   Array List Window

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

4 Press **Enter** to view and verify details.

The **Array Detail** screen appears.

```
            Array 2 : NVIDIA MIRROR 74.56G
                   – Array  Detail -

  RAID Mode:  Mirroring
  Striping Width :  1                    Striping Block 32K


  Adapt   Channel   M/S      Index   Disk Model Name     Capacity

    1       0       Master    0      ST380023AS          74.56GB
    1       1       Master    1      ST380023AS          74.56GB




         [R] Rebuid   [D] Delete   [C] Clear Diskt   [Enter] Return
```

Figure 2.19 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.

5 If you want to mark this disk as empty and wipe out all its contents, press **C**.

6 At the prompt, press **Y** to wipe out all the data, otherwise press **N**.

7 Press **Enter** again to go back to the previous screen and then press **F10** 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.

Windows Setup

Setup could not determine the type of one or more mass storage devices
installed in your system, or you have chosen to manually specify an adapter.
Currently, Setup will load support for the following mass storage device(s):

\<none\>

* To specify additional SCSI adapters, CD-ROM drives, or special
  disk controllers for use with Windows, including those for
  which you have a device support disk from a mass storage device
  manufacturer, press S.

* If you do not have any device support disks from a mass storage
  device manufaturer, or do not want to specify additional
  mass storage devices for use with Windows, press ENTER.

S=Specify Additional Devices   ENTER=Continue   F3=Exit

Figure 2.20   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::

Windows Setup

You have chosen to configure a SCSI Adapter for use with Windows,
using a device support disk provided by an adapter manufacturer.

Select the SCSI Adapter you want from the following list, or press ESC
to resutrn to the previous screen.

NVIDIA RAID CLASS DRIVER (required)
NVIDIA NForce Storage Controller (required)

Enter=Select   F3=Exit
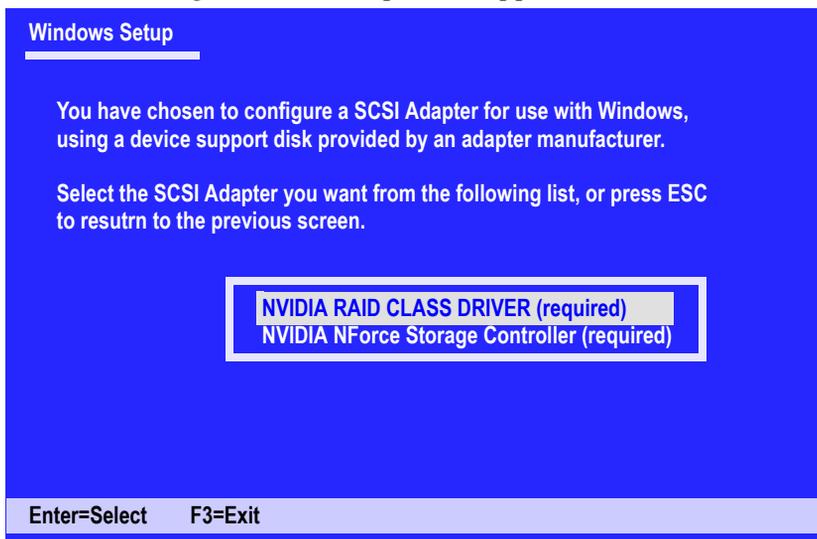
Figure 2.21   Windows Setup—Select SCSI Adapter

b Select "NVIDIA RAID CLASS DRIVER (required)" and then press **Enter**.

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

d Select "NVIDIA NForce Storage Controller (required)" and then press **Enter.**

The following Windows Setup screen appears listing both drivers:.

Windows Setup

Setup will load support for the following mass storage device:

NVIDIA RAID CLASS DRIVER
NVIDIA NForce Storage Controller

* To specify additional SCSI adapters, CD-ROM drives, or special
  disk controllers for use with Windows, including those for
  which you have a device support disk from a mass storage device
  manufacturer, press S.

* If you do not have any device support disks from a mass storage
  device manufaturer, or do not want to specify additional
  mass storage devices for use with Windows, press ENTER.

S=Specify Additional Devices   ENTER=Continue   F3=Exit

Figure 2.22   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 is recommended that you install the ForceWare software in order to access NVRAIDMAN—the 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.

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 2.23 Initialize and Convet Wizard

3 Click **Next**.

The Select Disks to Initialize window appears.
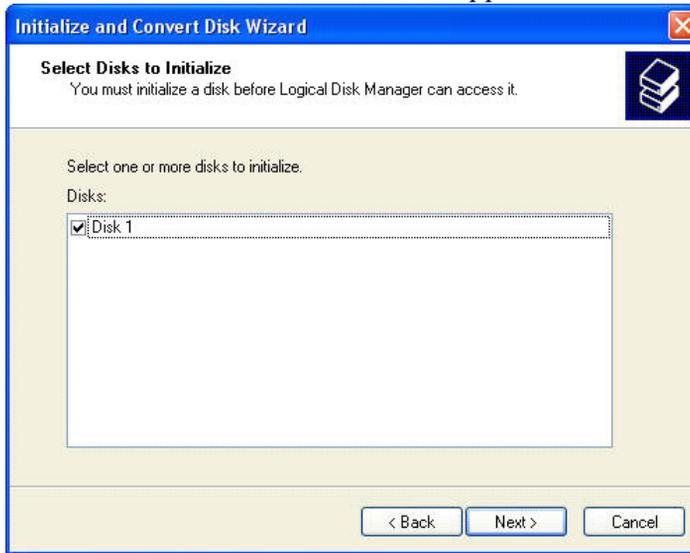
Figure 2.24   Select Disks to Initialize Page

The disks listed depend on how many arrays you have configured

4 Click **Next**.

The Select Disks to Convert window appears.

Figure 2.25   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.
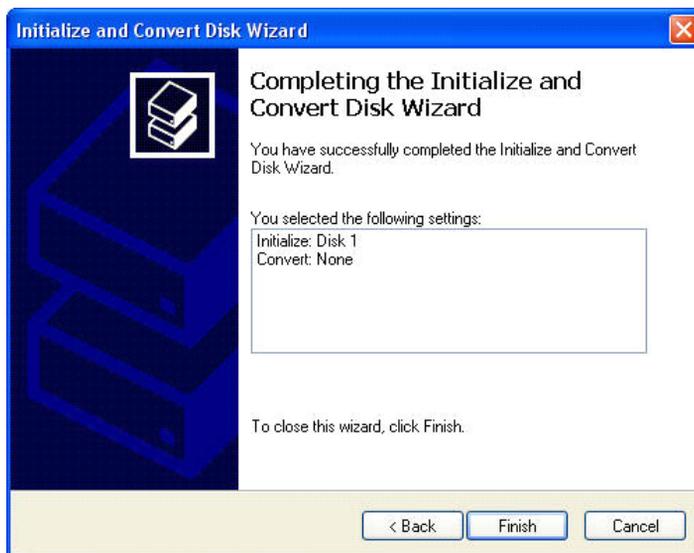
Figure 2.26 Completing the Initialize and Convert Disk Wizard Page

6 Click **Finish**.

The Computer Management window appears.
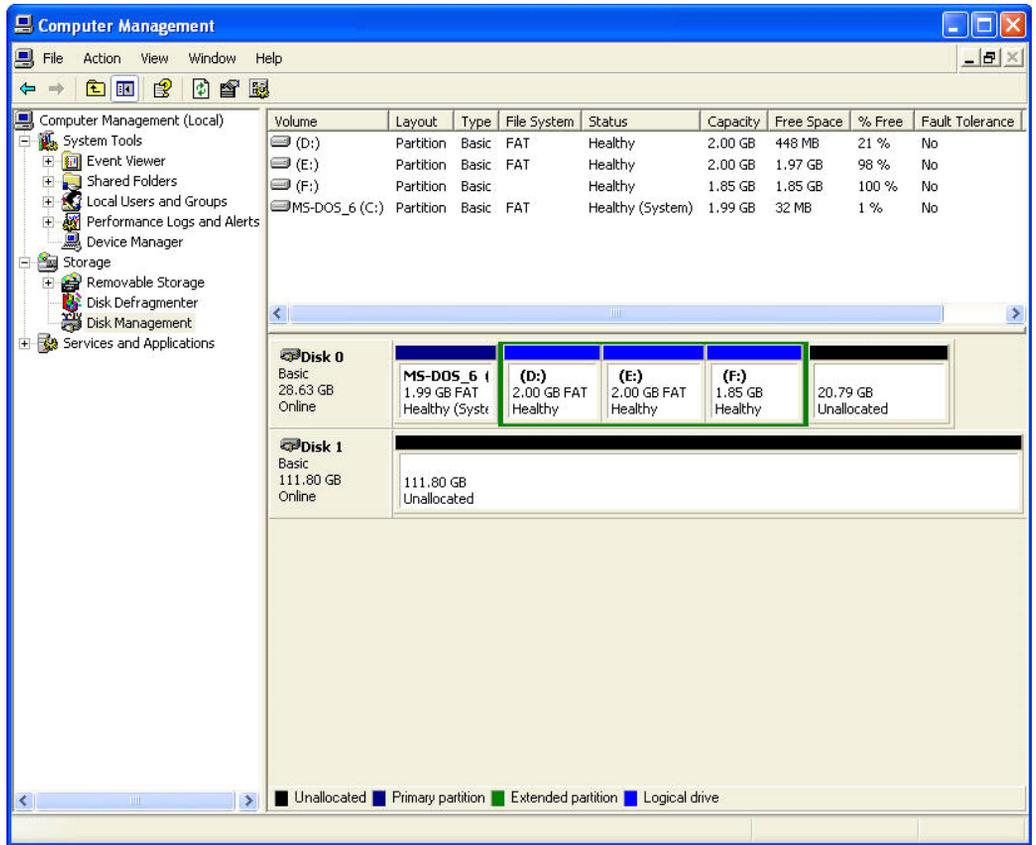
Figure 2.27 Computer Management Window

The actual disks listed will depend on your system. In Figure 2.27, 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 instrucrtions.

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

3

USING THE NVRAIDMAN UTILITY

About the NVIDIA RAID Management Utility

The NVIDIA RAID software ships with an application called NVRAIDMAN. This chapter describes the NVRAIDMAN tasks in the following sections:

- Viewing RAID Array Configurations

  View an array configuration (mirrored, striped, mirrored-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 Array
  - Rebuild a broken mirrored array
  - Watch the progress of rebuilding of an array
  - Only applies to RAID 1 or RAID 0+1 arrays

- Creating RAID Arrays

- Deleting a RAID Array

- Morphing From One RAID Array to Another

- Hot Plug Array

Viewing RAID Array Configurations

To view your RAID configuration from Windows, launch the NVIDIA RAID Management utility by double-clicking NVRAIDMAN.

The RAID configuration information appears in the right-side pane, as shown in Figure 3.1.
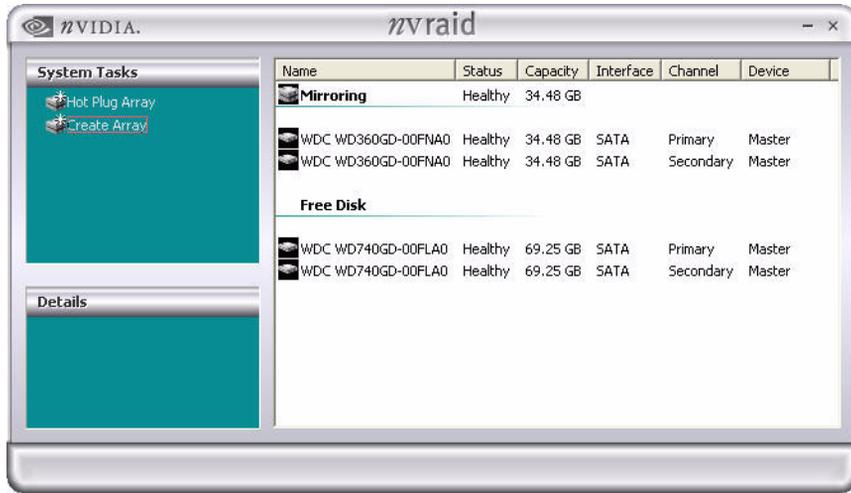
Figure 3.1   NVRAID Management Utility Window

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.

NVIDIA RAID Mirrored Array

Figure 3.2 shows an example of a two hard drive mirrored array using identical 34.4 GB[1] SATA hard drives (WD360GB), where one drive is configured as Primary and the other drive is configured as Secondary.The total hard disk space used is 34.4 GB.

Figure 3.2   NVRAIDMAN Mirrored Array Information

---

1. 1 GB = 1,073,741,824 bytes

NVIDIA RAID Striped Array

Figure 3.3 shows an example of a two hard drive striped array using identical 34.48 GB SATA hard drives (WD360GB), where one drive is configured as Primary and the other drive is configured as Secondary. The total disk space used is 68.95GB.

Name	Status	Capacity	Interface	Channel	Device
Striping	Healthy	68.95 GB			
WDC WD360GD-00FNA0	Healthy	34.48 GB	SATA	Primary	Master
WDC WD360GD-00FNA0	Healthy	34.48 GB	SATA	Secondary	Master

Figure 3.3   NVRAIDMAN Striped Array Information

NVIDIA RAID Mirrored-Stripe Array

Figure 3.4 shows an example of a four hard drive mirrored-stripe array. The total disk space used is 68.95 GB.

The total storage space is 68.95 GB because the two upper drives (the drives with the 34.48 GB size) are first striped, and then they are mirrored onto the 69.25 GB drives.

Name	Status	Capacity	Interface	Channel	Device
Stripe Mirroring	Healthy	68.95 GB			
WDC WD360GD-00FNA0	Healthy	34.48 GB	SATA	Primary	Master
WDC WD360GD-00FNA0	Healthy	34.48 GB	SATA	Secondary	Master
WDC WD740GD-00FLA0	Healthy	69.25 GB	SATA	Primary	Master
WDC WD740GD-00FLA0	Healthy	69.25 GB	SATA	Secondary	Master

Figure 3.4   NVRAIDMAN Stripe Mirroring Array Information

NVIDIA RAID Spanning (JBOD) Array

Figure 3.5 shows an example of a two hard drive spanning array. The total disk space used is 68.95 GB.

Name	Status	Capacity	Interface	Channel	Device
Spanning	Healthy	68.95 GB			
WDC WD360GD-00FNA0	Healthy	34.48 GB	SATA	Primary	Master
WDC WD360GD-00FNA0	Healthy	34.48 GB	SATA	Secondary	Master

Figure 3.5   NVRAIDMAN Spanning Array Information

NVIDIA RAID Mirrored Array and Striped Array

Figure 3.6 shows an example of a two hard drive mirrored array as well as a two hard drive striped array.
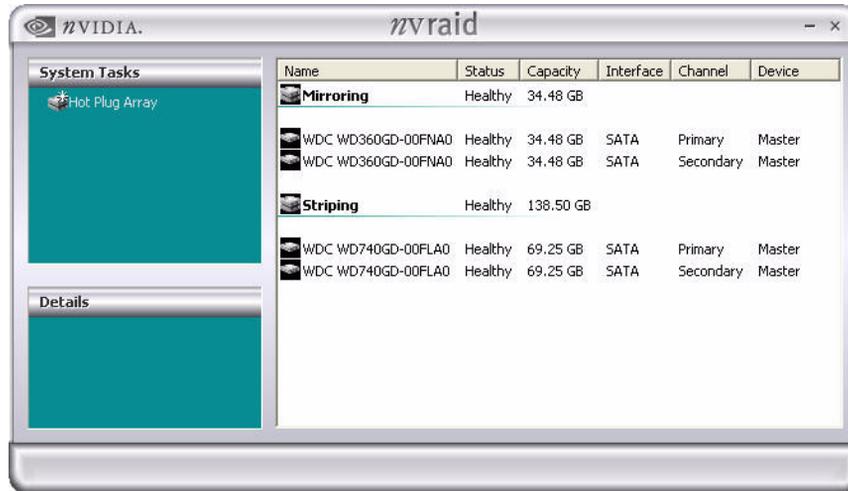
Figure 3.6   NVRAIDMAN Mirrored Array and Striped Array Information

Setting Up a Spare RAID Disk

You can designate a hard drive to be used as a spare drive for a RAID 1 or RAID 0+1 array[2]. The spare drive can take over for a failed disk. NVIDIA 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 or RAID 0+1 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 or RAID 0+1 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 or RAID 0+1 array.

  Note: You must have at least two RAID arrays to use this feature.

---

2. Spare disks cannot be used for RAID0 or JBOD arrays.

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 two free disks.
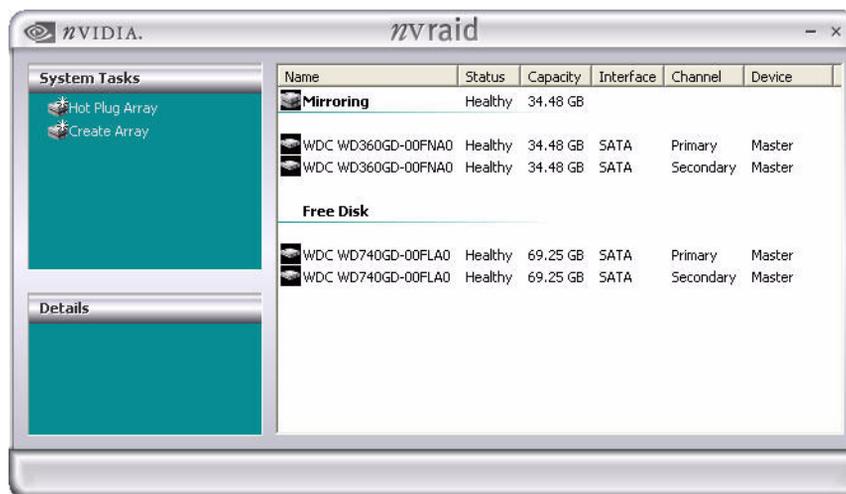
Figure 3.7   NVRAIDMAN Free Disk Information

Assigning a Dedicated Disk

To mark a disk as dedicated, or reserve it for use by a specific array, you must have at least one free disk and you must also have at least two RAID 1 or RAID 0+1 arrays created. In this example, there are four SATA drives and two PATA drives which are RAID enabled. Four SATA drives are used to create two mirrored arrays, while two PATA drives are used as free disks.

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 Boot into Windows and run the NVRAIDMAN program.

If the disk is not part of any RAID array, then it will appear under the Free Disk section of the RAID GUI.

Step 2: Dedicate the Free Disk to an Array

While running NVRAIDMAN, dedicate a free disk to an array by doing the following:

1 Right click one of the available free disks under the Free Disk section.
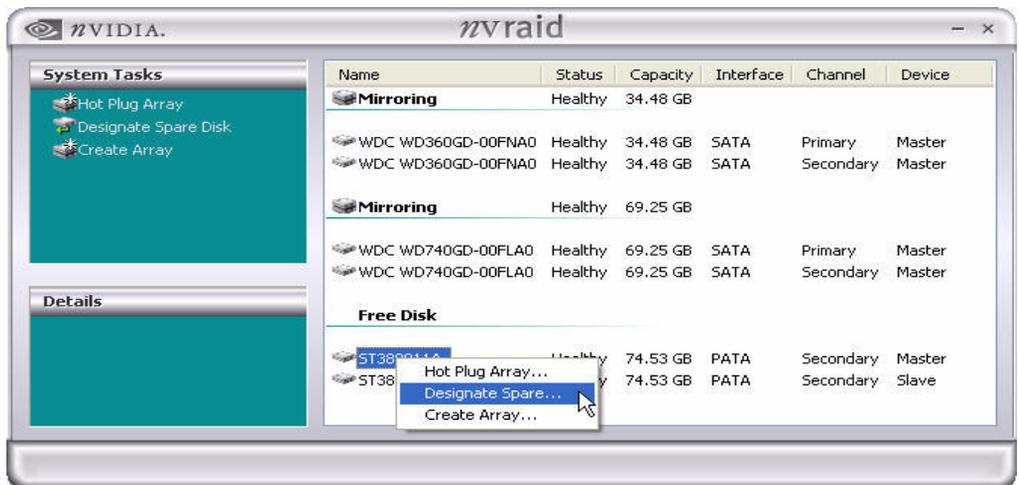
Figure 3.8   Designate Spare Pop-up Menu

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.
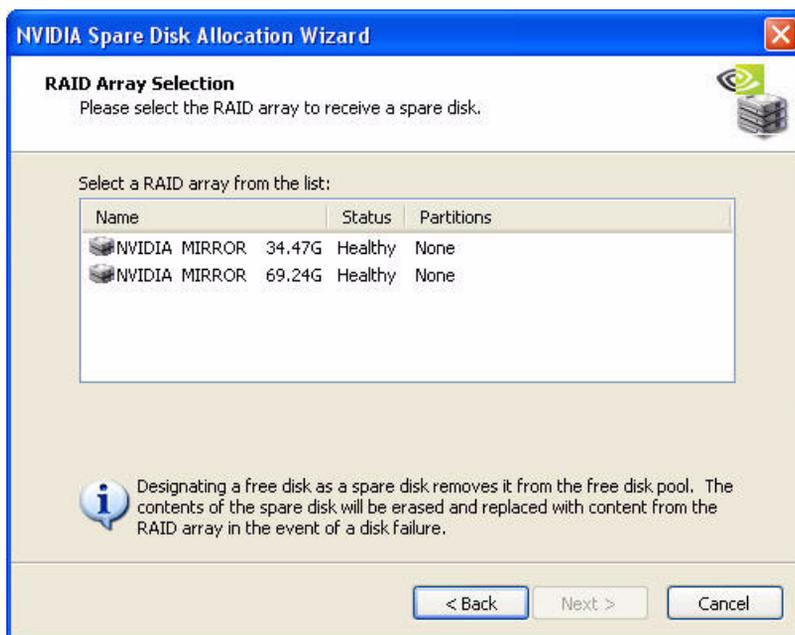
Figure 3.10 RAID Array Selection Page

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 are two arrays available.

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 ST380011A drive is now a dedicated free disk in the mirrored array.
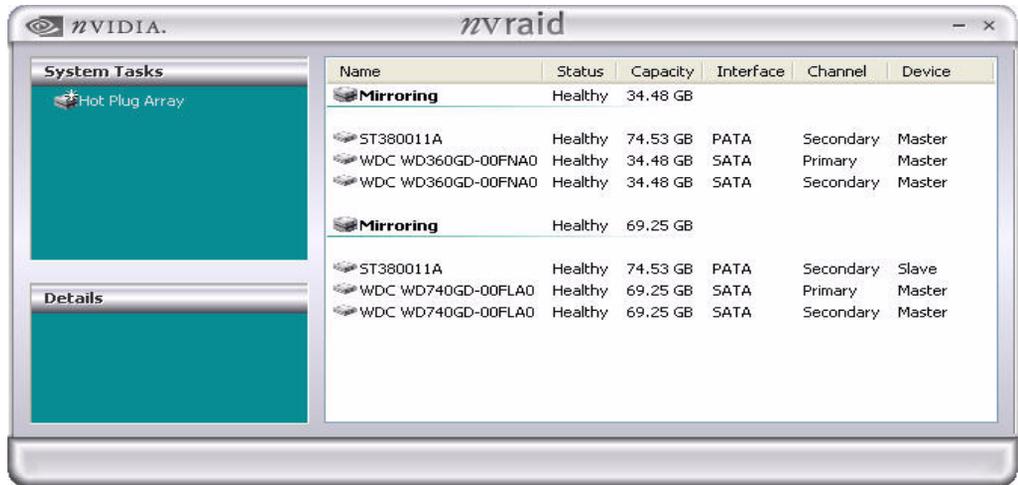
Figure 3.12 Designated Spare Disk

If a system crash occurs that causes any of the two WD360GD drives to fail, the ST380011A hard drive will take over and be used in the newly formed mirrored array.

Removing a Dedicated 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.

For example, right click on the ST380011A drive and select **Remove Disk** as shown in Figure 3.13.
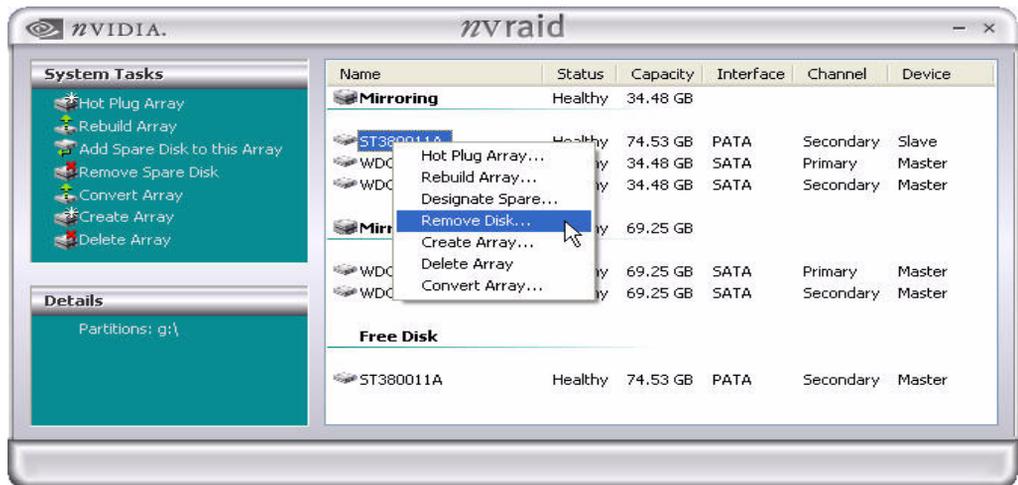
Figure 3.13 Removing a Dedicated Disk

Rebuilding a RAID 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 applies only to RAID 1 as well as a RAID 0+1 arrays.

Rebuilding Instructions

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

1 Go to Windows and run the NVIDIA RAID Management utility.

Figure 3.14 shows an example of a system with one mirrored array and two free disks.
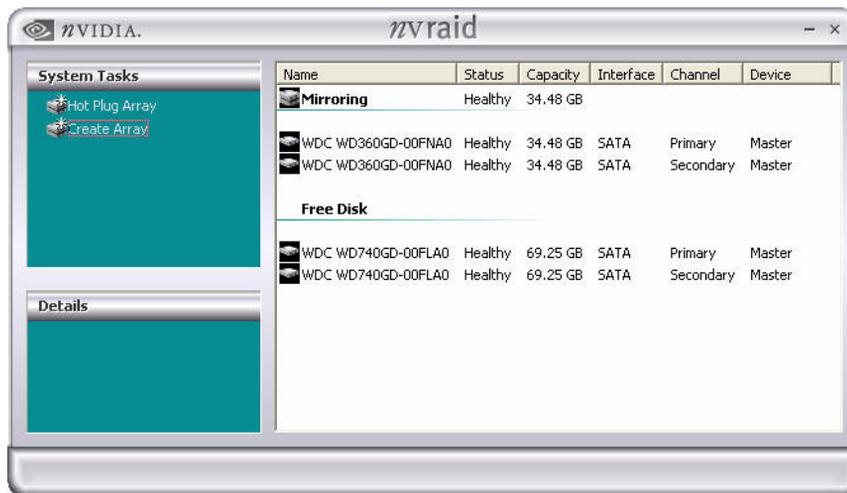
Figure 3.14   Mirrored Array

2 Right-click on Mirroring.

The popup menu appears.
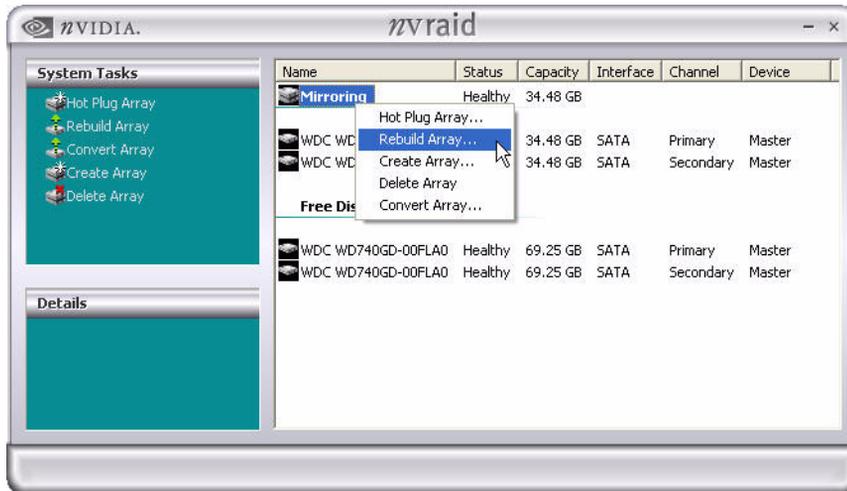
Figure 3.15 Array Pop-up Menu

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

The NVIDIA Rebuild Array Wizard appears.
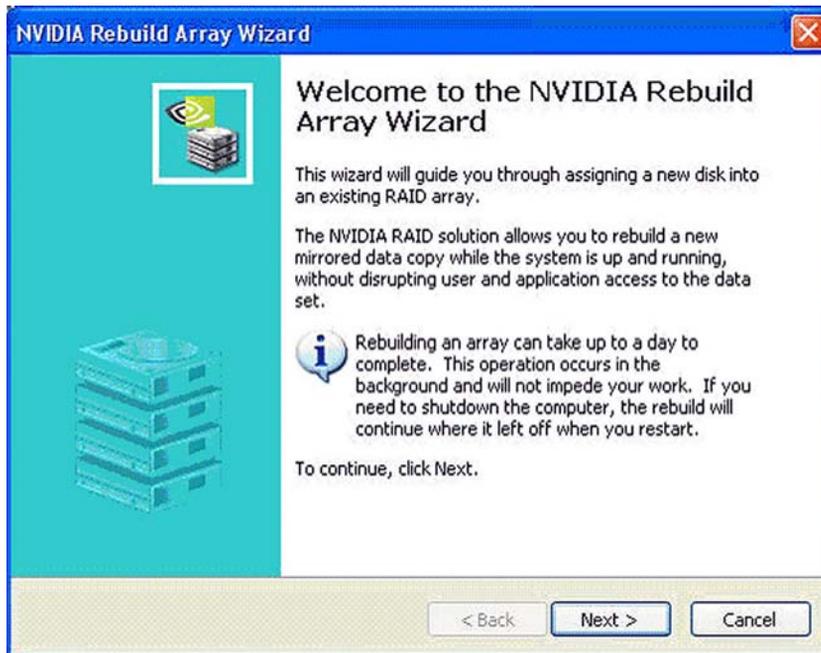
Figure 3.16 NVIDIA Rebuild Array Wizard

4 Click **Next.**

The Disk Selection page appears.

Figure 3.17   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.
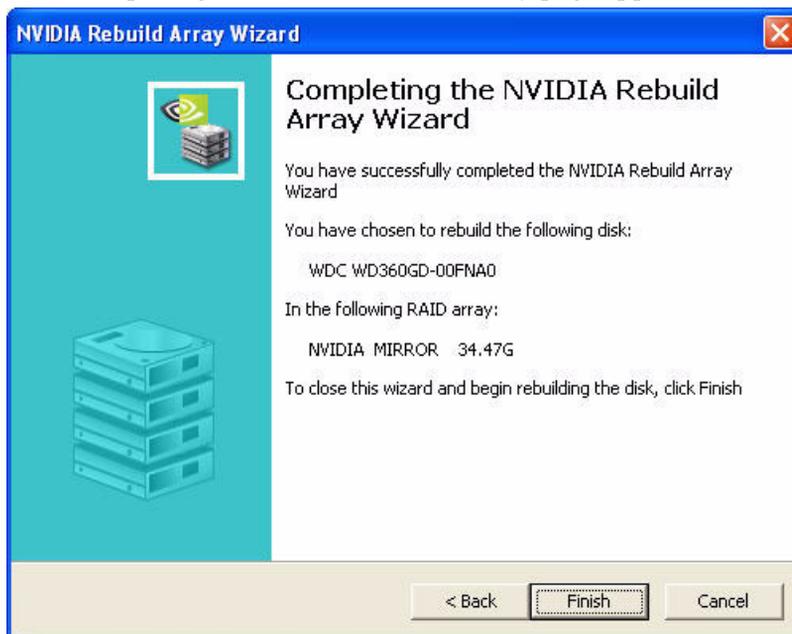
Figure 3.18   Completing the NVIDIA Rebuild Array Wizard Page

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 3.19.

Figure 3.19 Rebuild Bubble Message

When the rebuilding process is finished you will see the pop up box shown inFigure 3.20.

Figure 3.20 Rebuild Finished Bubble Message

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

Figure 3.21 Array Rebuilding Status Detail

More About Rebuilding Arrays

- **Rebuilding Occurs in the Background**

  The rebuilding process takes some time to complete, and occurs in the background so as not to affect the performance of the system.

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

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

- **Rebuilding applies to a degraded fault tolerant array**

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

  For example, Figure 3.22 shows a mirrored array using two 34.48 GB drives while having two Free Disks each 55.90 GB large.
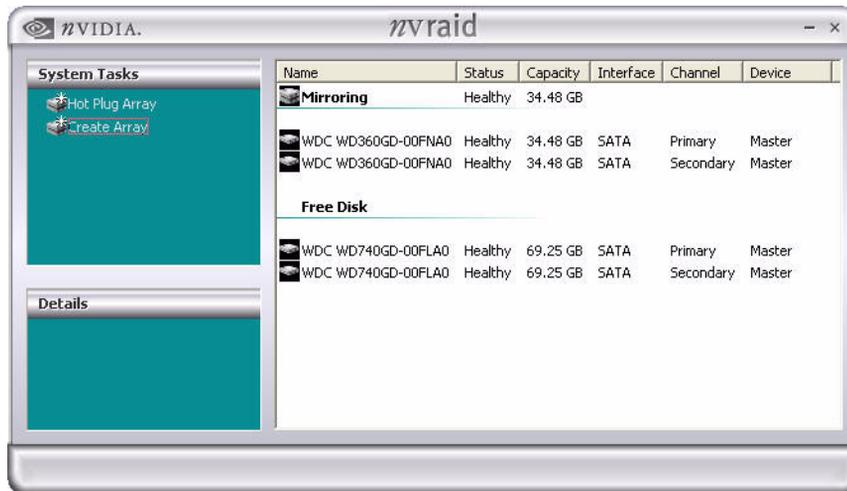
Figure 3.22   Free Disks Available for Rebuilding

To use one of these available free disks to rebuild your array, follow the same steps as explained in "Rebuilding a RAID Array" on page 47, except when prompted to select a disk, choose one of the two available free disks.

Creating RAID Arrays

This section includes examples of using NVRAIDMAN for

- Creating a Striped Array

- Creating a Mirrored Array

- Creating a Stripe Mirroring Array

- Creating a Spanning Array

In these examples, the system is configured with four SATA hard disks.

Creating a Striped Array

NVRAIDMAN can be used to create a striped array from one disk up to the maximum supported number of disks in the system.

To create a two-disk Striped Array do the following:

1 Go to the system BIOS and make sure that the drives that you want to use are RAID enabled.

2 Boot to Windows and launch the NVRAIDMAN application.

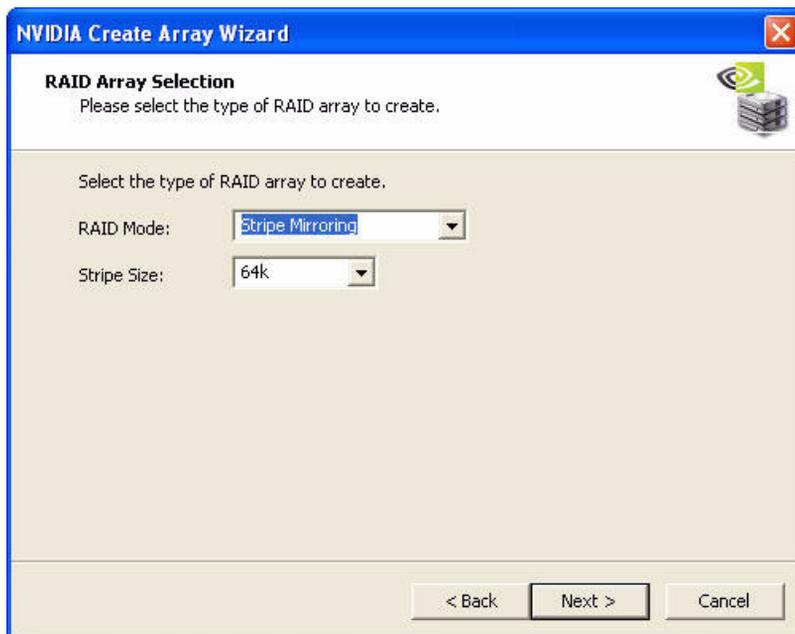**3** **Create Array** and the following screen will appear

Figure 3.23 Create Array Wizard—Welcome Screen

4 :Click **Next** and the following screen shot will appear:
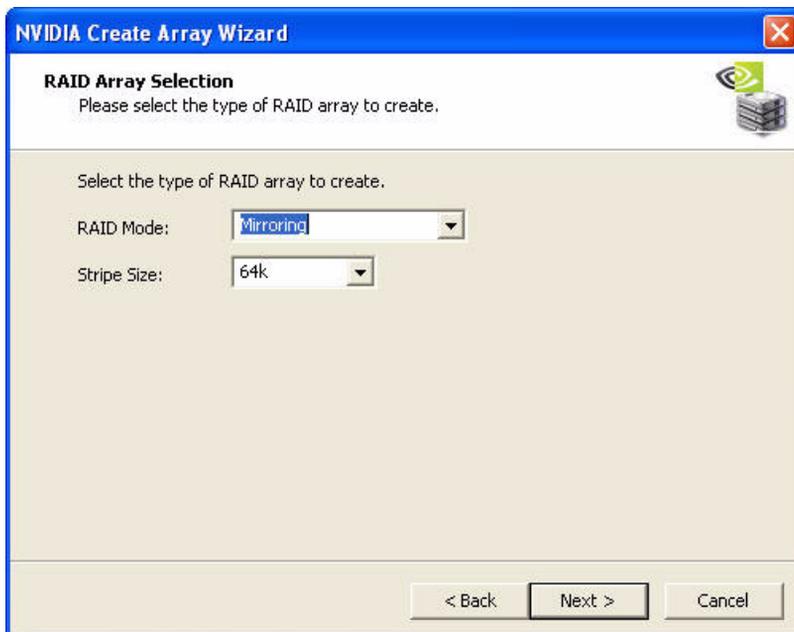
Figure 3.24 RAID Array Selection Page

5 Click the RAID Mode list arrow and select Striping, and leave the "Stripe Size" with its default value as shown in the following screen shot:
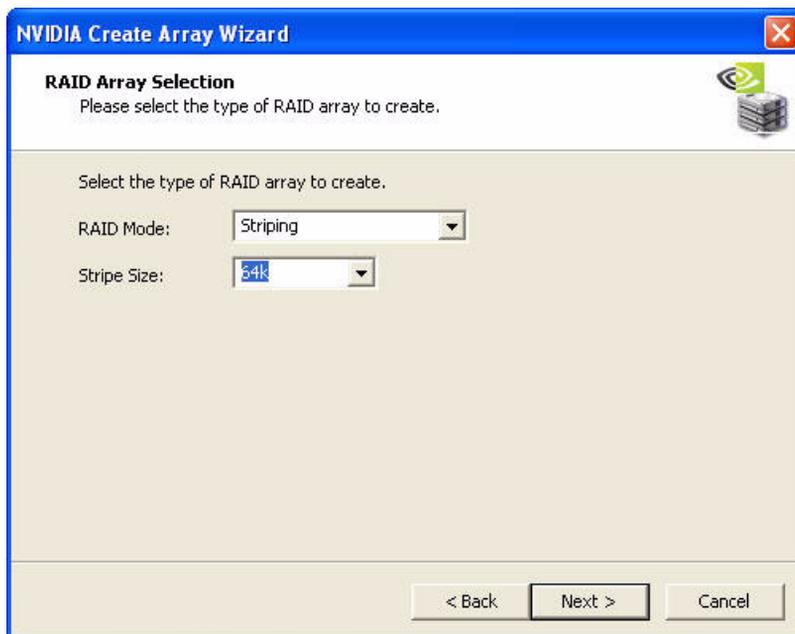

Figure 3.25 RAID Array Selection—Striping

6 Click **Next**, and the following screen shot will appear:
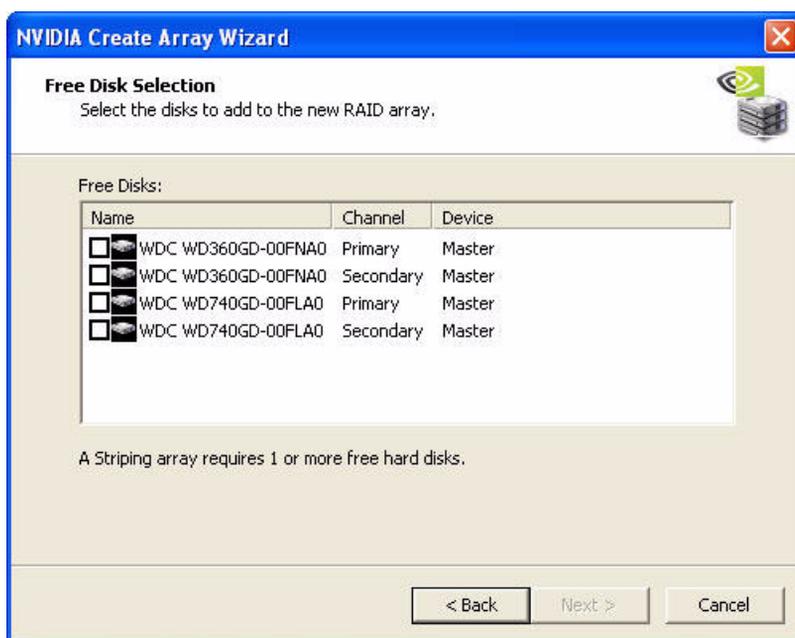
Figure 3.26 Free Disk Selection Page

7 Select the two disks that you want to include in the stripe set.

In this example the upper two disks were selected as shown in Figure 3.27.
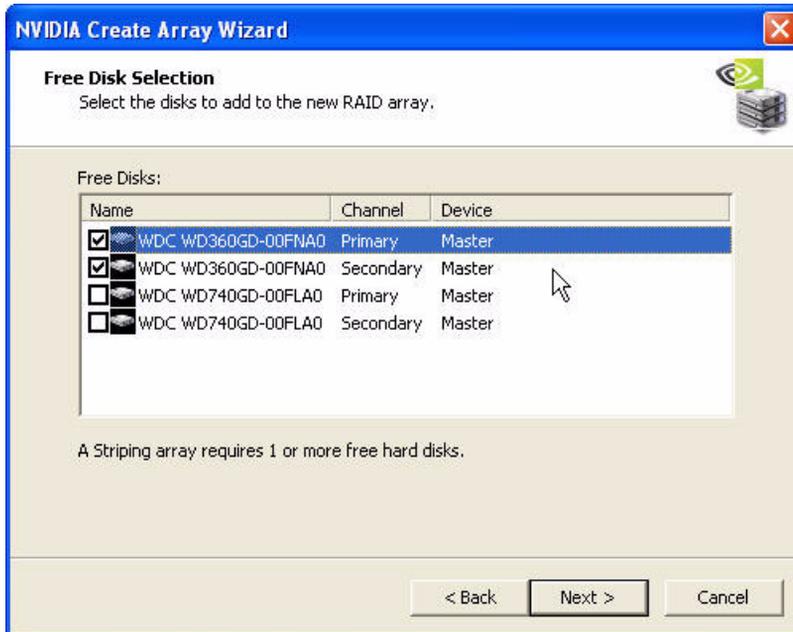
Figure 3.27 Free Disk Selection Page—Selecting Disks

To create a striped array with more disks, select additional disks from the list.

8 Click **Next** and the following screen shot will appear:

Figure 3.28 Completing the NVIDIA Create Array Wizard

9 Click **Finish** and the following screen shot will appear:
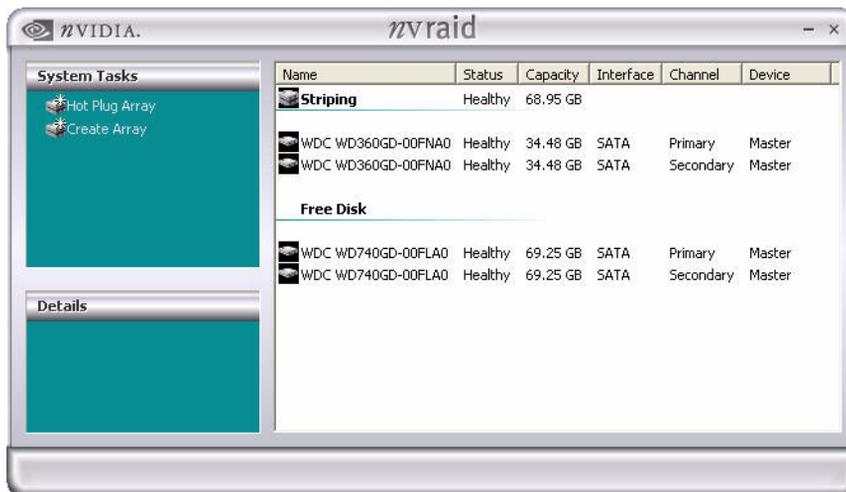
Figure 3.29 Stripe RAID Array Created

As you can see from the above screen shot a striped array with two SATA disks has been created, while the other two disks are allocated as Free Disks.

Similarly, to create an array with three or more disks, simply make sure to add the number of disks that you want to use in the array during creation.

You can also "extend" the size of an existing striped array but that requires that you use morphing— the ability to convert from one RAID array to another as described in "Morphing From One RAID Array to Another" on page 72.

Creating a Mirrored Array

The NVRAIDMAN application can be used to create a Mirrored Array. By definition, a mirrored array consists of two drives. Data is written to both drives, and if one drive fails then data can be recovered from the other drive.

To create a Mirrored Array, do the following:

1 Go to the system BIOS and make sure that the drives that you want to use are RAID enabled.

2 Boot to Windows and launch the NVRAIDMAN application, then click on Create Array and the following screen will appear

Figure 3.30   Create Array Wizard—Welcome Screen

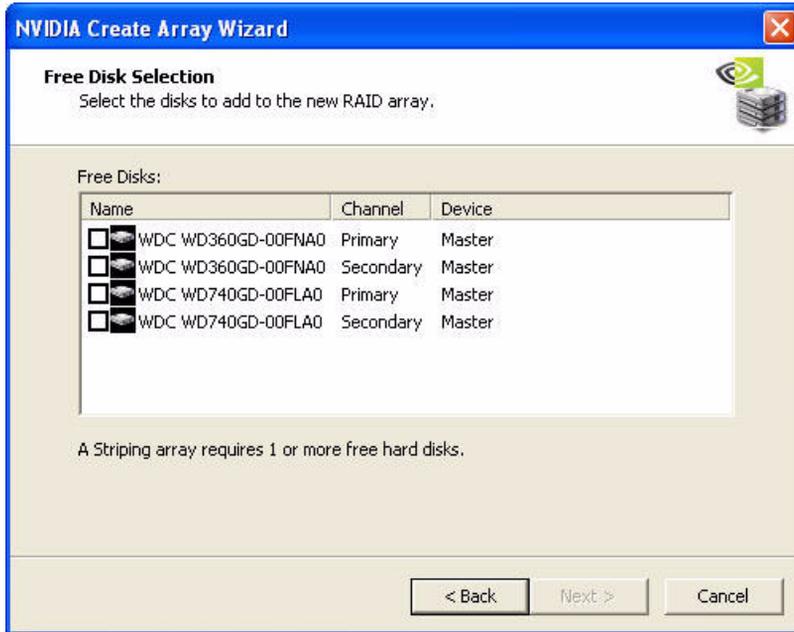**3** Click **Next** and the following screen will appear:
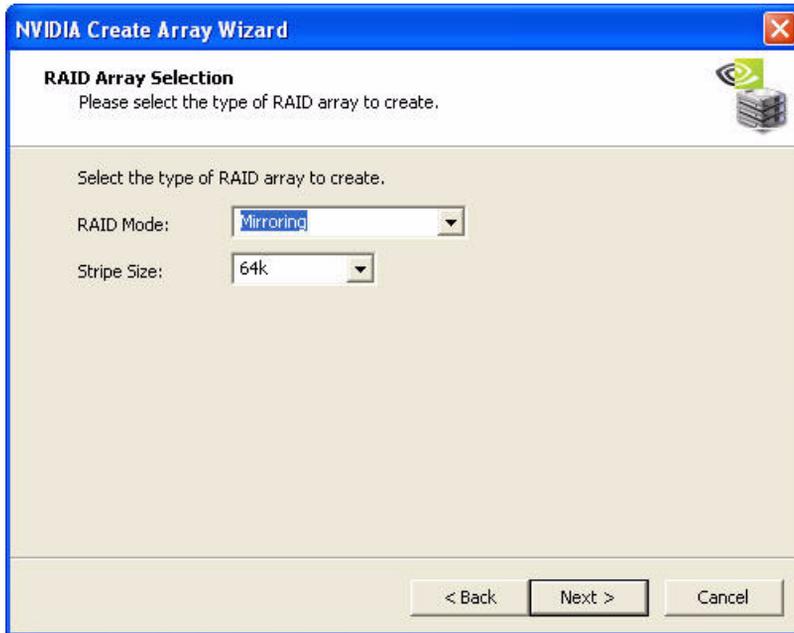
Figure 3.31 RAID Array Selection Page

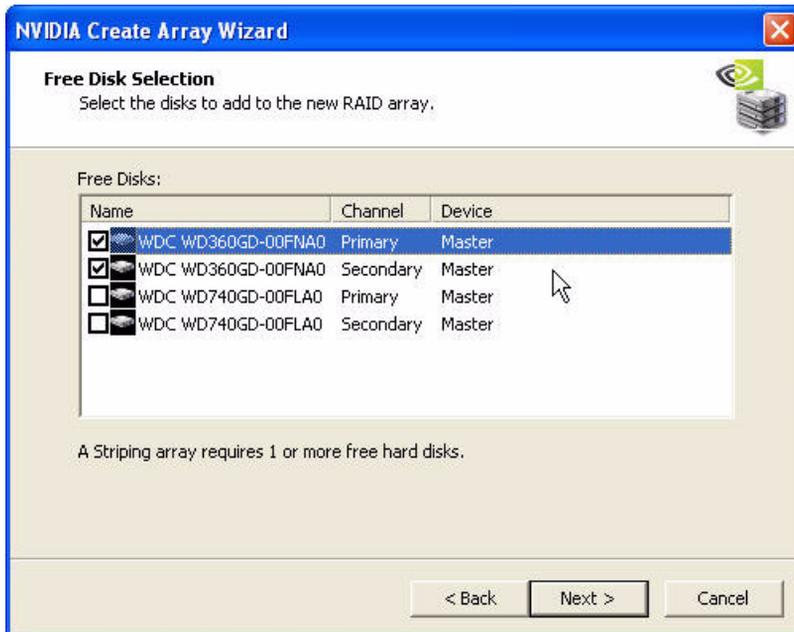**4** Click **Nex**t and the following screen will appear:
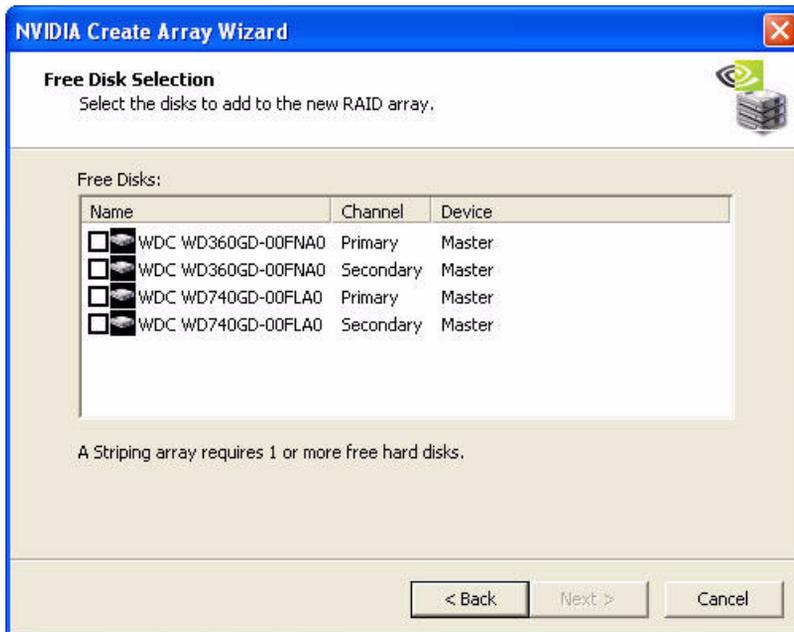
Figure 3.32 Free Disk Selection Page

5 Select the two drives that you want to use in the Mirrored array.

In this example the upper two disks were selected as shown in Figure 3.33.
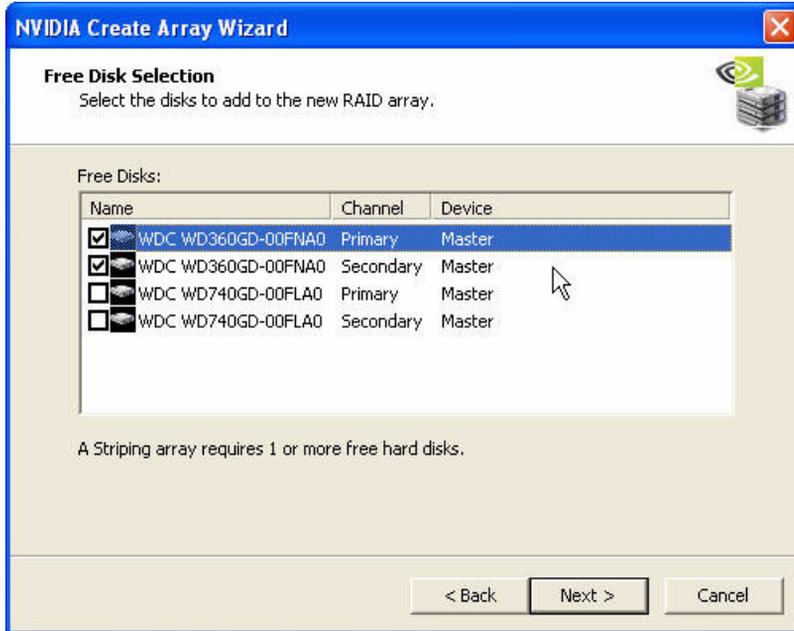
Figure 3.33   Free Disk Selection Page—Selecting Disks

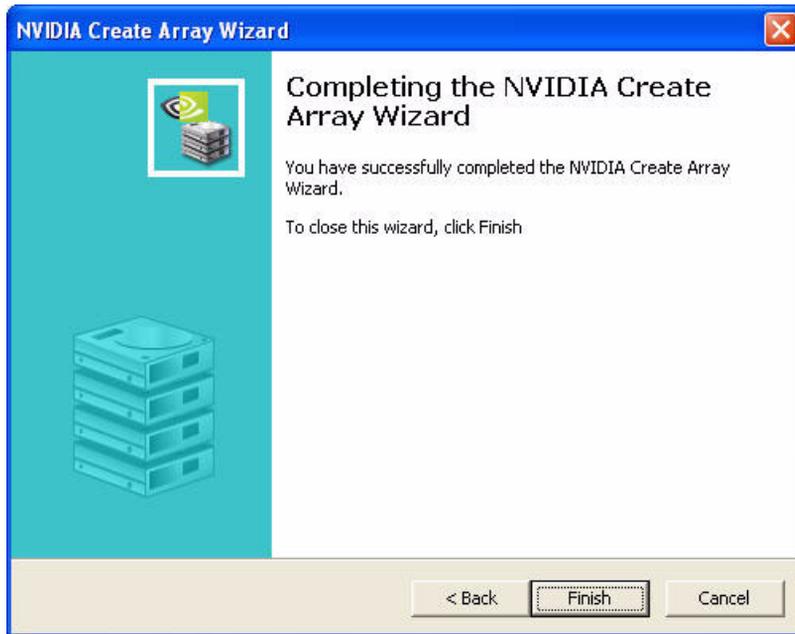**6** Click **Next** and the following screen shot will appear:
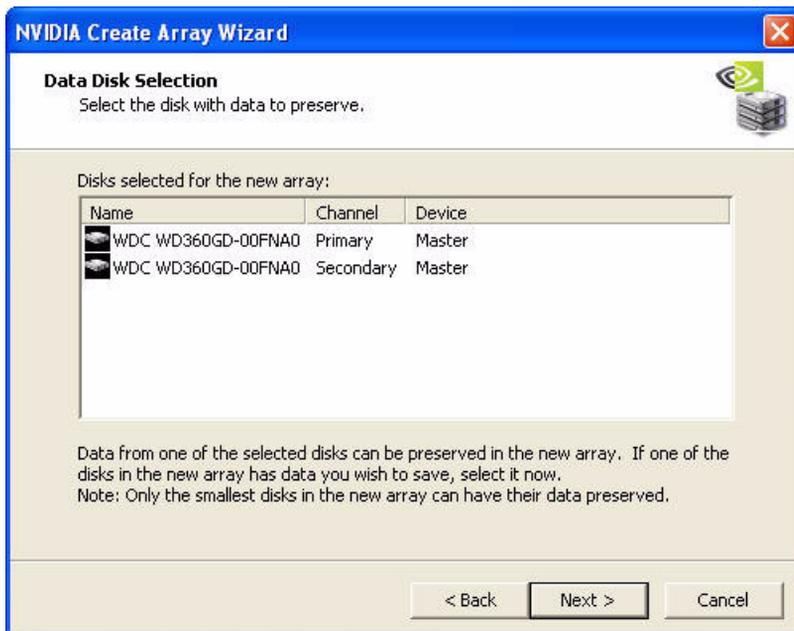
Figure 3.34   Data Disk Selection Page

7 If you want to start rebuilding the array right away (copy data from one disk to the other), select the disk that you wish to preserve.

Do not select a disk if you do not want to rebuild the array at this time.

8 Click **Next** and the following screen shot appears:
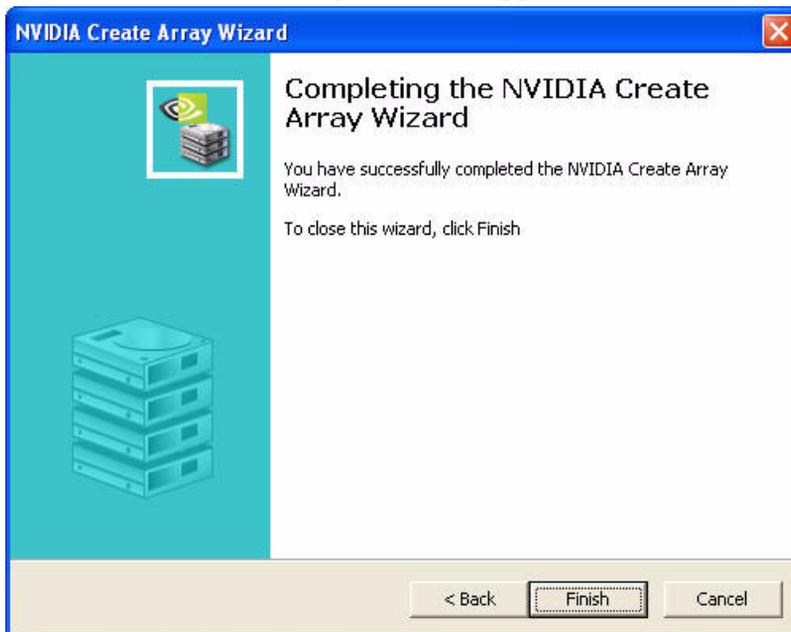
Figure 3.35 Completing the NVIDIA Create Array Wizard Page

9 Click **Finish.**

If you selected a disk to preserve in step 7, the rebuilding process begins.
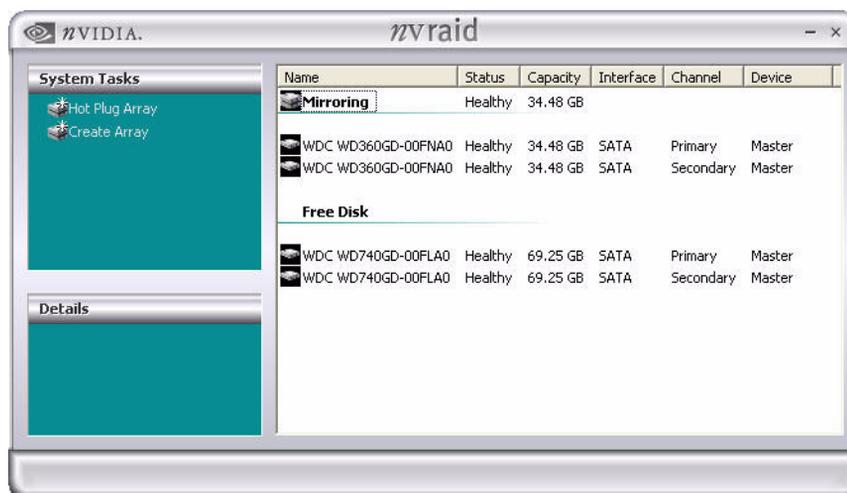
Figure 3.36 Mirrored RAID Array Created

A mirrored array has been created, while the other two disks are set to free disks.

Creating a Stripe Mirroring Array

NVRAIDMAN can be used to create a Stripe Mirroring array which requires at least four disks to start such an array.

To create a Stripe Mirror Array do the following:

1 Go to the system BIOS and make sure that the drives that you want to use are RAID enabled.

2 Boot to Windows, launch the NVRAIDMAN application, then click on Create Array and the following screen will appear

Figure 3.37   Create Array Wizard—Welcome Page

3 Click on Next and the following screen will appear:
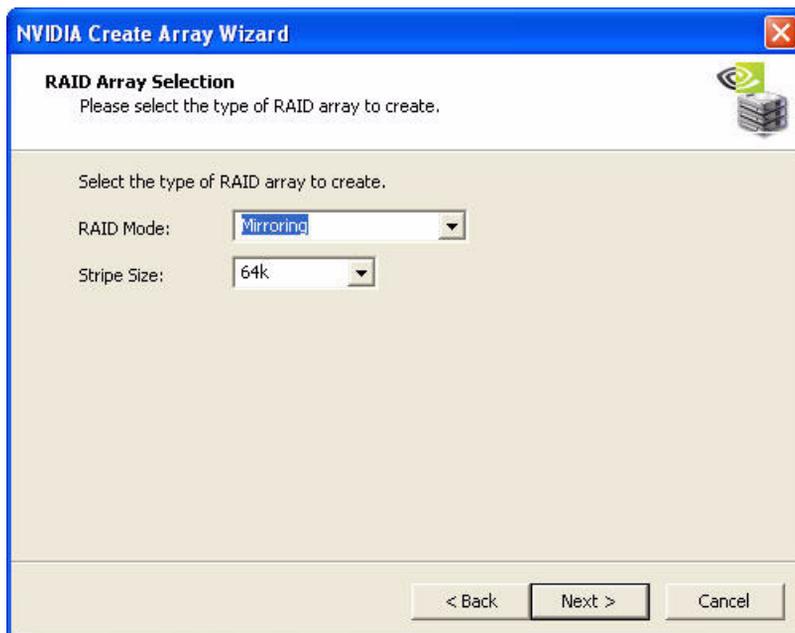
Figure 3.38 RAID Array Selection

4 Click on "RAID Mode:" and select "Stripe Mirroring" while leaving the Stripe Size set to its default value as shown in the following screen shot:

Figure 3.39 RAID Array Selection—Stripe Mirroring

5 Click **Next** and the following screen will appear:

Figure 3.40   Free Disk Selection Page

6 Select the four drives that you want to use in the Stripe Mirroring array.

In this example all of the drives are selected as shown in the following screen shot:
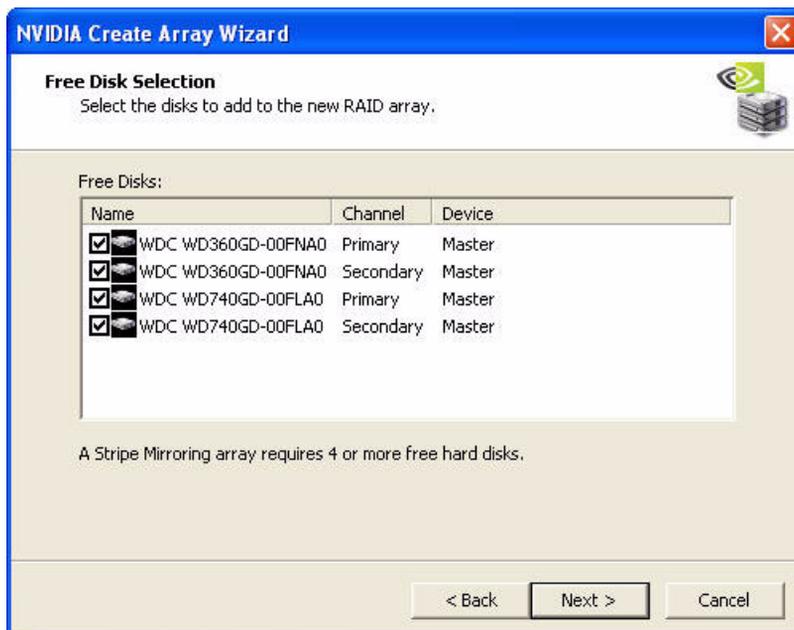
Figure 3.41   Free Disk Selection Page—Selecting Disks

7 Click **Next** and the following screen shot will eventually appear:

Figure 3.42 Completing the NVIDIA Create Array Wizard Page

8 Click **Finish** and the following screen shot will appear:
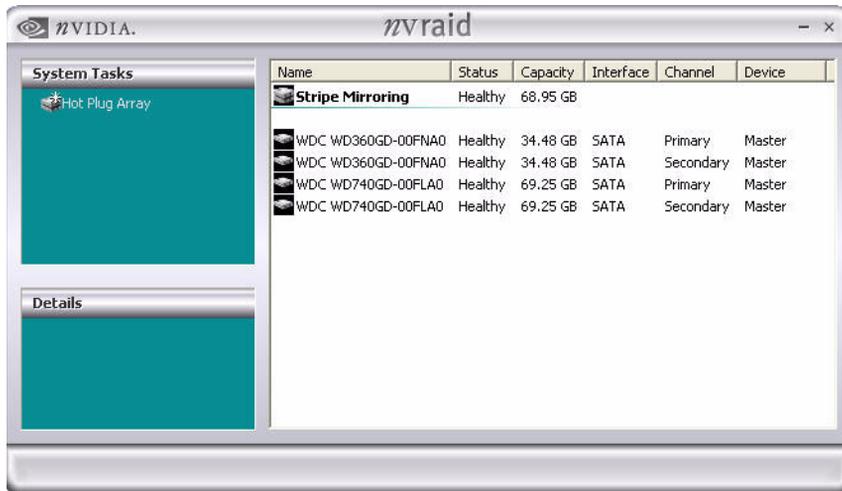
Figure 3.43 RAID Stripe Array Created

A Stripe Mirroring array has been created.

Creating a Spanning Array

NVRAIDMAN can be used to create a Spanning Array which requires at least one disk to start such an array.

To create a Spanning Array do the following:

1 Go to the system BIOS and make sure that the drives that you want to use are RAID enabled.

2 Boot to Windows and launch the NVRAIDMAN application, then click on Create Array and the following screen will appear

Figure 3.44   Create Array Wizard—Welcome Page

3 Click **Next** and the following screen will appear:
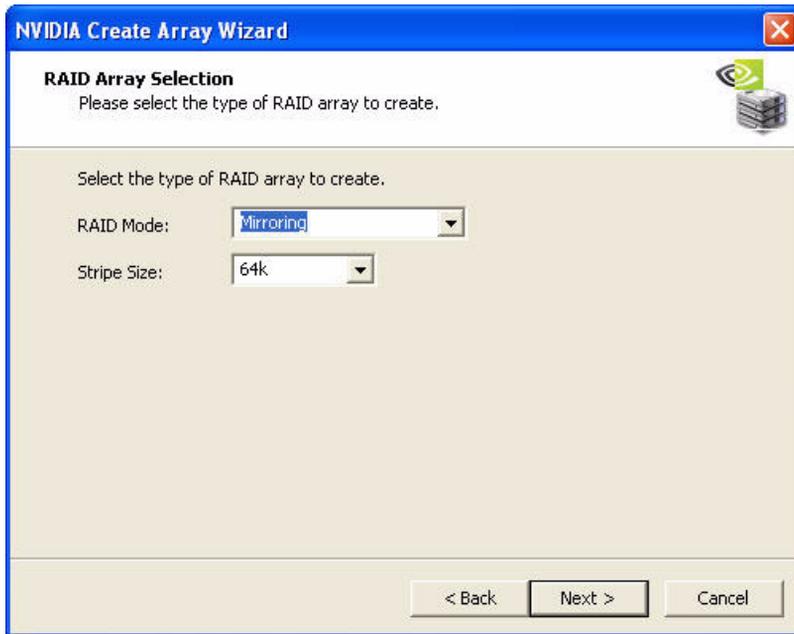
Figure 3.45 RAID Array Selection Page

4 Click the RAID Mode list arrow and select "Spanning" while leaving the Stripe Size set to its default value as shown in the following screen shot:
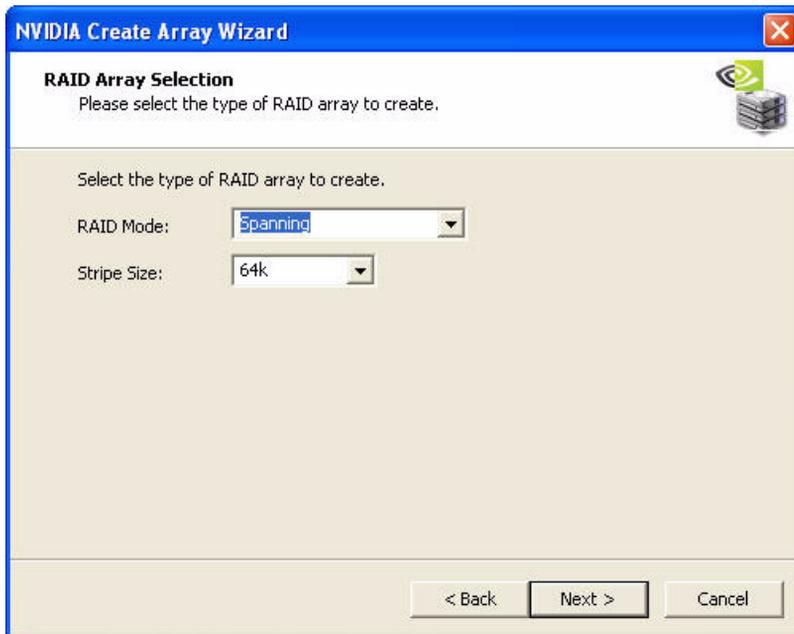
Figure 3.46 RAID Array Selection Page—Spanning

5 Click **Next** and the following screen shot will appear:

Figure 3.47   Free Disk Selection Page

6 Select the two drives that you want to use in the Spanned array.

In this example the upper two disks were selected as shown in the following screen shot:

Figure 3.48   Free Disk Selection Page—Selecting Disks

7 Click **Next** and the following screen shot will appear:

Figure 3.49 Completing the NVIDIA Create Array Wizard Page

8 Click **Finish** and the following screen shot will appear:
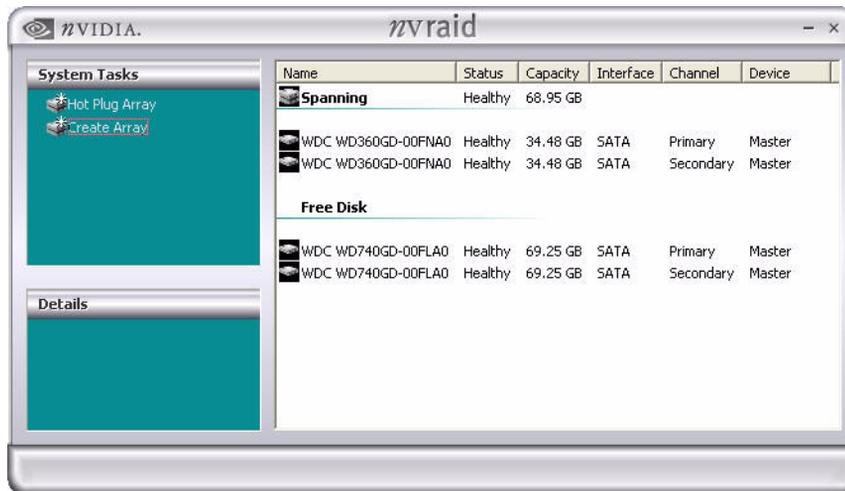
Figure 3.50 RAID Spanned Array Created

A Spanned Array has been created.

Deleting a RAID Array

NVRAIDMAN can be used to delete an Array.

To delete an Array do the following:

1 Launch the NVRAIDMAN application and right click on the RAID array that you want to delete (assuming that you have a RAID array already created) as shown in the following screen shot:
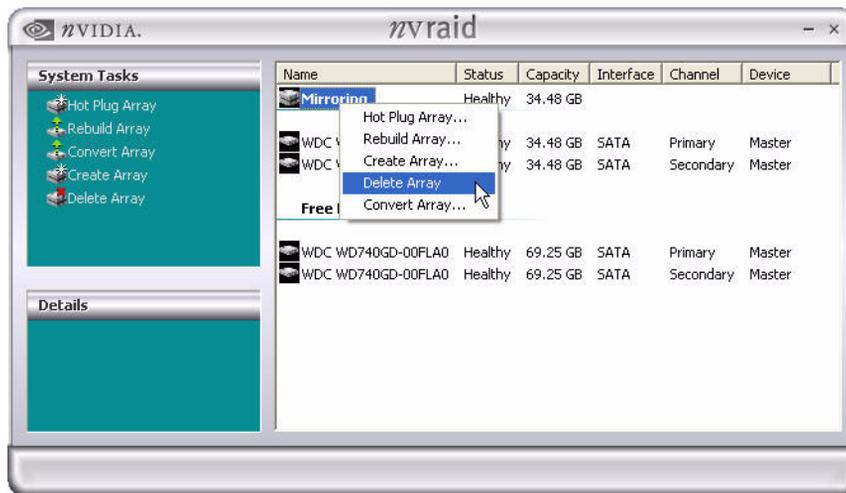
Figure 3.51   Selecting "Delete Array" from the Pop Up Menu

The above screen shot shows that there is a Mirrored array that will be deleted.

After the "Delete Array…" has been selected, the following screen shot appear:

Figure 3.52 Delete Array Wizard—Welcome Page

2 Click **Next** and the following screen shot will appear:

Figure 3.53 Completing the NVIDIA Delete Array Wizard Page

3 Click **Finish** and the array will be deleted and the following screen shot will appear showing all the free disks:
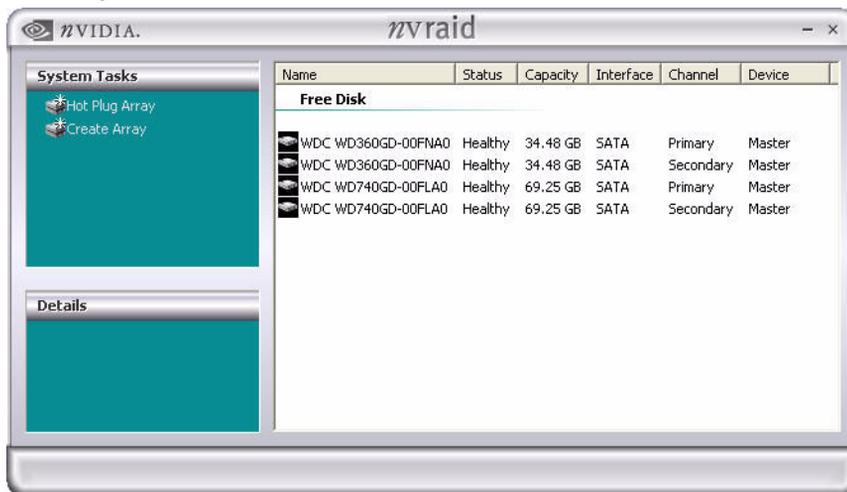
Figure 3.54 RAID Array Deleted

A similar process can be applied to delete any array created by NVIDIA RAID.

Morphing From One RAID Array to Another

In a traditional RAID environment, when a user wants to change the current state of a disk or a current array to a new RAID configuration, the process of reconfiguring the new array involves multiple steps. The user must back up the data, delete the array, re-boot the PC, and then reconfigure the new array.

NVIDIA RAID allows the end user to change the current state of the disk or array to another with a one-step process called "Morphing". This section describes the NVIDIA Morphing process and explains how to use Morphing to convert from one RAID array type to another.

General Morphing Principles

NVIDIA RAID includes extensive support for morphing, a process of converting from one RAID mode to another RAID mode.

General Requirements and Limitations

- The new array capacity must be equal to or greater than the previous array.

  For example, it is possible to morph from a RAID 1 array to a RAID 0 array as long as the RAID 0 array is the same size as (or larger than) the RAID 1 array.

- You can't morph
  - To or from a JBOD (Spanning) array
  - From RAID 1 to RAID 1
  - From RAID 0+1 to RAID 1

Specific Morphing Requirements

The following table lists the disk requirements for a new RAID array for various morphing combinations.

Table 3.1   RAID Array Disk Requirements for Morphing

From	To	New Array Disk Requirements[i]
RAID 0	**RAID 0**	$m > n$
		Number of disks in the new array must be greater than the original array.
	RAID 1	$m=2$, $n=1$
		RAID 1 array must include two disks, converted from a one disk RAID 0 array.
	RAID 0+1	$m >= 2 \times n$
		Number of RAID 0+1 disks must be equal to or greater than twice the number of RAID 0 disks.
RAID 1	**RAID 0**	No additional restrictions.
	RAID 1	**** Not a valid combination ****
	RAID 0+1	No additional restrictions.
RAID 0+1	**RAID 0**	$m >= n/2$
		Number of RAID 0 disks must be equal to or greater than half the number of RAID 0+1 disks.
	RAID 1	**** Not a valid combination ****
	RAID 0+1	$m >= n + 2$; where m must be an even number of disks.
		The new array must include at least two more disks than the original array, and can include any even number of disks beyond that.

i. m = quantity of disks in the new array. n = quantity of disks in the original array.

Morphing Instructions

This sections includes specific instructions for the following RAID morphing combinations:

Morphing from RAID 0 to RAID 0—Adding a Disk to a Stripe Set

The following example shows you how to expand a RAID 0 array with two disks to include an additional disk.

1 Go to the system BIOS and make sure that the drives that you want to use are RAID **enabled.**

2 Boot to Windows, launch the NVRAIDMAN application, then follow the steps outlined in "Creating a Striped Array" on page 52 to create a two disk stripe array.

When that is done, you should see a screen shot similar to the following:
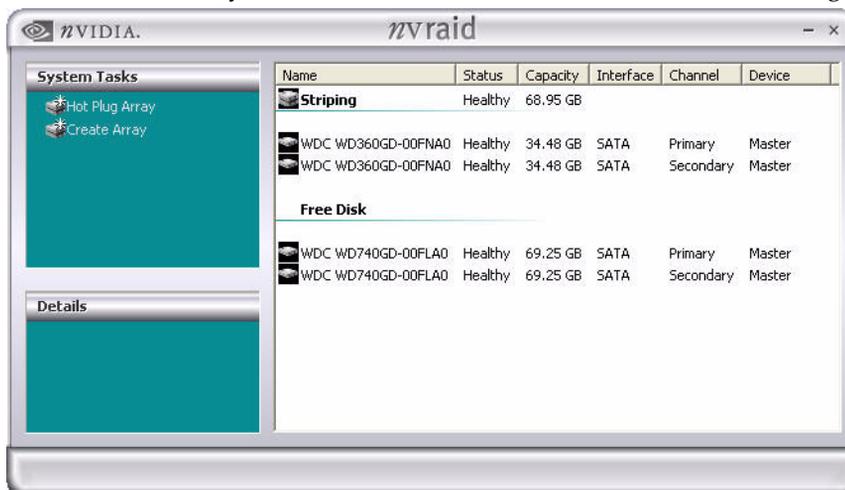
Figure 3.55 RAID Array Created

Now that a two disk stripe array has been created, you can use the NVRAIDMAN convert feature to morph the array from a two-disk RAID 0 into a three-disk RAID 0 array.

3 Right click on the newly created striped array (or existing striped array) and a select "Convert Array…" as shown from the following screen shot:
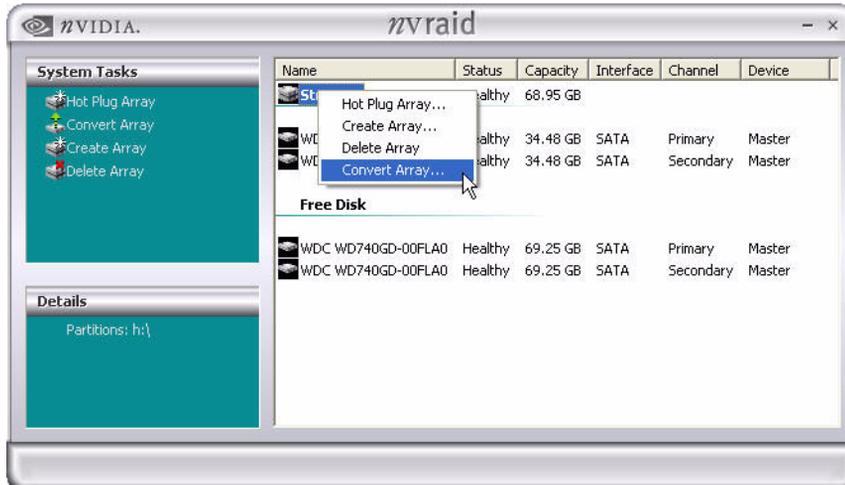
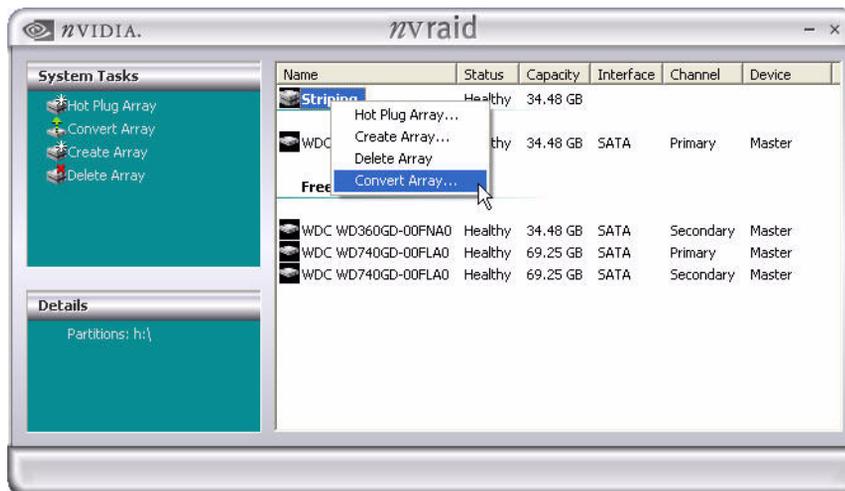**Figure 3.56**   Selecting "Convert Array" from the Pop Up Menu

4 After selecting "Convert Array…" the following screen shot will appear:

Figure 3.57   Convert Array Wizard—Welcome Screen

5 Click **Next** and the following screen shot will appear:
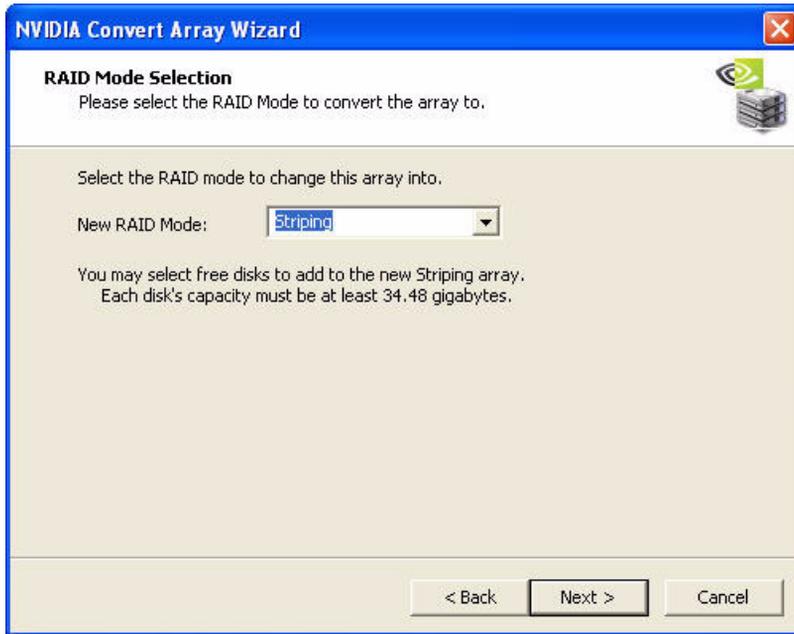
Figure 3.58 RAID Mode Selection Page

6 Click **Next** and the following screen shot will appear:
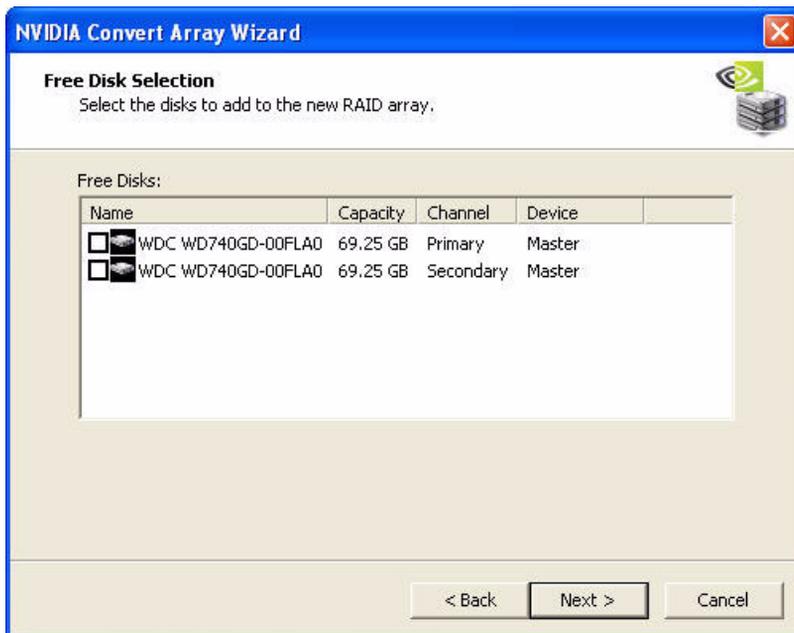
Figure 3.59 Free Disk Selection Page

7 Select the disk (or disks) that you want to add to the existing striped array.

In this example, we are adding one disk (which is the upper disk) to the existing two-disk striped array. So, select the first disk and click **Next** and the following screen shot will appear:

Figure 3.60 Completing the NVIDIA Convert Array Wizard Screen

8 Click **Finish** then click on the newly created three disk striped array and the following screen shot will appear:
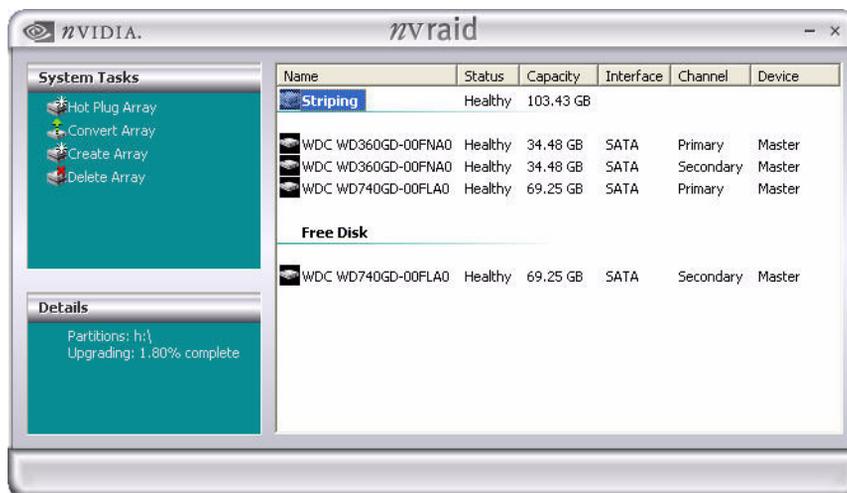
Figure 3.61 New Morphed RAID Array

The Morphing Process

As you can see from the screen shot above, a three disk stripe array has been created and the morphing process has begun. A pop up window similar to the following will appear:
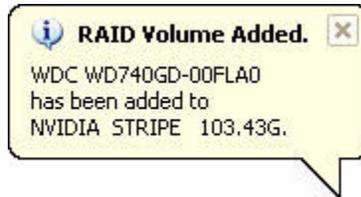
> **ⓘ RAID Volume Added.** ☒
>
> WDC WD740GD-00FLA0
> has been added to
> NVIDIA STRIPE 103.43G.

followed by the following pop up window:

> **ⓘ Upgrade In Progress.** ☒
>
> NVIDIA STRIPE 103.43G
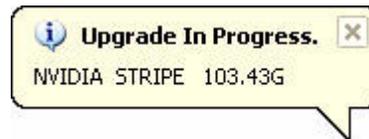
It will take some time before the entire process is completed. The time is takes to convert an array is dependent on several factors such as the speed of the CPU, the size and type of hard drive being used, the operating system, etc.

More About This Example

In the example above, we started with an identical two-disk (each disk had a size of 34.48 GB) striped array that had a total disk space of 68.95 GB. We then added a 69.25 GB disk to this array and the newly converted array had a size of 103.43 GB. The reason is that when creating a striped array with several disks of various size, the disk with the smallest size will be used as the base stripe disk size for the array. In this example 34.48 GB is the smallest size common to all three disks. Therefore, if you multiply 34.48 by three, the total will be 103.43 GB.The remainder of the disk space on the 69.25 GB disk cannot be used in the newly created array. That is why it is recommended to use identical disks (type and size) when creating a striped array.

Morphing from RAID 0 (with One Disk) to RAID 1 (with Two Disks)

The following example shows you how to convert a RAID 0 array with one disk to a RAID 1 array (with two disks)

1 Go to the system BIOS and make sure that the drives that you want to use are RAID **enabled.**

2 Boot to Windows, launch the NVRAIDMAN application, then follow the steps outlined in "Creating a Striped Array" on page 52 with the exception that you need to select one disk instead of two disks.

When that is done, you should see a screen shot similar to the following:
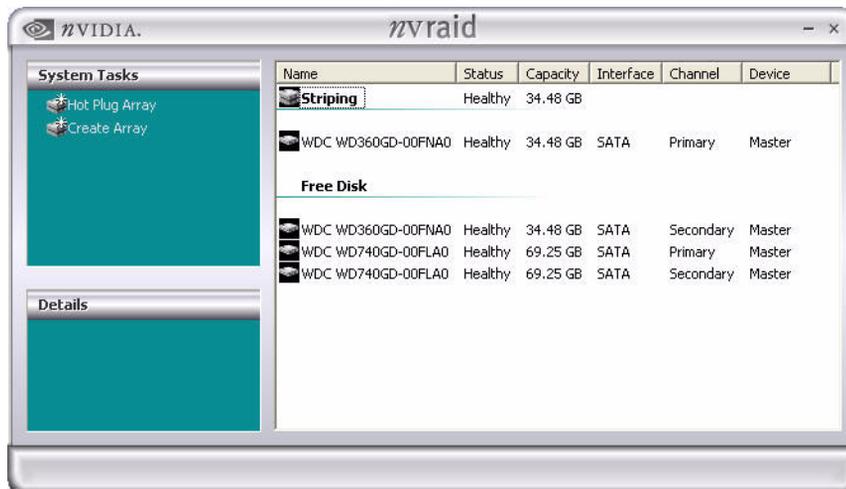
Figure 3.62 RAID Array Created

3 Click click on Striping and select "Convert Array..." as shown in the following screen shot:

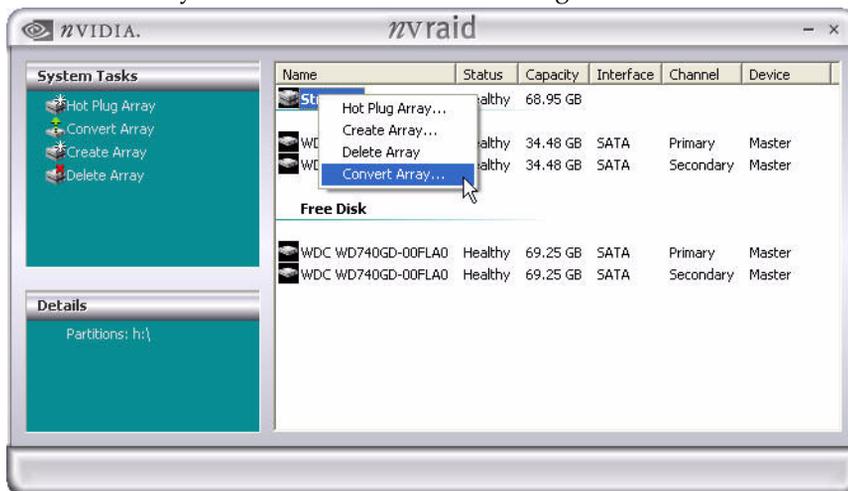**Figure 3.63** Selecting "Convert Array" from the Pop Up Menu

After selecting "Convert Array..." the following screen shot will appear:

Figure 3.64   Convert Array Wizard—Welcome Screen

4 Click **Next** and the following screen shot will appear:
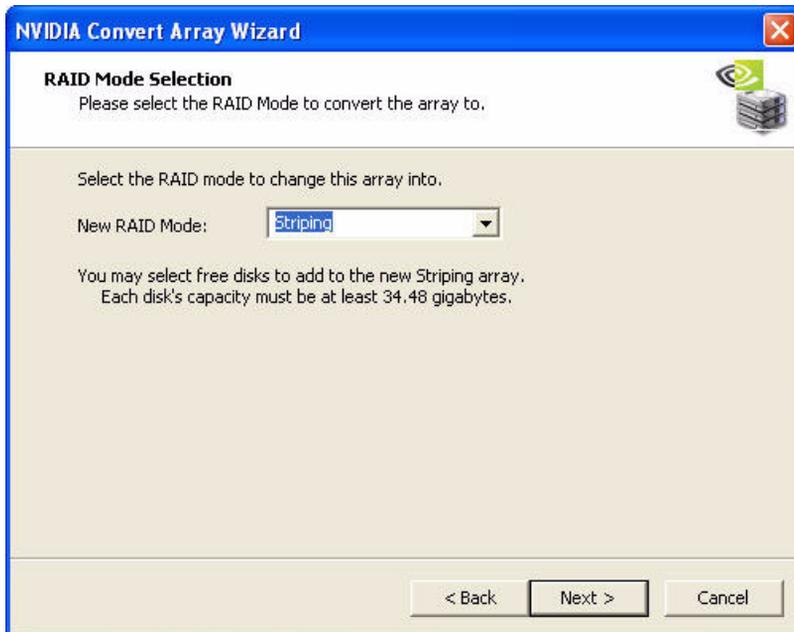
Figure 3.65   RAID Mode Selection Page

5 For the "New RAID Mode:" entry select Mirror as shown in the following screen shot:
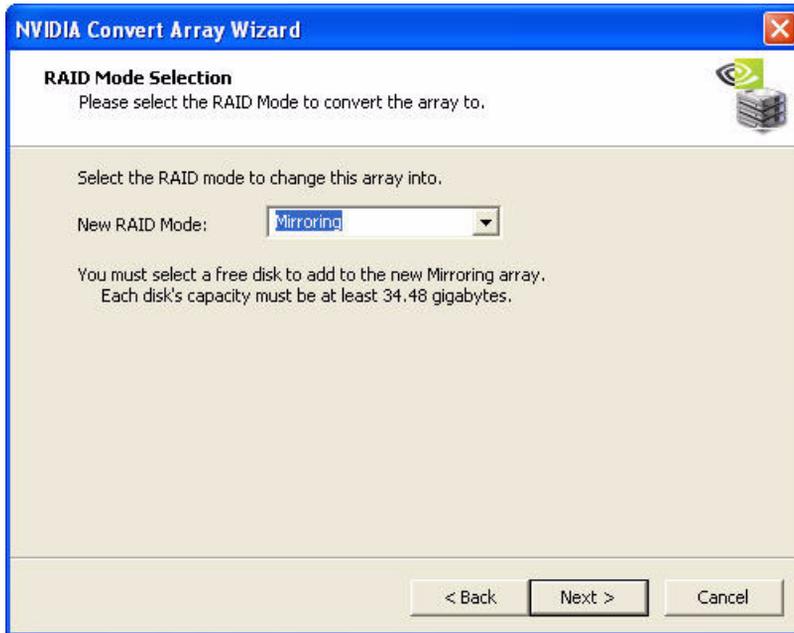
Figure 3.66 RAID Mode Selection Page—Selecting Mirroring

6 Click **Next** and the following screen shot will appear:
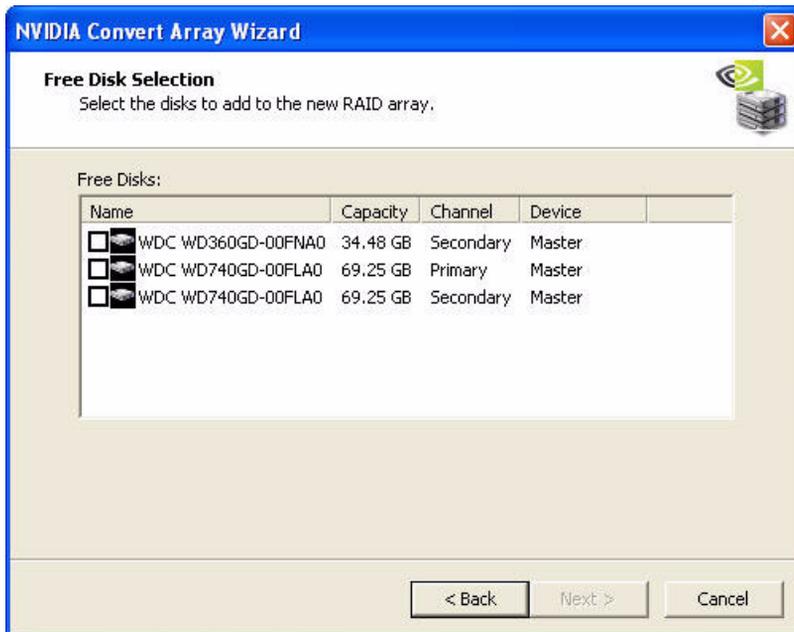
Figure 3.67 Free Disk Selection Page

7 Select one of the disks and click **Next**, then **Finish**.

In this example, the WD360GD was chosen as shown in Figure 3.68.
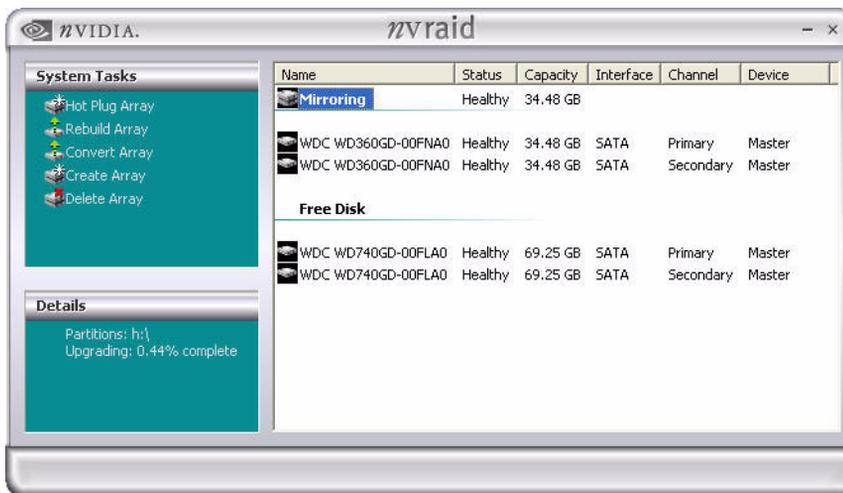

Figure 3.68 New Morphed RAID Array

The Morphing Process

As soon as the new three-disk striped array has been created, a pop up window similar to the following will appear:
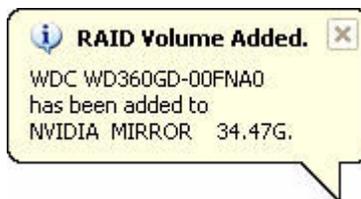
followed by the following pop up window:
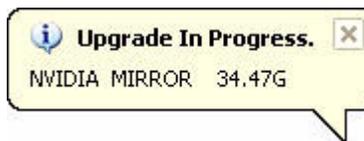
It will take some time before the entire process is completed. The time it takes to convert an array is dependent on several factors such as the speed of the CPU, the size and type of hard drive being used, the operating system, etc.

Morphing from RAID 0 to RAID 0+1

The following example shows you how to convert from a RAID 0 array with two disks to a four disk RAID 0+1 array.

1 Go to the system BIOS and make sure that the drives that you want to use are RAID **enabled.**

2 Boot to Windows, launch the NVRAIDMAN application, then follow the steps outlined in "Creating a Striped Array" on page 52 to create a two-disk striped array.

When that is done, you should see a screen shot similar to the following:
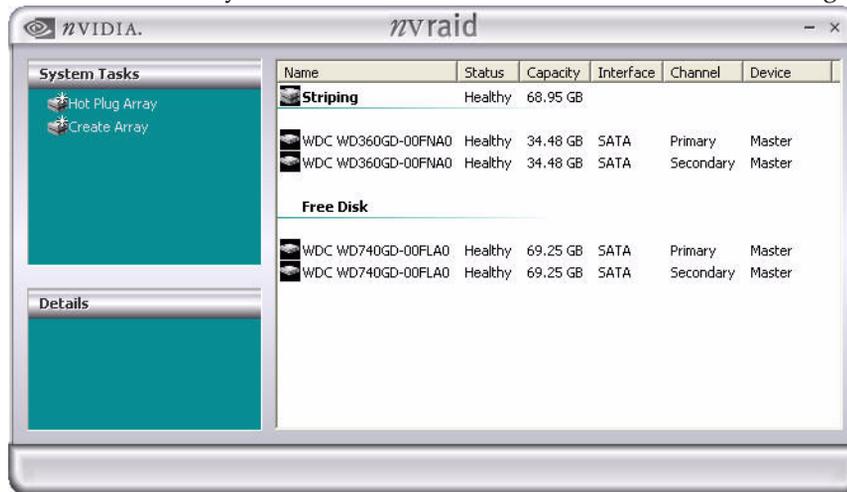
Figure 3.69 RAID Array Created

Now that a two-disk striped array has been created, you can use the NVRAIDMAN convert feature to morph the array from a two-disk RAID 0 into a four-disk RAID 0+1 array.

3 Right click on the newly created striped array (or existing striped array) and a select "Convert Array..." as shown from the following screen shot:

Figure 3.70 Selecting "Convert Array" from the Pop Up Menu

After selecting "Convert Array..." the following screen shot will appear:

Figure 3.71 Convert Array Wizard—Welcome Screen

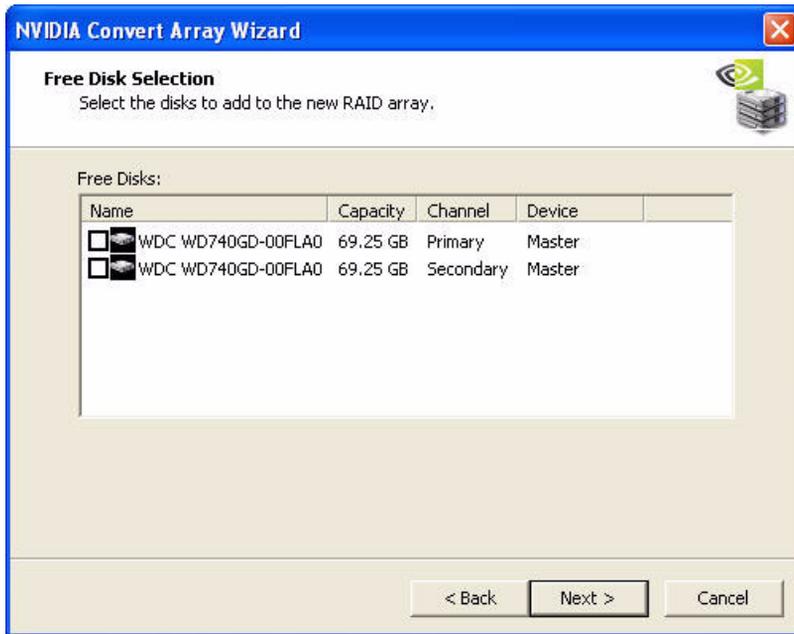**4** Click **Next** and the following screen shot will appear:
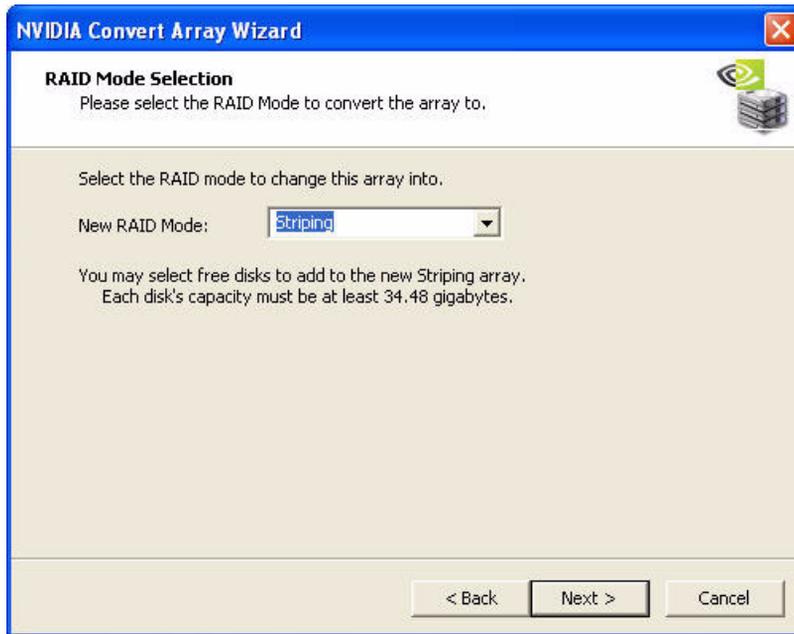
Figure 3.72 RAID Mode Selection Page

5 Change the "New RAID Mode:" to Stripe Mirroring as shown in the following screen shot:
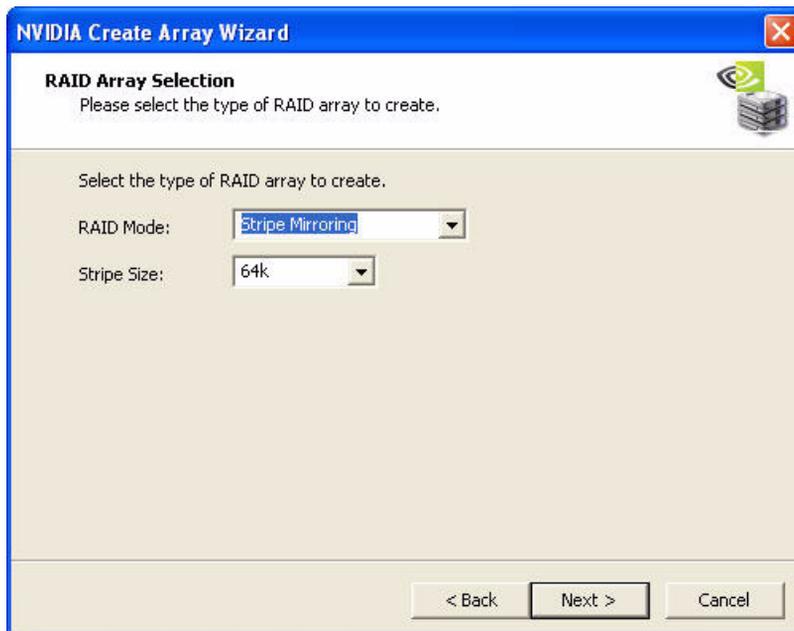
Figure 3.73 RAID Mode Selection Page—Selecting Stripe Mirroring

6 Click **Next** and the following screen shot will appear:

Figure 3.74 Free Disk Selection Page

7 Select the two disks that you want to add to the new stripe mirror array.

In this example, we are adding two disks (which are both of the upper disks) to the existing two-disk mirrored array. So, select both disks and click **Next** and the following screen shot will appear:

Figure 3.75 Convert Array Wizard—Welcome Screen

8 Click **Finish**, then click the newly created four-disk mirrored stripe array and the following screen shot will appear:
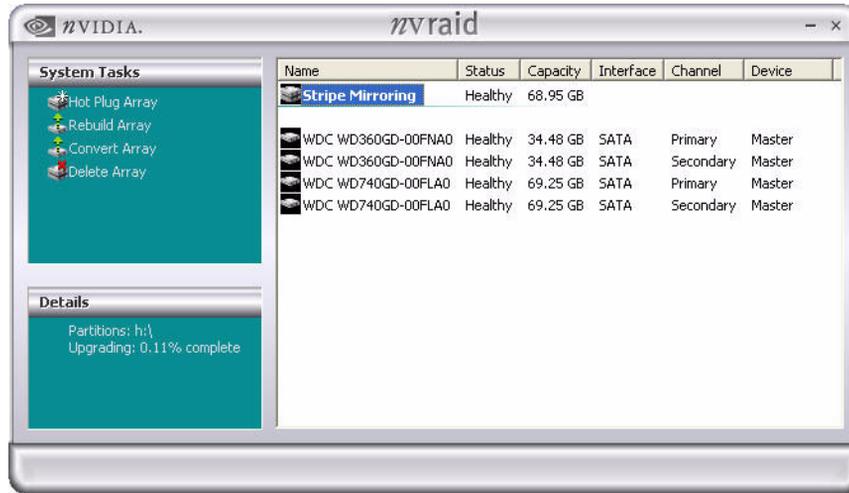
Figure 3.76   New Morphed RAID Array

The Morphing Process

As soon as the new four-disk mirrored stripe array has been created, a pop up window similar to the following will appear:
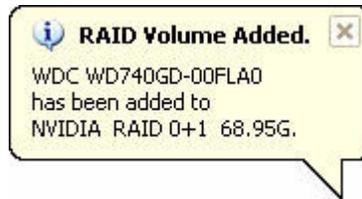

followed by the following pop up window:
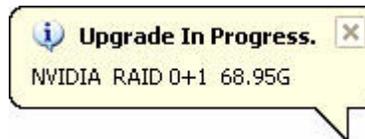
It will take some time before the entire process is completed. The time it takes to convert an array is dependent on several factors such as the speed of the CPU, the size and type of hard drive being used, the operating system, etc.

Morphing from RAID 1 to RAID 0

The following example shows you how to convert from a RAID 1 array with two disks to a RAID 0 array with two disks.

1 Goto the system BIOS and make sure that the drives that you want to use are RAID **enabled.**

2 Boot to Windows and launch the NVRAIDMAN application then follow the steps outlined in "Creating a Mirrored Array" on page 57 to create a two-disk mirror array.

When that is done, you should see a screen shot similar to the following:
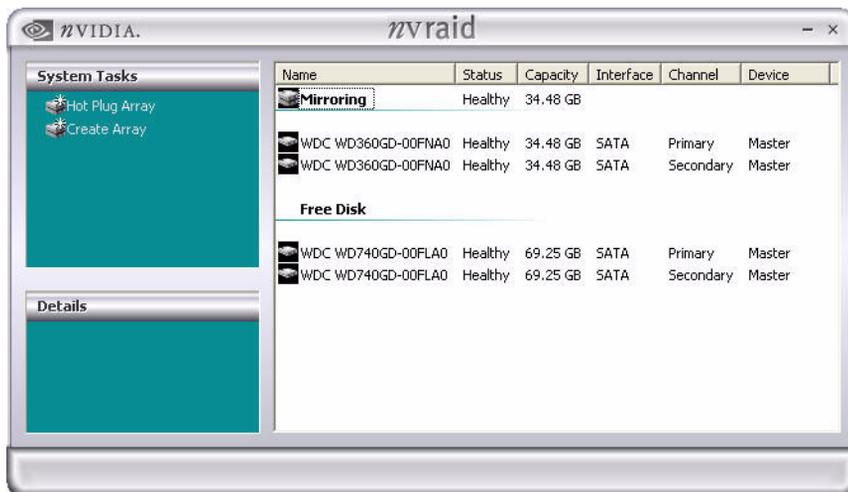
Figure 3.77 RAID Array Created

Now that a two disk mirrored array has been created, you can use the NVRAIDMAN convert feature to morph the array from a two-disk RAID 1 into a two-disk RAID 0 array.

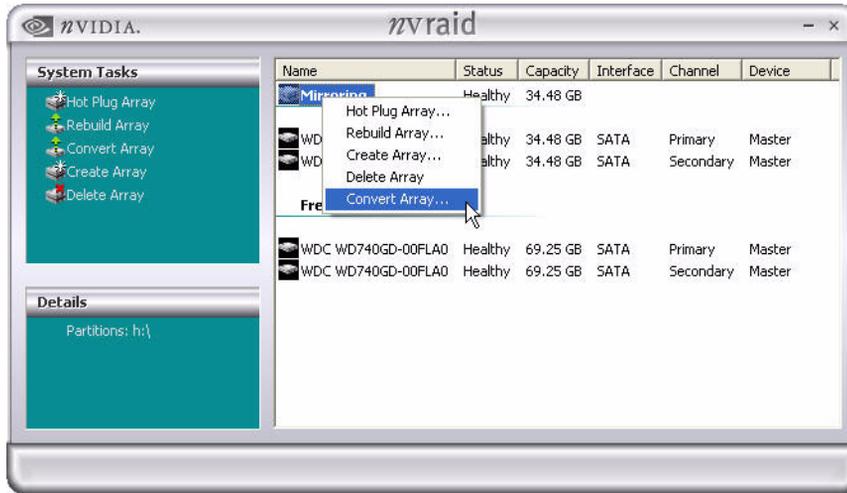**3** Right click on Mirroring and select "Convert Array…" as shown in the following screen shot:

Figure 3.78 Selecting "Convert Array" from the Pop Up Menu

4 After selecting "Convert Array…" the following screen shot will appear:

Figure 3.79 Convert Array Wizard—Welcome Screen

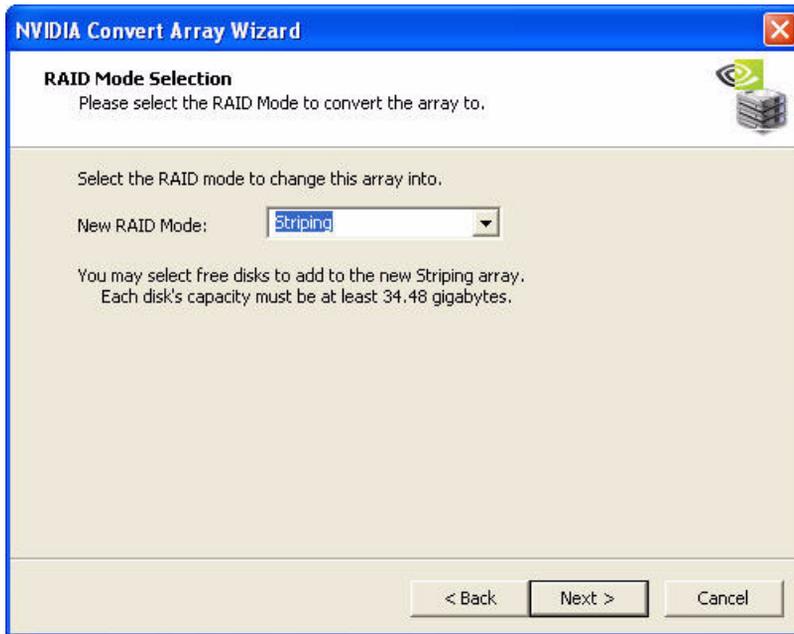**5** Click **Next** and the following screen shot will appear:

Figure 3.80 RAID Mode Selection Page

6 Click **Next** and the following screen shot will appear:
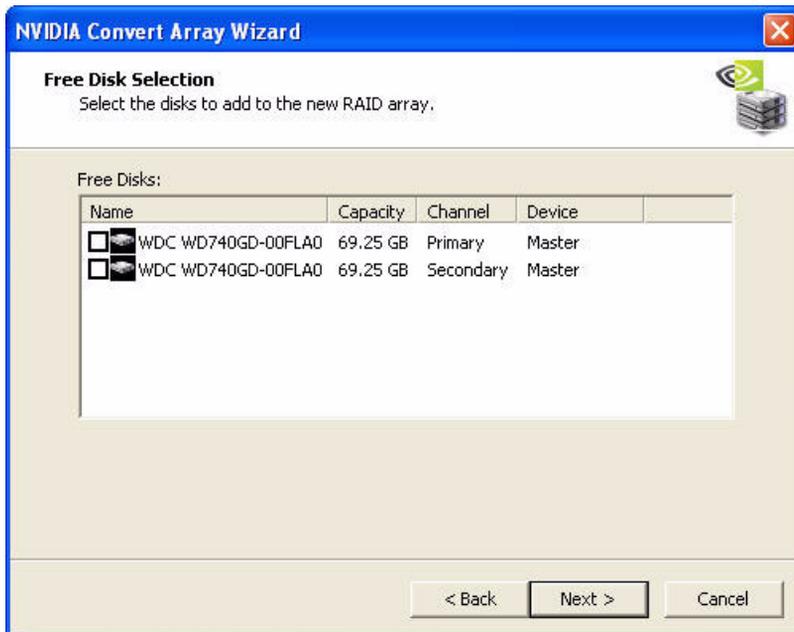

Figure 3.81 Free Disk Selection Page

7 Click **Next**, then click **Finish** to complete the process.

- If you want to convert the existing two-disk mirrored array into a three-disk (or more) striped array, then you need to select the number of disk(s) that you want to add to the newly created striped array and click **Next**.

- In this example, there is no need to select any additional disks since we are simply convert the existing two-disk mirrored array into a two-disk striped array.

8 Click on Striping and the following screen shot will appear:
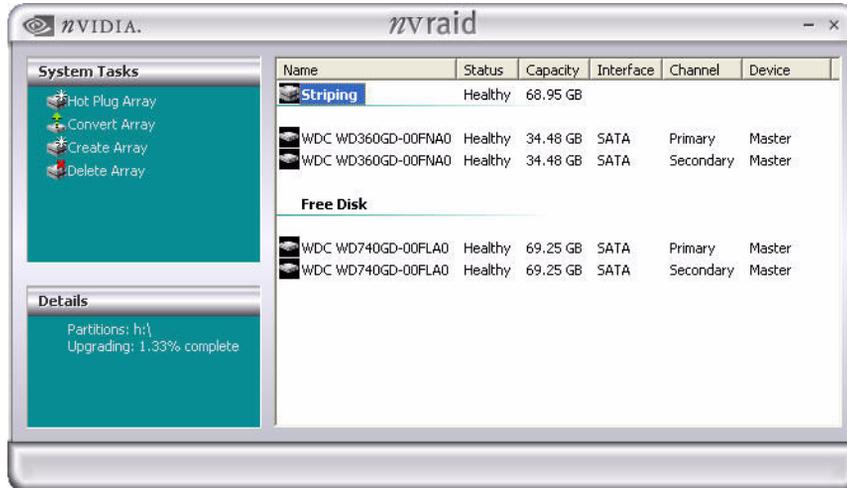
Figure 3.82 New Morphed RAID Array

The Morphing Process

As soon as the new array has been created, a pop up window similar to the following will appear:


It will take some time before the entire process is completed. The time it takes to convert an array is dependent on several factors such as the speed of the CPU, the size and type of hard drive being used, the operating system, etc.

Morphing from RAID 1 to RAID 0+1

The following example shows you how to convert from a RAID 1 array with two disks to a RAID 0+1 array with four disks.

1 Goto the system BIOS and make sure that the drives that you want to use are RAID **enabled.**

2 Boot to Windows, launch the NVRAIDMAN application, then follow the steps outlined in "Creating a Mirrored Array" on page 57 to create a two-disk mirrored array. When that is done, you should see a screen shot similar to the following:
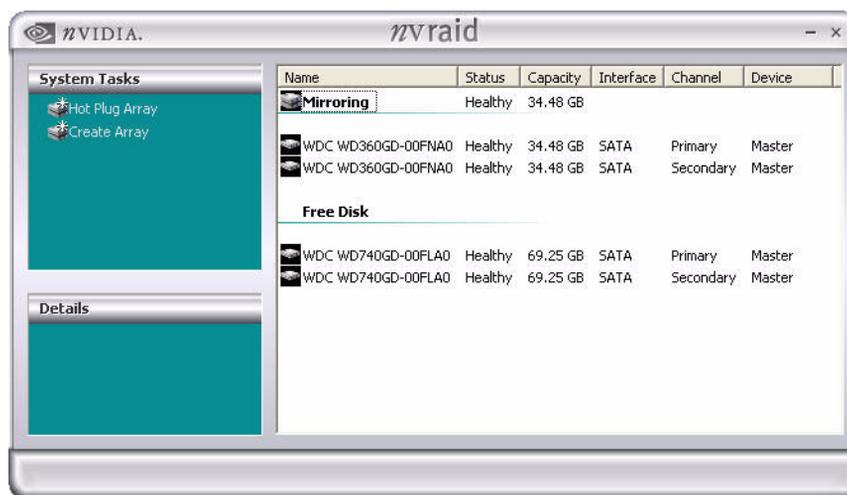
Figure 3.83   RAID Array Created

Now that a two-disk mirrored array has been created, you can use the NVRAIDMAN convert feature to morph the array from a two-disk RAID 1 into a four-disk RAID 0+1 array.

3 Right click on Mirroring and select "Convert Array…" as shown in the following screen shot:
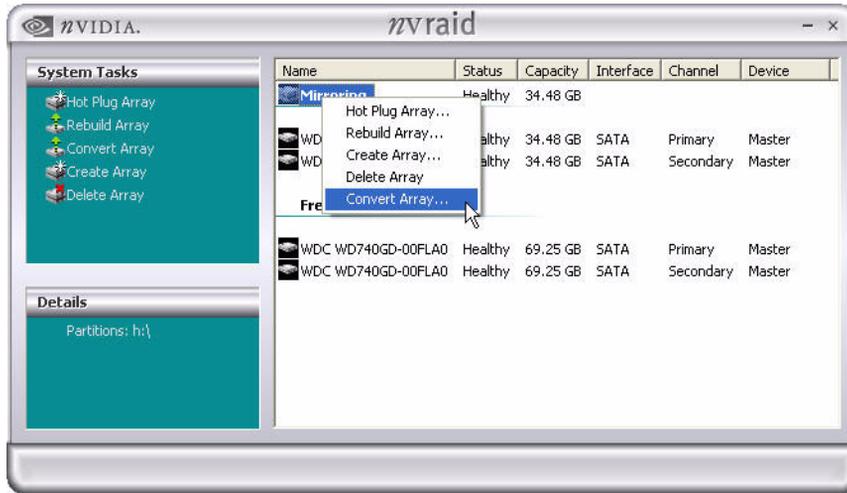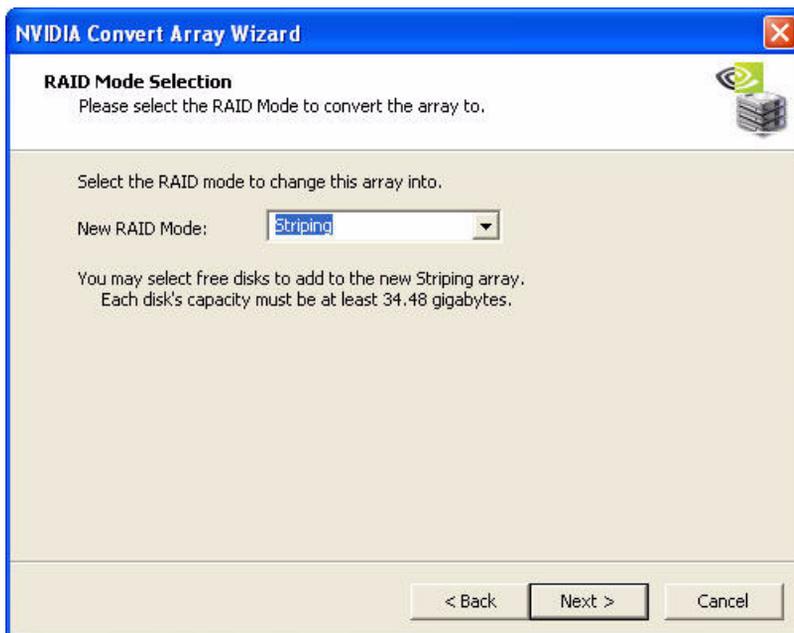

Figure 3.84   Selecting "Convert Array" from the Pop Up Menu

4 After selecting "Convert Array…" the following screen shot will appear:

Figure 3.85   Convert Array Wizard—Welcome Screen

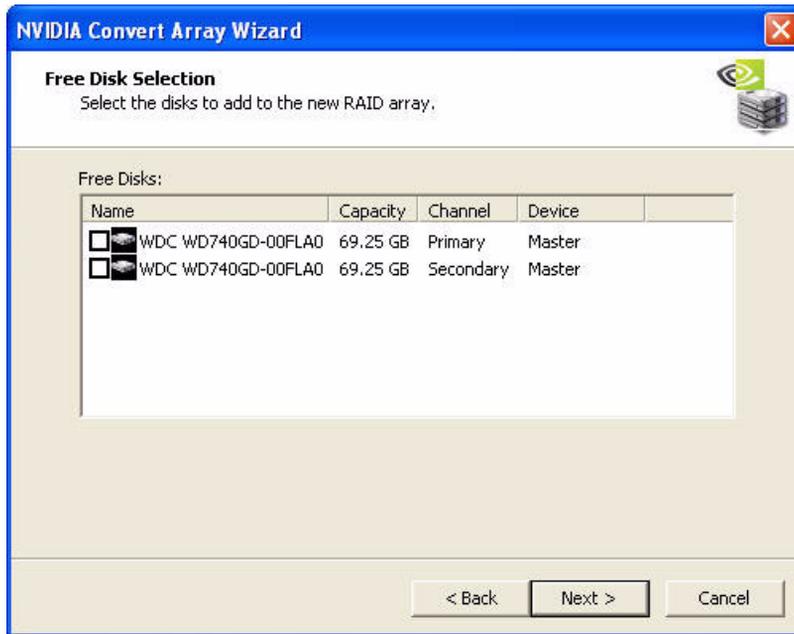**5** Click **Next** and the following screen shot will appear:

Figure 3.86 RAID Mode Selection Page

6 From the "New RAID Mode:" entry select "Stripe Mirroring" as shown in the following screen shot:

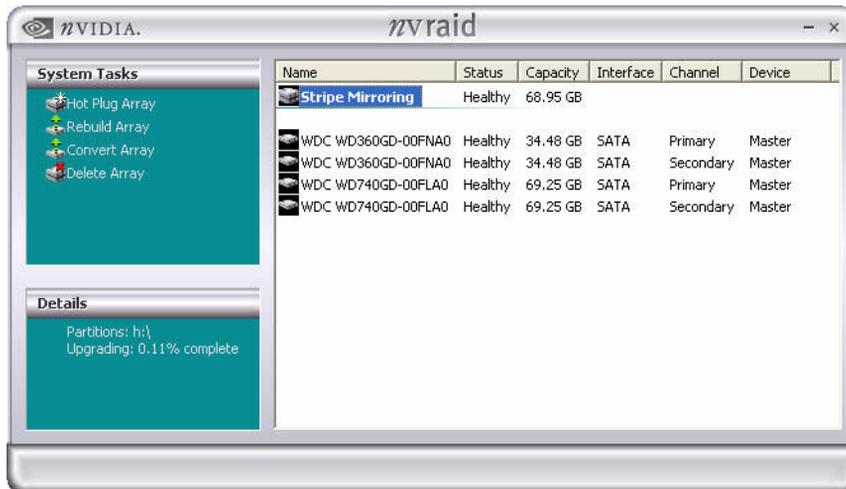**Figure 3.87** RAID Mode Selection Page—Selecting Stripe Mirroring

7 Click **Next** and the following screen shot will appear:

Figure 3.88 Free Disk Selection Page

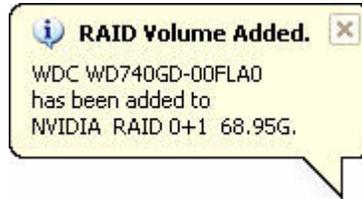**8** Select both of the disks and click **Next**, then click **Finish**.

9 Click on Stripe Mirroring and the following screen shot will appear:

Figure 3.89 New Morphed RAID Array

The Morphing Process

As soon as the new four-disk mirrored stripe array has been created, a pop up window similar to the following will appear:

followed by the following pop up window:
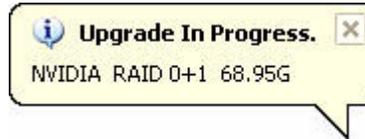
It will take some time before the entire process is completed. The time it takes to convert an array is dependent on several factors such as the speed of the CPU, the size and type of hard drive being used, the operating system, etc.

Morphing from RAID 0+1 to RAID 0

The following example shows you how to convert from a RAID 0+1 array with four disks to a RAID 0 array with four disks.

1 Go to the system BIOS and make sure that the drives that you want to use are RAID **enabled.**

2 Boot to Windows, launch the NVRAIDMAN application, then follow the steps outlined in "Creating a Stripe Mirroring Array" on page 61 to create a four-disk mirrored stripe array. When that is done, you should see a screen shot similar to the following:
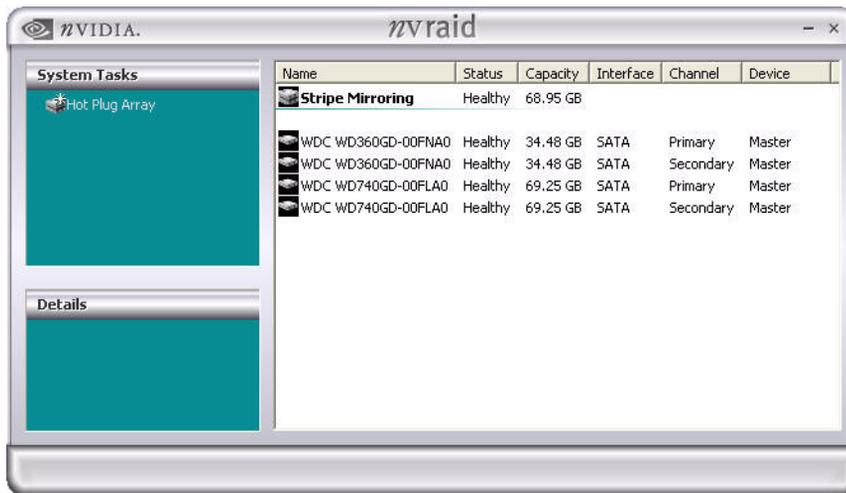

Figure 3.90   RAID Array Created

Now that a four-disk mirrored stripe array has been created, you can use the NVRAIDMAN convert feature to morph the array from a four-disk RAID 0+1 into a four-disk RAID 0 array.

3 Right click on Stripe Mirroring and select "Convert Array..." as shown in the following screen shot:
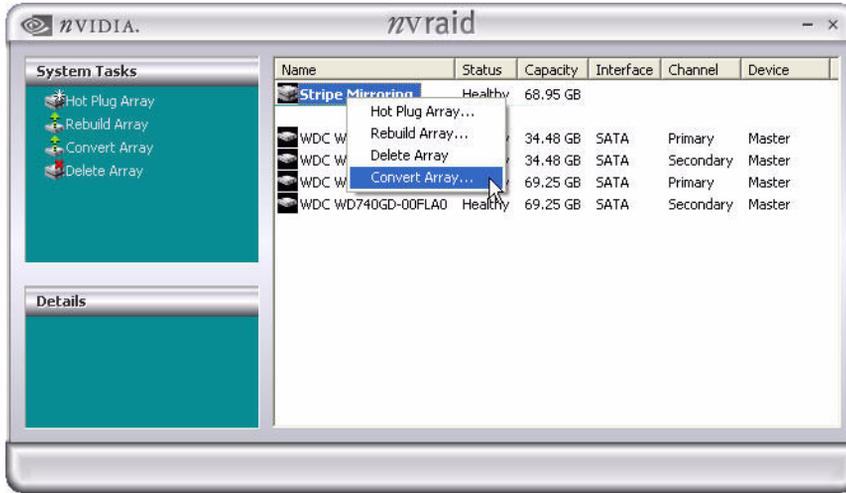
Figure 3.91   Selecting "Convert Array" from the Pop Up Menu

4 After selecting "Convert Array..." the following screen shot will appear:

Figure 3.92   Convert Array Wizard—Welcome Screen

5 Click **Next** and the following screen shot will appear:
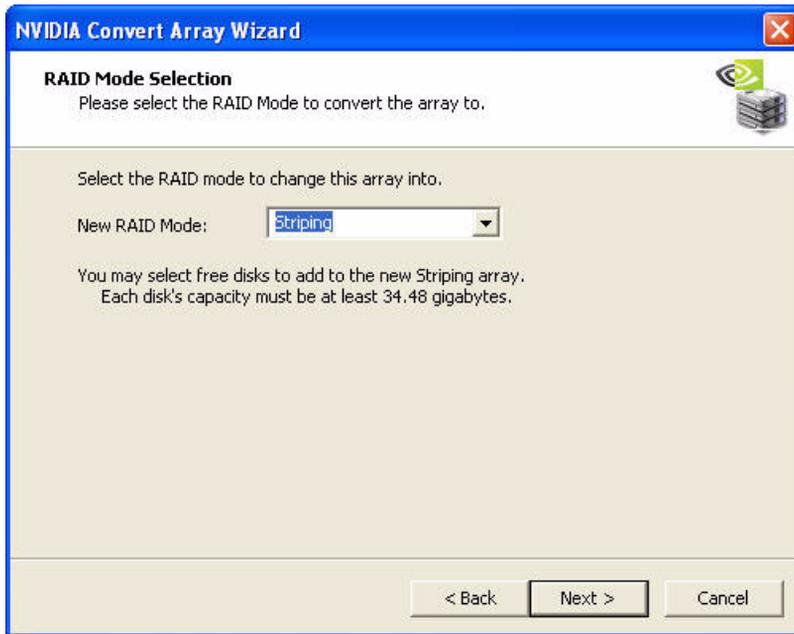
Figure 3.93 RAID Mode Selection Page

6 From the "New RAID Mode:" entry select "Striping" as shown in the following screen shot:
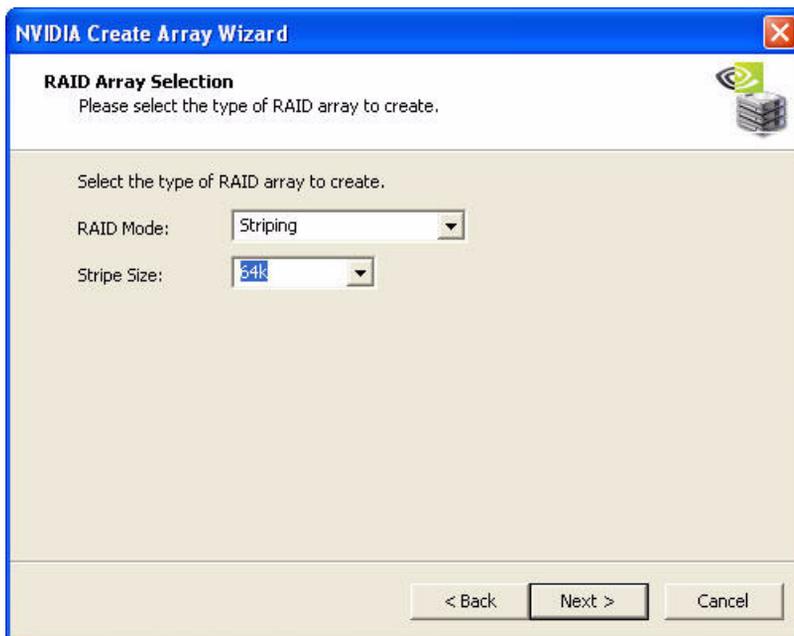
Figure 3.94 RAID Array Selection Page—Selecting Striping

7 Click **Next**, then click **Finish**.

8 Click on Striping and the following screen shot will appear:
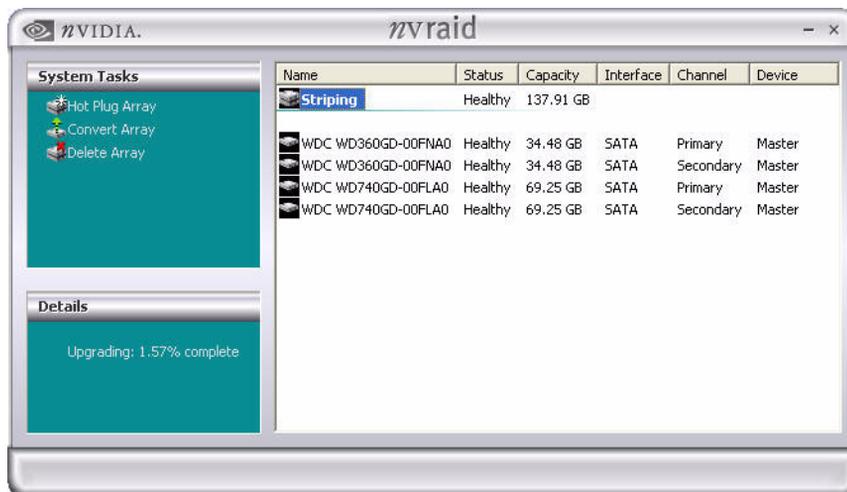
Figure 3.95 New Morphed RAID Array

The Morphing Process

As soon as the new four-disk striped array has been created, a pop up window similar to the following will appear:
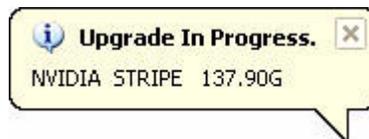
It will take some time before the entire process is completed. The time it takes to convert an array is dependent on several factors such as the speed of the CPU, the size and type of hard drive being used, the operating system, etc.

Morphing from RAID 0+1 to RAID 0+1

The following example shows you how to convert from a RAID 0+1 array with four disks to a RAID 0+1 array with six disks.

Note: To Morph from a RAID 0+1 array with four disks to a RAID 0+1 array with six disks, you must have at least six hard drives in the system. In this example, the system has six free RAID enabled disks.

1 Goto the system BIOS and make sure that the drives that you want to use are RAID **enabled.**

2 Boot to Windows, launch the NVRAIDMAN application, then follow the steps outlined in "Creating a Stripe Mirroring Array" on page 61 to create a four-disk mirrored stripe array.

When that is done, you should see a screen shot similar to the following:
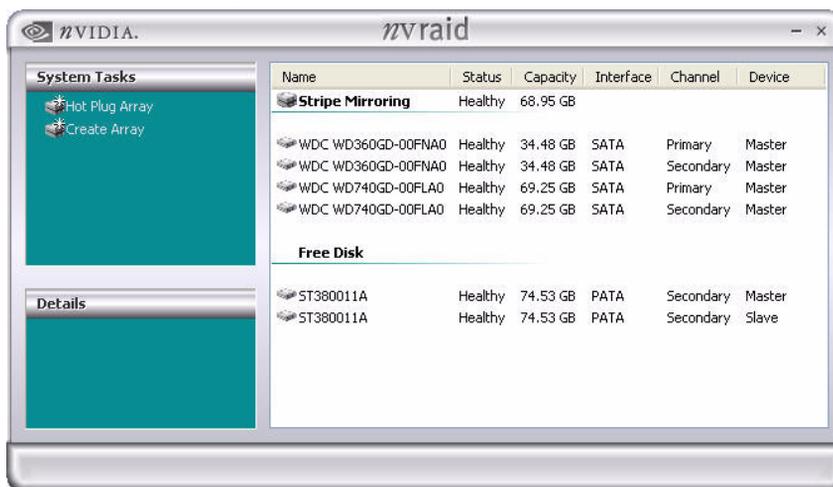
Figure 3.96 RAID Array Created

Now that a four-disk stripe mirror array has been created, you can use the NVRAIDMAN convert feature to morph the array from a four-disk RAID 0+1 into a six-disk RAID 0+1 array.

3 Right click on Stripe Mirroring and select "Convert Array..." as shown in the following screen shot:
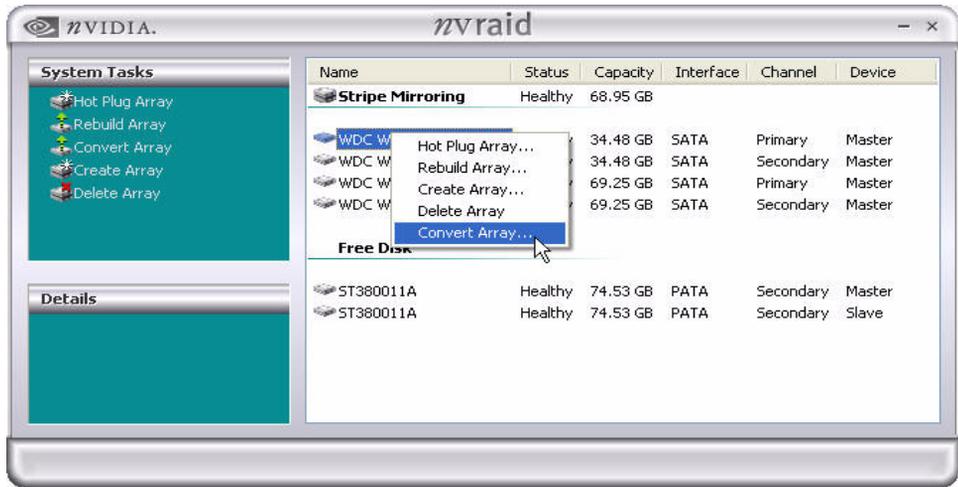
Figure 3.97   Selecting "Convert Array" from the Pop Up Menu

4 After selecting "Convert Array..." the following screen shot will appear:
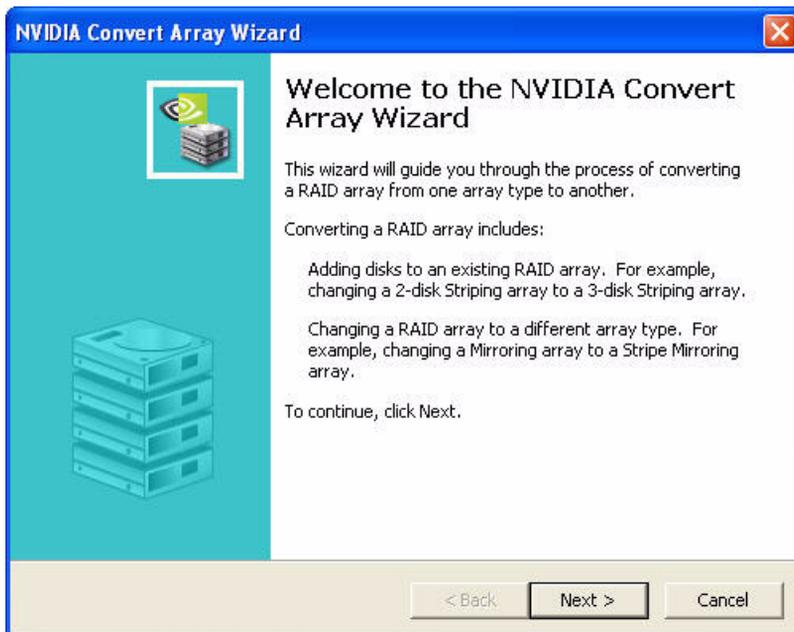

Figure 3.98   Convert Array Wizard—Welcome Screen

**5** Click **Next** and the following screen shot will appear:

Figure 3.99 RAID Mode Selection Page

6 From the "New RAID Mode:" entry select "Stripe Mirror", then click **Next** and the following screen shot will appear:
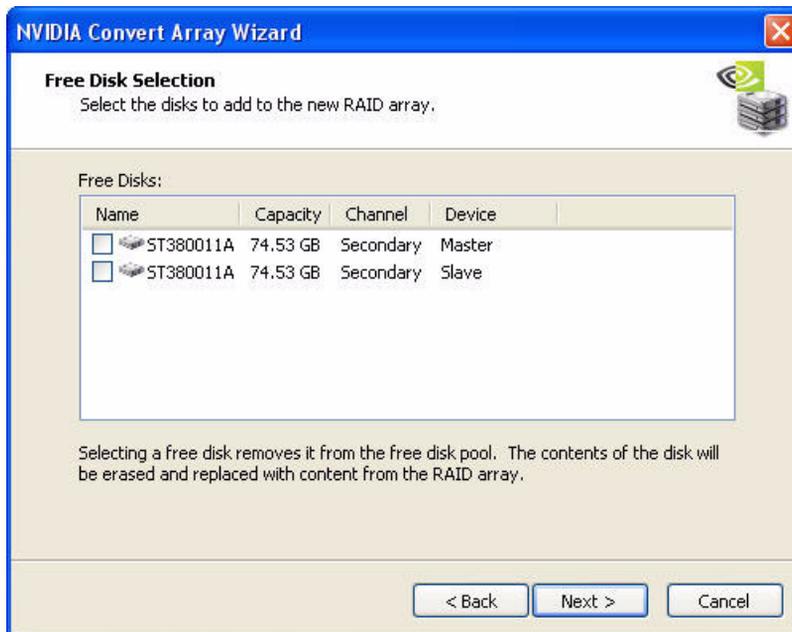
Figure 3.100 Free Disk Selection Page

7 Select the disks that you want to Morph (in increments of two), then click **Next** and **Finish**.

Hot Plug Array

With respect to RAID, hot plugging is the ability to add a disk to a system safely and without causing problems for the RAID software. For example, when a drive in a mirrored array fails, the user can launch the Hot Plug Array Wizard which instructs the user as to when a drive can be safely added to the system. As soon as the drive is added, the user can then finish running the RAID wizard and the drive becomes usable by the system. Hot Plug Array allows the user to add or remove an entire array without degrading the array in the process.

NVRAIDMAN can be used to hot plug a RAID disk. To hot plug a disk, simply do the following:

1 Launch NVRAIDMAN and click on "Hot Plug Array" and the following screen shot will appear:

Figure 3.101 NVIDIA Hot Plug Array Wizard—Welcome Screen

2 Click **Next** and the following screen shot will appear:
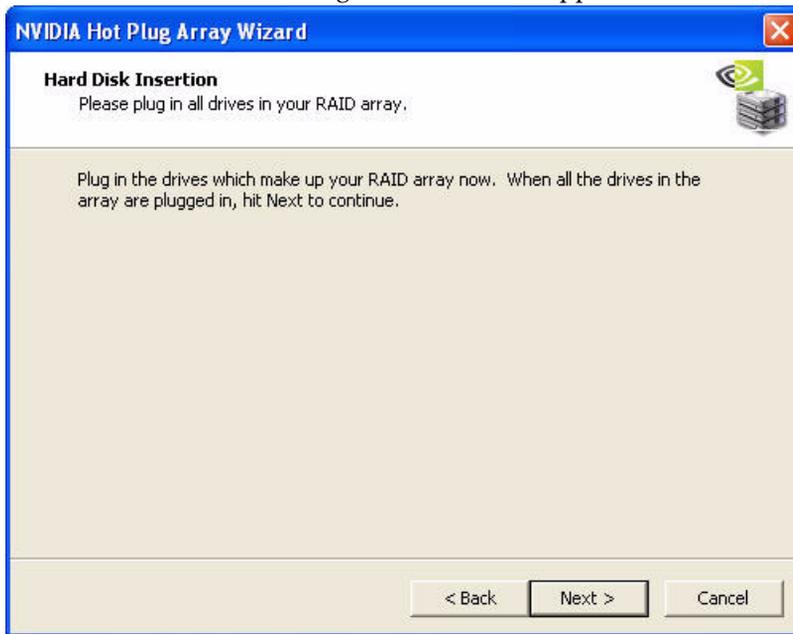
Figure 3.102 Hard Disk Insertion Screen

3 Connect the RAID disk that you want to use with any given RAID array.

4 Click **Next** and the following screen shot will appear:

Figure 3.103 Completing the NVIDIA Hot Plug Array Wizard Page

5 Click **Finish**.

4

NVIDIA RAID Frequently Asked Questions

The FAQ in this chapter are organized by the following categories:

- "Basic RAID Questions" on page 107
- "RAID ROM Setup Questions" on page 109
- "Rebuilding Arrays Questions" on page 109
- "Dedicated Disk Questions" on page 110
- "Windows RAID Application" on page 110

Basic RAID Questions

- *What is RAID?*

  RAID stands for *Redundant Array of Independent Disks*, 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 9 for more information.

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

  See "Bootable RAID Array" on page 9 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 9.

- *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.

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 11.

- *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 11 for more information.

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

  The default optimal striping block size is 64KB. 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.

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.

  See "Rebuilding a RAID Mirrored Array" on page 47 for more information.

Dedicated Disk Questions

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

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

- *Once a dedicated disk has been assigned to a RAID 1 or RAID 0+1 array can I remove it?*

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

Windows RAID Application

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

  The following tasks can be performed:

  - View information about RAID 0, 1, 0+1 and JBOD (as well as any supported configuration if you have more than one RAID array active)

  - Assign a dedicated disk to RAID 1 and RAID 0+1

  - Remove a dedicated disk from a RAID 1 or RAID 0+1 array

  - View Free Disks

  - Rebuild a RAID 1 or RAID 0+1 array

  - View the status of the rebuilding process

  - Create a RAID Array

  - Delete a RAID Array

  - Morph/Convert RAID Arrays

  - Hot Plug Array

5

NVIDIA RAID APPLICATION NOTES

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

- "Installing NVIDIA RAID on a New Windows XP Operating System" on page 112

  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 113

  describes how to create a bootable RAID volume with Windows 2000 via the morphing method.

- "Installing the NVIDIA IDE Driver in Windows 2000" on page 115

  describes how to install Windows 2000 Service Pack 4, which required for installing the NVIDAI IDE driver.

- "Using GHOST with NVIDIA RAID" on page 116

  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 process

Windows 2000 Limitation 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 **Next**.

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.

Note: Conversion may take 1–2 hours depending on disk size.

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

Note: If the end user chooses not to install Windows 2000 Service Pack 3 or 4, RAID is still supported on Windows 2000. However, the end user will not be able to create a bootable RAID volume.

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 the Microsoft 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 use 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 use 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.