MNAS-4100
User's Guide

Preliminary draft only

April 2006

NOTE
The information in this manual is subject to change without notice.

Safety Information

- **WARNING:** Before connecting to power, set the Voltage Switch on the rear of your system to the voltage matching your area – voltage rating 100~120 / 200~240 Vac.
- Maximum operating ambient temperature 40 ^{o}C degree
- **CAUTION:** Turn off the system before removing the cabinet cover.
- **CAUTION on using the RTC battery:** Danger of explosion if battery is incorrectly placed. Replace only with the same or equivalent type recommended by the manufacturer. Dispose of used batteries according to the manufacturer's instructions.

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Chapter 1 Introduction

Your MNAS is a storage solution for small offices and home network environments. With its high-speed networked storage, network users can easily access and share music, pictures, and real-time video files. Also, it has a program for discovering the storage system automatic assigned IP address. The **Backup** program provides superior data protection, allowing you to back up and restore system and data files.

Your storage system can accommodate up to four hard disks with standard RAID 0, 1, 5, 5+spare, 10, and Linear configurations, providing up to 2.0 TB (terabytes) of shared network storage. Supporting industry-standard protocols, you can easily add it to your existing network. In addition, network management and security is greatly simplified through the Web-based User Interface (UI).

Additional features include:

- A single administrative account.
- Support for dynamically increasing logical drive size. For example, if two hard disks are in use as a logical drive, a third hard disk can be added and you can increase the size of the logical drive configuration to include the third drive without destroying any existing data.
- User-defined partition and drive names.
- CIFS and NFS file system support.
- HTML-based configuration utility with username/password login security.
- Support for 64 User and 16 Group level accounts.
- User and Group level security settings (No Access, Read Only, Read/Write)
- Folder level security settings (sub-folders inherit security settings from parent folder).
- Private directories for personal accounts.
- Up to 32 folder/drive shares (no quota management).
- Built-in backup utility with one client license (and ability to activate additional licenses) – optional.

- Built-in FTP server with private directory support. Anonymous logins access a public folder; user accounts access their private directory and the public folder.

1.1 Package Contents

Includes the following:

- MNAS Storage System
- Power Cord
- RJ-45 Ethernet Cable
- Installation CD

1.2 Specifications

NOTE: Specifications are subject to change without notice.

Hardware

Cabinet Form Factor
Small Tower

Processor
Intel® IOP 80219 400 MHz

System Memory
256 MB of DDR SDRAM (up to 512 MB)

Flash Memory
8 MB

Hard Disk Drive Bay/Type
Up to four 3.5-inch SATA (Serial ATA)

Storage Capacity
Using 500 GB drives provides up to 2 TB

Network
Intel® 10/100/1000 Mbps Fast Ethernet RJ-45 GbE connector

Power Supply
100~120/200~240 Vac 50/60 Hz 160 W

Environment

- Operating temperature:
  0 ^{0}C (32 ^{0}F) to 40 ^{0}C (104 ^{0}F)
- Operating relative humidity:
  20 % to 85 % non-condensing
- Storage temperature:
  –20 ^{0}C (–4 ^{0}F) to 70 ^{0}C (158 ^{0}F)
- Storage relative humidity:
  5 % to 95 % non-condensing

Software

Network Client Support
- Microsoft Windows
- Linux
- UNIX

Network Transport Protocol
TCP/IP

Network File Protocol
- CIFS/NFS
- HTTP
- FTP

Support Industry Standards
DHCP

Hardware Monitor
Temperature Sensor

Disk Configuration
Linear, RAID 0/1/5/5+spare/10

Application for NAS Management
- Data Sharing, Protection
- System (OS) and Data Backup (optional)
- Web User Interface

Others
- English / Simplified Chinese (multiple language – option) support
- Real Time Clock (RTC)
- Programmable System Clock
- Hardware/Software Power Off
- Reset Button to return to factory default setting
- Firmware upgradeable
- Event Logs and Email Alerts

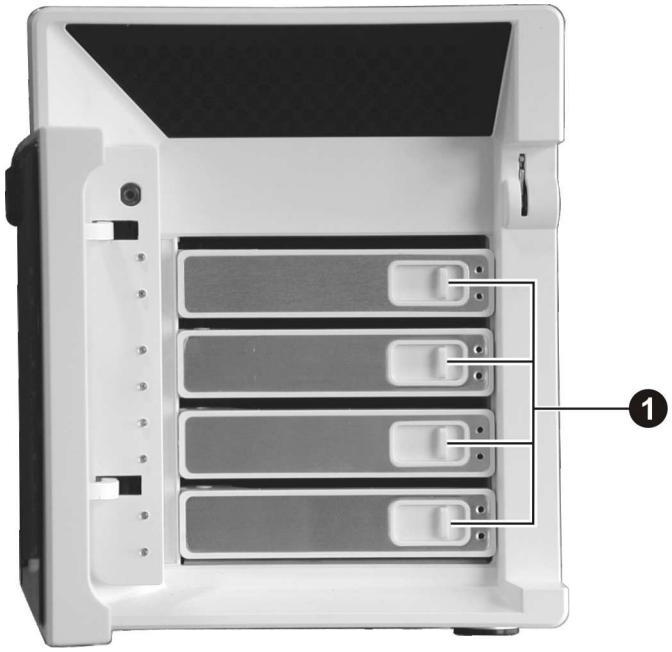
1.3 System View

Front Components

Ref	Component		Description
❶	**Power Button**		Turns the power on and off (soft-off).
❷	**Power Indicator**		Shows the current power status.
		Power On	Glows blue when the power is on.
		Standby	Glows red when the system is in Standby mode.

Ref	Component		Description
❸	**Network Indicator**		Shows the current network status.
		Link	Glows green when system is connected to the network.
		Active	Blinks green to indicate system is trying to establish a network connection.
		100 Mbps	Glows green to indicate a network connection speed at 100 Mbps.
		1000 Mbps	Glows blue to indicate a network connection speed at 1000 Mbps (Giga LAN).
❹	**RAID Indicator**		Shows the current RAID status.
		RAID On	Glows blue to indicate RAID function is implemented.
		RAID Fail	Glows red to indicate RAID function is inactive or malfunctioning.
❺	**Hard Disk Drive Compartment**		Inside are four hard disk trays.
❻	**Disk Information Indicator**		Shows the current hard disk drive status.
		Access	Blinks green to indicate hard disk drive read/write function.
		Status	Glows blue to indicate hard disk drive is workable.

Front Components (Compartment Door Open)

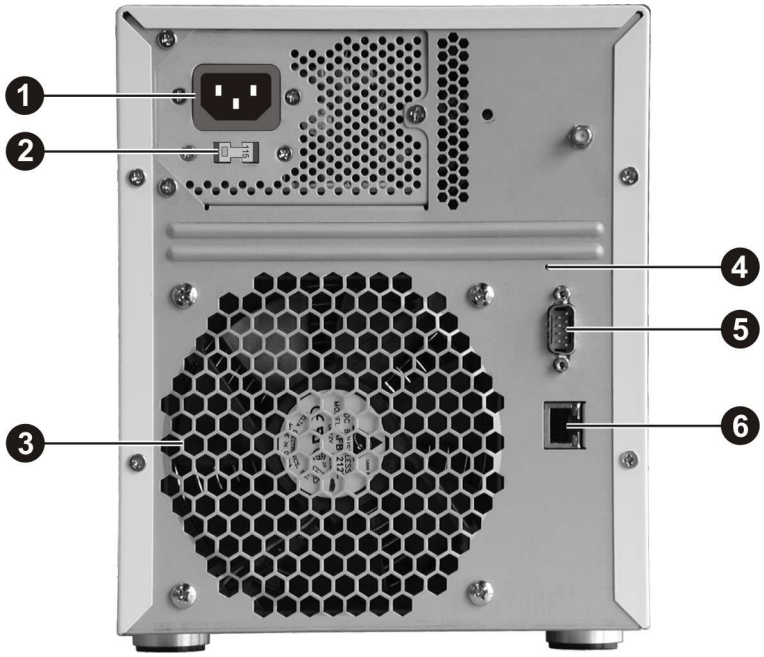


Ref	Component	Description
1	**Hard Disk Tray Door Handle**	Opens the hard disk tray.

Right-Side Components

Ref	Component	Description
1	**Door Lock**	Locks the hard disk drive compartment door for security.

Rear Components



Ref	Component	Description
❶	**Power Connector**	Connects the power cord.
❷	**Voltage Switch**	Select the voltage matching your area.
❸	**Ventilation Opening**	Maintain proper operating temperature. Do not cover or block the openings.
❹	**Reset Button**	Allows you to reset the system to the factory default username, password, and IP.
❺	**RS-232 Port**	For manufacturer use only.
❻	**RJ-45 Connector**	Connects the LAN cable.

Chapter 2 Setting Up

Step 1. Install the Hard Disks

1. Insert the key and turn clockwise to unlock and open the door.

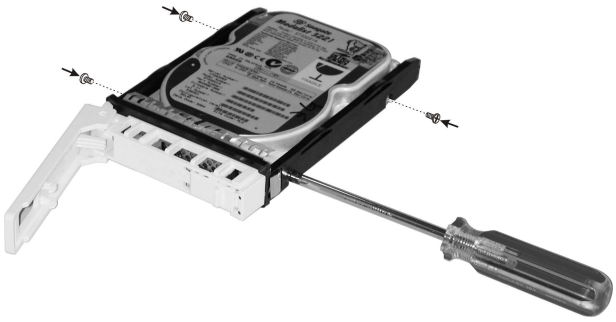
2. Slide the latch toward the right to release the handle.

NOTE: Install the first hard disk on the lowest level tray, the second hard disk on the second lowest level tray, and so forth.

3. Pull the handle to slide the hard disk tray forward. Then pull the hard disk tray out of the device.

4. Unfasten two screws from each side of the hard disk tray and remove the metal bracket.

5. Fit the hard disk into the tray with the connectors pointing toward the rear. Then align and fasten four screws to secure the hard disk in place.



6. Keeping the handle in its full-open state, slide the hard disk tray all the way into the device until the hinge of the handle is inside the device. Then, close the handle. The latch should click into place.

7. Follow the same procedure for installing other hard disk(s) in the other compartment(s).

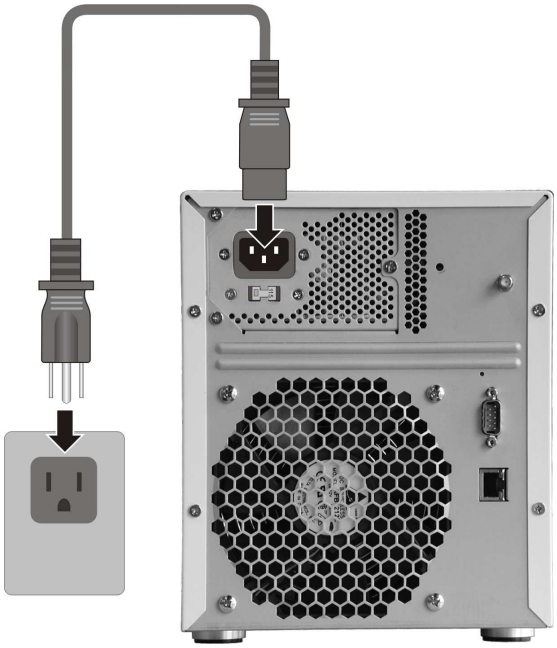
Step 2. Connect to the Network

Connect one end of the Ethernet cable to the network connector on the back of your storage system and the other end to a switch or router.

Step 3. Connect to Power

1. Before connecting to power, set the Voltage Switch to the voltage matching your area.

2. Connect one end of the power cord to your storage system and the other end to a standard electrical outlet.



3. To turn on your storage system, press the Power button.

Step 4. Configure Your Storage System

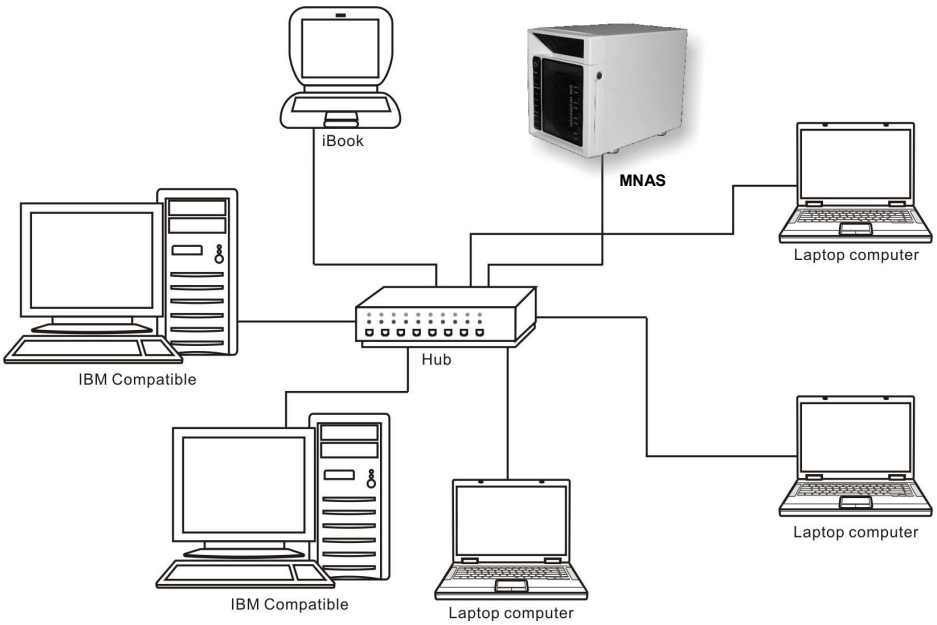
See the next chapter for the software configuration instructions.

Chapter 3 Configuring Your Storage System

Inside the included CD in your package are three main folders namely:

- **`StorageSystemConsole`**
- **`FW_Upgrade`**
- **`UserManual`**

You must install at least one hard disk (lowest level tray) before your storage system can provide services.

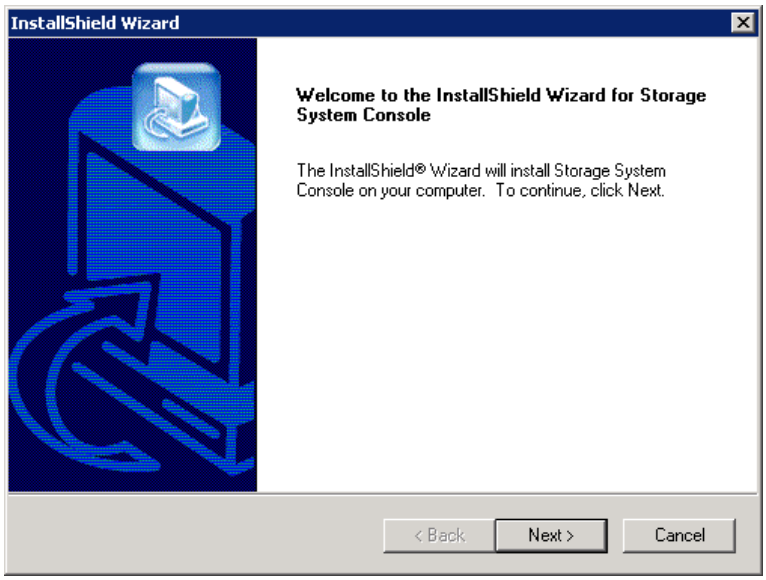


A MNAS network consists of a MNAS server and several clients connected via network links.

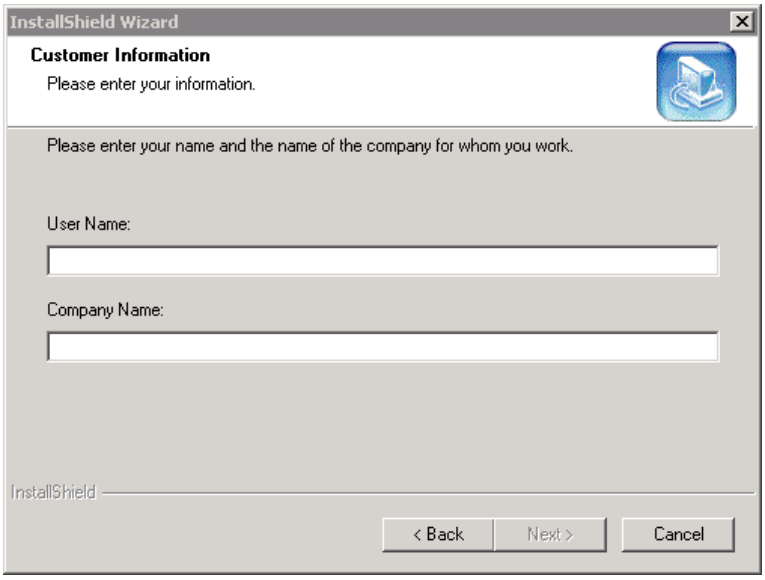
3.1 Installing the Storage System Console

You need to install the **Storage System Console** before you can perform any system configurations.

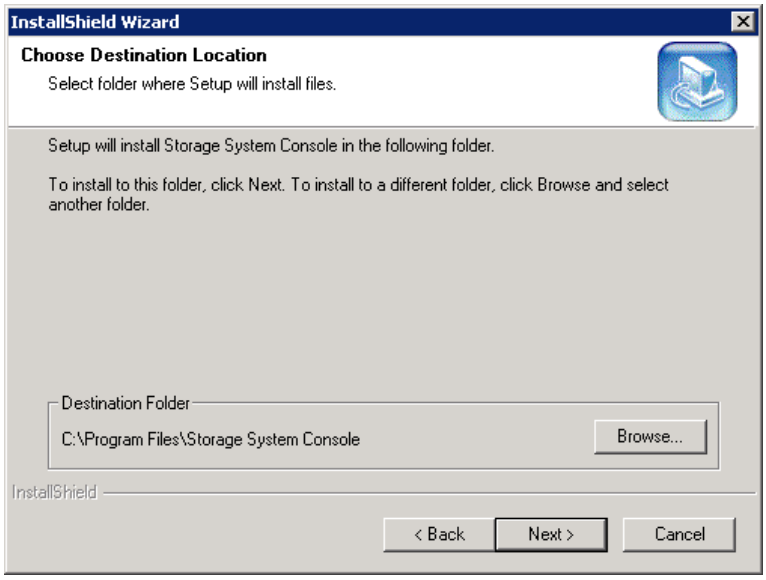
1. Install the **Storage System Console** on your computer by double-clicking on **`Setup.exe`** under the **`StorageSystemConsole`** folder of your included CD. The following screen appears. Click on **Next** to continue.



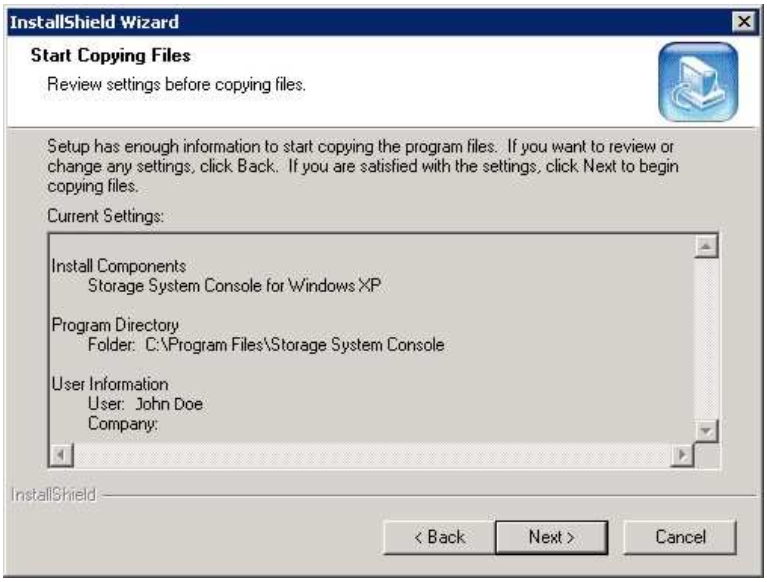
2. The following screen appears. Enter the pertinent information, then click on **Next** to continue.



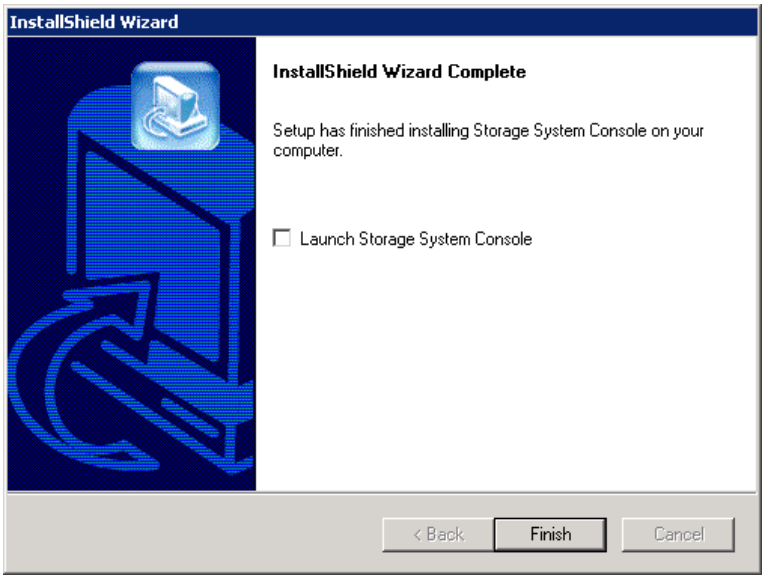
3. The following screen appears. Select the default destination folder or change it by clicking on **Browse**. Then click on **Next** to continue.



4. The following screen appears. Click on **Next** to start copying the files.



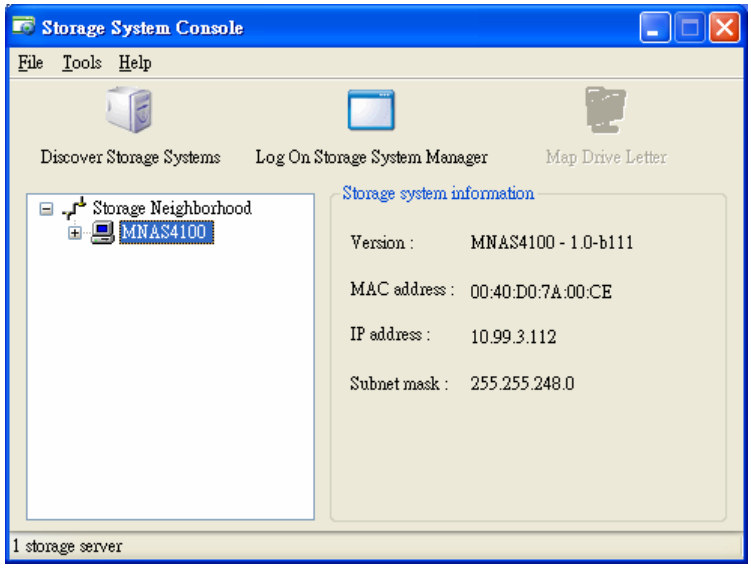
5. The following screen appears. To start the **Storage System Console** click on the radio button besides **Launch Storage System Console**. Then click on **Finish** to exit the installation.



3.2 Initializing the Hard Disk(s)

After you insert the hard disk into the system for the first time or when you replace them with a new disk, you need to initialize the hard disk before using the system.

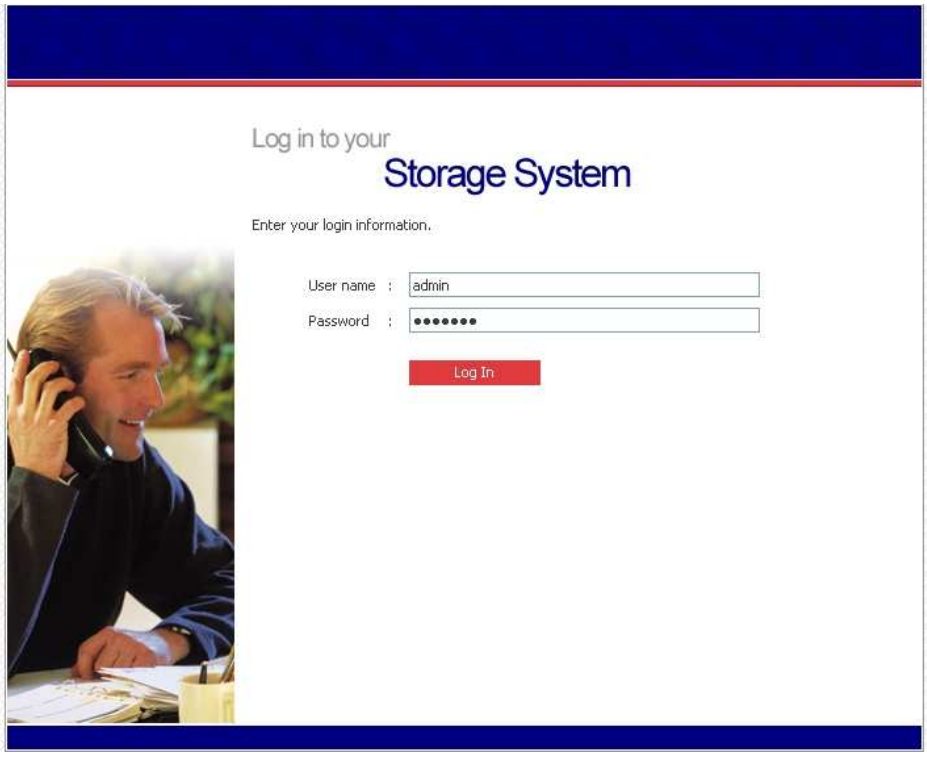
1. Upon starting the **Storage System Console**, the following screen appears. As soon as you start the Console, it automatically scans the network for storage systems. This might take a few minutes. As soon as the scan is complete, the left pane displays a tree view of all the storage systems it found. Select the storage system that you want to manage (for example, **MNAS4100**).



> **NOTE:** The next time you want to start the **Storage System Console**, click on **Start**, then **Programs**, then **Storage System Console**.

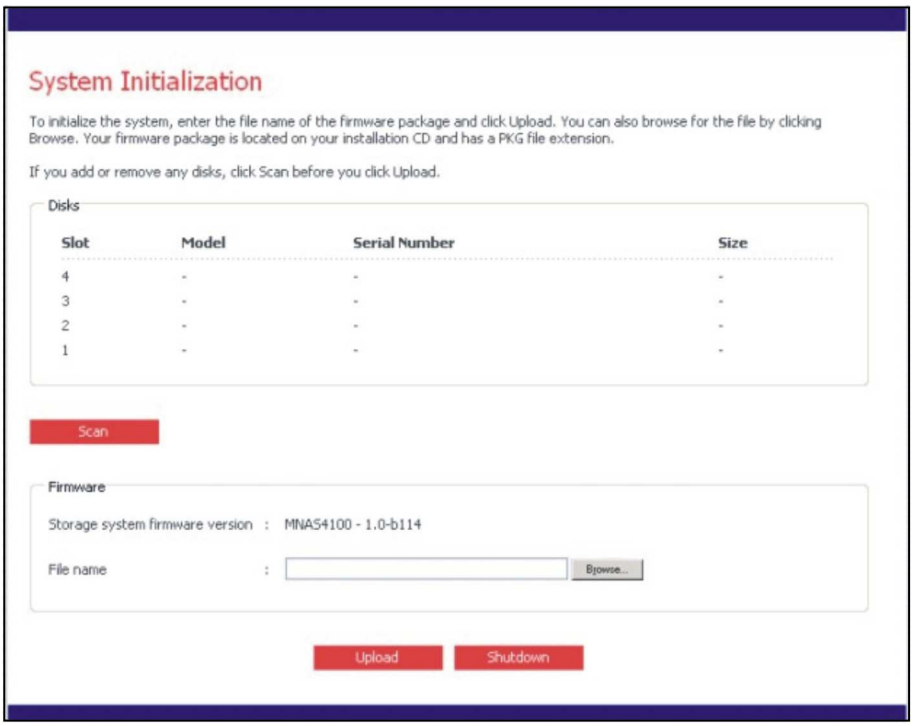
2. Click on **Log On Storage System Manager**.

3. The following screen appears. Enter the default user name **admin** and default password **storage**.

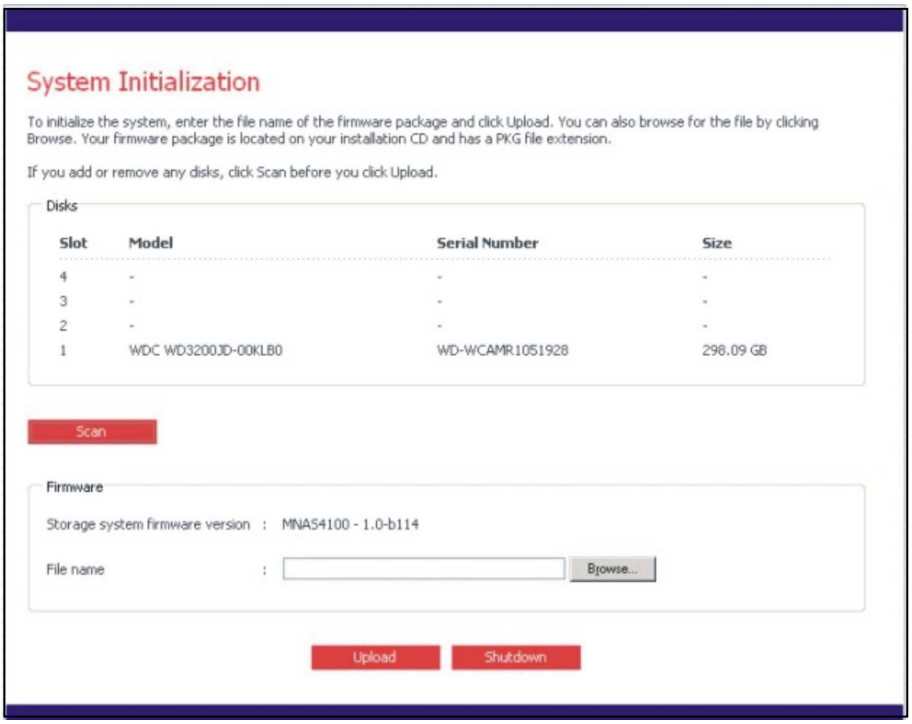


4. Click on **Log In**.

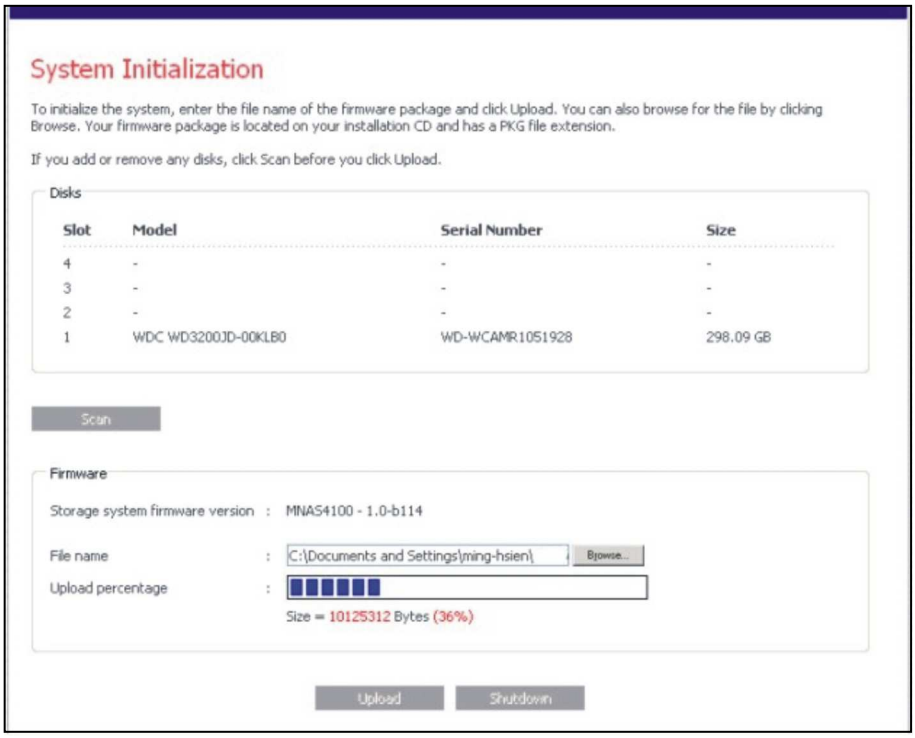
5. The following screen appears. Click on **Scan**.

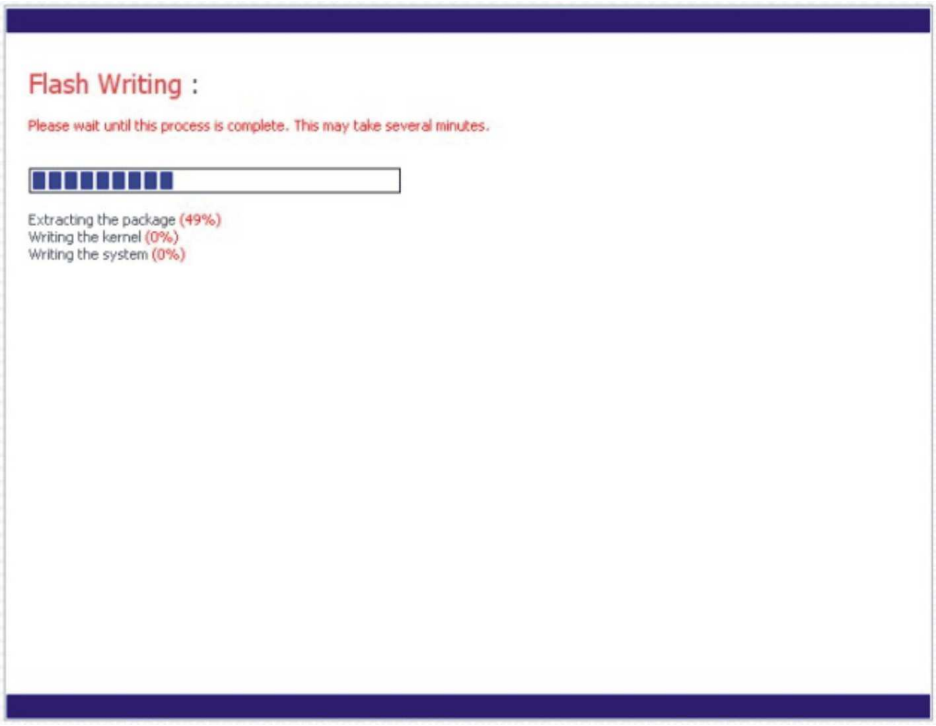


6. The following screen appears. Click on **Browse** to select the firmware file under the **`FW_Upgrade`** folder of your included CD.

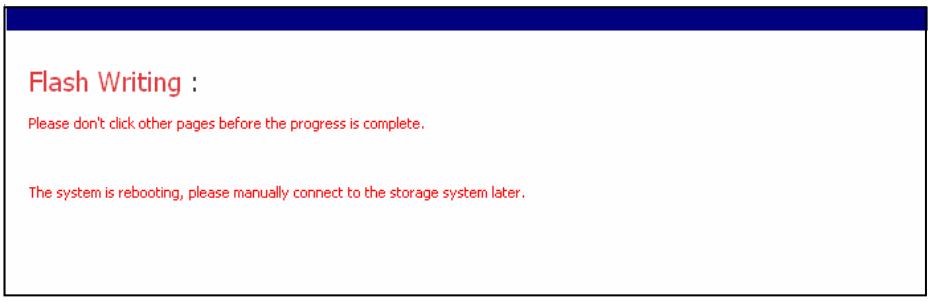


7. Click on **Upload** and the following screens would appear in sequence.

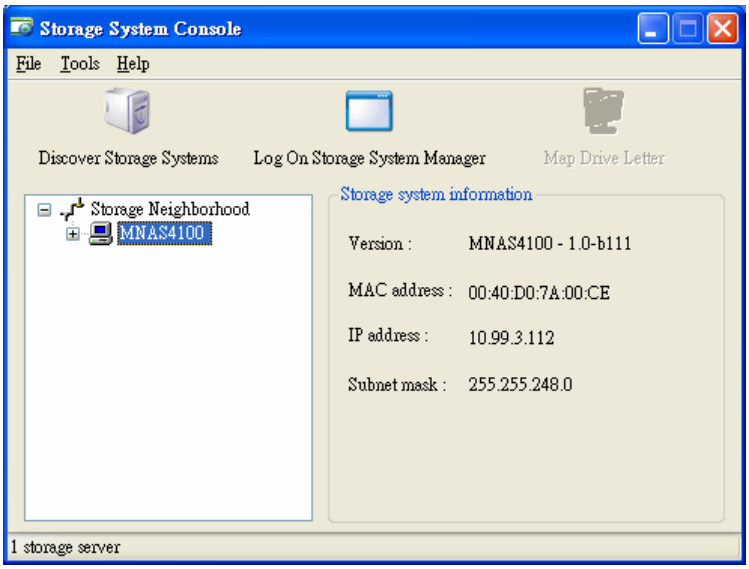




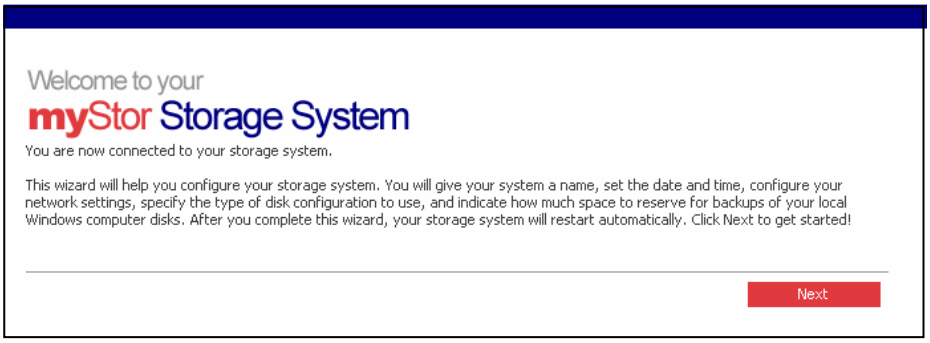
8. The system will reboot.



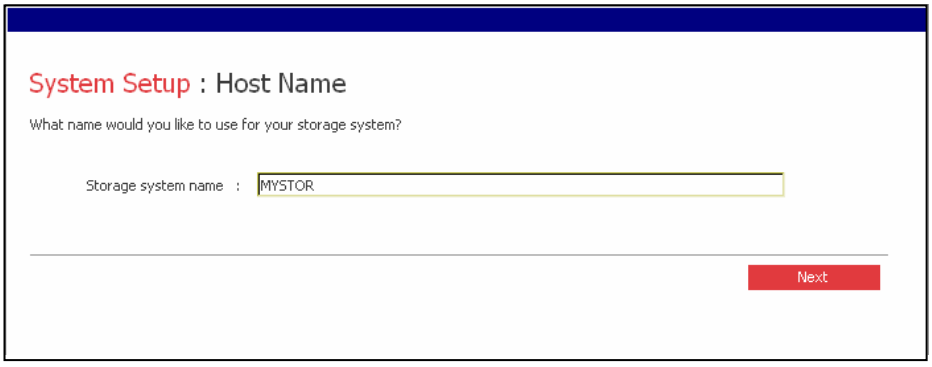
9. After rebooting, run the **Storage System Console** by clicking on **Start**, then **Programs**, then **Storage System Console**. Wait awhile as it scans the network for storage systems. The following screen appears. Click on **Discover Storage Systems.**



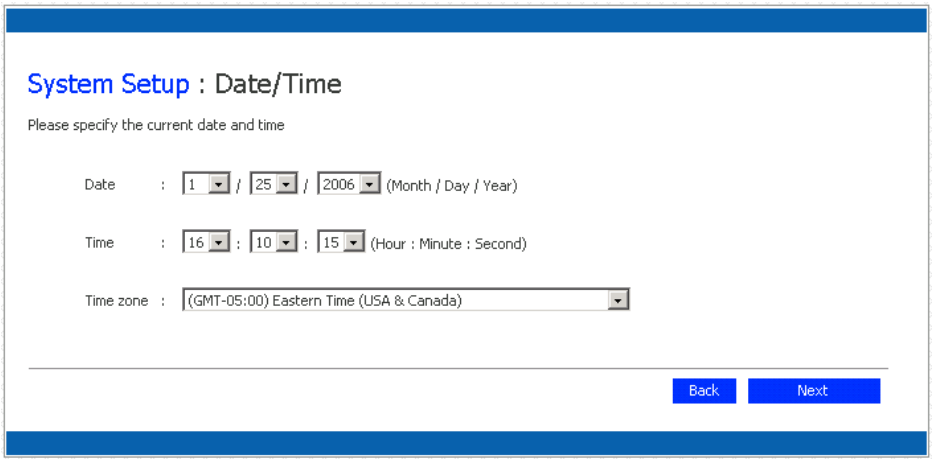
10. The following screen appears. Click on **Next** to continue.



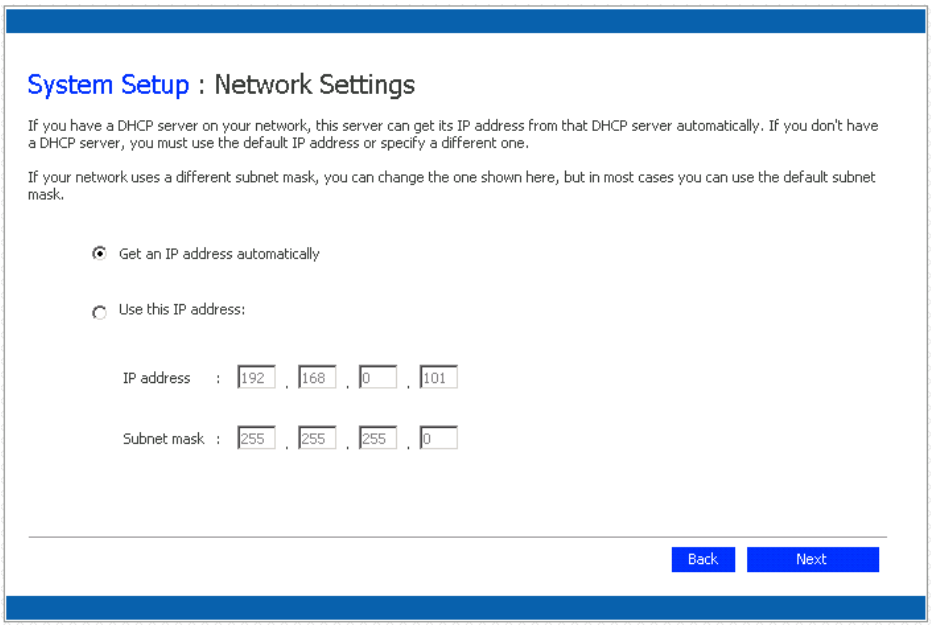
11. The following screen appears. Enter the **Storage system name**, then click on **Next**.



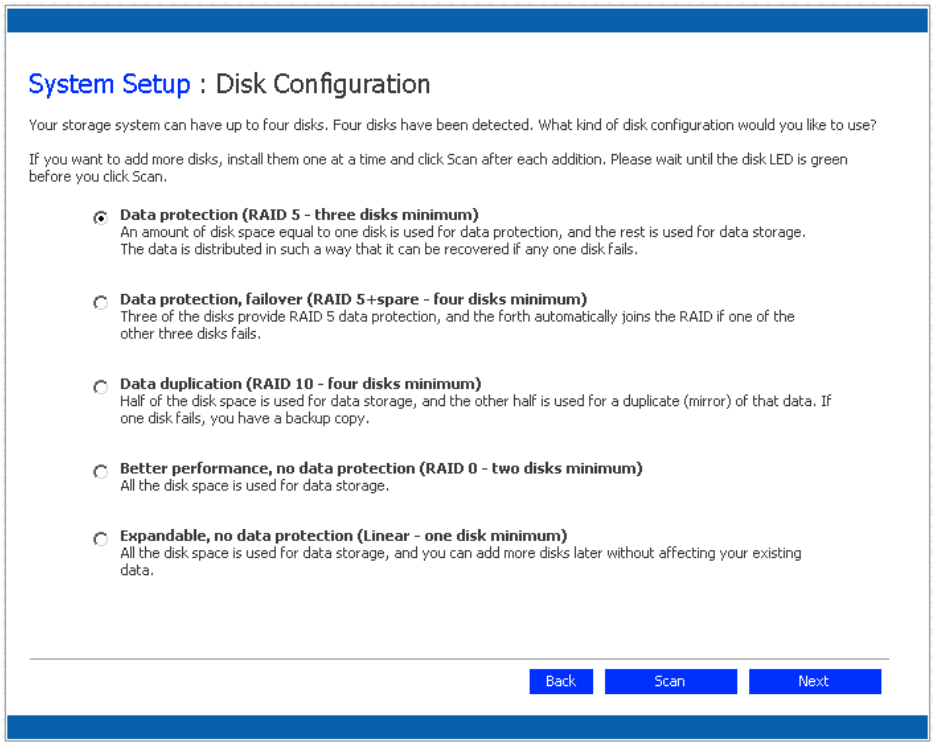
12. The following screen appears. Set the **Date**, **Time**, and **Time zone**, then click on **Next**.



13. The following screen appears. Set the network settings, then click on **Next**.

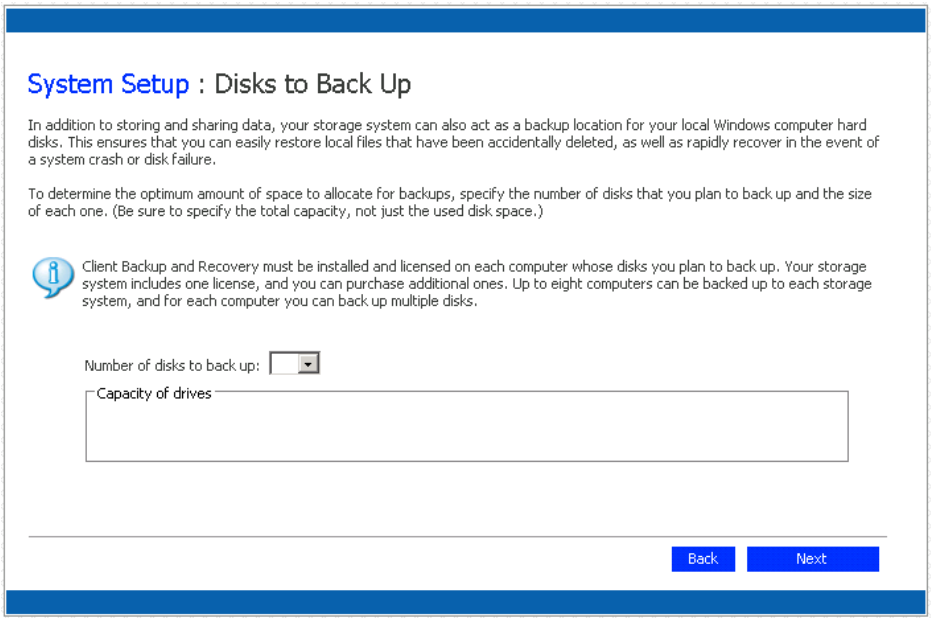


14. The following screen appears. Select a RAID mode, then click on **Next**.



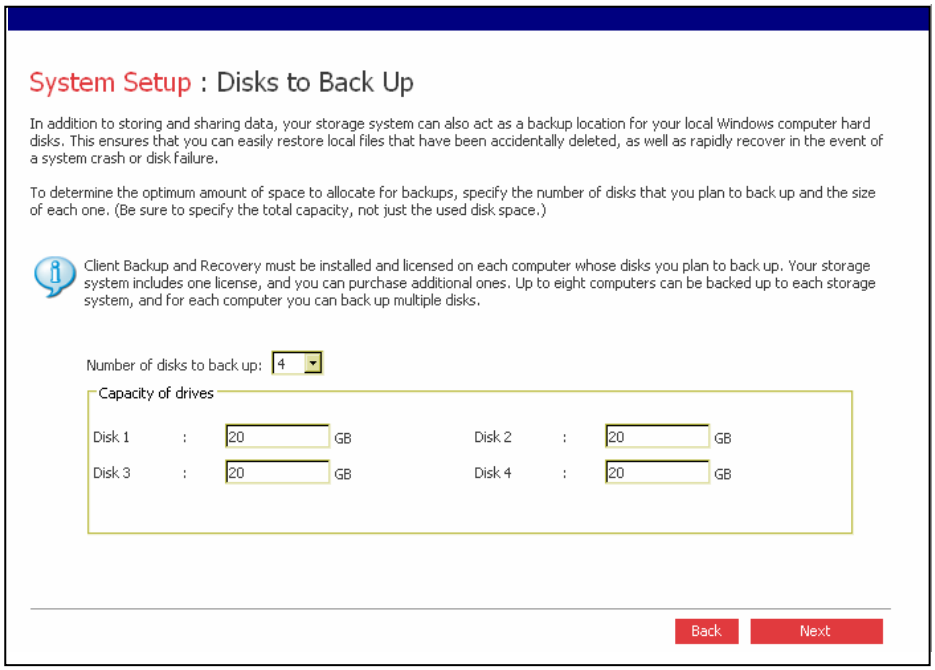
> **NOTE:** Your MNAS uses RAID (Redundant Array of Independent Disks) technology to manage up to four hard disks. Refer to the later section “Disk Configurations” (see page 63) to learn more about choosing the type of RAID for your system.

15. The following screen appears. Select the **Number of disks to back up**, then click on **Next**.

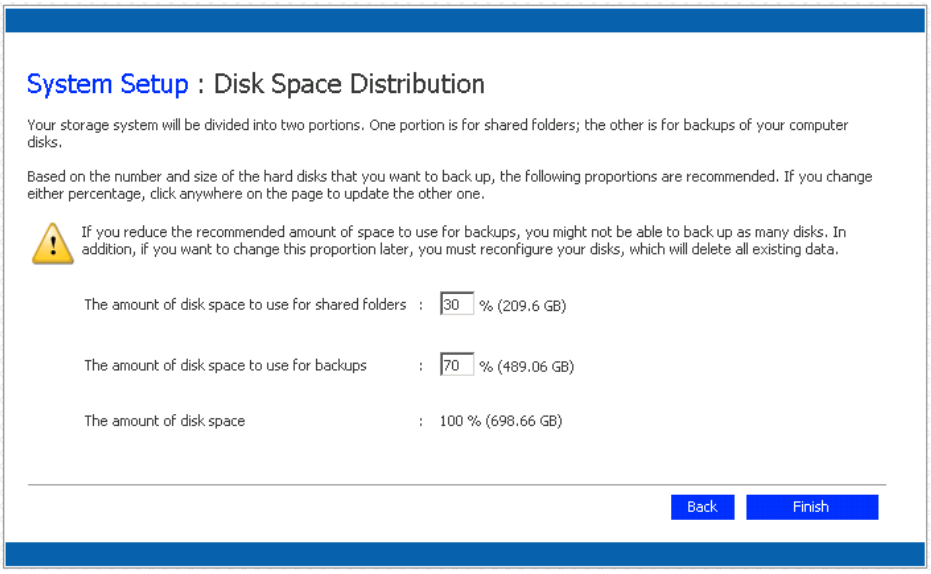


> **NOTE:** The backup software is optional, if the storage system does not contain the backup software, and you do not plan to use the backup feature in the future, please select **0**.

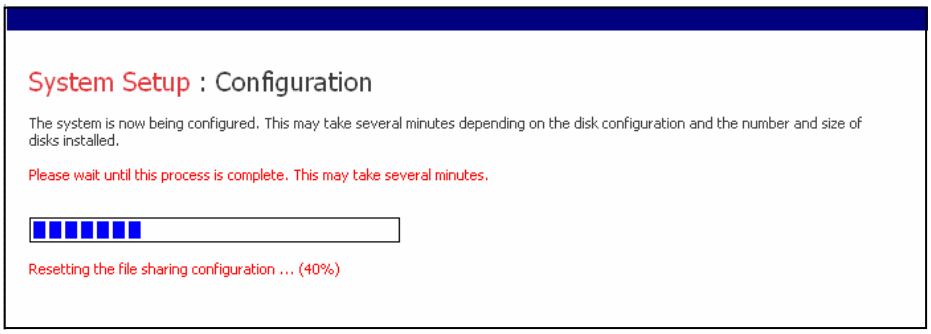
16. The following screen appears. Enter the capacity of the disks to back up, then click on **Next**.



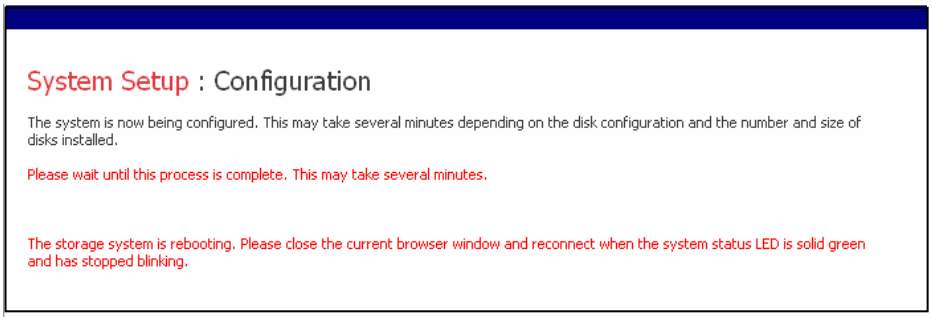
17. The following screen appears. Set the amount (percentage) of disk space to be allocated for shared folders and backups, then click on **Finish.**



18. On the next dialog box click on **OK** to confirm setup information will be written to the system. The following screen would appear.



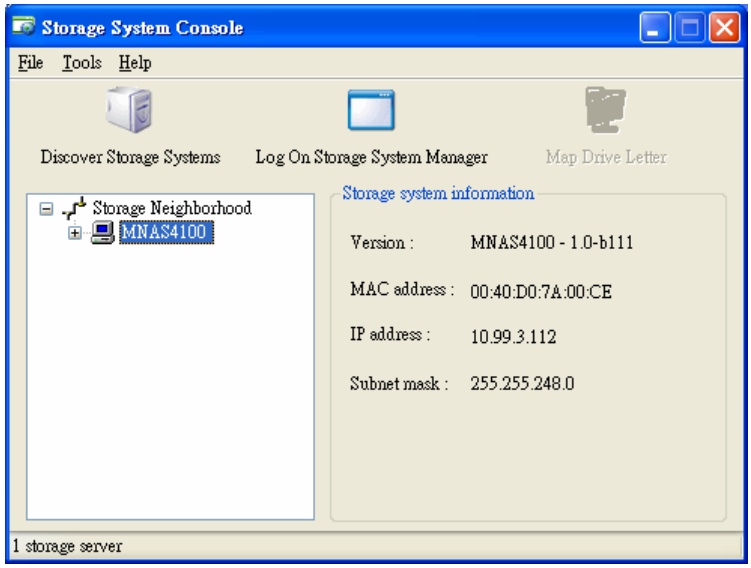
19. The system will reboot.



3.3 Starting Web Management

To perform system management using the Web Management:

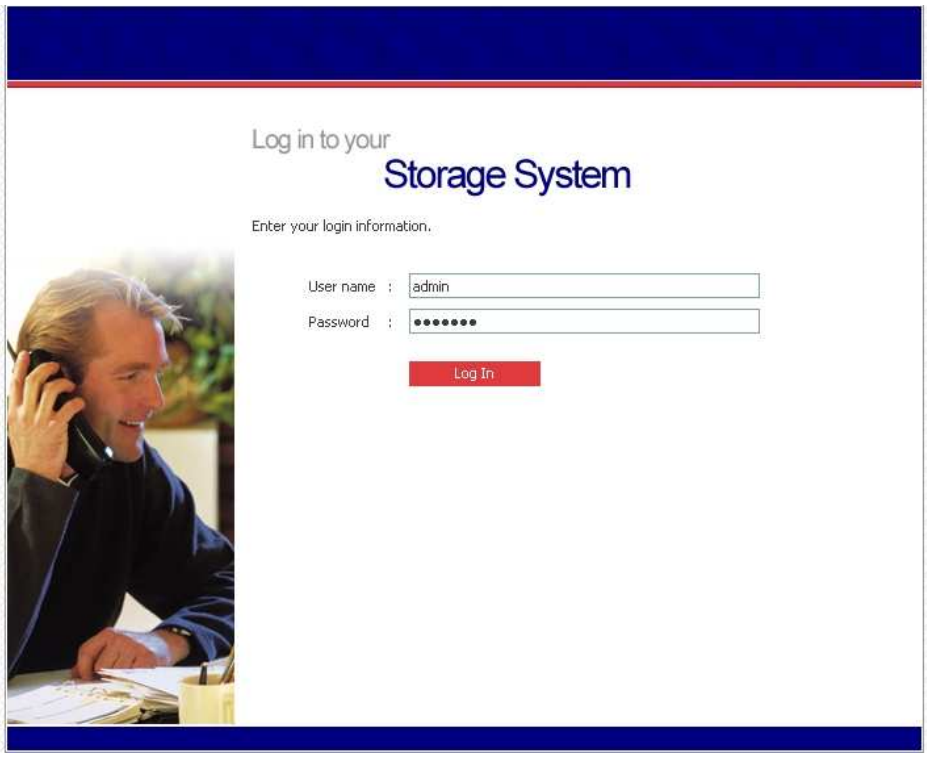
1. Run the **Storage System Console** by clicking on **Start**, then **Programs**, then **Storage System Console**. As soon as you start the Console, it automatically scans the network for storage systems. This might take a few minutes. As soon as the scan is complete, the left pane displays a tree view of all the storage systems it found. The following screen appears.



2. In the left pane, select the name of the storage system that you want to manage (for example, **MNAS4100**), then click on **Log On Storage System Manager**.

> **NOTE:** If you connect a storage system to the network after the Console has already scanned it, or if you change the IP address of the storage system, you must click on **Discover Storage Systems** to scan the network again and update the tree in the left pane.

3. The following screen appears. Input the default user name **admin** and the default password **storage**.



4. Then click on **Log In**.

   Refer to the next section on performing various system management tasks.

3.4 System Management

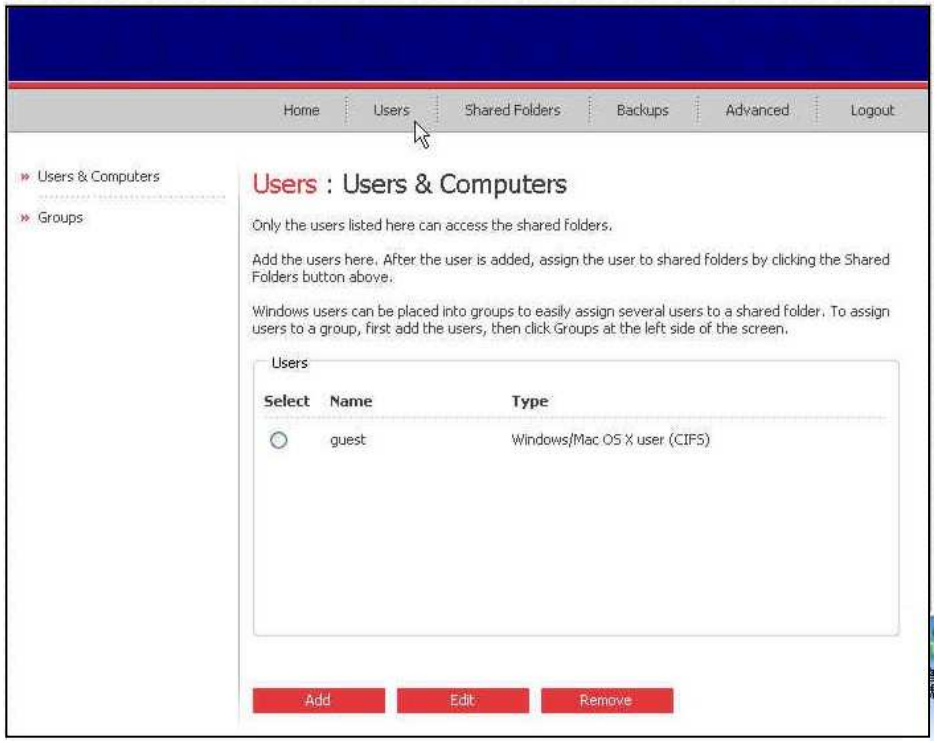
You can perform system management via the Web UI, Web Management. (See previous section on accessing Web Management.)

Users Page

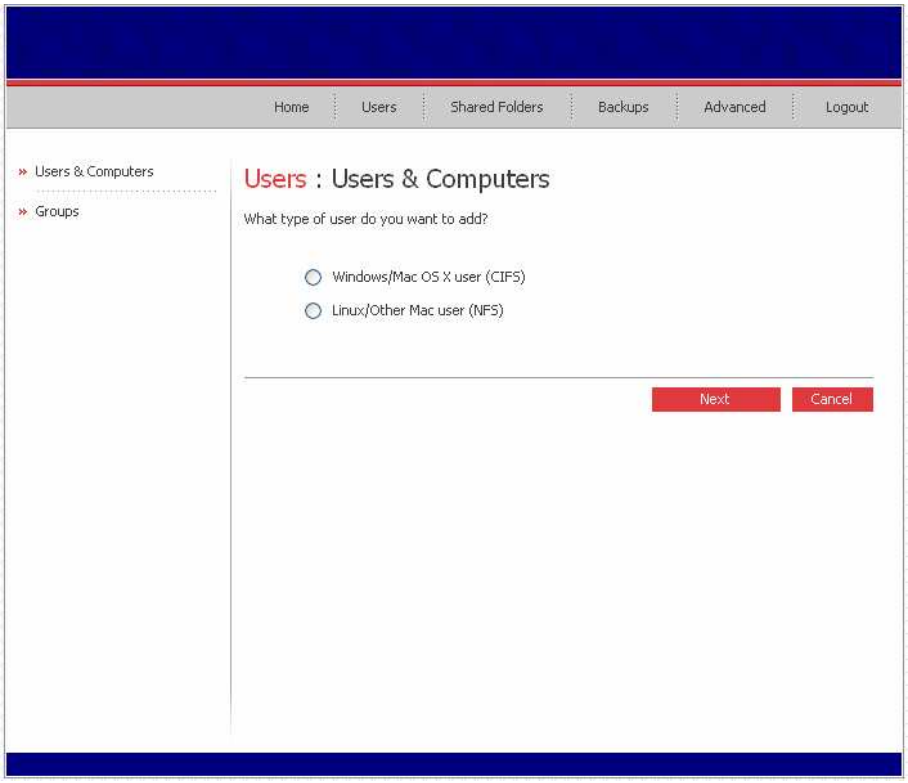
Displays a list of all currently configured users and lets you add, modify, and remove users. This area also lets you add, modify, and remove groups.

Users & Computers

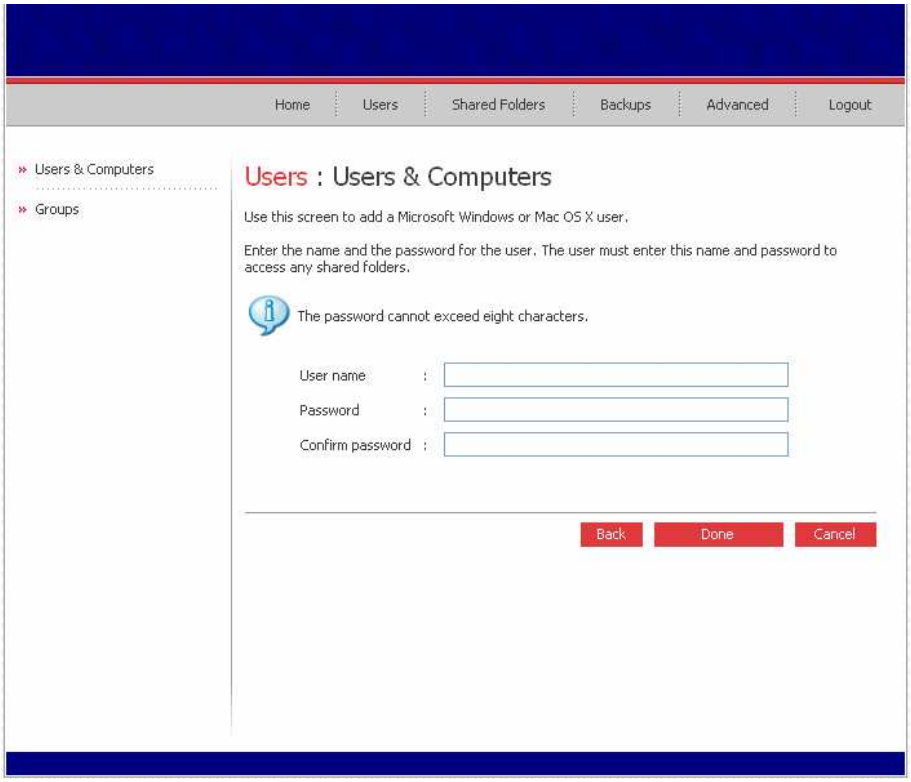
1. To get started, click the **Users** button on your homepage. The following screen appears.



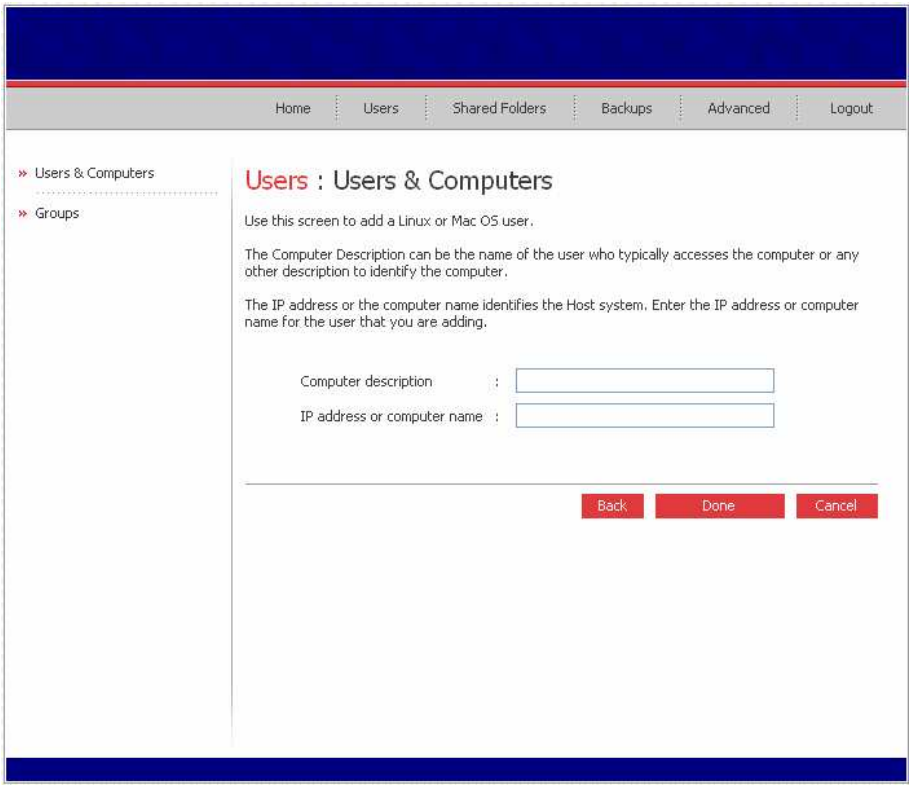
2. Click on **Add** and the following screen appears, allowing you to specify the type of user (Windows/Mac OS X or Linux/Other Mac) you want to add.



3. Click on **Next** and the following screen appears. You must provide the requested user information. For Windows/Mac OS X user (CIFS) –



For Linux/other Mac user (NFS) –

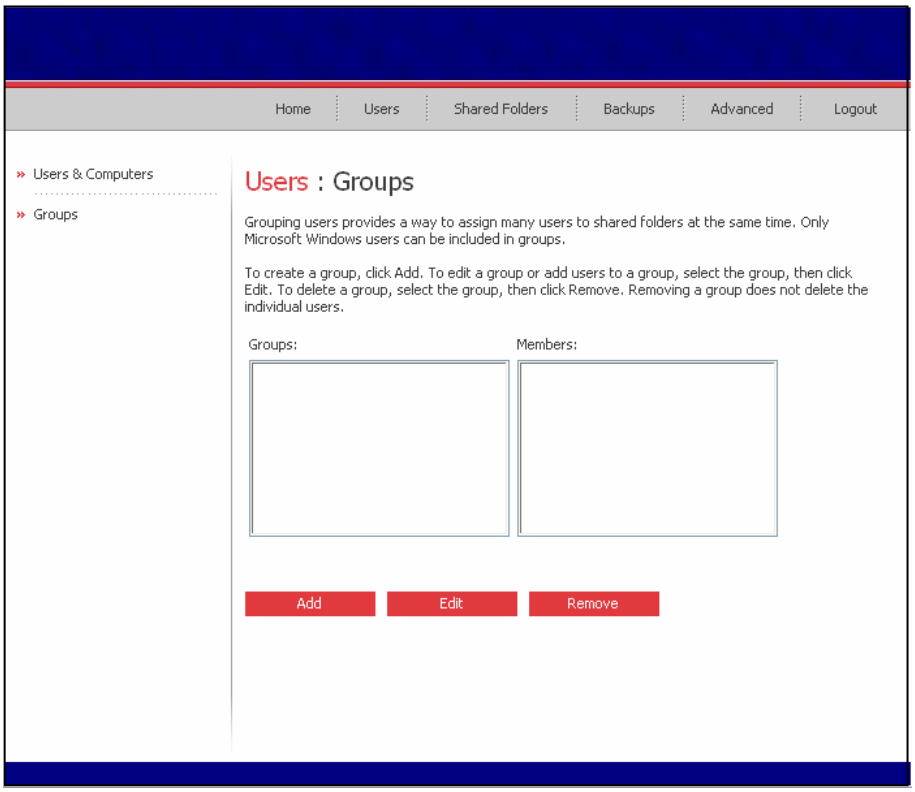


4. Click on **Done** and the new user would be added. Repeat the above steps until you have added all the users that you want to add at this time (you can always add more users later).

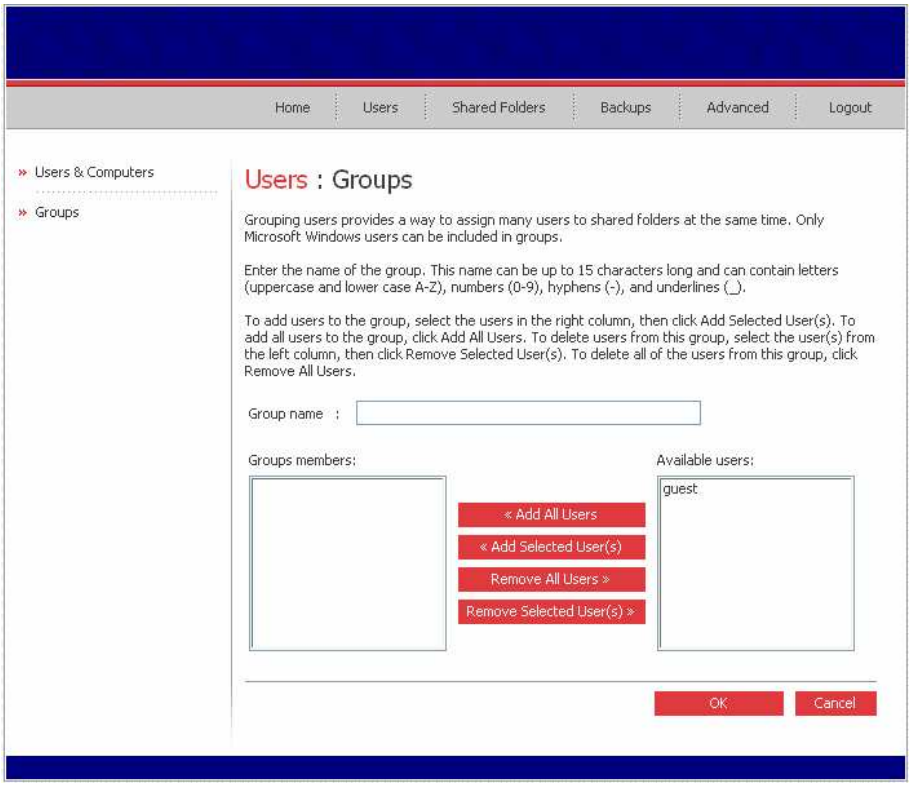
Groups

Placing users into groups makes it easier to give several users access to the same shared folder at once.

1. Click on **Groups** on the **Users** page. The following screen appears.



2. Click on **Add** and the following screen appears. Enter a group name and add all or selected users to this group.

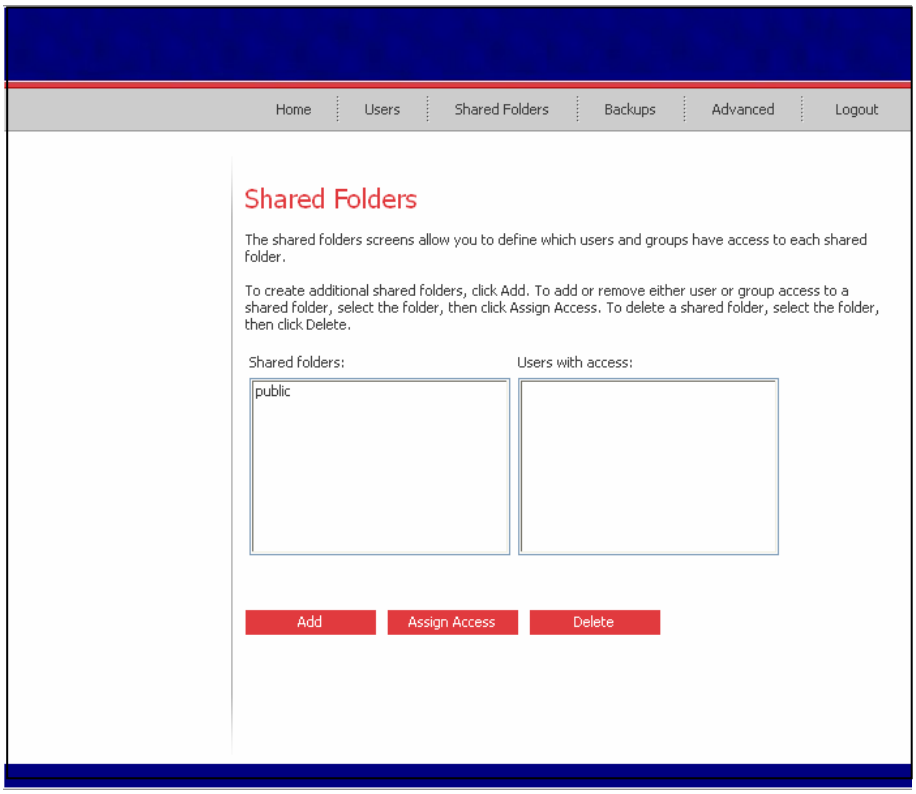


You can also remove all or selected users from a group.

Shared Folders Page

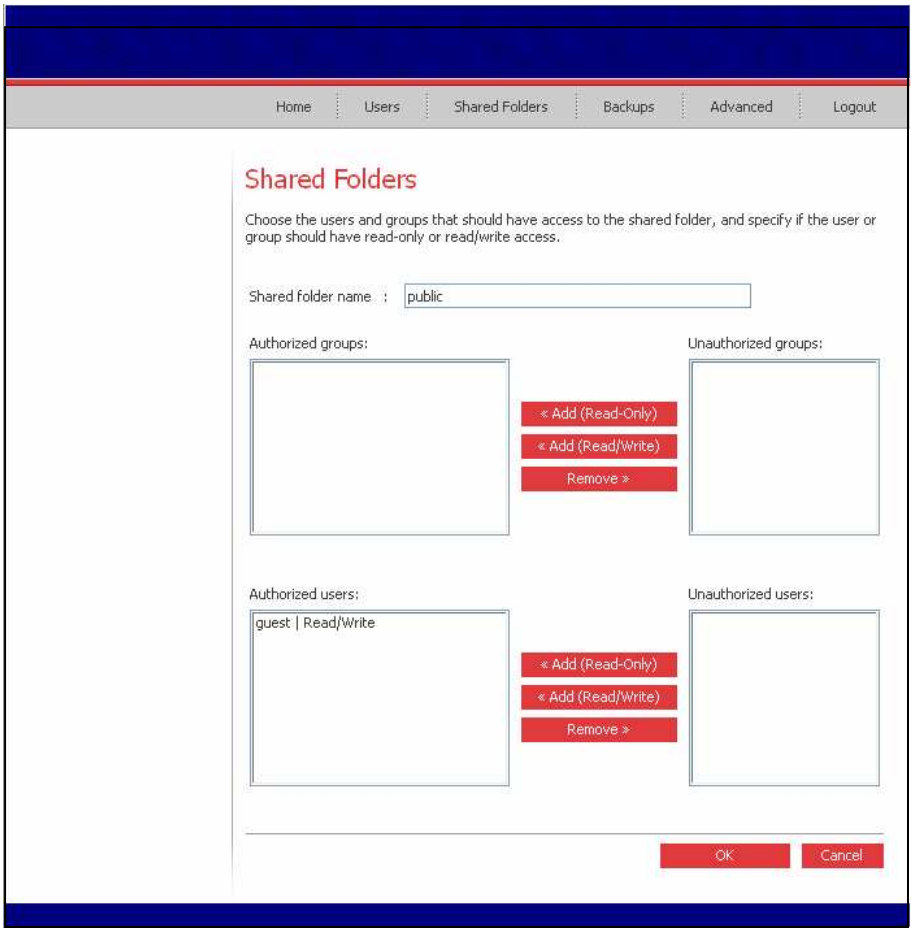
Displays a list of all currently configured and shared folders and lets you add shared folders, change which users can access them, and remove them.

1. Click the **Shared Folders** button on your homepage. The following screen appears.

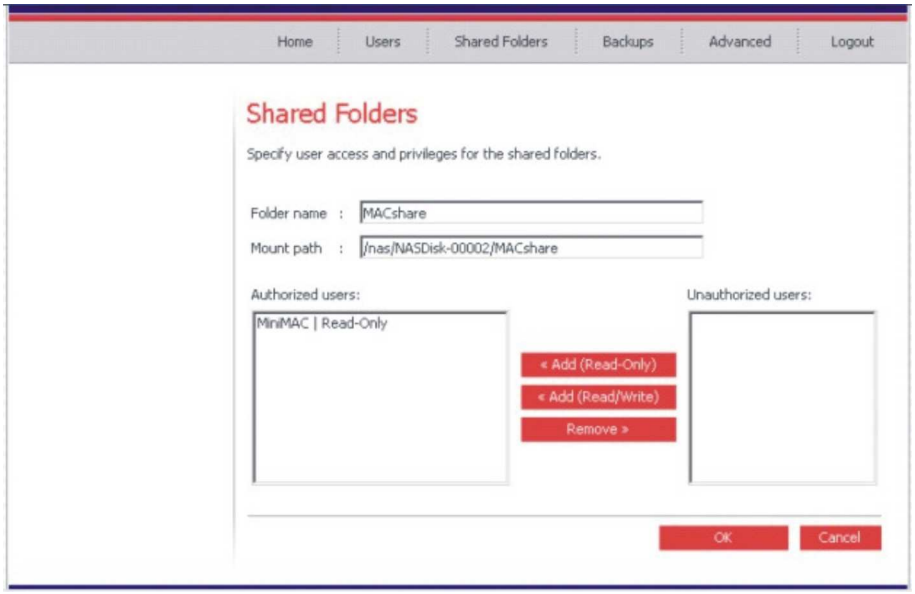


2. Select the shared folder whose user access you want to change.

3. Click on **Assign Access** and the following screen appears. For Windows/Mac OS X user (CIFS) –



For Linux/other Mac user (NFS) –

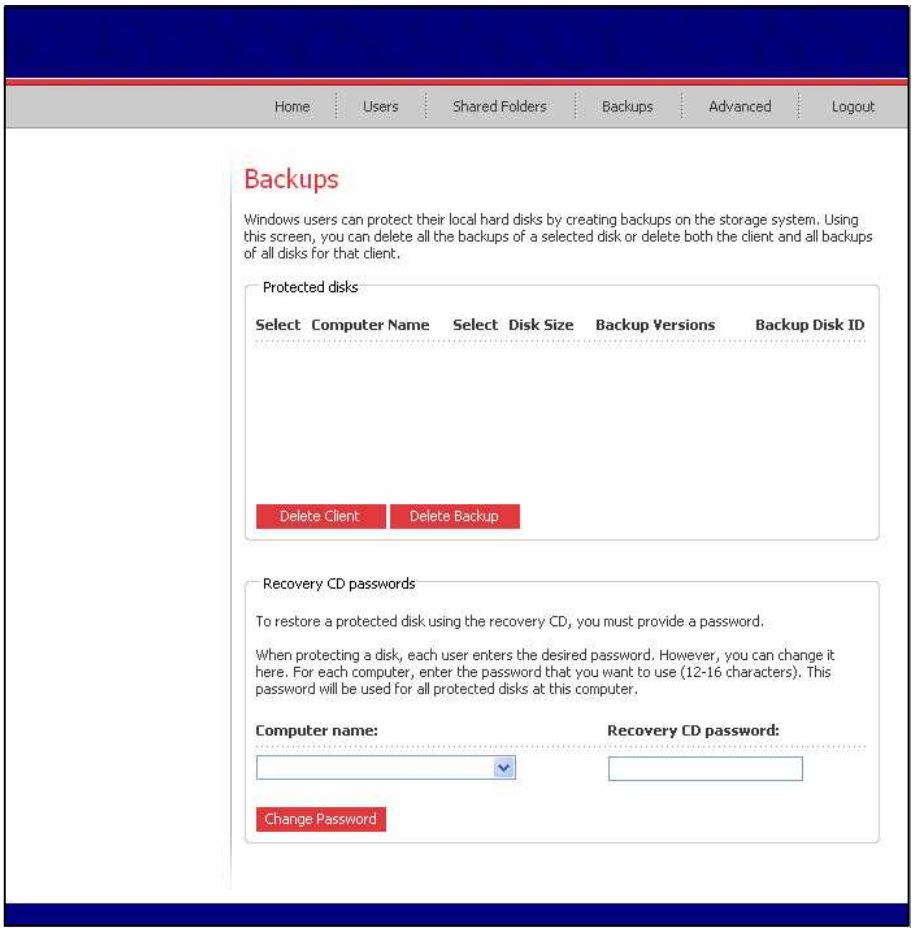


4. You can Add (specify as Read-Only or Read/Write) users/groups to, as well as Remove existing users/groups from Shared Folders.
5. Click on **OK**.

Backups Page (Optional)

> **NOTE:** If your storage system does not contain the backup software, skip this section and proceed to the next section **Advanced Page**.

The **Backups** page displays a list of all computer disk backups that currently exist and lets you change the recovery disc password or delete the backups for a particular computer hard disk.



Changing the Recovery Disc Password

1. In the **Computer name** list, select the name of the computer whose recovery disc password you want to change.
2. In the **Recovery CD password** text box, type the password to use. The password must be 12~16 characters long.
3. Click on **Change Password**.

Deleting a Backup

1. Select the radio button next to the disk whose backups you want to delete (in the second **Select** column).
2. Click on **Delete Backup**.
3. When prompted to confirm the deletion, click on **Yes**.

Deleting a Client

1. Select the radio button to the left of the computer whose backups and computer name you want to delete from the storage system (in the first **Select** column).
2. Click on **Delete Client**.
3. When prompted to confirm the deletion, click on **Yes**.

Advanced Page

Provides access to advanced storage system configuration options, such as setting up email alerts; upgrading the firmware; changing the system, network, or disk configuration settings; viewing information about system events; and shutting down the system remotely.

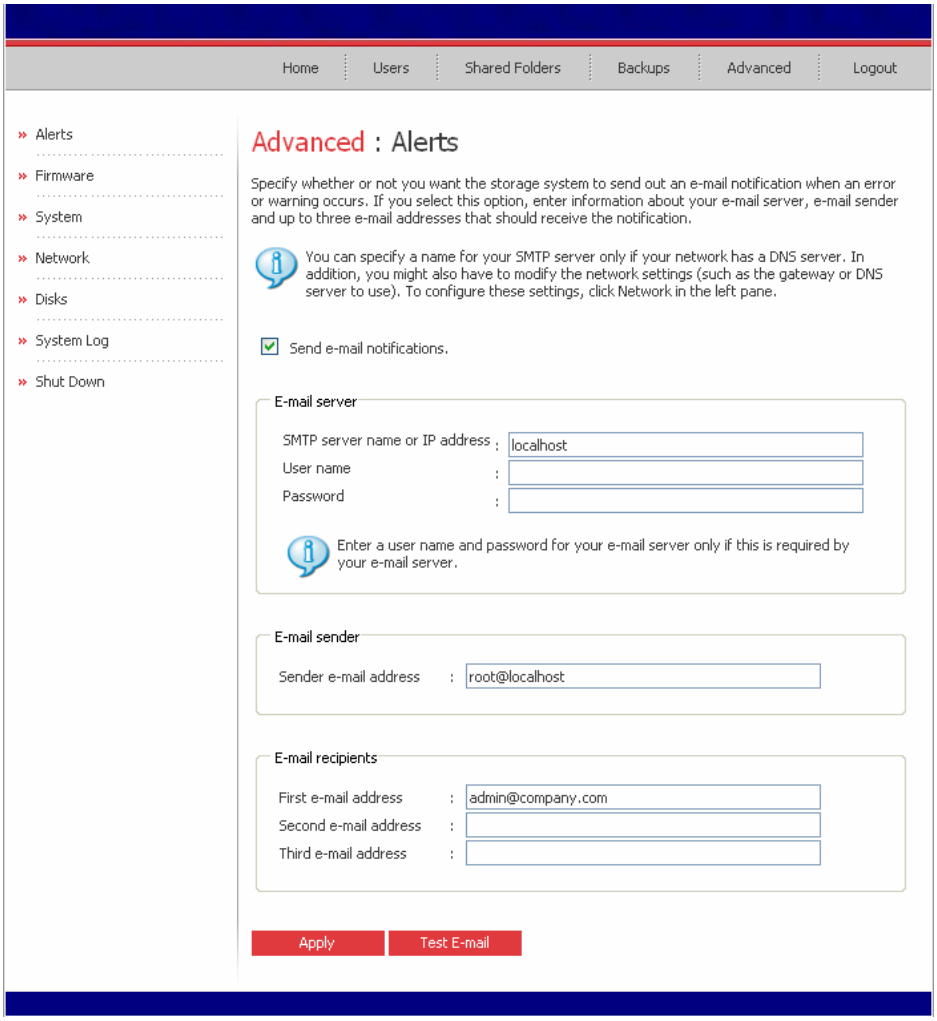
Email Alerts

Allows you to set up the storage system to notify up to three people via email if a problem occurs – for example, if one of the disks fails, or if insufficient space is available for creating new files or performing a backup.

To take advantage of this feature, you must have access to an SMTP email server, either within your own network or through an Internet service provider.

> **NOTE:** In order to be able to send out email alerts, the "Authentication" feature of the intended email recipient must be disabled.

1. Click the **Advanced** button on your homepage. The following screen appears.

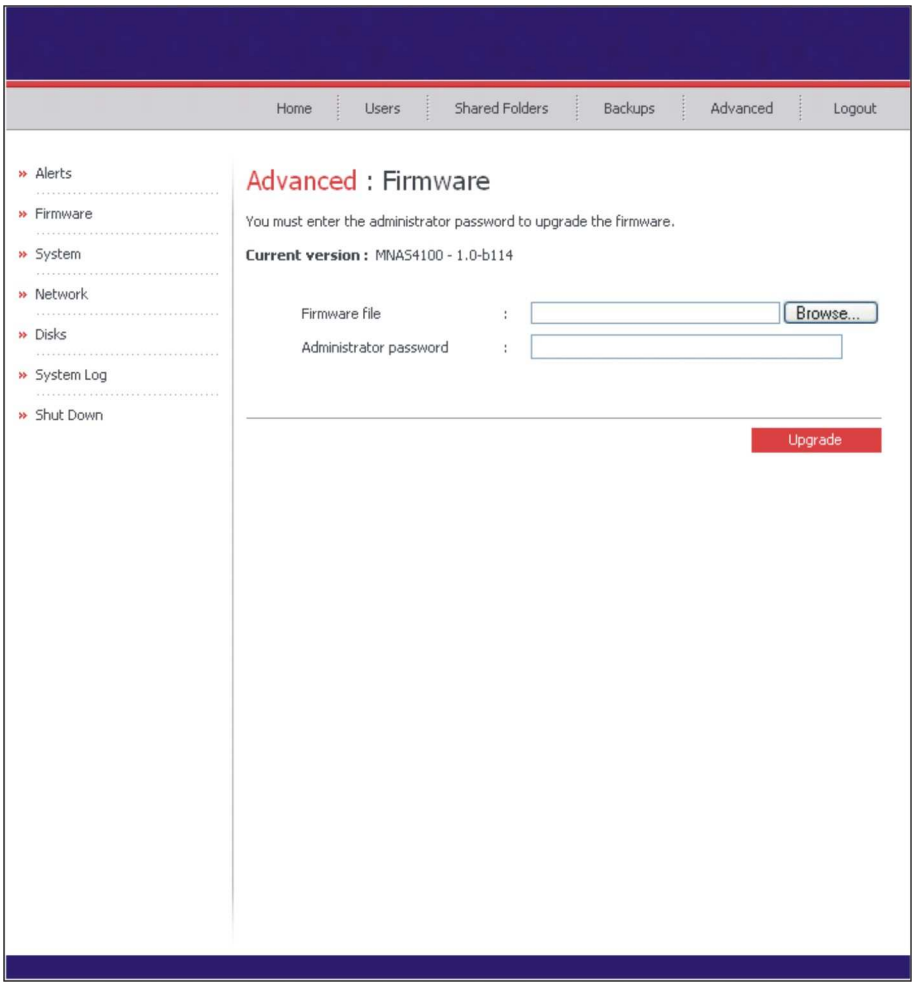


2. Enter the information about your email server and up to three email addresses that should receive the notification.
3. Click on **Apply**.

Firmware

Displays the current version of the firmware that is installed on your storage system. It also allows you to upgrade it if a newer firmware become available.

1. Click on **Firmware** and the following screen appears. For additional security, you must enter your administration password in order to upgrade the firmware.

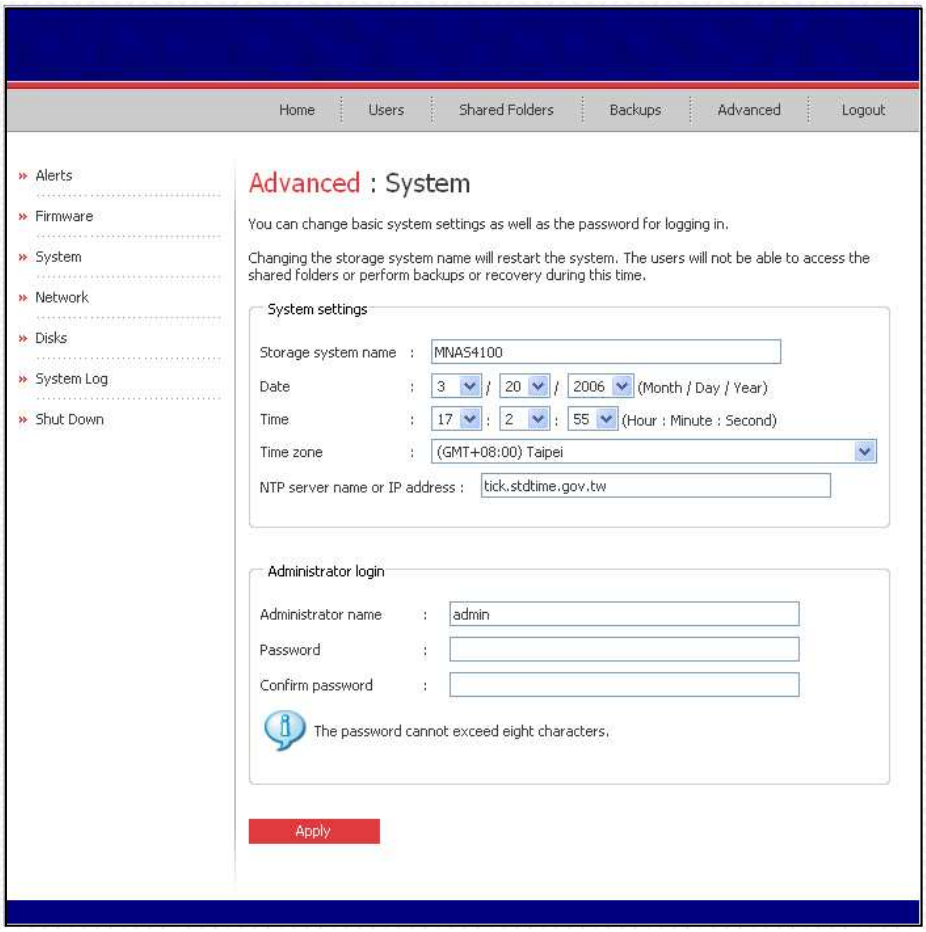


2. In the **Firmware file** text box, enter the path and filename for the firmware package (such as `D:\fs20060921.pkg`), or click **Browse** and select the file from the displayed list.
3. In the **Administrator password** text box, enter the password that you use for logging in to the **Storage System Console**.
4. Click on **Upgrade**.
5. When the confirmation message appears, click on **OK**.

System

Displays the settings that you specified when you initially configured the storage system, such as the storage system name, and the current date and time. You can also change the administrator name and password to use for logging in to the Storage System Manager.

1. Click on **System** and the following screen appears.



> **NOTE:** Changing the **Storage system name** might affect access to shared folders or backups, depending on how your network is configured and how users access the storage system

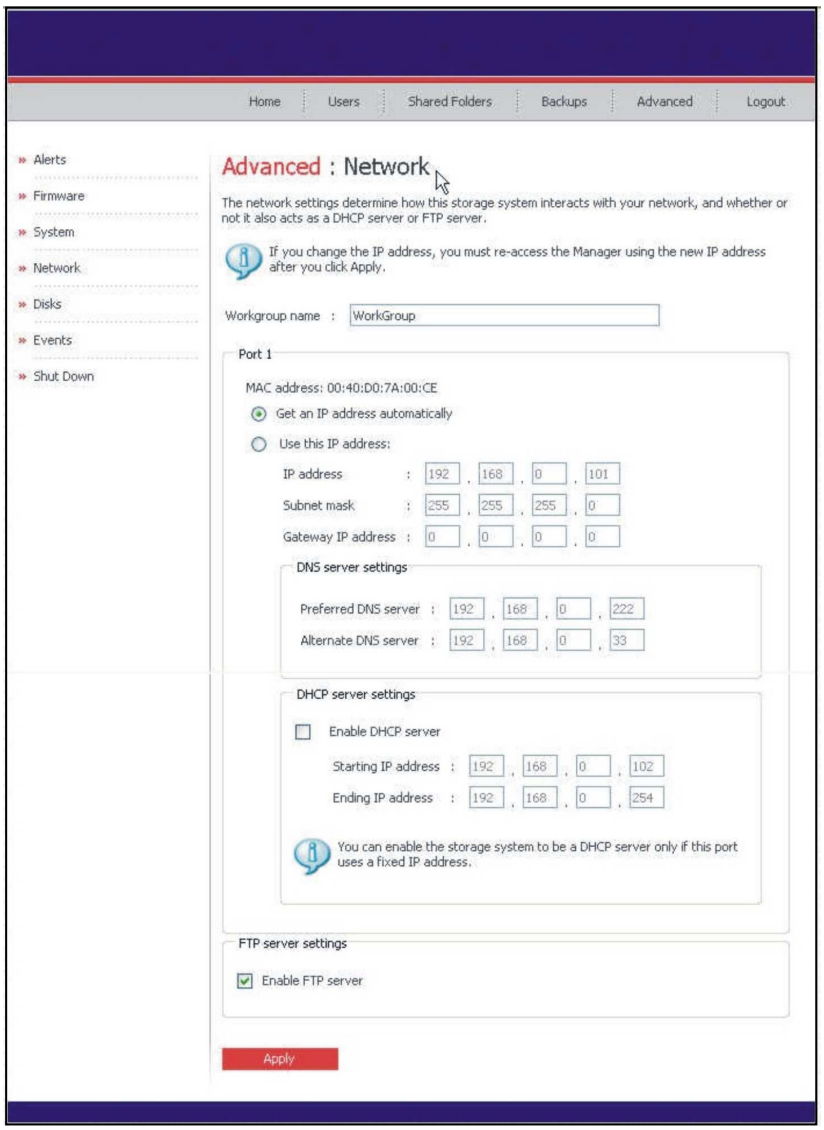
To change this . . .	Do this . . .
Storage system name	Enter the new name to use for the storage system. The name can be up to 15 characters long and can include letters, numbers, and hyphens.
Date, Time, Time zone	In the **Date** fields, enter or select the desired month, day, and year. In the **Time** fields, enter or select the desired hour, minute, and second. In the **Time zone** list, select the desired time zone.
NTP server name or IP address	Enter the name or IP address of the Network Time Protocol server from which the storage system should adjust its time. You can use a NTP server name only if it is resolvable.
Administrator name **Password** **Confirm password**	In the **Administrator name** field, enter the user name for logging in to the Storage System Manager. In the **Password** and **Confirm password** fields, enter the password for logging in to the Storage System Manager. The user name and password are case-sensitive.

2. After making the necessary changes, click on **Apply**.
3. When the confirmation message appears, click on **OK** for the changes to take effect.

Network

Displays the network settings that were set when you initially configured the storage system (only the first Ethernet port was configured during setup, the second uses its default settings unless you change them here).

1. Click on **Network** and the following screen appears.

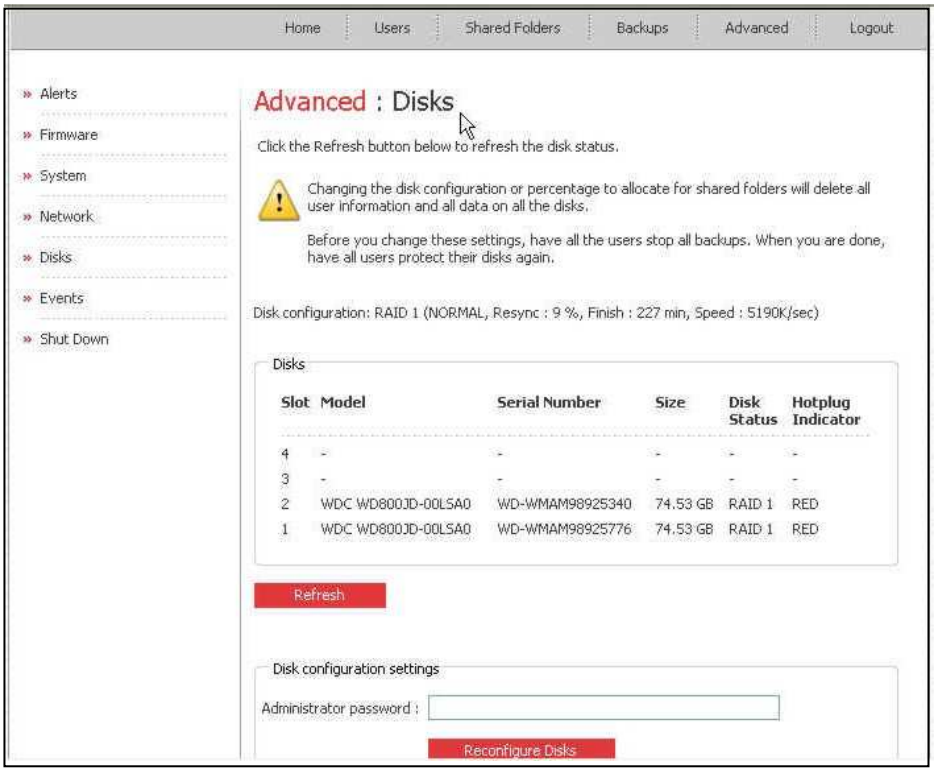


2. Make the necessary changes and click on **Apply** for the settings to take effect.

Disks

Displays information about all the hard disks that are currently installed in your storage system.

1. Click on **Disks** and the following screen appears.



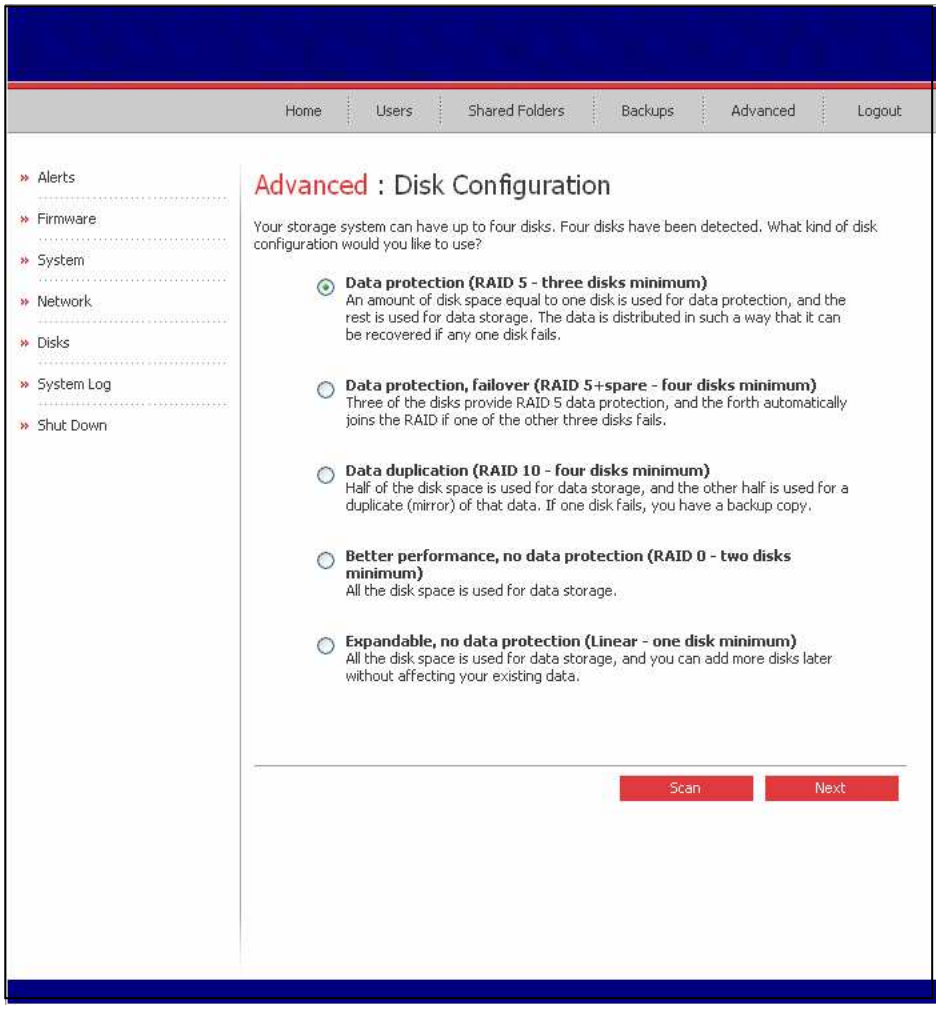
> **NOTE:** The color indicated on the **Hotplug Indicator** column is as follows:
> - **RED** – cannot hotswap hard drive, data will be loss.
> - **GREEN** – can hotswap hard drive.
> - **YELLOW** – can hotswap hard drive, but it will be downgraded.

2. In the **Administrator password** text box, enter your password for logging in to the **Storage System Console**.

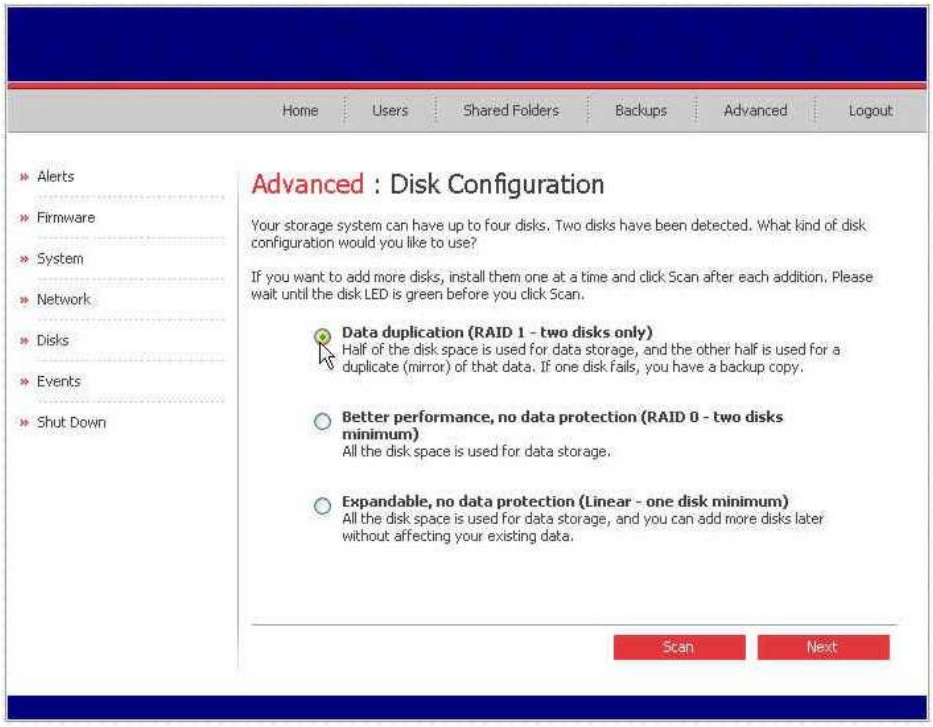
3. Click on **Reconfigure Disks**.

4. When the confirmation message appears, click on **OK**. The **Disk Configuration** page appears (the options that appear on this page vary, depending on the number of hard disks that are currently installed in the system).

   If you have four disks installed, the following screen appears.



If you have two disks installed, the following screen appears.

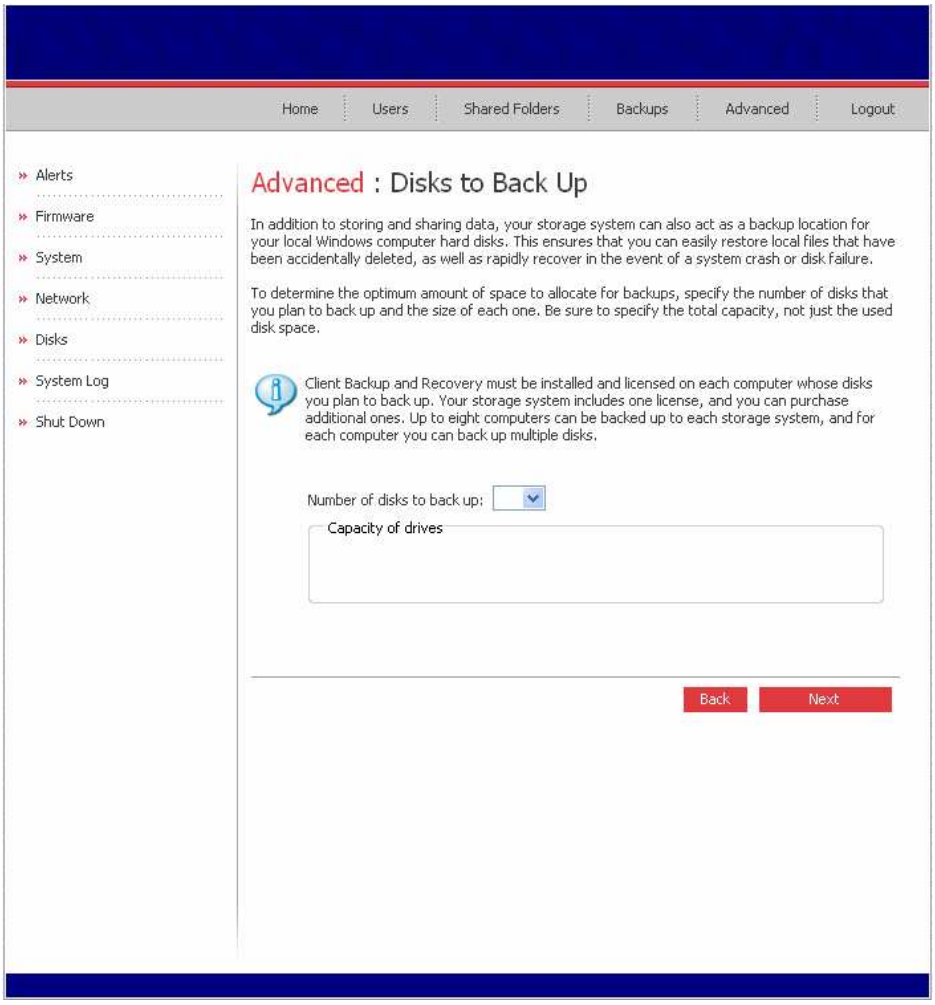


5. If you want to add or remove hard disks, do so one at a time and click on **Scan** after each action. If you are adding disks, wait until the disk LED is green before you click on **Scan**.

   To accept the default disk configuration (which will provide the best level of data protection available for the number of hard disks currently installed), click on **Next**.

   If you want to change the disk configuration, select the desired RAID level and then click on **Next**.

The **Disks to Back Up** page appears on screen.



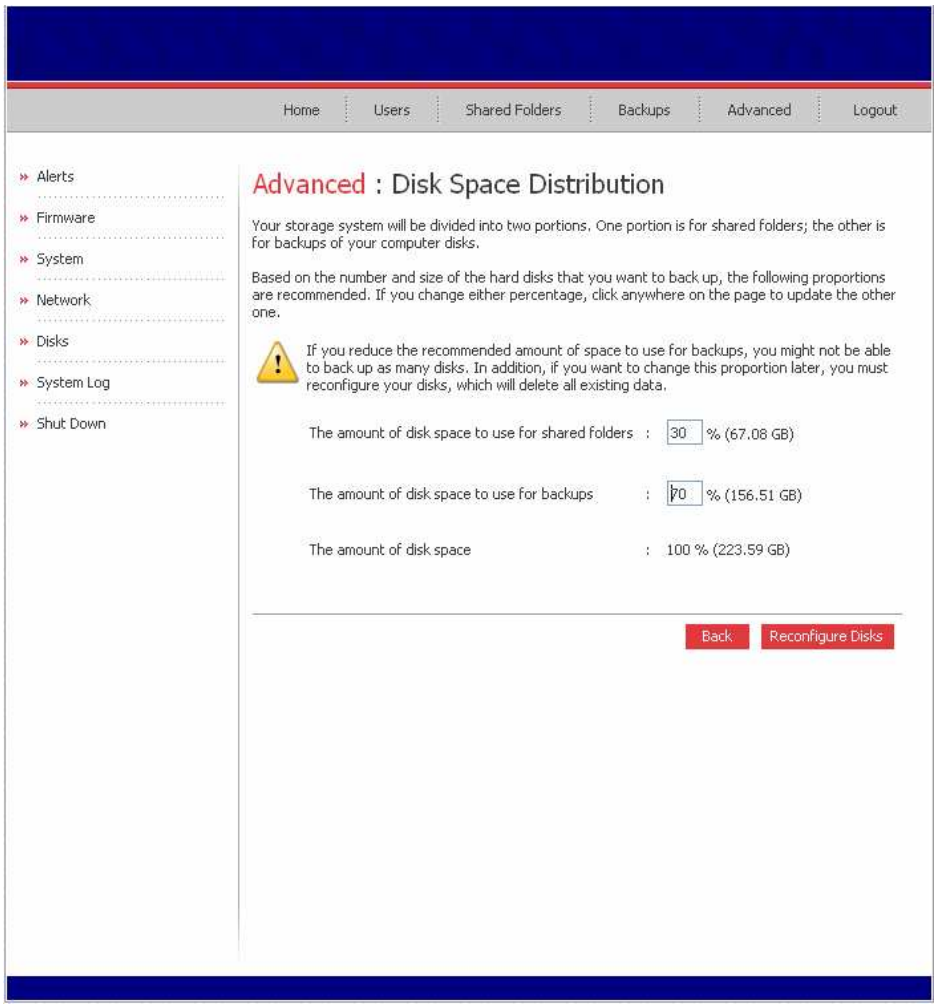
6. In the **Number of disks to back up** list, select the total number of disks that you plan to back up to this storage system.

   If some computers have multiple disks, be sure to select the total number of disks that you plan to back up. For example, if your network has five computers and each computer has two hard disks, you would select **10**.

When you select a number from this list box, a corresponding number of text boxes (**Disk 1**, **Disk 2**, etc.) appear in the **Capacity of drives** group box.

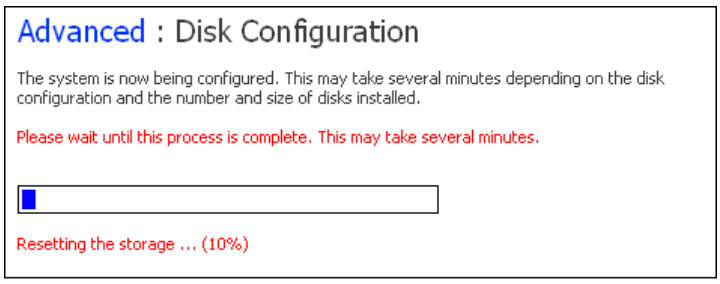
> **IMPORTANT:** If your storage system does not contain the backup software, and you do not plan to add it in the future, select **0**, click on **Next**, and go directly to step 10.

7. In each text box, enter the size of each disk that you plan to back up (in gigabytes). The **Disk Space Distribution** page appears on screen.

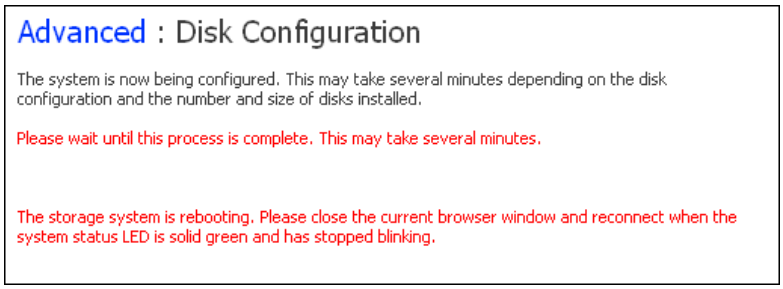


8. To change the percentage of space allocated for shared folders and backups, enter the desired percentage for each usage type (the percentages must add up to 100 %). Then click on **Reconfigure Disks**.

9. When the confirmation message appears, click on **OK**. The following screen appears showing the progress of the process.



When this process is complete, the storage system restarts.



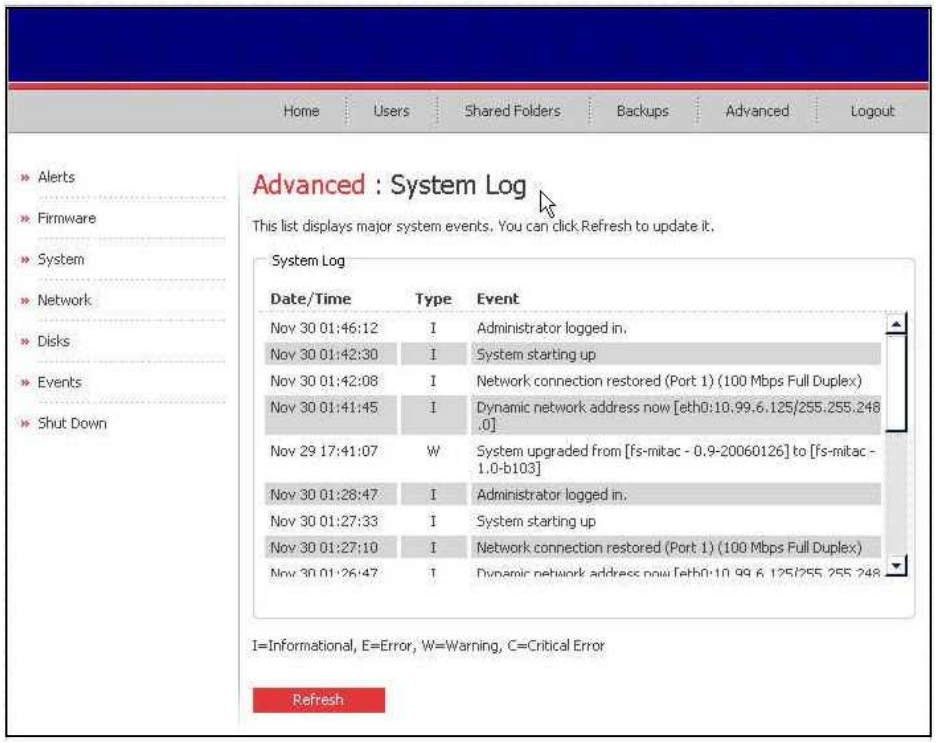
10. Close the **Storage System Console**.

After the system has restarted (when the system status LED is once again green), you can access the **Storage System Console** and re-create your users and shared folders (see previous sections).

System Log

Displays a list of events that have occurred on the storage system. Reviewing this list can help you identify and resolve any problems that you might encounter.

1. Click on **System Log** and the following screen appears. The date and time of the event, the type of event (**I** for informational, **E** for error, **W** for warning, and **C** for critical), and a brief description of the event are displayed.



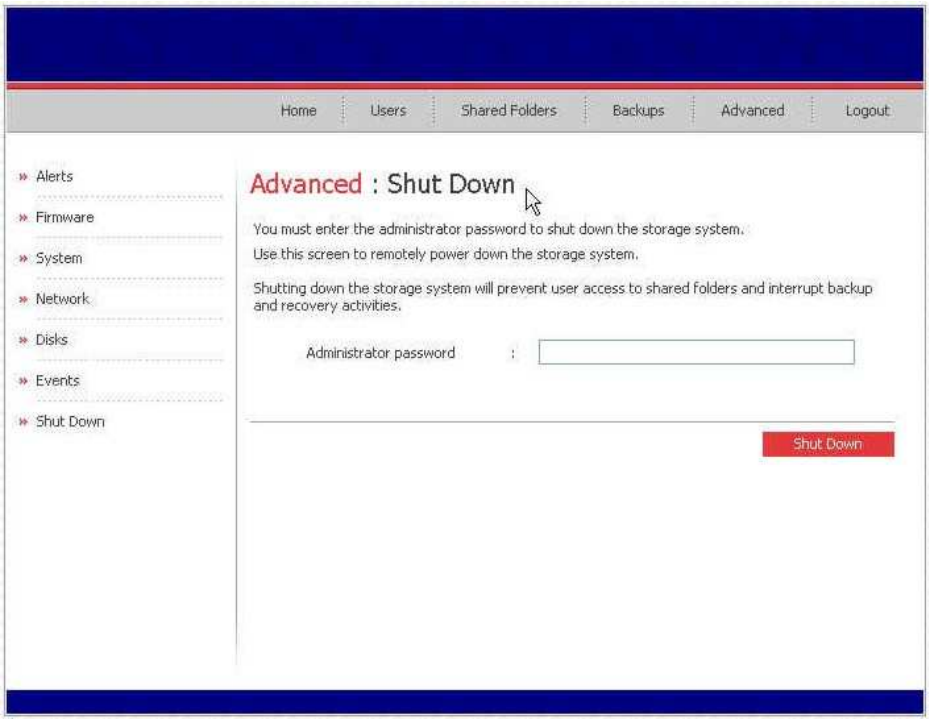
2. If an event occurs while you are viewing this list, click on **Refresh** to update it.

Shutdown

To shut down the storage system, you can press the power button on the unit itself and hold it until the system status and disk activity LEDs start flashing, or you can shut the storage system down using the Web Management. To use the Web Management:

1. Click on **Shutdown** and the following screen appears, allowing you to shutdown the storage system.

   > **CAUTION:** Make sure no one is backing up a disk or using a shared folder before you shut down the storage system.



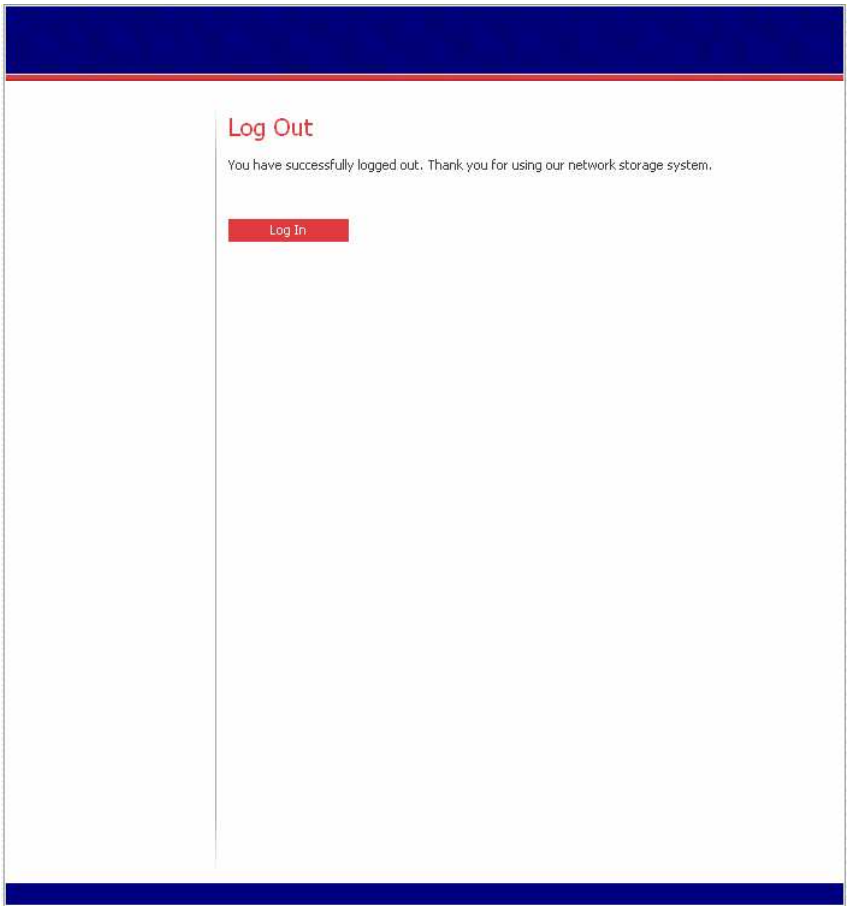
2. To ensure that you do not shut down the system accidentally, enter the **Administrator password**.

3. Click on **Shut Down**. A message appears indicating that the system is shutting down. Once the storage system shuts down, users will no longer be able to access the shared folders or backup their disks. To start the storage system again, press the Power button.

CAUTION: Always shutdown the system in accordance with the instructions above. An improper shutdown may affect the functionality of storage system in the next startup.

3.5 Logging Out of Web Management

1. To log out of the Web Management system, click on the **Logout** button on your homepage
2. When the confirmation message appears, click on **OK** and the following screen appears.



To use the Web Management later, click on **Log In**.

Chapter 4 Disk Configurations

Your storage system supports the following types of disk configurations:

- **Linear**—A linear configuration is similar to using multiple hard disks in a regular computer. Each disk is an independent entity, and the data on it is self-contained. You can add or remove the disks without affecting the other disks. All the available disk space is used for data.

  If your storage system has only one disk, you must use a linear configuration. However, you can use a linear configuration for two, three, or four disks as well.

Linear

- **RAID 0**—Instead of writing all the data to one disk in a linear fashion, some bytes are written to one disk, and other bytes are written to another. Performance is faster because reading and writing activities can occur on multiple disks simultaneously. All the available disk space is used for data.

  For RAID 0, your storage system must have at least two disks. However, you can use RAID 0 with three or four disks as well, and the disks can be any size.

RAID 0 : Striping

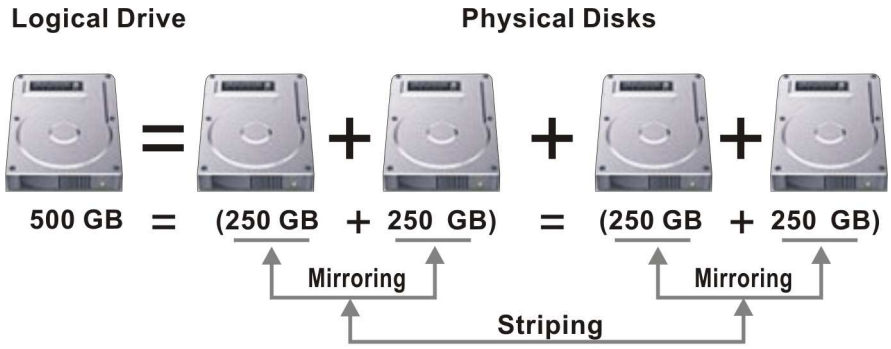
- **RAID 1**—In this configuration, all the data written to one disk is duplicated on the other disk. This offers greater data protection since if one disk fails, all your data is still intact on the other disk. However, using RAID 1 means only half your available disk space is used for data; the other half is used for a duplicate (mirror) of that data.

  You can use RAID 1 only if your storage system has only two disks. If the disks are not the same size, the smaller of the two disks is used for data, and the larger of the two disks is used as the mirror. If one disk fails, the other disk continues to make its data available.

RAID 1 : Mirroring

- **RAID 10**—RAID 10 is similar to RAID 1, but rather than having one disk mirror to one other disk, two disks mirror to the two other disks.

  You can use RAID 10 only if your storage system has four disks. The disks in the first two slots constitute the first pair, and the disks in the second two slots constitute the second pair. In each pair, the smaller of the two disks is used for data, and the larger of the two disks is used as the mirror. If one disk in the pair fails, the other disk continues to make its data available.



RAID 10（Mirroring + Striping）

- **RAID 5**—Like RAID 0, RAID 5 offers increased performance by distributing the data across multiple disks. But unlike RAID 0, RAID 5 also offers data protection. If your storage system has three disks of equal size, two thirds of each disk are used for data, and the remaining third contains the parity information needed to reconstruct either of the other two. In this way, if any of the three disks fails, it can be reconstructed when a new disk is installed in the storage system.

  If your storage system has four disks of equal size, three fourths of each disk are used for data, and the remaining fourth contains the parity information needed to reconstruct either of the other three. If any of the four disks fails, it can be reconstructed when a new disk is installed.

RAID 5: Striping + Rotating Parity

- **RAID 5 + spare**—In this configuration, three of the disks use RAID 5, and the fourth is empty. If any of the three disks fails, it is immediately rebuilt using the fourth spare disk. As a result, you can remove the failed disk and still have the ongoing fast performance and data protection offered by RAID 5. When the failed disk is repaired or replaced and re-installed into the storage system, it automatically becomes the spare for the other functioning three.

  You can use RAID 5 + spare only if your storage system has four disks. If the disks are not the same size, the smallest of the disks determines how much disk space is available for data, similar to RAID 5.

RAID 5+spare : Striping + Rotating Parity + one spare disk

4.1 Adding hard disks

The effect of adding hard disks to your storage system varies, depending on the disk configuration you chose when you configured the system and the current state of the existing disks.

For example, in a linear configuration, you can add a new disk at any time, and data can be written to that disk as soon as it is added. Whether you previously removed a disk or one of the other disks failed makes no difference.

In a RAID configuration, the effect of adding a disk varies, depending on whether the RAID is in a normal or degraded state (as indicated on the **Disks** page of your **Storage System Console**). A normal state indicates that the RAID is functioning properly. A degraded state indicates that one or more disks have been removed or failed, but because of the data protection offered by the RAID, you can continue to access all the data.

In a normal state, you cannot add a disk to a RAID 0 or RAID 1 configuration. Any disk that you install will not be used unless you subsequently reconfigure the storage system.

> **CAUTION:** Reconfiguring your storage system disks deletes all the data on your storage system.

However, if you currently have three disks and a RAID 5 configuration, you can add a fourth disk as a spare (essentially changing from RAID 5 to RAID 5 + spare while retaining all your existing data).

In a degraded state, you can add a disk to a RAID at any time, and the new disk will be rebuilt to replace the disk that was removed or failed.

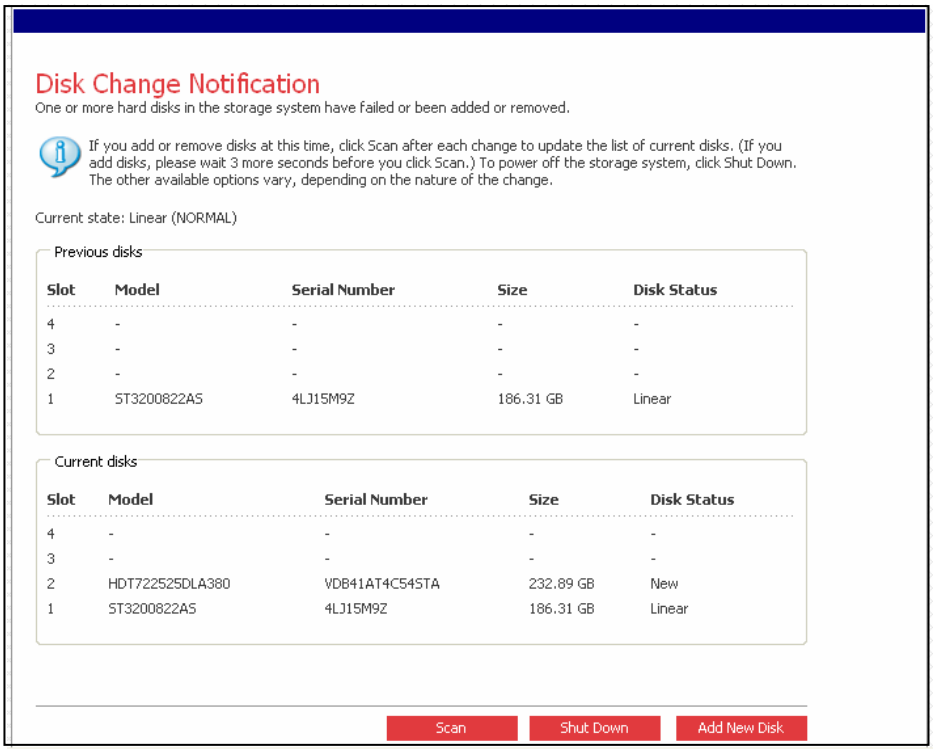
> **CAUTION:** If the RAID has failed – that is, if so many disks have failed or been removed that the RAID can no longer function – you must either re-install the disks or reconfigure the entire storage system, deleting all the data on your system.

Adding Hard Disks to a Linear or Normal RAID Configuration

To add a hard disk to a linear or normal RAID configuration:

1. Insert the hard disk into the storage system. You can do this whether the storage system is powered on or off.

2. Access the **Storage System Console** or refresh the browser window. The **Disk Change Notification** page appears.

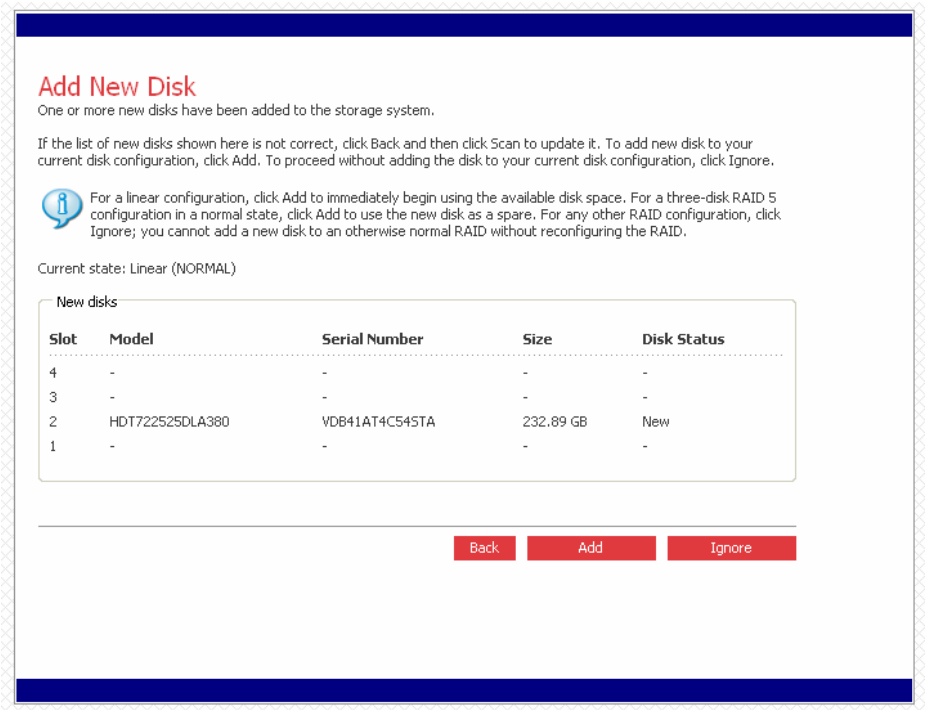


3. To add the disk to the storage system, click on **Add New Disk**.

   If the information on this page is not correct, click on **Scan** to scan the storage system again and update the page.

   You can also click on **Shut Down** to shut down the storage system, but you will be presented with this page again the next time you access the **Storage System Console**.

When you click on **Add New Disk**, the following page appears.



4. To add the disk to a linear configuration or use it as a spare for a normal three-disk RAID 5 configuration, click on **Add**. The **Disks** page indicates the current state of the disk configuration.

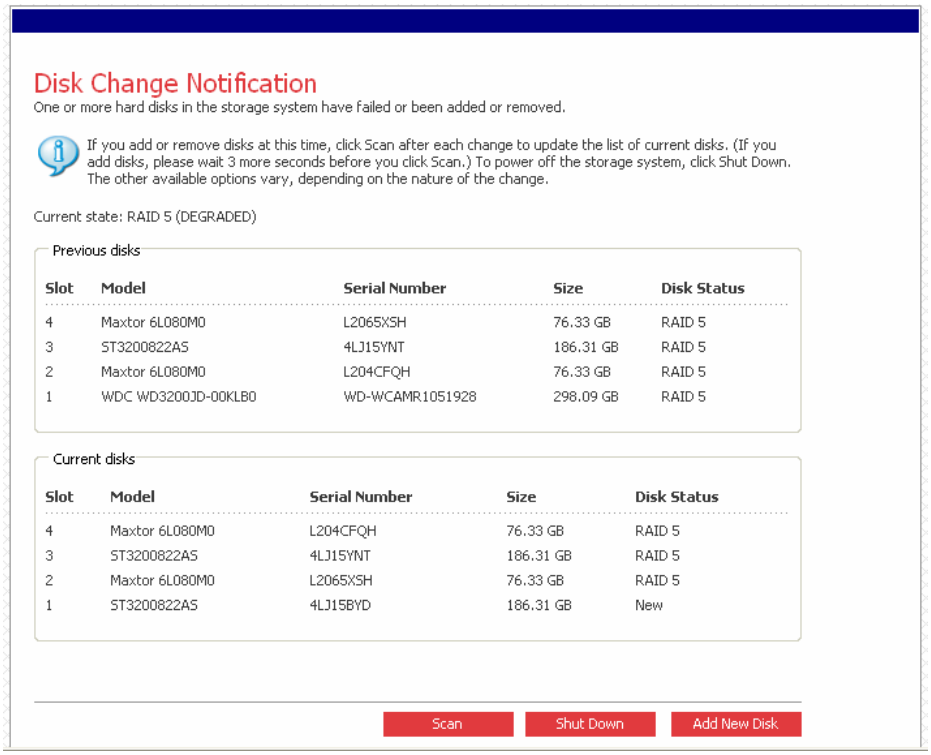
   To add the disk to the storage system but not add it to the RAID at this time, click on **Ignore**. The **Disks** page lists the disk that is part of the storage system, but its status is **New**, indicating that it is not being used. If you subsequently reconfigure the disks, you will be able to use this new disk.

   To return to the previous page (for example, to re-scan the storage system), click on **Back**.

Adding Hard Disks to a Degraded RAID Configuration

To add a hard disk to a degraded RAID configuration:

1. Insert the hard disk into the storage system. You can do this whether the storage system is powered on or off.
2. Access the **Storage System Console** or refresh the browser window. The **Disk Change Notification** page appears.



3. Click on **Add New Disk** to add the disk to the storage system.

The **Disks** page shows the progress of the rebuilding progress.

Alternatively, if the information on this page is not correct, click on **Scan** to scan the storage system again and update the page.

You can also click on **Shut Down** to shut down the storage system. When you restart the storage system, this page re-appears.

Removing Hard Disks or Responding to Disk Failure

The effect of removing hard disks from your storage system or disk failure varies, depending on the disk configuration you chose when you configured the system and the current state of the existing disks.

For example, in a linear configuration, when you remove a disk or a disk fails, the data associated with that disk is no longer available, but the data on all the other disks remains available.

In a RAID configuration, the effect of disk removal/failure varies, depending on the RAID level and whether the RAID is in a normal or degraded state. You can determine the effect of disk removal/failure by looking at the **Hotplug Indicator** on the **Disks** page. If this indicator is **GREEN**, disk removal/failure will have no effect on the RAID. If this indicator is **YELLOW**, disk removal/failure will cause RAID degradation, but you will still be able to access all the data. If the indicator is **RED**, disk removal/failure will cause the entire RAID to fail.

For example, in a RAID 5 configuration, all the disks are **YELLOW**. Removing any one of them will cause the RAID to be degraded, but all the data will still be available. However, after you remove one disk, all the other disks become **RED**, since removing any one of them at this point will cause the entire RAID to fail.

> **NOTE:** In a linear configuration, the **Hotplug Indicator** is **RED** for all the disks because removing any one of them will remove data from the storage system. However, this will not adversely affect any of the other disks.

In addition, while a disk is being rebuilt, all the other disks are **RED**, since removing any one of them at this point will cause the RAID to fail.

If you remove a viable disk and cause only RAID degradation, you can re-install the same disk and resume normal operation. (For information about adding a disk, refer to “Adding Hard Disks” on the previous section.)

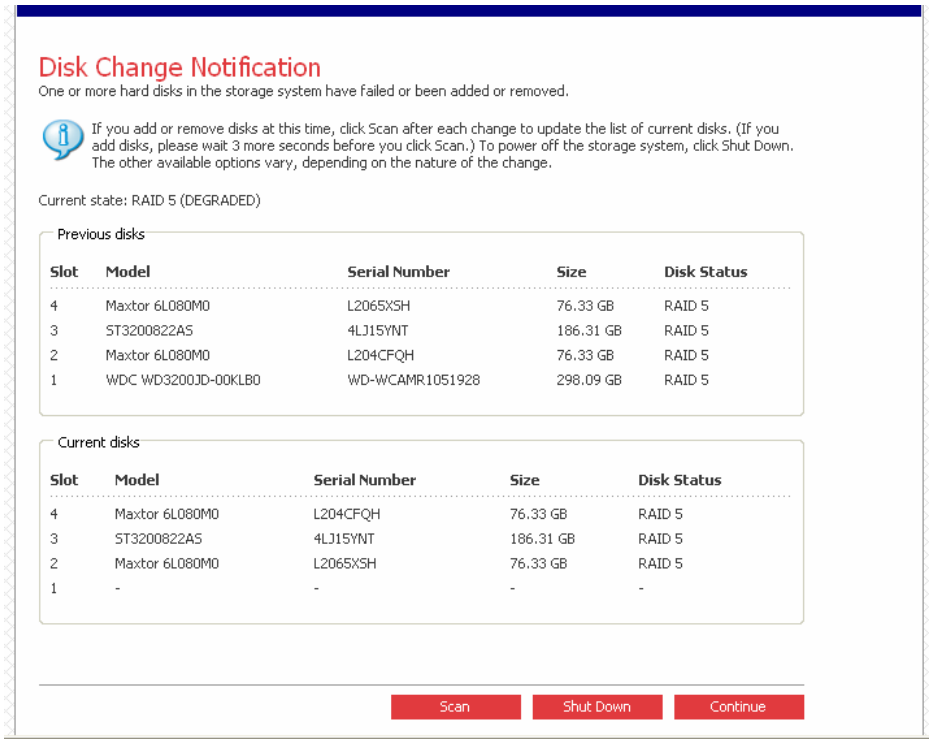
> **NOTE:** If you remove two or more disks, you must re-install them in the reverse order to help maintain data integrity. For example, if you remove disk A from slot 1 and then remove disk B from slot 2, you must re-install disk B first, then disk A. You can put the disks back into different slots, but they must be re-installed in the opposite order from which they were removed.

If you remove one or more viable disks and cause the entire RAID to fail, you can shut down the storage system, re-install the same disks, and then restart the storage system. As long as you re-install the original disks, the storage system should be able to resume proper operation, although the integrity of the data cannot be guaranteed. However, if you replace the removed disks with new disks, you must reconfigure your disks.

> **CAUTION:** Reconfiguring your disks will delete all the data on your storage system.

Responding to RAID Degradation

When disk removal/failure causes RAID degradation, the **Disk Change Notification** page appears when you access the **Storage System Console** or refresh the browser window.



To scan the storage system again and update the information on the page, click on **Scan**.

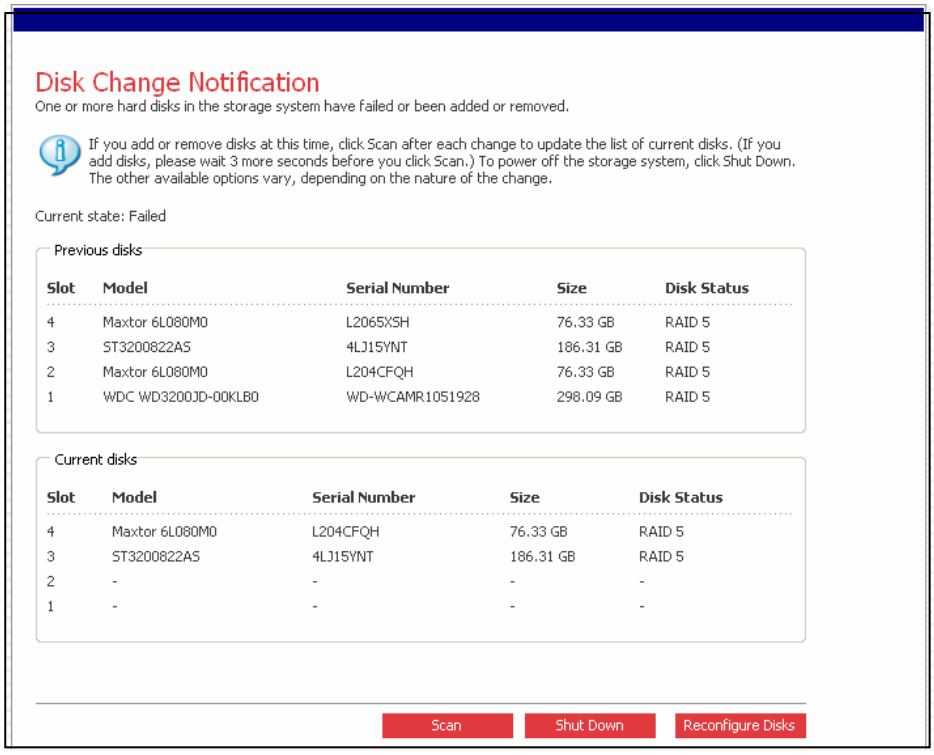
To re-install the same disk or install a new disk, click on **Shut Down**. After the storage system shuts down, install the disk and then restart the system.

> **NOTE:** If you are re-installing multiple disks, be sure to re-install them in the opposite order that you removed them.

To return to the **Storage System Console** and continue to operate in a degraded mode, click on **Continue**.

Responding to RAID Failure

When disk removal/failure causes the entire RAID to fail, the **Disk Change Notification** page appears when you access the **Storage System Console** or refresh the browser window.



To scan the storage system again and update the information on the page, click on **Scan**.

To re-install the same disk, click on **Shut Down**. After the storage system shuts down, re-install the same disk and then restart the system.

> **NOTE:** If you removed multiple disks, be sure to re-install them in the opposite order that you removed them.

To reconfigure the storage system using the available disks, click on **Reconfigure Disks** and complete the system setup pages.

> **CAUTION:** Reconfiguring the storage system deletes all user information and all data on all the disks.

Swapping Hard Disks

If you are using RAID 5 + spare or RAID 10, you can move the hard disks from one slot to another whether or not the storage system is running. However, if you do this when the storage system is running, you can swap only two disks, and you must restart the system after you swap the disks. If you swap the disks when the storage system is not running, you can swap all four disks, and the system will function as it previously did when you restart it.

> **NOTE:** For RAID 5 + spare, if you swap the disks when the storage system is running, one of the swapped disks must be the spare.
> For RAID 10, the swapped disks must be in different pairs. For example, you can swap disks 1 and 3 or disks 2 and 4, but not disks 1 and 2, as those are members of the same pair.

If the storage system is running when you swap the disks, the **Disk Change Notification** page appears (as shown in the preceding section). Click on **Shut Down** and then restart the system.

For all other disk configurations (linear, RAID 0, RAID 1, and RAID 5), you can swap the hard disks only when the storage system is powered off, and you can swap all four disks.

Transferring Hard Disks to a New Storage System

If your storage system unit fails but the hard disks themselves are viable, you can transfer your existing hard disks to a new storage system, thereby preserving all your existing data.

To transfer hard disks to a new storage system:

1. Shut down both the old unit and the new unit.

> **CAUTION:** If you do not shut down the new unit before you insert the hard disks, you will be prompted to re-initialize the disks. If you do this, all the data on your hard disks will be lost.

2. Transfer the hard disks to the new unit.
3. Connect the new unit to your network and power on the new unit.
4. Access the **Storage System Console** for the new unit.

   As long as the new unit is in the same subnet as the old unit, you can access the **Storage System Console** using the same procedure you used previously. However, if the new unit is in a different subnet, you might have to install the Console on a computer in the same subnet as the storage system and use the Console to access it.

5. If the firmware in the flash memory of the new unit differs from the firmware on the hard disks, a message appears, prompting you to update the flash memory on the storage system with the firmware from the hard disks. Click on **Update** to proceed. If you do not want to upgrade the firmware at this time, click on **Shut Down** to shut down the system.

   > **NOTE:** If the firmware on your new unit is newer than the firmware on your hard disks, you might want to contact your vendor about obtaining the latest firmware. Refer to "Firmware" on the previous section for information about upgrading to newer firmware.

   If no message appears, you can manage the unit as you did before.

Limited Warranty

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