

Chapter 4

Configuring Disks

When you install Windows 7, you designate the initial configuration for your disks. Through Windows 7's utilities and features, you can change that configuration and perform disk-management tasks. Some of the tasks and decisions that you need to consider when you configure disks are file system configuration and disk type configuration. In this chapter, we'll discuss how to configure these by using Disk Management.

For file system configuration, we recommend that you use NTFS, although you could also format the disk drive as FAT32. You can also update a FAT32 partition to NTFS. This chapter covers the features of each file system and how to use the Convert utility to upgrade to NTFS.

Another task in disk management is choosing the configuration for your physical drives. Windows 7 supports basic, dynamic, and the GUID partition table (GPT) disks. When you install Windows 7 or upgrade from Windows 7 using basic disks, the drives are configured as basic disks.

Dynamic disks are supported by Windows 7, Windows Vista, Windows XP Professional, Windows 2000 (all versions), Windows Server 2003, and Windows Server 2008 and allow you to create simple volumes, spanned volumes, and striped volumes.

After you decide how your disks should be configured, you implement the disk configurations through the Disk Management utility. This utility helps you view and manage your physical disks and volumes. In this chapter, you'll learn how to manage both types of storage and how to upgrade from basic storage to dynamic storage.

This chapter also covers other disk-management features such as data compression, data encryption, disk defragmentation, disk cleanup, and disk error checking.

In this chapter, you'll learn how to:

- ◆ Understand the different file systems
- ◆ Identify disk storage types
- ◆ Understand the benefits of NTFS
- ◆ Use disk-management utilities

Configuring File Systems

Each partition (each logical drive that is created on your hard drive) you create under Windows 7 must have a file system associated with it.

When you select a file system, you can select FAT32 or NTFS. You typically select file systems based on the features you want to use and whether you will need to access the file system using other operating systems. If you have a FAT32 partition and want to update it to NTFS, you can use the Convert utility. The features of each file system and the procedure for converting file systems are covered in the following sections.

Selecting a File System

Your file system is used to store and retrieve the files stored on your hard drive. One of the most fundamental choices associated with file management is the choice of your file system's configuration. Microsoft recommends that you use NTFS with Windows 7, because doing so will allow you to take advantage of features such as local security, file compression, and file encryption. You should choose FAT32 if you want to dual-boot your computer with a version of Windows that does not support NTFS because these file systems are backward compatible with other operating systems.

Table 4.1 summarizes the capabilities of each file system, and they are described in more detail in the following sections.

TABLE 4.1: File System Capabilities

FEATURE	FAT32	NTFS
Supporting operating systems	Windows 95 OSR2, Windows 98, Windows Me, Windows 2000, Windows XP, Windows Server 2003, Windows Server 2008, Windows Vista, and Windows 7	Windows NT, Windows 2000, Windows XP, Windows Server 2003, Windows Vista, and Windows 7
Long filename support	Yes	Yes
Efficient use of disk space	Yes	Yes
Compression support	No	Yes
Encryption support	No	Yes
Support for local security	No	Yes
Support for network security	Yes	Yes
Maximum volume size	32 GB	16 TB with 4 KB clusters or 256 TB with 64 KB clusters

WINDOWS 7 FILE SYSTEM SUPPORT

Windows 7 also supports Compact Disk File System (CDFS). However, CDFS cannot be managed. It is used only to mount and read CDs.

Let's start looking at the supported file systems.

FAT32

FAT32 is an updated version of FAT. FAT32 was first shipped with Windows 95 OSR2 (Operating System Release 2), and can be used by Windows 7.

One of the main advantages of FAT32 is its support for smaller cluster sizes, which results in more efficient space allocation than was possible with FAT16. Files stored on a FAT32 partition can use 20 to 30 percent less disk space than files stored on a FAT16 partition. FAT32 supports drive sizes from 512 MB up to 2 TB, although if you create and format a FAT32 partition through Windows 7, the FAT32 partition can only be up to 32 GB. Because of the smaller cluster sizes, FAT32 can also load programs up to 50 percent faster than programs loaded from FAT16 partitions.

The main disadvantages of FAT32 compared to NTFS are that it does not provide as much support for larger hard drives and it does not provide very robust security options. It also offers no native support for disk compression. Now that you understand FAT32, let's take a look at NTFS.

NTFS

NTFS, which was first used with the NT operating system, offers the highest level of service and features for Windows 7 computers. NTFS partitions can be up to 16 TB with 4 KB clusters or 256 TB with 64 KB clusters.

NTFS offers comprehensive folder- and file-level security. This allows you to set an additional level of security for users who access the files and folders locally or through the network. For example, two users who share the same Windows 7 computer can be assigned different NTFS permissions, so that one user has access to a folder but the other user is denied access to that folder.

NTFS also offers disk-management features — such as compression and encryption services — and data recovery features. The disk-management features are covered later in this chapter. The data-recovery features are covered in Chapter 15, "Maintaining and Optimizing Windows 7."

You should also be aware that there are several different versions of NTFS. Every version of Windows 2000 uses NTFS 3.0. Windows 7, Windows Vista, Windows XP, and Windows Server 2003 use NTFS 3.1. NTFS versions 3.0 and 3.1 use similar disk formats, so Windows 2000 computers can access NTFS 3.1 volumes and Windows 7 computers can access NTFS 3.0 volumes.

NTFS 3.1 includes the following features:

- ◆ When files are read or written to a disk, they can be automatically encrypted and decrypted.
- ◆ Reparse points are used with mount points to redirect data as it is written or read from a folder to another volume or physical disk.

- ◆ There is support for sparse files, which are used by programs that create large files but allocate disk space only as needed.
- ◆ Remote storage allows you to extend your disk space by making removable media (for example, external tapes) more accessible.
- ◆ You can use recovery logging on NTFS metadata, which is used for data recovery when a power failure or system problem occurs.

Now that you have seen the differences between FAT32 and NTFS, let's discuss how to change a FAT32 drive to an NTFS drive.

Converting a File System

In Windows 7, you can convert FAT32 partitions to NTFS. File system conversion is the process of converting one file system to another without the loss of data. If you format a drive as another file system, as opposed to converting that drive, all the data on that drive will be lost.

To convert a partition, use the Convert command-line utility. The syntax for the Convert command is as follows:

```
Convert [drive:] /fs:ntfs
```

For example, if you wanted to convert your D drive to NTFS, you'd type the following command from a command prompt:

```
Convert D: /fs:ntfs
```

When the conversion process begins, it will attempt to lock the partition. If the partition cannot be locked — perhaps because the partition contains the Windows 7 operating system files or the system's page file — the conversion won't take place until the computer is restarted.

USING THE Convert COMMAND

You can use the `/v` switch with the Convert command. This switch specifies that you want to use verbose mode, and all messages will be displayed during the conversion process. You can also use the `/NoSecurity` switch that specifies that all converted files and folders will have no security applied by default so they can be accessed by anyone.

In the following steps, you convert your D drive from FAT32 to NTFS. These steps assume that you have a D drive that is formatted with the FAT32 file system.

Perform the following steps to convert a FAT32 partition to NTFS:

1. Copy some folders to the D drive.
2. Select Start, then type **cmd** into the Search box to open a command prompt.
3. In the Command Prompt dialog box, type **Convert D: /fs:ntfs** and press Enter.
4. After the conversion process is complete, close the Command Prompt dialog box.
5. Verify that the folders you copied in step 1 still exist on the partition.

STOPPING A CONVERSION

If you choose to convert a partition from FAT32 to NTFS, and the conversion has not yet taken place, you can cancel the conversion by editing the Registry with the `regedit` command. The key that needs to be edited is `HKEY_LOCAL_MACHINE\System\CurrentControlSet\Control\SessionManager`. The `BootExecute` value should be changed from `autoconv\DosDevices\X: /FS:NTFS to autocheck autochk*`.

After you decide which file system you want to use, you need to decide what disk storage type you want to configure. Let's take a look at some of the disk storage options that you have.

Configuring Disk Storage

Windows 7 supports three types of disk storage: basic, dynamic, and GUID partition table (GPT). Basic storage is backward compatible with other operating systems and can be configured to support up to four partitions. Dynamic storage is supported by Windows 2000, Windows XP, Windows Server 2003, Windows Server 2008, Windows Vista, and Windows 7, and allows storage to be configured as volumes. GPT storage allows you to configure volume sizes larger than 2 TB and up to 128 primary partitions. The following sections describe the basic storage, dynamic storage, and GPT storage configurations.

Basic Storage

Basic storage consists of primary and extended partitions and logical drives. The first partition that is created on a hard drive is called a primary partition and is usually represented as drive C. Primary partitions use all of the space that is allocated to the partition and use a single drive letter to represent the partition. Each physical drive can have up to four partitions and only four partitions. You can set up four primary partitions, or you can have three primary partitions and one extended partition. With an extended partition, you can allocate the space however you like, and each suballocation of space (called a logical drive) is represented by a different drive letter. For example, a 500 GB extended partition could have a 250 GB D partition and a 250 GB E partition.

At the highest level of disk organization, you have a physical hard drive. You cannot use space on the physical drive until you have logically partitioned the physical drive. A partition is a logical definition of hard drive space.

One of the advantages of using multiple partitions on a single physical hard drive is that each partition can have a different file system. For example, the C drive might be FAT32 and the D drive might be NTFS. Multiple partitions also make it easier to manage security requirements.

Basic storage is the default setting, and this is the type that many users continue to use. But what if you want some additional functionality from your storage type? Let's take a look at some of the more advanced disk storage options.

Dynamic Storage

Dynamic storage is a Windows 7 feature that consists of a dynamic disk divided into dynamic volumes. Dynamic volumes cannot contain partitions or logical drives.

Dynamic storage supports three dynamic volume types: simple volumes, spanned volumes, and striped volumes. Dynamic storage also supports software-based Redundant Array of Inexpensive Disks (RAID).

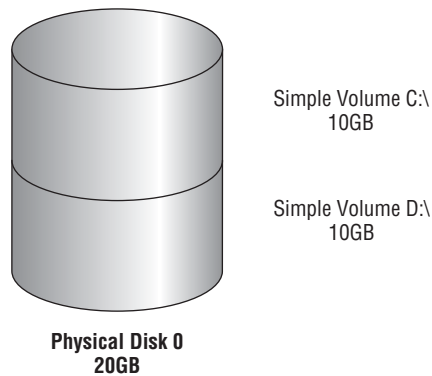
To set up dynamic storage, you create or upgrade a basic disk to a dynamic disk. When you convert a basic disk to dynamic, you do not lose any of your data. After the disk is converted, you can then create dynamic volumes within the dynamic disk.

You create dynamic storage with the Windows 7 Disk Management utility, which we'll explore following the descriptions of the dynamic volume types. Let's take a closer look at the various types of dynamic volumes.

SIMPLE VOLUMES

A simple volume contains space from a single dynamic drive. The space from the single drive can be contiguous or noncontiguous. Simple volumes are used when you have enough disk space on a single drive to hold your entire volume. Figure 4.1 shows two simple volumes on a physical disk.

FIGURE 4.1
Two simple volumes



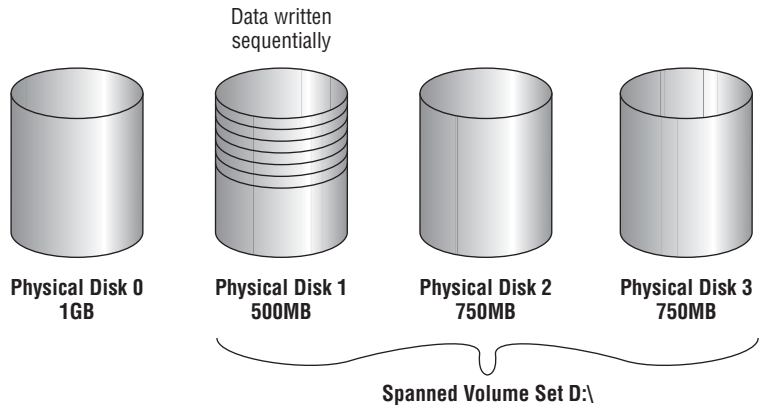
SPANNED VOLUMES

A spanned volume consists of disk space on two or more dynamic drives; up to 32 dynamic drives can be used in a spanned volume configuration. Spanned volume sets are used to dynamically increase the size of a dynamic volume. When you create spanned volumes, the data is written sequentially, filling space on one physical drive before writing to space on the next physical drive in the spanned volume set. Typically, administrators use spanned volumes when they are running out of disk space on a volume and want to dynamically extend the volume with space from another hard drive.

You do not need to allocate the same amount of space to the volume set on each physical drive. This means you could combine a 500 GB partition on one physical drive with two 750 GB partitions on other dynamic drives, as shown in Figure 4.2.

Because data is written sequentially, you do not see any performance enhancements with spanned volumes as you do with striped volumes (which we discuss next). The main disadvantage of spanned volumes is that if any drive in the spanned volume set fails, you lose access to all of the data in the spanned set.

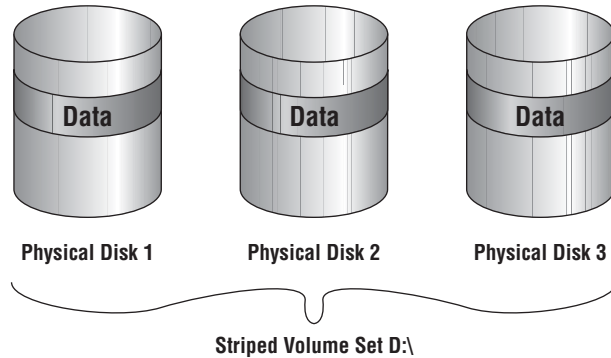
FIGURE 4.2
A spanned volume set



STRIPED VOLUMES

A striped volume stores data in equal stripes between two or more (up to 32) dynamic drives, as shown in Figure 4.3. Because the data is written sequentially in the stripes, you can take advantage of multiple I/O performance and increase the speed at which data reads and writes take place. Typically, administrators use striped volumes when they want to combine the space of several physical drives into a single logical volume and increase disk performance.

FIGURE 4.3
A striped volume set



The main disadvantage of striped volumes is that if any drive in the striped volume set fails, you lose access to all of the data in the striped set.

In the last few years a new storage type has emerged in the Microsoft computer world and as with most new technologies, it also has some advantages over the previous technologies. Let's take a look at the newest advantage to storage types.

GUID Partition Table

The GUID partition table (GPT) is available for Windows 7 and was first introduced as part of the Extensible Firmware Interface (EFI) initiative from Intel. Basic and dynamic disks use the Master Boot Record (MBR) partitioning scheme that all operating systems have been using

for years. Basic and dynamic disks use Cylinder-Head-Sector (CHS) addressing with the MBR scheme.

The GPT disk partitioning system uses the GUID partition table to configure the disk area. GPT uses a newer addressing scheme called Logical Block Addressing (LBA). Another advantage is that the GPT header and partition table is written to both the front and the back end of the disk, which in turn provides for better redundancy.

The GPT disk partitioning system gives you many benefits over using the MBR system, including the following:

- ◆ Allows a volume size larger than 2 TB
- ◆ Allows up to 128 primary partitions
- ◆ Used for both 32-bit or 64-bit Windows 7 editions
- ◆ Includes cyclical redundancy check (CRC) for greater reliability

There is one disadvantage to using the GPT drives. You can only convert a GPT drive if the disk is empty and unpartitioned. We'll show you the steps to creating a GPT disk later in this chapter in the "Upgrading a Basic Disk to a Dynamic or GPT Disk section."

To convert any disk or format any volume or partition, you can use the Disk Management utility. Let's take a look at how to manage your disks using the Disk Management Utility.

Accessing and Managing the Disk Management Utility

The Disk Management utility is a Microsoft Management Console (MMC) snap-in that gives administrators a graphical tool for managing disks and volumes within Windows 7. In this section, you'll learn how to access the Disk Management utility and use it to manage basic tasks, basic storage, and dynamic storage. You will also learn about troubleshooting disks through disk status codes.

But before we dive into the Disk Management utility, let's first take a look at the MMC. It's important to understand the MMC because Disk Management (like many other tools) is actually an MMC snap-in.

Using the MMC

The MMC is the console framework for application management. The MMC provides a common environment for snap-ins. Snap-ins are administrative tools developed by Microsoft or third-party vendors. Some of the MMC snap-ins that you may use are Computer Management, Active Directory Users and Computers, Active Directory Sites and Services, Active Directory Domains and Trusts, and DNS Management.

Knowing how to use and configure the MMC snap-ins allows you to customize your work environment. For example, if you are in charge of Active Directory Users and Computers and DNS, you can add both of these snap-ins into the same window. This would then allow you to just open one application to configure all your tasks.

The MMC offers many other benefits, including the following:

- ◆ The MMC is highly customizable — you add only the snap-ins you need.
- ◆ Snap-ins use a standard, intuitive interface, so they're easier to use than previous versions of administrative utilities.
- ◆ You can save and share MMC consoles with other administrators.

- ◆ You can configure permissions so that the MMC runs in authoring mode, which an administrator can manage, or in user mode, which limits what users can access.
- ◆ You can use most snap-ins for remote computer management.

By default, the MMC console contains three panes: a console tree on the left, a details pane in the middle, and an optional Actions pane on the right, as shown in Figure 4.4. The console tree lists the hierarchical structure of all snap-ins that have been loaded into the console. The details pane contains a list of properties or other items that are part of the snap-in that is highlighted in the console tree. The Actions pane provides a list of actions that the user can access depending on the item selected in the details pane.

FIGURE 4.4
The MMC console tree, details pane, and Actions pane



Accessing the MMC

On a Windows 7 computer, to open the MMC, click Start and type **MMC** in the Search dialog box. When you first open the MMC, it contains only the Console Root folder, as shown in Figure 4.4 earlier. The MMC does not have any default administrative functionality. It is simply a framework used to organize administrative tools through the addition of snap-in utilities.

The first thing that you should decide when you use the MMC is which of the different administrative mode types is best suited for your organization.

CONFIGURING MMC MODES

You can configure the MMC to run in author mode, for full access to the MMC functions, or in one of three user modes, which have more limited access to the MMC functions. To set a console mode, while in the MMC editor, select **File > Options** to open the Options dialog box. In this dialog box, you can select from the console modes listed in Table 4.2.

After you decide which administrative role you are going to run, it's time to start configuring your MMC snap-ins.

TABLE 4.2: MMC Console Modes

CONSOLE MODE	DESCRIPTION
Author mode	Allows use of all the MMC functions.
User mode — full access	Allows users full access to window management commands, but they cannot add or remove snap-ins or change console properties.
User mode — limited access, multiple window	Allows users to create new windows, but not close any existing windows. Users can access only the areas of the console tree that were visible when the console was last saved.
User mode — limited access, single window	Allows users to access only the areas of the console tree that were visible when the console was last saved, and they cannot create new windows.

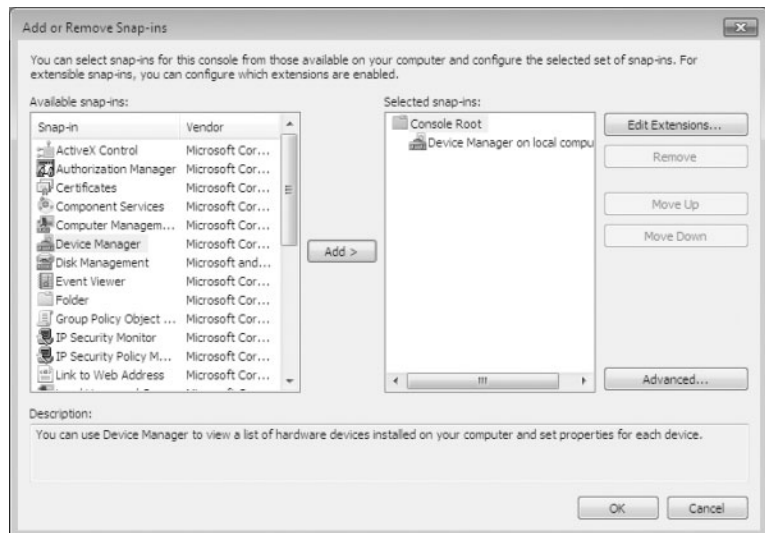
ADDING SNAP-INS

The biggest advantage of using the MMC is to add snap-ins the way your organization needs them. Adding snap-ins is a simple and quick procedure.

Perform the following steps to add snap-ins to the MMC console and save it:

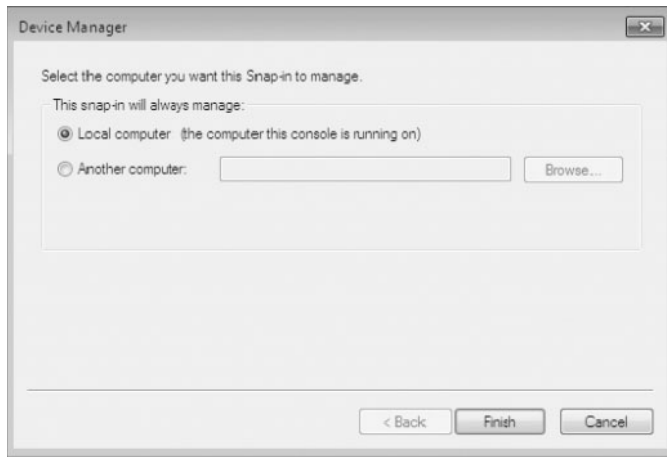
1. To start the MMC editor, click Start, type **MMC** in the Search box, and press Enter.
2. From the main console window, select File ➤ Add/Remove Snap-In to open the Add/Remove Snap-In dialog box.
3. Highlight the snap-in you want to add and click Add, as shown in Figure 4.5.

FIGURE 4.5
The MMC Add Or
Remove Snap-ins screen



4. If prompted, specify whether the snap-in will be used to manage the local computer or a remote computer, as shown in Figure 4.6. Then click Finish.

FIGURE 4.6
Choose between a local
or remote computer.



5. Repeat steps 2 and 3 to add each snap-in you want to include in your console.
6. When you finish adding snap-ins, click OK.
7. Click OK to return to the main console screen.
8. After you have added snap-ins to create a console, you can save it by selecting File > Save As and entering a name for your console.

You can save the console to a variety of locations, including a program group or the Desktop. By default, custom consoles have an .msc extension.

Many applications that are MMC snap-ins, including Disk Management, are already configured for you under the administrative tools section of Windows 7. Now that we have looked at the MMC editor, let's take a look at the Disk Management utility.

Accessing the Disk Management Utility

The Disk Management utility, located under the Computer Management snap-in by default, is a one-stop shop for configuring your disk options.

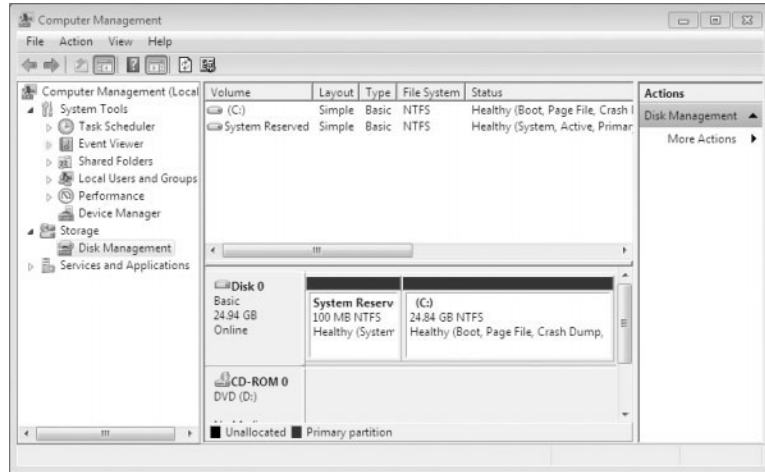
First, to have full permissions to use the Disk Management utility, you must be logged on with Administrative privileges. You can access the Disk Management utility a few different ways. You can right-click Computer from the Start menu and select Manage, and then in Computer Management, select Disk Management. You could also choose Start > Control Panel > Administrative Tools > Computer Management.

The Disk Management utility's opening window, shown in Figure 4.7, shows the following information:

- ◆ The volumes that are recognized by the computer
- ◆ The type of disk, either basic or dynamic
- ◆ The type of file system used by each partition

- ◆ The status of the partition and whether the partition contains the system or boot partition
- ◆ The capacity (amount of space) allocated to the partition
- ◆ The amount of free space remaining on the partition
- ◆ The amount of overhead associated with the partition

FIGURE 4.7
The Disk Management
window



Windows 7 also includes a command-line utility called Diskpart, which you can use as a command-line alternative to the Disk Management utility. You can view all the options associated with the Diskpart utility by typing **Diskpart** at a command prompt, and then typing **?** at the Diskpart prompt.

The Disk Management utility allows you to configure and manage your disks. Let's take a look at some of the tasks that you can perform in Disk Management.

Managing Administrative Hard Disk Tasks

The Disk Management utility allows you to perform a variety of hard drive administrative tasks. These tasks are discussed in the sections that follow:

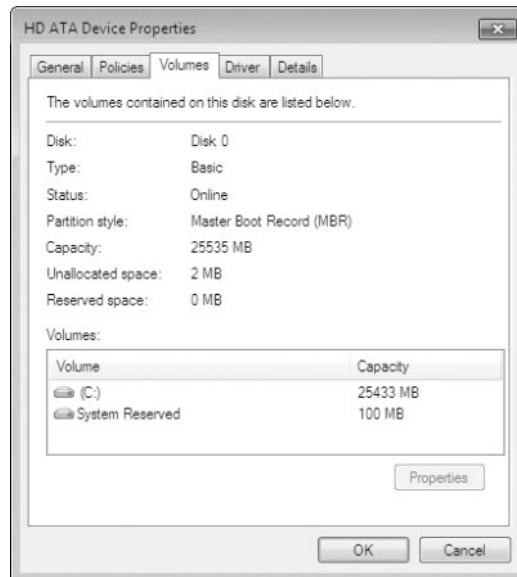
- ◆ Viewing disk properties
- ◆ Viewing volume and local disk properties
- ◆ Adding a new disk
- ◆ Creating partitions and volumes
- ◆ Upgrading a basic disk to a dynamic disk
- ◆ Changing a drive letter and path
- ◆ Deleting partitions and volumes

VIEWING DISK PROPERTIES

To view the properties of a disk, right-click the disk number in the lower panel of the Disk Management main window and choose Properties from the context menu. This brings up the disk's Properties dialog box. Click the Volumes tab, as shown in Figure 4.8, to see the volumes associated with the disk, which contains the following disk properties:

- ◆ The disk number
- ◆ The type of disk (basic, dynamic, CD-ROM, removable, DVD, or unknown)
- ◆ The status of the disk (online or offline)
- ◆ Partition style (MBR)
- ◆ The capacity of the disk
- ◆ The amount of unallocated space on the disk
- ◆ The logical volumes that have been defined on the physical drive

FIGURE 4.8
The Volumes tab of a disk's Properties dialog box



DISK PROPERTIES

If you click the General tab of a disk's Properties dialog box, the hardware device type, the hardware vendor that produced the drive, the physical location of the drive, and the device status are displayed.

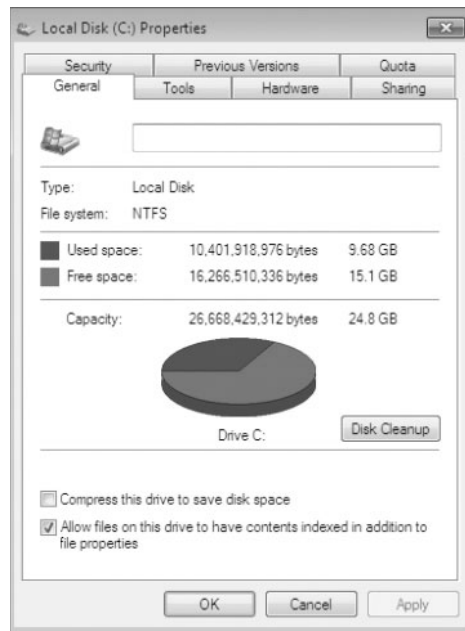
VIEWING VOLUME AND LOCAL DISK PROPERTIES

On a dynamic disk, you manage volume properties. On a basic disk, you manage partition properties. Volumes and partitions perform the same function, and the options discussed in the following sections apply to both. (The examples here are based on a dynamic disk using a simple volume. If you're using basic storage, you'll view the local disk properties rather than the volume properties.)

To see the properties of a volume, right-click the volume in the upper panel of the Disk Management main window and choose Properties. This brings up the volume's Properties dialog box. Volume properties are organized on seven tabs: General, Tools, Hardware, Sharing, Security, Quota, and Previous Versions. The Security and Quota tabs appear only for NTFS volumes. Let's explore all these tabs in detail:

General The information on the General tab of the volume's Properties dialog box, as shown in Figure 4.9, gives you an idea of how the volume is configured. This dialog box shows the label, type, file system, used and free space, and capacity of the volume. The label is shown in an editable text box, and you can change it if desired. The space allocated to the volume is shown in a graphical representation as well as in text form.

FIGURE 4.9
General properties for a volume



The label on a volume or local disk is for informational purposes only. For example, depending on its use, you might give a volume a label such as APPS or ACCTDB.

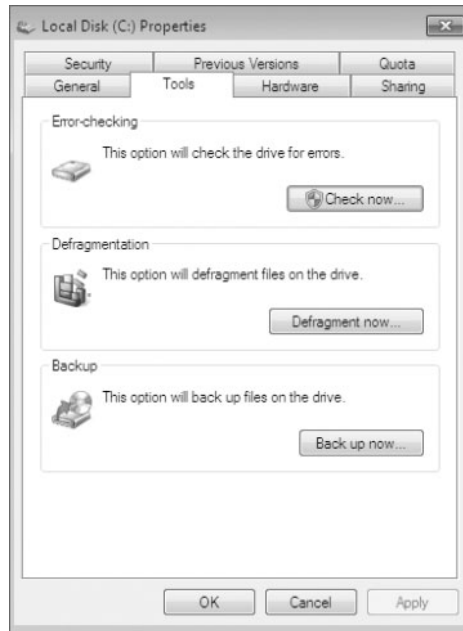
The Disk Cleanup button starts the Disk Cleanup utility, with which you can delete unnecessary files and free disk space. This utility is discussed later in this chapter.

This tab also allows you to configure compression for the volume and to indicate whether the volume should be indexed.

Tools The Tools tab of the volume's Properties dialog box, shown in Figure 4.10, provides access to three tools:

- ◆ Click the Check Now button to run the Error-Checking utility to check the volume for errors. You'd do this if you were experiencing problems accessing the volume or if the volume had been open during a system restart that did not go through a proper shutdown sequence.
- ◆ Click the Defragment Now button to run the Disk Defragmenter utility. This utility defragments files on the volume by storing the files contiguously on the hard drive.
- ◆ Click the Backup Now button to open the Backup Status and Configuration dialog box, which allows you to configure backup procedures.

FIGURE 4.10
The Tools tab of the volume's Properties dialog box

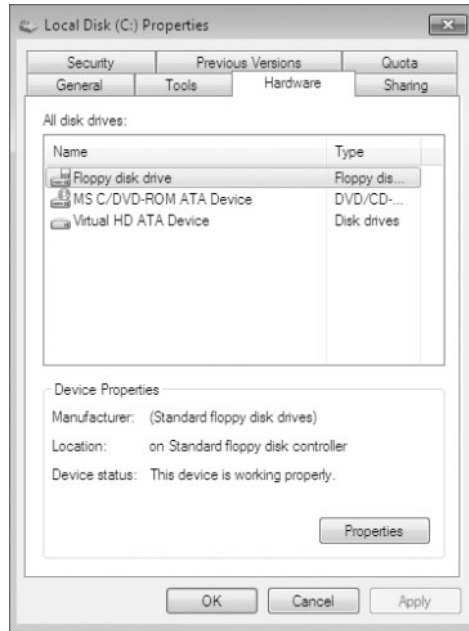


Hardware The Hardware tab of the volume's Properties dialog box, shown in Figure 4.11, lists the hardware associated with the disk drives that are recognized by the Windows 7 operating system. The bottom half of the dialog box shows the properties of the device that's highlighted in the top half of the dialog box.

For more details about a hardware item, highlight it and click the Properties button in the lower-right corner of the dialog box. This brings up a Properties dialog box for the item. Your Device Status field should report that "This device is working properly." If that's not the case, you can click the Troubleshoot button to open a troubleshooting wizard that will help you discover what the problem is.

FIGURE 4.11

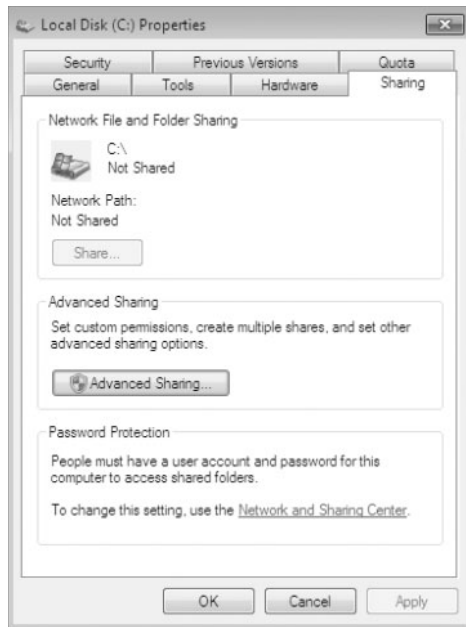
The Hardware tab of the volume's Properties dialog box



Sharing On the Sharing tab of the volume's Properties dialog box, shown in Figure 4.12, you can specify whether or not the volume is shared. Volumes are not shared by default. To share a volume, click the Advanced Sharing button, which lets you specify whether the volume is shared and, if so, what the name of the share should be. You can also specify who will have access to the shared volume.

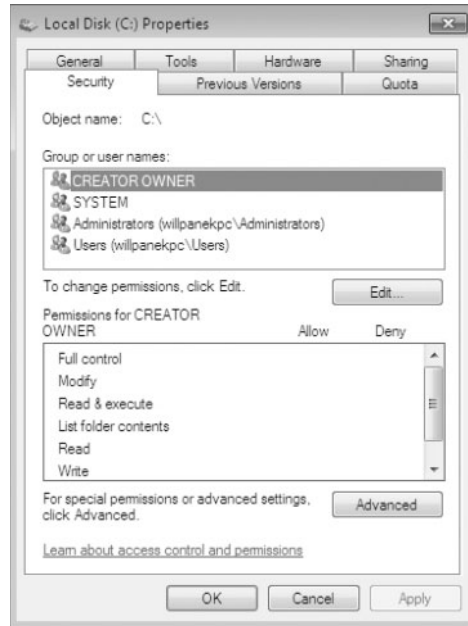
FIGURE 4.12

The Sharing tab of the volume's Properties dialog box



Security The Security tab of the volume’s Properties dialog box, shown in Figure 4.13, appears only for NTFS volumes. Use the Security tab to set the NTFS permissions for the volume.

FIGURE 4.13
The Security tab of the volume’s Properties dialog box



Previous Versions The Previous Versions tab displays shadow copies of the files that are created by System Restore, as shown in Figure 4.14. Shadow copies of files are backup copies created by Windows in the background in order to enable you to restore the system to a previous state. On the Previous Versions tab, you can select a copy of the volume and either view the contents of the shadow copy or copy the shadow copy to another location. If System Restore is not enabled, then shadow copies of a volume will not be created.

Quota Quotas give you the advantage to limit the amount of hard disk space that a user can have on a volume or partition, as shown in Figure 4.15. There are a few options that you can configure when you enable quotas. By default, quotas are disabled. To enable quotas, check the Enable Quota Management check box.

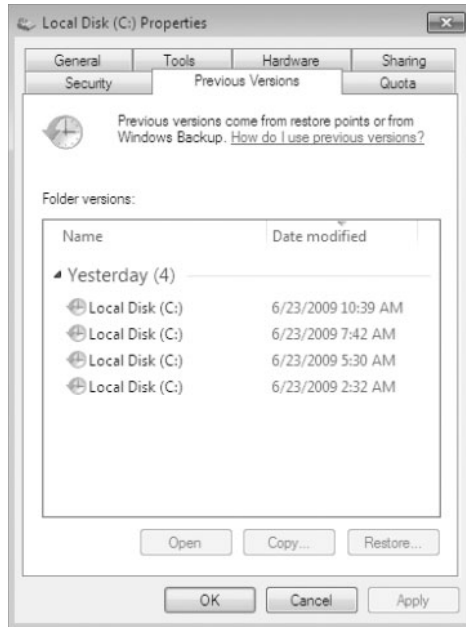
The “Deny disk space to users exceeding quota limit” check box is another option. By enabling this box, any user who exceeds their quota limit is denied disk storage. You can choose not to enable this option and this allows you to just monitor the quotas. You also have the ability to set the quota limit and warning size. You can also choose to log all quota events as they happen.

ADDING A NEW DISK

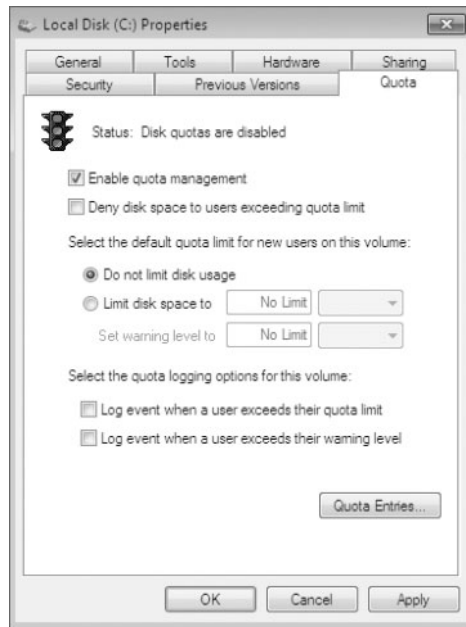
You can add new hard disks to a system in order to increase the amount of disk storage you have. This is a fairly common task that you’ll need to perform as your application programs and files grow larger.

FIGURE 4.14

The Previous Versions tab of the volume's Properties dialog box

**FIGURE 4.15**

The Quota tab of the volume's Properties dialog box



How you add a disk depends on whether your computer supports hot swapping of drives. Hot swapping is the process of adding a new hard drive while the computer is turned on. Most desktop computers do not support this capability. Remember, your user account must be a member of the Administrators group in order to install a new drive. The following list specifies configuration options:

Computer Doesn't Support Hot Swapping If your computer does not support hot swapping, you must first shut down the computer before you add a new disk. Then add the drive according to the manufacturer's directions. When you finish, restart the computer. You should find the new drive listed in the Disk Management utility.

Computer Supports Hot Swapping If your computer does support hot swapping, you don't need to turn off your computer first. Just add the drive according to the manufacturer's directions. Then open the Disk Management utility and select Action > Rescan Disks. You should find the new drive listed in the Disk Management utility.

Creating Partitions and Volumes After you add a new disk, the next step is to create a partition (on a basic disk) or a volume (on a dynamic disk). Partitions and volumes fill similar roles in the storage of data on disks, and the processes for creating them are the same.

CREATING A VOLUME OR A PARTITION

Creating a volume or partition is a fairly easy process. To do so, right-click the unformatted free space and start the wizard. The New Volume Wizard guides you through the process of creating a new volume, as follows:

1. In the Disk Management utility, right-click an area of free storage space and choose the type of volume to create. If only one drive is installed, you'll only be able to create a simple volume. You can click New Simple Volume to create a new simple volume.
2. The Welcome to the New Simple Volume Wizard appears. Click Next.
3. The Select Volume Size screen appears. Select the size of the volume that you want to create and then click Next.
4. Next you see the Assign Drive Letter or Path screen, as shown in Figure 4.16. You can specify a drive letter, mount the volume as an empty folder, or choose not to assign a drive letter or drive path. If you choose to mount the volume as an empty folder, you can have an unlimited number of volumes, negating the drive-letter limitation. If you choose not to assign a drive letter or path, users will not be able to access the volume. Make your selections and click Next.
5. The Format Partition screen appears, as shown in Figure 4.17. This screen allows you to choose whether you will format the volume. If you choose to format the volume, you can format it as FAT32 or NTFS. You can also select the allocation block size, enter a volume label (for information only), specify a quick format, or choose to enable file and folder compression. After you've made your choices, click Next.
6. The Completing the New Volume Wizard screen appears next. Verify your selections. If you need to change any of them, click the Back button to reach the appropriate screen. When everything is correctly set, click Finish.

Now that we created a new volume or partition, let's take a look at how to convert a basic disk to dynamic or GPT.

FIGURE 4.16
The Assign Drive Letter or Path
or Path screen

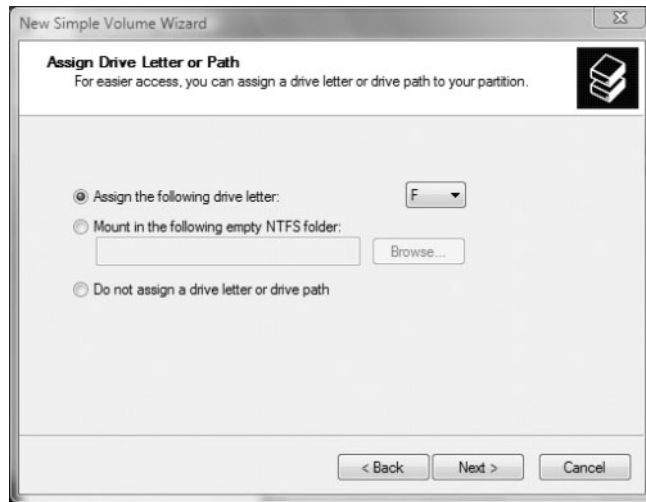
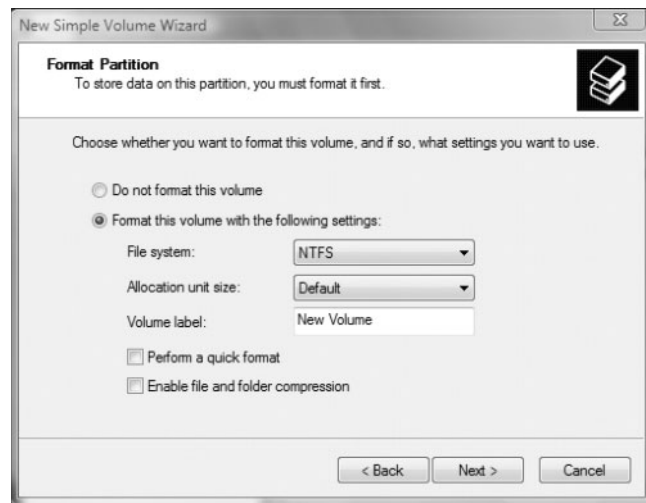


FIGURE 4.17
The Format Partition
screen



UPGRADING A BASIC DISK TO A DYNAMIC OR GPT DISK

When you install a fresh installation of Windows 7, your drives are configured as basic disks. To take advantage of the features offered by Windows 7 dynamic or GPT disks, you must upgrade your basic disks to either dynamic or GPT disks.

UPGRADING DISKS

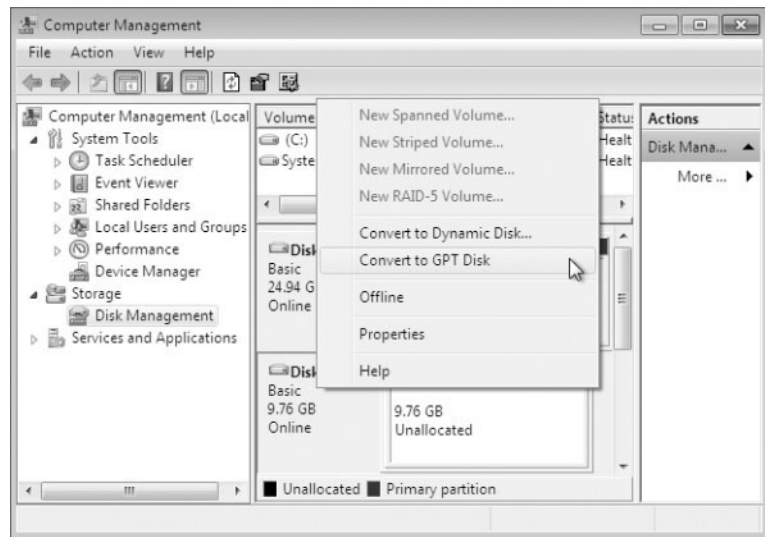
Upgrading basic disks to dynamic disks is a one-way process as far as preserving data is concerned and a potentially dangerous operation. Before you perform this upgrade (or make any major change to your drives or volumes), create a new backup of the drive or volume and verify that you can successfully restore the backup.

You can convert any basic partition to a dynamic disk, but you can only convert unformatted free space to a GPT disk.

Perform the following steps to convert a drive to a GPT:

1. If the volume or partition that you want to convert has data, first delete the partition or volume.
2. Open the Disk Management utility by clicking the Start button, right-click Computers, and choose Manage.
3. Click Disk Management in the lower-left section.
4. Right-click the drive letter and choose Convert To GPT Disk, as shown in Figure 4.18.

FIGURE 4.18
Choosing Convert
To GPT Disk



5. After the disk converts, you can right-click the disk and see that the Convert To MBR Disk is now available.

CONVERTING TO A GPT DISK

There are a few other methods for converting a basic disk to a GPT disk. You can use the Diskpart utility and type in the **Convert GPT** command. You can also create a GPT disk when you first install a new hard drive. After you install the new hard drive, during the initialization phase, you can choose GPT Disk.

Another type of conversion that you might need to perform is converting a basic disk to a dynamic disk.

Follow these steps to convert a basic disk to a dynamic disk:

1. In the Disk Management utility, right-click the disk you want to convert and select the Convert To Dynamic Disk option.
2. In the Convert To Dynamic Disk dialog box, check the disk that you want to upgrade and click OK.
3. In the Disks To Convert dialog box, click Convert.
4. confirmation dialog box warns you that you will no longer be able to boot previous versions of Windows from this disk. Click Yes to continue to convert the disk.



Real World Scenario

BENEFITS OF CONVERTING DISKS

For many years as IT managers we used just basic disks. There's a huge disadvantage to just using basic disks. Basic disks can't be extended without the use of a third-party utility. One problem that many IT managers ran into related to home folder storage. Home folders are storage areas on the server for your users. Users store data on the home folders and that data can then be backed up.

The main issue with home folders is that the space you give your users is never enough. The home folders tend to fill up your hard drive or partition. With basic disks, you could not extend the partition. But one of the advantages of dynamic disks is that they can be extended (as long as they are formatted with NTFS). Now if the hard disk or volume fills up, just extend the volume to a free area on the hard disk or add another hard drive. This is a huge advantage to anyone who has dealt with hard drives or partitions filling up.

As you are configuring the volumes or partitions on the hard drive, another thing that you might need to configure is the drive letter and paths.

CHANGING THE DRIVE LETTER AND PATH

There might be times when you need to change drive letters and paths when you add new equipment. Let's suppose that you have a hard drive with two partitions; drive C assigned as your first partition and drive D assigned as your second partition. Your DVD-ROM is

assigned the drive letter of E. You add a new hard drive and partition it as a new volume. By default, the new partition is assigned as drive F. If you want your logical drives to appear listed before the DVD-ROM drive, you can use the Disk Management utility's Change Drive Letter And Paths option to rearrange your drive letters.

When you need to reassign drive letters, right-click the volume for which you want to change the drive letter and choose Change Drive Letter And Paths. This brings up the dialog box shown in Figure 4.19. Click the Change button to access the Change Drive Letter Or Path dialog box, as shown in Figure 4.20. Use the drop-down list next to the Assign The Following Drive Letter option to select the drive letter you want to assign to the volume.

FIGURE 4.19
The dialog box for changing a drive letter or path

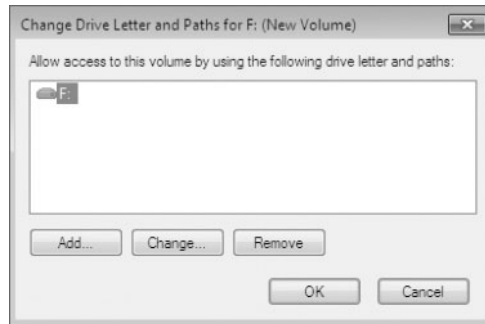
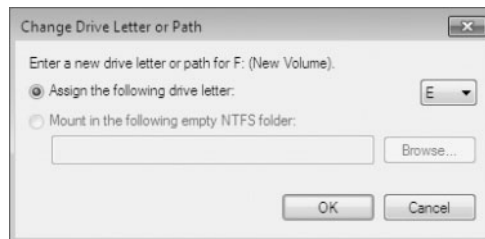


FIGURE 4.20
Editing the drive letter



Perform the following steps to edit the drive letter of the partition you created:

1. Select Start > Control Panel > System And Maintenance > Administrative Tools. Double-click Computer Management; then expand Storage and then Disk Management.
2. Right-click a drive that you have created and select Change Drive Letter And Paths.
3. In the Change Drive Letter And Paths dialog box, click Change.
4. In the Change Drive Letter Or Path dialog box, select a new drive letter and click OK.
5. In the dialog box that appears, click Yes to confirm that you want to change the drive letter.

Another task that you might need to perform is deleting a partition or volume that you have created. The next section looks at these tasks.

DELETING PARTITIONS AND VOLUMES

When you configure your hard disks, there may be a time that you want to reconfigure your drive by deleting the partitions or volumes on the hard drive. You may also want to delete

a volume so that you can extend another volume. You can configure these tasks in Disk Management.

When you delete a volume or partition, you see a warning that all the data on the partition or volume will be lost. You have to click yes to confirm that you want to delete the volume or partition. This confirmation is important because after you delete a partition or volume, it's gone for good.

DELETING SYSTEM VOLUMES

The system volume, the boot volume, or any volume that contains the active paging (swap) file can't be deleted through the Disk Management utility. If you are trying to remove these partitions because you want to delete Windows 7, you can use a third-party disk-management utility.

In the following steps, you will delete a partition that you have created. When you delete a partition or volume, make sure that it's an empty partition or volume or back up all the data before the deletion.

1. In the Disk Management utility, right-click the volume or partition that you want to remove and choose Delete Volume.
2. A warning box appears stating that after this volume is deleted, all data will be lost. Click Yes. The volume will be removed and the area will be returned as unformatted free space.

Now that we've looked at some of the basic tasks of Disk Management, let's explore how to manage storage.

Managing Dynamic Storage

The Disk Management utility offers support for managing storage. You can create, delete, and format partitions or volumes on your hard drives. You can also extend or shrink volumes on dynamic disks. Additionally, you can delete volume sets and striped sets. The first topic we'll cover is dynamic storage and volumes.

As noted previously in this chapter, a dynamic disk can contain simple, spanned, or striped volumes. With the Disk Management utility you can create volumes of each type. You can also create an extended volume, which is the process of adding disk space to a single simple volume. The following sections describe these disk-management tasks.

Creating Simple, Spanned, and Striped Volumes

As explained previously in "Creating Partitions and Volumes," you use the New Volume Wizard to create a new volume. To start the New Volume Wizard, in the Disk Management utility right-click an area of free space where you want to create the volume. Then you can choose the type of volume you want to create: Simple, Spanned, or Striped.

When you choose to create a spanned volume, you are creating a new volume from scratch that includes space from two or more physical drives, up to a maximum of 32 drives.

When you choose to create a striped volume, you are creating a new volume that combines free space from two to 32 drives into a single logical partition. The free space on all drives must

be equal in size. Data in the striped volume is written across all drives in 64 KB stripes. (Data in spanned and extended volumes is written sequentially.)

Striped volumes are RAID 0 because striped volumes do not offer any type of redundancy. Striped volumes offer you better performance and are normally used for temporary files or folder. The problem with a striped volume is if you lose one of the drives in the volume, the entire striped volume is lost.

Another option that you have with volumes is extending the volumes to create a larger storage area, which we discuss in the next section.

Creating Extended Volumes

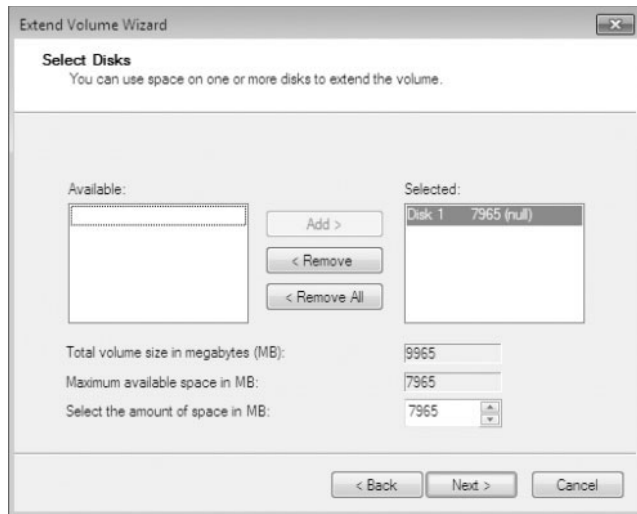
When you create an extended volume, you are taking a single, simple volume (maybe one that is almost out of disk space) and adding more disk space to it, using free space that exists on the same physical hard drive. When the volume is extended, it is seen as a single drive letter. To extend a volume, the simple volume must be formatted as NTFS. You cannot extend a system or boot partition.

An extended volume assumes that you are using only one physical drive. A spanned volume assumes that you are using two or more physical drives.

Perform the following steps to create an extended volume:

1. In the Disk Management utility, right-click the volume you want to extend and choose Extend Volume.
2. The Extend Volume Wizard starts. Click Next.
3. The Select Disks screen appears, as shown in Figure 4.21. You can specify the maximum size of the extended volume. The maximum size you can specify is determined by the amount of free space that exists in all of the dynamic drives on your computer. Click Next.

FIGURE 4.21
The Select Disks screen



4. The Completing The Extend Volume Wizard screen appears. Click Finish.

After a volume is extended, no portion of the volume can be deleted without losing data on the entire set. (However, you can shrink a volume without losing data by using the Shrink Volume option in Disk Management.)



Real World Scenario

YOU'RE RUNNING OUT OF DISK SPACE

Crystal, a user on your network, is running out of disk space. The situation needs to be corrected so she can be brought back up and running as quickly as possible. Crystal has a 250 GB drive (C) that runs a very large customer database. She needs additional space added to the C drive so the database will recognize the data, because it must be stored on a single drive letter. Crystal's computer has a single IDE drive with nothing attached to the second IDE channel.

You have two basic options for managing space in these circumstances. One is to upgrade the disk to a larger disk, but this will necessitate reinstalling the OS and the applications and restoring the user's data. The other choice is to add a temporary second drive and extend the volume. This will at least allow Crystal to be up and running — but it should not be considered a permanent solution. If you do choose to extend the volume, and then either drive within the volume set fails, the user will lose access to both drives. When Crystal's workload allows time for maintenance, you can replace the volume set with a single drive.

One issue that you might run into with hard drives is that they go bad from time to time. In case you have never heard a hard drive fail, it is a distinct clicking. Once you experience it, you will never forget it. When drives go bad, Disk Management can help determine which drive and what the issue may be. In the next section, we'll look at hard disk errors.

Troubleshooting Disk Management

You can use the Disk Management utility to troubleshoot disk errors through a set of status codes; however, if a disk will not initialize, no status code is displayed. Disks will not initialize if there is no valid disk signature.

The problem with disk errors is that you don't know when a disk fails or which disk failed. Disk Management can help you with this. When disks have problems or errors, status codes are assigned. Knowing what these codes mean will help you determine what the problem is, but more importantly, what steps you need to take to fix the problem.

In this section we'll discuss many of the error codes that Disk Management can issue to the disk, volume, or partition.

Using Disk Management Status Codes

The main window of the Disk Management utility displays the status of disks and volumes. The following list contains the possible status codes and a description of each code; these are very useful in troubleshooting disk problems.

Online Indicates that the disk is accessible and that it is functioning properly. This is the normal disk status.

Online (Errors) Indicates that I/O errors have been detected on the dynamic disk. Only used with dynamic disks. One possible fix for this error is to right-click the disk and select Reactivate Disk to attempt to return the disk to Online status. This fix will work only if the I/O errors were temporary. You should immediately back up your data if you see this error and suspect that the I/O errors are not temporary.

Healthy Specifies that the volume is accessible and functioning properly.

Healthy (At Risk) Indicates that a dynamic volume is currently accessible, but I/O errors have been detected on the underlying dynamic disk. This option is usually associated with Online (Errors) for the underlying disk.

Offline or Missing Indicates that the disk is not accessible. Used only with dynamic disks. This error can occur if the disk is corrupted or the hardware has failed. If the error is not caused by hardware failure or major corruption, you may be able to re-access the disk by using the Reactivate Disk option to return the disk to Online status. If the disk was originally offline and then the status changed to Missing, it indicates that the disk has become corrupted, has been powered down, or was disconnected.

Unreadable Indicates that the disk is inaccessible and might have encountered hardware errors, corruption, or I/O errors or that the system disk configuration database is corrupted. This can occur on basic or dynamic disks. This message may also appear when a disk is spinning up while the Disk Management utility is rescanning the disks on the computer.

Failed Specifies that the volume can't be started. Can be seen with basic or dynamic volumes. This error can occur because the disk is damaged or the file system is corrupted. If this message occurs with a basic volume, you should check the underlying disk hardware. If the error occurs on a dynamic volume, verify that the underlying disks are Online.

Unknown Occurs if the boot sector for the volume becomes corrupted — for example, from a virus. Used with basic and dynamic volumes. This error can also occur if no disk signature is created for the volume.

Incomplete Occurs when you move some, but not all, of the disks from a multidisk volume. If you do not complete the multivolume set, then the data will be inaccessible.

Foreign Occurs if you move a dynamic disk from a computer running Windows 2000 (any version), Windows XP Professional, Windows Vista, Windows Server 2003, or Windows Server 2008 to a Windows 7 computer. This error is caused because configuration data is unique to computers where the dynamic disk was created. You can correct this error by right-clicking the disk and selecting the option Import Foreign Disks. Any existing volume information will then be visible and accessible.

Besides knowing the error codes, you might face other issues that can arise when installing or configuring disks. One issue that might occur is that a disk fails to initialize when installed.

Troubleshooting Disks That Fail to Initialize

When you add a new disk to your computer in Windows 7, the disk does not initially contain a disk signature, which is required for the disk to be recognized by Windows. Disk signatures are at the end of the sector marker on the Master Boot Record (MBR) of the drive.

When you install a new drive and run the Disk Management utility, a wizard starts and lists all new disks that have been detected. The disk signature is written through this process. If

you cancel the wizard before the disk signature is written, you see the disk status Not Initialized. To initialize a disk, right-click the disk you want to initialize and select the Initialize Disk option.

As you have seen, Disk Management can be a useful tool in your computer management arsenal. If you decide to format your partition or volume using NTFS, you then receive added benefits like compression, encryption, quotas, and security. In the next section, we'll explore some of these benefits.

Managing Data Compression

One of the advantages of using NTFS over FAT32 is the ability to compress data. There's a well-known infomercial where people put all of their blankets into a large bag and then they hook a vacuum to the bag and suck all the air out. This is a great example of how compression works. Data compression is the process of storing data in a form that takes less space than uncompressed data.

If you have ever "zipped" or "packed" a file, you have used a form of data compression. The compression algorithms support cluster sizes only up to 4 KB, so if you are using larger cluster sizes, NTFS compression support is not available. If you have the Modify permission on an NTFS volume, you can manage data compression through Windows Explorer or the Compact command-line utility.

Files as well as folders in the NTFS file system can be either compressed or uncompressed. Files and folders are managed independently, which means that a compressed folder can contain uncompressed files, and an uncompressed folder can contain compressed files.

Access to compressed files by applications is transparent. For example, if you access a compressed file through Microsoft Word, the file will be uncompressed automatically when it is opened and then automatically compressed again when it is closed.

Compression happens quickly, but if, for example, you compress a 500 GB hard drive, we can't guarantee that there won't be any lag time on your machine or server.

Data compression is available only on NTFS partitions. Because of this, if you copy or move a compressed folder or file to a FAT32 partition, Windows 7 automatically uncompresses the folder or file.

Certain system files (for example, `Pagefile.sys`) can't be compressed. You also have the ability to show compressed files and folders with an alternate color.

Perform the following steps to compress and uncompress folders and files:

1. Select Start > Run, type **Explorer**, and click OK.
2. In Windows Explorer, find and select Computer, the Local Disk (C), and then a folder on the C drive. The folder you select should contain files.
3. Right-click the folder and select Properties. In the General tab of the folder's Properties dialog box, note the value listed for Size On Disk. Then click Advanced.
4. In the Advanced Attributes dialog box, check the Compress Contents To Save Disk Space option, as shown in Figure 4.22. Then click OK.
5. In the Confirm Attribute Changes dialog box, select the option Apply Changes To This Folder, Subfolders and Files. (If this confirmation dialog box does not appear, you can display it by clicking the Apply button in the Properties dialog box.) Click OK to confirm your changes.

FIGURE 4.22
Advanced Attributes
screen



6. On the General tab of the folder's Properties dialog box, note the value that now appears for Size On Disk. This size should have decreased because you compressed the folder.

To uncompress folders and files, repeat the steps of this exercise and uncheck the Compress Contents To Save Disk Space option in the Advanced Attributes dialog box.

As I said previously, you can specify that compressed files be displayed in a different color from the uncompressed files. To do so, in Windows Explorer, select Organize > Folder And Search Options > View. Under Files And Folders, check the Show Encrypted Or Compressed NTFS Files In Color option.

Besides compressing files and folders in Windows Explorer, you can also compress the files and folders using the Compact command-line utility.

Using the Compact Command-Line Utility

The command-line options for managing file and folder compression are Compact and Expand. You can access these commands from a command prompt. Using the Compact utility offers you more control over file and folder compression than Windows Explorer. For example, you can use the Compact command with a batch script or to compress only files that meet a specific criterion (for example, all the .doc files in a specific folder). Some of the options that you can use with the Compact command are shown in Table 4.3.

Another way that you can save space is by zipping folders. In the following section we'll discuss how to save space using zipped folders.

Using Compressed (Zipped) Folders

Windows 7 also supports compressed (zipped) folders. This feature is different from NTFS compressed folders. The advantage of using compressed (zipped) folders is that they are supported on FAT32 or NTFS volumes. In addition, you can use compressed (zipped) folders to share data with other programs that use zipped files. The downside to using compressed (zipped) folders is that it is slower than using NTFS compression.

Within Windows Explorer you create a zipped folder (or file) by right-clicking a folder and selecting Send To > Compressed (Zipped) Folder. You create a zipped file by right-clicking a file and selecting New > Compressed (Zipped) Folder. When you create a compressed folder, it displays as a folder with a zipper.

TABLE 4.3: Compact and Expand Commands

OPTION	PURPOSE
/C	Compresses the specified file or folder
/U	Uncompresses the specified file or folder
/S:dir	Specifies which folder should be compressed or uncompressed
/A	Displays any files that have hidden or system file attributes
/I	Indicates that any errors should be ignored
/F	Forces a file to be compressed
/Q	Reports only critical information, when used with reporting
/?	Displays help

Compression is a nice advantage to using NTFS; another advantage is data encryption. In the following section you'll learn the benefits of using data encryption.

Managing Data Encryption with EFS

Data encryption is a way to increase data security. Encryption is the process of translating data into code that is not easily accessible to users other than the person who encrypted the data. After data has been encrypted, you must have the correct key (SID number) to decrypt the data. Unencrypted data is known as plain text, and encrypted data is known as cipher text.

The Encrypting File System (EFS) is the Windows 7 technology that is used to store encrypted files on NTFS partitions. Encrypted files add an extra layer of security to your file system. A user with the proper key can transparently access encrypted files. A user without the proper key is denied access. If the user who encrypted the files is unavailable, you can use the data recovery agent (DRA) to provide the proper key to decrypt folders or files.

The EFS features included with Windows 7 include some of the following:

- ◆ The ability to automatically color-code encrypted files in green text, so you can easily identify files that have been encrypted
- ◆ Support so that offline folders can also be encrypted
- ◆ A shell user interface (UI) that is used to support encrypted files for multiple users
- ◆ Control over who can read the encrypted files

In the following sections you'll learn how to encrypt and decrypt data, create and manage DRAs, recover encrypted files, share encrypted files, and use the Cipher utility.

Encrypting and Decrypting Folders and Files

To use EFS, a user specifies that a folder or file on an NTFS partition should be encrypted. The encryption is transparent to users. However, when other users try to access the file, they will

not be able to unencrypt the file — even if those users have Full Control NTFS permissions. Instead, they receive an error message.

COMPRESSION AND ENCRYPTION

Windows 7 does not allow you to have a folder or file compressed and encrypted at the same time. A feature included with Windows Server 2003 and Windows Server 2008 is support for concurrent compression and encryption.

Perform the following steps to use EFS to encrypt a folder. Before you encrypt any data, first you must create a new user.

1. To create a new user, select Start > Control Panel > System And Maintenance > Administrative Tools. Under System Tools, expand Local Users And Groups and right-click the Users folder. Choose New User.
2. Create a new user named Paige and make her password **P@ssw0rd**. Deselect the User Must Change Password At Next Logon option for this user. Click Create.
3. Close Computer Management.
4. Select Start and type **Explorer** in the Search box.
5. In Windows Explorer, find and select a folder on the C drive. The folder you select should contain files. Right-click the folder and select Properties.
6. On the General tab of the folder's Properties dialog box, click Advanced.
7. In the Advanced Attributes dialog box, check the Encrypt Contents To Secure Data option. Then click OK.
8. In the Confirm Attribute Changes dialog box (if this dialog box does not appear, click the Apply button in the Properties dialog box to display it), select Apply Changes To This Folder, Subfolders And Files. Then click OK.
9. Log off as Administrator and log on as Paige.
10. Open Windows Explorer and attempt to access one of the files in the folder you encrypted. You should receive an error message stating that the file is not accessible.
11. Log off as Paige and log on as Administrator.

To decrypt folders and files, repeat these steps, but uncheck the Encrypt Contents To Secure Data option in the Advanced Attributes dialog box.

The problem with encryption is that no one but the user who encrypts the data is the only one who can open the files. But the owner of the data can share the encrypted files with other users. In the next section, we'll look at how to share your encrypted data with other users.

Managing EFS File Sharing

In Windows 7, it is possible to share encrypted files with another person or between two computers. To share encrypted files, you must have a valid EFS certificate for the user who should have access to the file. By implementing EFS file sharing, you provide an additional level of recovery in the event that the person who encrypted the files is unavailable.

Perform the following steps to implement EFS file sharing:

1. Encrypt the file if it is not already encrypted (see the previous section for the steps involved).
2. Through Windows Explorer, access the encrypted file's properties. At the bottom of the dialog box, click Advanced.
3. The Advanced Attributes dialog box appears. In the Compress Or Encrypt Attributes section of the Advanced Attributes dialog box, click the Details button, which brings up the Encryption Details dialog box.
4. In the Encryption Details dialog box, click the Add button to add any additional users (provided they have a valid certificate for EFS in Active Directory or that you have imported a valid certificate onto the local computer) who should have access to the encrypted file.
5. Close the Properties box for the folder.

One issue that you might run into is if someone has encrypted files or folders and then they leave the company. There are a few ways to unencrypt the data. In the next section we'll show you how to recover encrypted data.

Using the DRA to Recover Encrypted Data

If the user who encrypted the folders or files is unavailable or no longer with the company and they can't decrypt the folders or files, you can use the data recovery agent (DRA) to access the encrypted files. DRAs are implemented differently depending on the version of your operating system and the configuration of your computer.

- ◆ For Windows 7 computers that are a part of a Windows Server 2008 Active Directory domain, the domain Administrator user account is automatically assigned the role of DRA.
- ◆ For Windows 7 computers that are installed as stand-alone computers or if the computer is a part of a workgroup, no default DRA is assigned.

You should use extreme caution when using EFS on a stand-alone Windows 7 computer. If the key used to encrypt the files is lost, there is no default recovery process, and all access to the files will be lost.

Creating a DRA on a Stand-Alone Windows 7 Computer

If you install Windows 7 on a stand-alone computer or on a computer that is part of a workgroup, then no DRA is created by default. To manually create a DRA, use the Cipher command-line utility as follows:

```
Cipher /R:filename
```

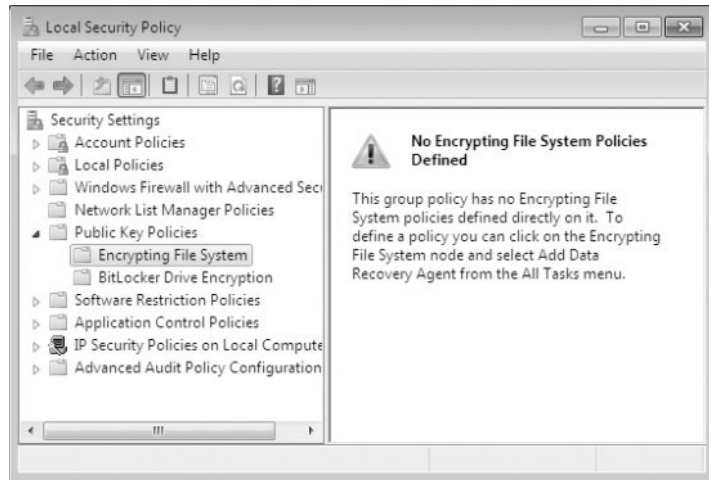
The /R switch is used to generate two files, one with a .pfx extension and one with a .cer extension. The .pfx file is used for data recovery, and the .cer file includes a self-signed EFS recovery agent certificate.

The .cer file (self-signed public key certificate) can then be imported by an administrator into the local security policy, and the .pfx file (private key) can be stored by an administrator in a secure location. Cipher is explained further in the next section.

After you create the public and private keys to be used with EFS, perform the following steps to specify the DRA through Local Security Policy:

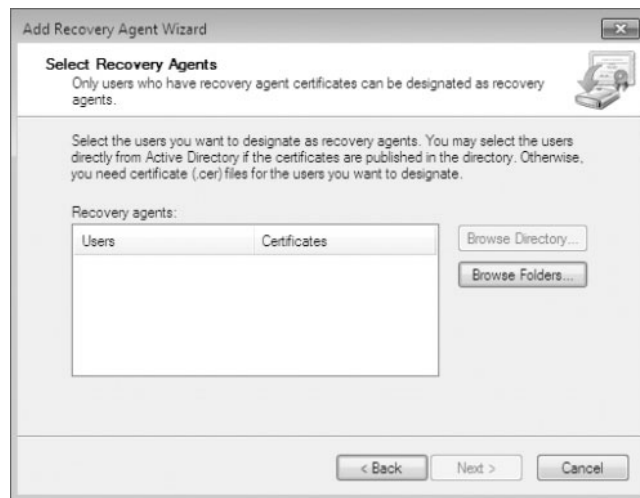
1. Through Local Security Policy, which you can access through Administrative Tools or the Local Computer Policy MMC snap-in, expand Public Key Policies and then Encrypting File System, as shown in Figure 4.23.

FIGURE 4.23
Encrypting File System
in Local Policies



2. Right-click Encrypting File System and select Add Data Recovery Agent.
3. The Add Recovery Agent Wizard starts. Click Next to continue.
4. The Select Recovery Agents screen appears, as shown in Figure 4.24. Click the Browse Folders button to access the .cer file you created with the Cipher /R: filename command. Select the certificate and click Next.

FIGURE 4.24
The Select Recovery
Agents screen of the Add
Recovery Agent Wizard



5. The Completing The Add Recovery Agent Wizard screen appears. Confirm that the settings are correct and click Finish.

You will see the data recovery agent listed in the Local Security Settings dialog box, under Encrypting File System. Let's continue encryption with recovering encrypted files in the next section.

Recovering Encrypted Files

If the DRA has the private key to the DRA certificate (that was created through Cipher */R:filename*), the DRA can decrypt files in the same manner as the user who originally encrypted the file. After the encrypted files are opened by a DRA, they are available as unencrypted files and can be stored as either encrypted or unencrypted files.

Using the Cipher Utility

Cipher is a command-line utility that you can use to encrypt files on NTFS volumes. The syntax for the Cipher command is as follows:

```
Cipher /[command parameter] [filename]
```

Table 4.4 lists common command parameters associated with the Cipher command. This list is only a partial representation of all the Cipher commands.

TABLE 4.4: Cipher Command Parameters

PARAMETER	DESCRIPTION
/E	Specifies that files or folders should be encrypted. Any files that are subsequently added to the folder will be encrypted.
/D	Specifies that files or folders should be decrypted. Any files that are subsequently added to the folder will not be encrypted.
/S:dir	Specifies that subfolders of the target folder should also be encrypted or decrypted based on the option specified.
/I	Causes any errors that occur to be ignored. By default, the Cipher utility stops whenever an error occurs.
/H	Specifies that hidden and system files should be displayed. By default, files with hidden or system attributes are omitted from display.
/K	Creates a new certificate file and certificate key.
/R	Generates a recovery agent key and certificate for use with EFS.
/X	Backs up the EFS certificate and keys into the specified file name.

Perform the following steps to use the Cipher utility to encrypt files. Make sure that you have encrypted a folder on the C drive before you complete these steps.

1. Select Start > All Programs > Accessories > Command Prompt.
2. In the Command Prompt dialog box, type **C:** and press Enter to access the C drive.
3. At the C:\> prompt, type **cipher**. You'll see a list of folders and files and the state of encryption. The folder you encrypted should be indicated by an E.
4. Type **MD TEST** and press Enter to create a new folder named Test.
5. Type **cipher /e test** and press Enter. You'll see a message verifying that the folder was encrypted.

By now you have seen many of the advantages of using NTFS to format your volumes and partitions. Next we'll look at how to keep these volumes and partitions running at peak performance.

Using Disk Maintenance Tools

As an IT professional, part of our job is to keep our systems running the best way that they can. Most of us have seen machines running quickly when they are new but then they start to slow down over time — even when we do not install any new software.

Microsoft Windows 7 includes a few utilities that you can run to help keep your system running efficiently. In the next sections we'll discuss three of these utilities: Disk Defragment, Disk Cleanup, and Check Disk.

Running the Disk Defragment Utility

Data is normally stored sequentially on the disk as space is available. Fragmentation naturally occurs as users create, delete, and modify files. The access of noncontiguous data is transparent to the user; however, when data is stored in this manner, the operating system must search through the disk to access all the pieces of a file. This slows down data access.

Disk defragmentation rearranges the existing files so they are stored contiguously, which optimizes access to those files. In Windows 7, you use the Disk Defragmenter utility to defragment your disk.

The Disk Defragmenter window displays, as shown in Figure 4.25; you can schedule when the Disk Defragmenter should run or run the Disk Defragmenter tool immediately.

You can also defragment disks through the command-line utility, Defrag. The disk needs to have at least 15 percent free space for Defrag to run properly. You can analyze the state of the disk by using Defrag VolumeName /a.



Real World Scenario

DISK DEFRAGMENT ISSUES

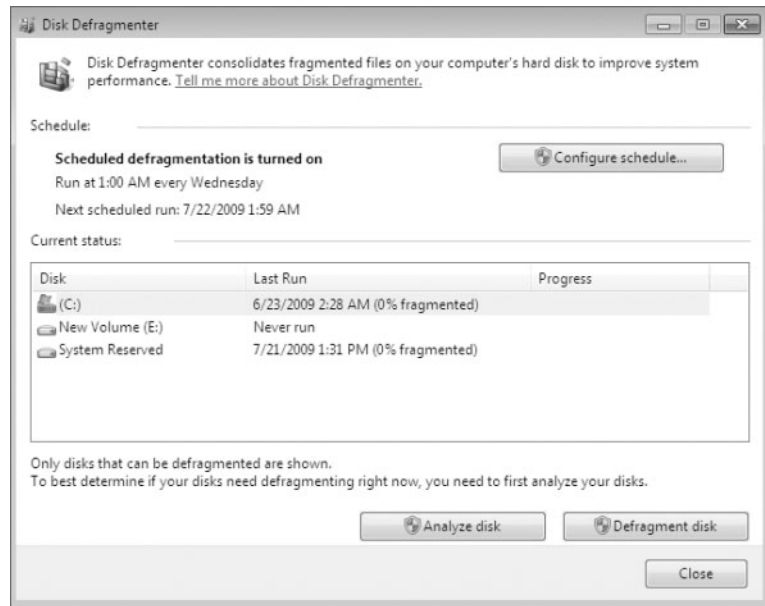
One issue that we have run into with Disk Defragment is the amount of time the process might take to complete. When a client asks us to make their machine quicker, one thing we always do is run the Disk Defragment utility, but the problem is that most users have never run it before.

Because most users haven't run the utility before, it could take hours to defrag a machine. It is important to inform your users to run this utility on a regular basis or set it to run automatically.

Another issue with Disk Defragment is your antivirus programs. Make sure that all programs are closed (including antivirus software) before running the Disk Defragment utility.

If applications are open when the Disk Defragment utility runs, it could cause the Disk Defragment utility to stop working or run even slower than normal.

FIGURE 4.25
The Disk Defragmenter
window



Perform the following steps to defragment your Windows 7 machine:

1. Start the Disk Defragmenter utility by opening Computer Management.
2. Right-click the C drive and choose Properties.
3. Click the Tools tab.
4. Click the Defragment Now button.
5. Either schedule a defragment or click the Defragment Disk button to start the defragment immediately.

It is a good practice to run the disk defragmenter at least once a week on a Windows 7 machine that is constantly being used. If the machine is not used that often, you can space out how often you defrag the machine.

In the next section we'll discuss another tool that is included with Windows 7: the Disk Cleanup utility.

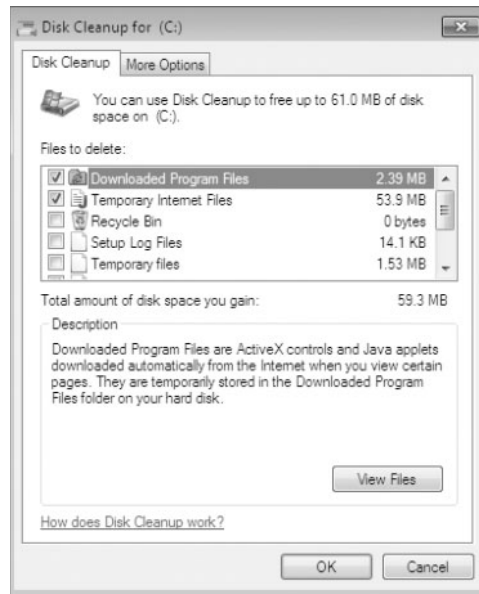
Running the Disk Cleanup Utility

One concern that most IT professionals face is how to conserve hard disk space for users. Hard drives continue to get larger and larger but so do applications. This is where the Disk Cleanup utility can help.

When the Disk Cleanup utility runs, it calculates the amount of disk space you can free up. Perform the following steps to run the Disk Cleanup utility:

1. Select Start > Control Panel > System And Maintenance > Administrative Tools > Computer Management.
2. Right-click the drive and choose Properties.
3. On the General tab, click the Disk Cleanup button. The Disk Cleanup utility will start to calculate the system data.
4. After the analysis is complete, you will see the Disk Cleanup dialog box, as shown in Figure 4.26, which lists files that are suggested for deletion and shows how much space will be gained by deleting those files. Click OK.

FIGURE 4.26
The Disk Cleanup utility



5. When you are asked to confirm that you want to delete the files, click Yes. The Disk Cleanup utility deletes the files and automatically closes the Disk Cleanup dialog box.

Another issue that you might run into is bad sectors on your hard disk. Windows 7 also includes a utility to help you troubleshoot disk devices and volumes.

Running the Check Disk Utility

If you are having trouble with your disk devices or volumes, you can use the Windows 7 Check Disk utility. This utility detects bad sectors, attempts to fix errors in the file system, and

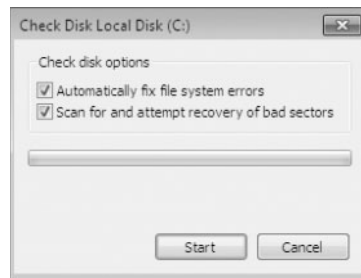
scans for and attempts to recover bad sectors. In order to use Check Disk you must be logged in as a member of the Administrators group.

File system errors can be caused by a corrupted file system or by hardware errors. If you have software errors, the Check Disk utility might help you find them. There is no way to fix hardware errors through software, however. If you have excessive hardware errors, you should replace your disk drive.

Perform the following steps to run the Check Disk utility:

1. Select Start > Control Panel > System And Maintenance > Administrative Tools.
2. Double-click Computer Management and then expand Storage and select Disk Management.
3. Right-click the C drive and choose Properties.
4. Click the Tools tab and then click the Check Now button.
5. In the Check Disk dialog box, you can choose one or both of the options to automatically fix file system errors and to scan for and attempt recovery of bad sectors, as shown in Figure 4.27. For this exercise, check both of the disk options check boxes. Then click Start.

FIGURE 4.27
The Check Disk utility



Another way to run the Check Disk utility is from the command line, using the command `Chkdsk`. `Chkdsk` is used to create and display a status report, which is based on the file system you are using.

The Bottom Line

Understand the different file systems. When you select a file system, you can select FAT32 or NTFS. You typically select file systems based on the features you want to use and whether you will need to access the file system using other operating systems. If you have a FAT32 partition and want to update it to NTFS, you can use the Convert or Disk Management utility.

Master It You are the system administrator for your organization and you have to install a new Windows 7 laptop for a salesperson who goes on the road. Data protection and hard drive space are important features that must be included on the Windows 7 laptop. How would you configure the file system?

Identify disk storage types. Windows 7 supports three types of disk storage: basic, dynamic, and GUID partition table (GPT). Basic storage is backward compatible with other operating systems and can be configured to support up to four partitions. Dynamic storage is supported by Windows 2000, Windows XP, Windows Server 2003, Windows Server 2008, Windows Vista, and Windows 7, and allows storage to be configured as volumes. GPT storage allows you to configure volume sizes larger than 2 TB and up to 128 primary partitions.

Master It Your organization has asked you to configure a Windows 7 Desktop. The Desktop was already installed but the company would like you to reconfigure the disks so that some of the storage areas can be extended. How would you set up the disk storage?

Understand the benefits of NTFS. NTFS offers comprehensive folder and file-level security. This allows you to set an additional level of security for users who access the files and folders locally or through the network. NTFS also offers disk management features such as compression, encryption, quotas, and data recovery features.

Master It You have a Windows 7 machine in your organization that multiple users operate. The users keep complaining that other users are using too much hard disk space. Your organization has asked you to set up disk space limits for the Windows 7 machine. How would you configure this?

Use disk-management utilities. Microsoft Windows 7 includes a few utilities that you can run to help keep your system running efficiently. Two utilities that continue to allow the machine to run at its peak performance are Disk Defragment and Disk Cleanup.

Master It You have users on your network who are complaining that their Windows 7 machines are starting to show slower response times when opening or managing files and applications. What are some of the ways you can help speed up the machines?