Tips, Secrets and Solutions

Windows XP
Annoyances
for Geeks

Presented by:

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CHAPTER 5

Maximizing Performance

Although your computer spends 99.9% of the time waiting for you to do something, the biggest concern is that other 0.1% of the time when eight seconds can seem like an eternity.

A common misconception is that—with all else being equal—a computer with a fast processor, say 3 GHz, will naturally be faster than a 2 GHz system, and the microprocessor industry wouldn't have it any other way. Sure that new system you're eyeing seems a whole lot faster than your year-old machine, but how much is due merely to the processor's clock speed and how much is determined by other factors?

Now, the increased processor speed is an obvious benefit in some specific circumstances, such as when you're performing intensive statistical calculations, using 3D modeling software, or playing particularly processor-intensive games. But in most cases, one's qualitative assessment of a computer's speed is based on its ability to respond immediately to mouse clicks and keystrokes, start applications quickly, open menus and dialog boxes without a delay, start up and shut down Windows quickly, and display graphics and animation smoothly. For the most part, all of these things depend far more upon correctly optimized software, the amount of installed memory, the speed of your hard drive, and the amount of free disk space than on mere processor power.

Probably the biggest drag on an older system's performance, and the primary reason it may seem so much slower than a new system (not to mention slower than it might have been only last year), is the glut of applications and drivers that have been installed. Any computer that has been around for a year or more will likely suffer a slowdown, the only remedy being either a thorough cleansing or a complete reinstall of the operating system (see "Reinstalling Windows XP" in Chapter 1).

Because financial limitations prevent most people from replacing all their hardware every three months (or whenever the proverbial ashtray gets full), most of this chapter is devoted to solutions that will help improve the performance of your existing system without spending a fortune on new gadgets. For example, the way Windows uses the swapfile (virtual memory) can be inefficient, and spending a few minutes fixing this bottleneck can result in performance increases all across the system.

Of course, this doesn't mean it never makes sense to upgrade, only that it's not always the best answer to a performance problem. Even if money were no object and you could simply buy a new computer or component without thinking twice, you'd still have to take the time to install and troubleshoot the new hardware and reconfigure your software.

Naturally, there is a certain point past which your computer is going to turn into a money and time pit. The older your system is, the less vigorously you should try to keep it alive. It's easy to calculate the point of diminishing returns: just compare the estimated cost of an upgrade (both the monetary cost and the amount of time you'll have to commit) with the cost of a new system (minus what you might get for selling or donating your old system). I stress this point a great deal, because I've seen it happen time and time again: people end up spending too much and getting too little in return. A simple hardware upgrade ends up taking days of troubleshooting and configuring, only to result in the discovery that yet something *else* needs to be replaced as well. Taking into account that whatever you end up with will still eventually need to be further upgraded to remain current, it is often more cost effective to replace the entire system and either sell or donate the old parts.

Trimming the Fat

In many ways, Windows XP is able to better take advantage of your hardware than Windows 9x/Me, but that doesn't mean it's configured for optimal performance right out of the box. Because all the software you run is dependent upon the operating system, tweaking Windows for better performance can result in performance gains across the board.

To start off, there are several easy settings that can have a substantial effect on Windows responsiveness. The next few sections explain these settings.

Tame Mindless Animation and Display Effects

Windows XP adds animation to almost every visual component of the operating system. While these affectations may be cute, they can easily

make a 2 GHz computer perform as though it were an antiquated 386. Rather than watch your Start Menu crawl to its open position, you can configure your menus and list boxes to snap to position. You'll be surprised at how much faster and more responsive Windows will feel.

The settings that can affect performance are scattered throughout the interface, but the ones that control display effects are the ones that concern us here. Double-click the System icon in Control Panel, choose the **Advanced** tab, and click **Settings** in the Performance section. The **Visual Effects** tab, shown in Figure 5-1, contains sixteen settings, all explained later.
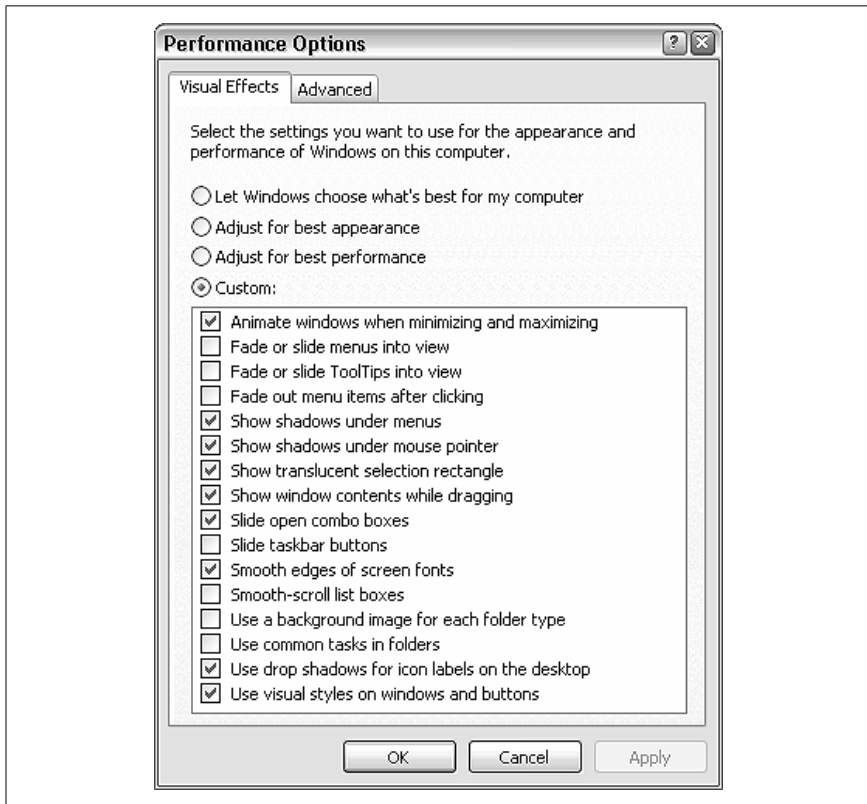

Figure 5-1. The Performance Options window is a good place to start when looking for Windows bottlenecks to eliminate

Unfortunately, the four selections above the list are rather misleading. For example, the **Let Windows choose what's best for my computer** option reverts all settings to their defaults, chosen by a marketing committee at Microsoft to best showcase their product's features. The **Adjust for best**

appearance option simply enables all features in the list, while the **Adjust for best performance** option just disables them.

Keep in mind that disabling some of these options will definitely improve Windows performance, while others may only be of benefit if you are using older video hardware.
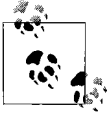
> Newer video cards (display adapters), especially better 3D-accelerated AGP cards, have built-in processors that handle drawing routines, such as shadows and translucent effects. If your video card is fast enough, these effects won't cause a performance hit. Other settings, such as animated menus, rely on time-based delays and slow down everyone's system, regardless of hardware.

Ultimately, the choice comes down to personal preference: some of these features are just plain annoying, and turning them off can be beneficial to your sanity. Others are actually kinda cool:

Animate windows when minimizing and maximizing
> If enabled, this option causes windows to appear to shrink into their respective taskbar buttons when minimized, and expand to their full-size windows when restored or maximized. Although not as slick as the minimize/maximize animation in Apple's OS X, it can nonetheless give a quick clue as to where your window goes when it's minimized. If you see excessive flickering when you minimize or maximize, try turning this one off.

> If you have both the **Auto-hide the taskbar** setting in Taskbar and Start Menu Properties and the **Show window contents while dragging** option (described later) enabled, turning off the **Animate windows** option will also disable the animation for the disappearing taskbar.

Fade or slide menus / ToolTips into view
> This is the option that enables or disables animation shown when menus are opened. Turn this option off to have menus "snap" open.[*]

> If you choose to keep menu animation, you can change the type of animation used by double-clicking on the Display icon in Control Panel, choosing the **Appearance** tab, and clicking **Effects**.

Show shadows under menus / mouse pointer
> If you have a newer video card, disabling this option should have no discernible effect on performance.

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[*] By default, there will still be a short delay before a menu is opened. See "Speed Up Menu Responsiveness," later in this chapter, for more information.

Show translucent selection rectangle

The translucent selection rectangle (referred to as a "rubber band" in Chapter 2) takes advantage of extended support for alpha channels in your display driver. Only those systems with older video cards will see a performance hit from this feature. With this option disabled, rubber bands appear as dotted rectangles.

Show window contents while dragging

Disable this option to show only window outlines when dragging and resizing windows. Unless you have a very old video card, you most likely won't see any difference in performance with this turned off. In fact, your system is likely to seem more responsive with this feature enabled, as windows will appear to respond immediately to dragging rather than responding only after you let go of the mouse button.

Slide open combo boxes

This option controls the animation of drop-down listboxes, similar to the fade or slide menus option described earlier.

Slide taskbar buttons

When a window is closed, its taskbar button disappears. If this option is enabled, the taskbar buttons to its right will slide to the left to close the gap. Since this animation doesn't cause any delays, you're unlikely to achieve any performance gains by disabling this option. However, I find the taskbar animation rather annoying and personally prefer to have this one turned off.

Smooth edges of screen fonts

Using a process called anti-aliasing, Windows fills in the jagged edges of larger text on the screen with gray pixels, making the edges appear "smooth." Turn this option off to slightly improve the speed at which larger fonts are drawn on the screen.

If you're using a flat-panel display (laptop or otherwise), you may find smoothed fonts more difficult to read. Instead of simply turning the option off, you may wish to try an alternate anti-aliasing method. Double-click the Display icon in Control Panel, choose the **Appearance** tab, and click **Effects** to choose between the **Standard** and **Clear Type** smoothing methods. Experiment with this setting to see which one looks best on your display.

Smooth-scroll list boxes

Just because standard listboxes don't "open" like menus and drop-down listboxes doesn't mean they're not animated. By default, when you scroll a listbox, its contents move slowly. Turn this option off to improve the responsiveness of listboxes.

Use a background image for each folder type

Turn this off to disable the background image shown in some system folders, such as Control Panel (category view only) and the *My Pictures* folder. These folders will not only open more quickly without the background images, but they'll be more readable as well.

Use common tasks in folders

The common task pane can also be disabled by opening Folder Options in Control Panel, and selecting **Use Windows classic folders**. Common tasks, described in more detail in Chapter 2, are the panes shown on the left of single-folder windows and contain links to related areas and features.

Use drop shadows for icon labels on the desktop

This option does more than simply enable or disable shadows for desktop icon captions. If you turn this option off, not only will the shadows disappear, but the background behind the text will no longer be transparent. Windows XP is the first version of Windows to offer this option. See Figure 5-2 for an illustration of this setting.
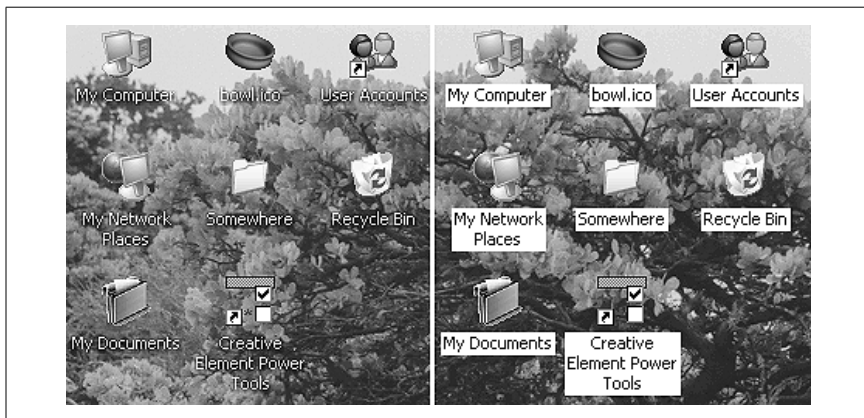

Figure 5-2. If you turn off shadows for desktop icon labels and you're using a background image, desktop icon labels will be shown over rectangles of the current background color

Use visual styles on windows and buttons

Turning this option off is essentially the same as choosing **Windows Classic style** from the **Windows and buttons** list in **Control Panel → Display → Appearance** tab. See "Dealing with Themes, Schemes, Styles, and Skins" in Chapter 2 for more information.

Other settings that affect your display performance can be found by going to **Control Panel → Display → Settings** tab **→ Advanced**. The **Troubleshoot** tab has a couple of settings that allow you to disable some video functionality,

useful to help isolate video driver problems. See also "Get the Most Out of Your Games, Speed-Wise" for more settings, including those that affect the Direct3D and OpenGL subsystems.

You'll find additional settings in TweakUI, although many are simply duplicates of the settings described above. See also Appendix A, for details on TweakUI and additional performance-related settings.

Speed Up Menu Responsiveness

In addition to turning off the menu animation, as described in the previous section, there's another setting that affects how responsive menus (including the Start Menu) are. By default, there's a half-second or so delay between the time you move the mouse over a menu item and the time the menu is opened. If you reduce this value, your menus will open much more quickly.

There's another feature that is incidentally affected by this setting. In all releases of Microsoft Windows since Windows 95, all menus "follow" the mouse, which allows you to navigate through menus without having to click repeatedly. The problem with this design is that it can be very difficult to navigate menus unless you're able to hold your mouse or other pointing device very steadily. Even the smallest unintentional move in the wrong direction can cause the menu you're using to disappear. This can be even more annoying to those with more sensitive pointing devices, such as touch pads, pens, and other digitizers. This behavior can be completely disabled by increasing the menu open delay to a sufficiently large value:

1. Open the Registry Editor (described in Chapter 3).

2. Expand the branches to HKEY_CURRENT_USER\Control Panel\Desktop.

3. Double-click the MenuShowDelay value. If it's not there, go to **Edit → New → String Value** and type MenuShowDelay for the name of the new value.

4. The numeric value you enter here is the number of milliseconds (thousandths of a second) Windows will wait before opening a menu. The default is 400 (a little less than half a second). Enter 0 (zero) here to eliminate the delay completely, or a very large value (65534 is the maximum) to disable the automatic opening of menus.

5. Click **OK** and close the Registry Editor when you're finished. You may have to log out and then log back in for this change to take effect.

This setting can also be changed in the **Mouse** category of TweakUI (see Appendix A) or in Creative Element Power Tools (available at *http://www. creativelement.com/powertools/*).

Speed Up System Startup

Several factors can impact the amount of time it takes for your computer to load Windows and display the desktop so you can start working. As you install software and add devices, Windows gets more and more bogged down. The most effective way to combat this is to routinely format your hard disk and reinstall the operating system and all applications. In fact, the computer on which I wrote this book was wiped clean before I began the project. Initially, I had upgraded a Windows 2000 system with XP, and it took 2–3 minutes to boot each time. After wiping it clean and reinstalling, the boot time dropped to about 45 seconds.

Unfortunately, reinstalling is a whole lot easier said than done, and is simply not practical for many of us. The following is a checklist of ways to more easily (although less substantially) reduce Windows boot time.

Add more memory

You should have a minimum of 256 MB of memory (RAM) to run Windows XP, but 384 MB to 512 MB is better. Many systems can accept up to 768MB or even 1 GB (1024 MB), although only users of graphic-intensive applications (such as Photoshop) are likely to benefit from that much memory.

Memory prices are always dropping, typically making it remarkably inexpensive to add more RAM to your system, and doing so will *significantly* improve performance across the board.

Make more free disk space

You may not have sufficient free disk space for your swap (paging) file. Windows uses part of your hard disk to store portions of memory; the more disk space you devote to your swapfile, the easier it will be for Windows to store data there. See "Optimize Virtual Memory and Cache Settings" later in this chapter for more information.

The easiest way to create more free disk space is to delete the files on your hard disk that you no longer need. It's best to back up your system before deleting anything, or at least to rename (or move) files to see if they're being used before you get rid of them permanently. See "Increasing Disk Space (or What to Throw Away)," later in this chapter, for more information.

Lastly, a new hard disk will give you dramatically more disk space. A faster hard disk can also improve boot time. If you're on the fence about replacing that older drive, consider the performance boost of getting a larger, faster drive.

Clean out your Temp folder

Sometimes having too many files in your \Windows\Temp folder can not only slow Windows startup but, in extreme cases, can prevent Windows from loading at all. Windows and your applications use this folder to temporarily store data while you're working with documents. When those applications and documents are closed (or when the applications just crash), they often leave the temporary files behind, and they accumulate fast.

See "Mirror a Folder with Folder Shortcuts" in Chapter 4 for more information on the *Temp* folder, including a hint on automatically clearing out the *Temp* folder when Windows starts.

Thin out your fonts

If you have more than 600 fonts installed on your system, it may be negatively impacting the time it takes to load Windows. If you can survive without 400 different decorative fonts (especially if all you ever use is Times Roman), try temporarily removing them. If you periodically need a lot of fonts, you might want to invest in font-management software, such as Adobe Type Manager, which can remove and reinstall fonts in groups at the click of a button.

Tame antivirus software

Antivirus programs are typically configured to be run whenever you turn on your computer. These programs are always in memory, scanning programs as you open them and files as you download them. In some cases, this is overkill. For most users—especially those who take the proper precautions—getting a computer virus is about as likely as getting struck by lightning.

I certainly wouldn't recommend getting rid of all antivirus programs; just restrict their use to manually scanning your system when you want by disabling the automatic feature. You'll notice a faster startup for Windows and applications alike. See "Viruses, Malware, and Spyware" in Chapter 6 for details.

Eliminate autostart programs

Probably the most common thing that slows down the loading of Windows is all of the programs that are configured to load at boot time. Not only do they take a while to load, but they commonly eat up processor cycles while they're running. There are several places such programs are specified. Look carefully in each location, and feel free to remove anything you don't want running. See "Programs Run by Windows when It Starts" in Chapter 5 and "Eliminate Unwanted Windows Components" later in this chapter for details.

Nitpicking

Leaving removable media (such as memory cards and removable hard disks) connected when you boot up may add boot delays. This is reportedly fixed in Service Pack 2, but it's still good practice to remove all CDs, disks, and cards from your computer when you're not using them.
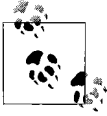
> Some people recommend using Microsoft's free BootVis tool to analyze your system's boot time and make appropriate changes to speed things up. Although it has some snazzy graphs, it has not been proven to have any noticeable effect on your system's boot time. Of course, because of the interest in this tool, Microsoft has decided to remove it from their site (see *http://www.microsoft.com/whdc/system/sysperf/ fastboot/bootvis.mspx*), although you will likely be able to find it elsewhere.

Another thing that can increase boot time is network adapters that aren't plugged in. Windows polls each active network connection on your system when you boot your system and quits as soon as a connection is confirmed. If Windows can't establish a connection, it waits as long as 30 seconds before it gives up and moves on. (You can tell that Windows is doing this when hard disk activity ceases and the activity lights on your network devices start to blink.) To solve this problem, open the Network Connections window (see Chapter 7), right-click on each network connection you're not using, and select **Disable**.

While you're at it, disable any other networking components you don't need, including unnecessary protocols and drivers. Also, disable drive-letter mapping (discussed in Chapter 8) unless you use those drive letters all the time.

Start Windows Instantly

You can optimize Windows all you want, possibly shaving ten to fifteen seconds off your boot time (see the last section), or you can approach the problem from a different angle. Most new computers, and nearly all laptops, have a functional *Stand by* mode, allowing you to shut down Windows quickly, and more importantly, start it back up in only a few seconds.

Start by going to Control Panel and opening Power Options. Choose the **Advanced** tab, and then choose **Stand by** from all available listboxes in your **Power buttons** section, as shown in Figure 5-3. Click **OK** when you're done.
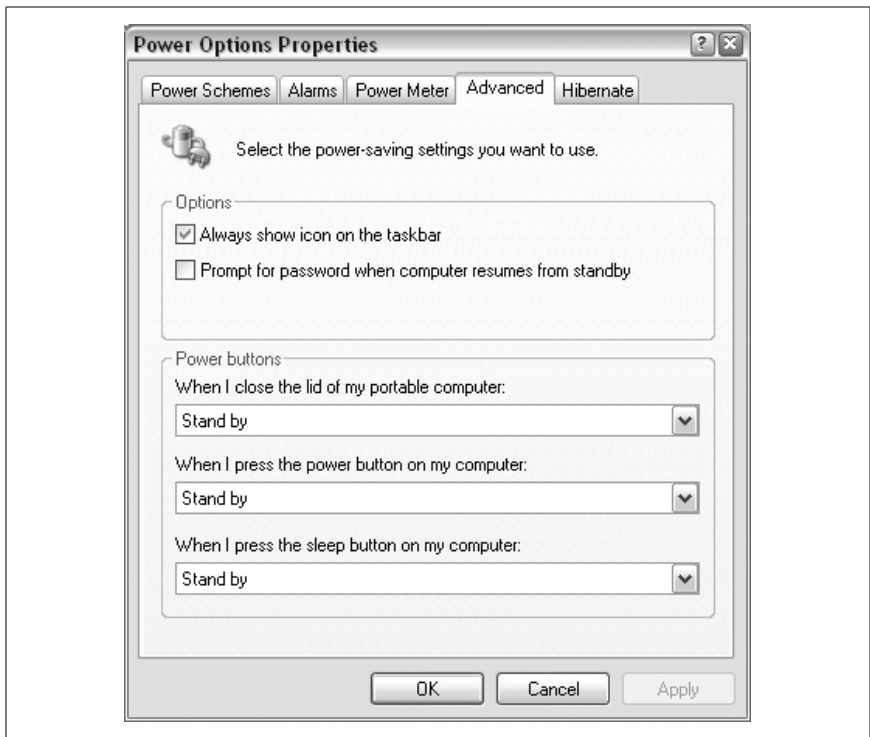
Figure 5-3. Make the Stand By mode more accessible to facilitate near-instant boots

> If any of these options (or the entire **Advanced** tab) isn't
> available in your Power Options Properties window, then
> your computer's support for Advanced Power Management
> (APM) is likely disabled in your system's BIOS. See Appen-
> dix B for details on APM and APM-related settings, or jump
> to the next section for APM troubleshooting.

Then, while Windows is still running, press your computer's power switch
(or, if it's a laptop, close its lid). Don't go through the normal shut down
process via the Start Menu; just turn it off. Windows will briefly display a
"Preparing to stand by…" message, and then your computer should shut
itself off.

Now, press the power switch again. Your computer should power itself on,
and the Windows desktop should appear in less than five seconds, allowing
you to pick up where you left off. You can even leave applications open. The
problem, of course, is when this doesn't work like it's supposed to, which,
as it turns out, is most of the time.

Hibernate vs. Stand by

When you place a computer into Stand by mode, you're placing it into a "deep sleep" power-saving mode (known as the S3 sleep state), instead of actually turning it off. During Stand by, power to your system memory is maintained while power is cut to most of the rest of your system's hardware. This allows your computer to resume to the exact state it was in before it entered Stand by mode with a minimum of power consumption. Unfortunately, if power is cut completely, which can happen if you unplug your desktop system or remove the battery from your laptop, it will be equivalent to powering it off without going through the shutdown procedure, and you may lose data.

The other option is to have your computer enter *hibernation* mode (S4 sleep state), which saves an image of your system memory into a file on your hard disk (known as a *memory dump*) before power to the computer is completely shut off. The obvious benefit over Stand by mode is that the system memory isn't being kept alive with electricity, making it a better choice if you're shutting the computer down for the weekend. The downside is that writing to disk takes more time, as does reading the image file from disk when you wake up the system.

To enable hibernation mode, go to Control Panel → Power Options → **Hibernate** tab (Figure 5-4). Turn on the **Enable hibernation** option, and you'll see that the **disk space required to hibernate** is equal to the amount of installed RAM in your computer.
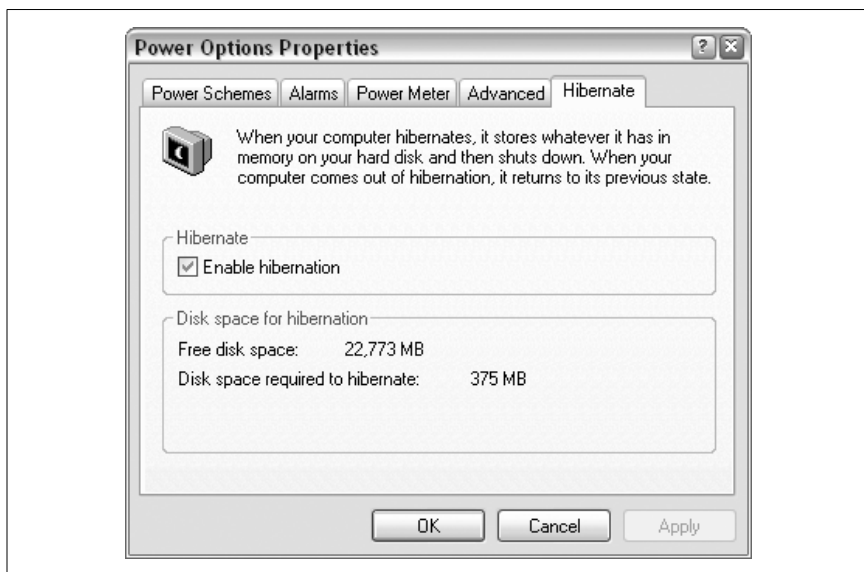
Figure 5-4. Use Hibernate instead of Stand by to enable more robust, yet slightly slower system boots

Other Ways to Wake Your Computer

You can use your computer's power switch to wake up your system from Stand by or Hibernate mode, but it may not be your only choice. Provided that your mouse and its respective driver supports it, you can wake up a sleeping system as though it were nothing but a screensaver. To configure your mouse to wake your system, follow these steps:

1. Open Device Manager (*devmgmt.msc*).
2. Expand the **Mice and other pointing devices** category, right-click the entry for your mouse, and select **Properties**.
3. Choose the **Power Management** tab, and turn on the **Allow this device to bring the computer out of standby** option. (If this Properties box doesn't have a **Power Management** tab, then your mouse driver doesn't support this feature.)
4. Click **OK** when you're done.

These other devices may also be capable of waking up your computer:

Network adapters
> Using the Wake-on-LAN protocol (sometimes called Remote Wake Up), you can wake a computer remotely over a network connection.

Modems
> Wake your computer every time your phone rings. Of course, this may be an annoyance you're trying to solve, rather than a feature you're trying to enable, but, nevertheless, now you know where it is.

IEEE 1394 (FireWire) devices
> Actually, you'll probably never have a reason to enable this option for FireWire controllers or devices, but the option can appear by mistake in some circumstances and can cause problems if it's enabled. Make sure it's turned off on your system.

Next, choose the **Advanced** tab and change all the **Power buttons** options to **Hibernate** (just like in the last section). Click **OK** when you're done. You can make your computer hibernate at any time by simply pressing the power switch (or closing the lid, if you're using a laptop).

Whether you choose to have your computer Stand by or Hibernate, you can configure Windows to go to sleep after a certain period of inactivity. It works like a screensaver, but saves power instead of displaying a cheerful animation. Just choose the **Power Schemes** tab of the aforementioned Power

Options properties dialog, and set the **System standby** (or **System hibernates**) option to a suitable amount of time (e.g., "After 30 mins").

> You can also make your computer enter Stand by mode by selecting **Shut Down** (or **Turn Off Computer**) from the Start menu and then selecting **Stand by**. If you're using the classic log-off screen, you'll also see a **Hibernate** option in the list (assuming the option above has been enabled). But if you're using the default Welcome screen and the corresponding Turn Off Computer dialog (discussed in Chapter 8), you'll only see the **Stand by** option. Just press and hold the **Shift** key to temporarily switch the button to Hibernate, should you need it.

Troubleshooting Stand by and Hibernate modes

If you experience a problem with one of the sleep modes (Stand by or Hibernate), it's likely one of the following:

- Windows won't go to sleep at all; either nothing happens when you try to stand by, or the system just crashes in the middle of the process.
- Windows wakes up after going to sleep, or Windows simply boots normally instead of recovering your previous session.
- Some features stop working after waking from hibernation or Stand by, such as the Internet connection. (Hint: restart Windows to fix the problem.)
- Once Windows has been placed in Stand by or Hibernate mode and is then woken up, it's unable to go back to sleep.
- Some or all of the power-management features and settings discussed here are grayed-out (disabled) or missing.

Unfortunately, all of these problems are extremely common, mostly because of the sloppy and inconsistent support for Advanced Power Management (APM) and Advanced Configuration and Power Interface (ACPI) in the computer industry. The good news is that there are a few things you can do to help improve your computer's support for APM and ACPI, should you be experiencing any of the above problems:

Get a BIOS update
Check with the manufacturer of your computer system (or motherboard) for a BIOS update, the most likely fix (if available) for any power-management problems you might be having. See Appendix B for details.
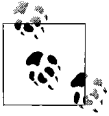
Here's a little Microsoft-sponsored paradox for you: you'll know that your motherboard isn't fully APM-compliant if your Power Options dialog box has an APM tab. If the APM tab is present on your system, try turning on the **Enable Advanced Power Management support** option and then clicking **Apply**. (If there's no tab, then your computer does indeed support ACPI and APM, and you don't have to do anything.)

Look for incompatible hardware or drivers

The second-most common cause of power-management problems is a hardware device or driver that isn't fully APM-compliant, meaning that it doesn't support S3 sleep mode or can't be woken up after entering this power-saving state. Video cards (display adapters) and many USB devices are common culprits; check with their respective manufacturers for firmware and driver updates (see Chapter 6). See the "Increase the USB Polling Interval" sidebar for another solution.

Make room for the hibernation file

As explained earlier, the Hibernate feature creates an image file on your hard disk equal in size to the amount of installed memory. If you have 384 megabytes of RAM, then Windows will need 402,653,184 bytes of free space. This feature may not work reliably if you don't have enough disk space, or if there's excessive fragmentation, so try deleting some unnecessary files and running Disk Defragmenter (*dfrg.msc*, discussed later in this chapter) if your PC is having difficulty hibernating.

Turn off the Indexing Service

If your hard disk won't turn off after a certain period of inactivity, Windows Indexing Service may be keeping them awake. See Microsoft Knowledge Base article 313300 (*http://support.microsoft.com/?id=313300*) for more information.

Use Sleeper

Go to *http://www.passmark.com/products/sleeper.htm* and download the free PassMark Sleeper utility to help test your computer's ability to enter and recover from sleep and hibernation modes.

Keep in mind that you may never get your system to reliably go to sleep and wake up, but if you are able to get it working, it can be very convenient.

Speed Up System Shutdown

Theoretically, when you shut down Windows, your computer should be powered down in under fifteen seconds. The problem is that all of the cleanup that is done before Windows considers it "safe" to power the

Increase the USB Polling Interval

One of the things that can prevent your computer from entering its Stand by or Hibernate modes is Windows's support for USB. In order to detect newly connected USB devices, Windows polls your USB controller(s) once each millisecond by default. Unfortunately, this frequent polling may prevent your processor from believing that it is idle, a necessary condition before it can initiate any power-saving features.

The solution is to give your CPU a rest by increasing the interval between polls to the USB controller. Open the Registry Editor (see Chapter 3) and expand the branches to `HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Control\Class\{36FC9E60-C465-11CF-8056-444553540000}`. You'll know you have the right key if its (`default`) value is "Universal Serial Bus controllers."

In this key, you'll find one or more numbered subkeys (e.g. `0000`, `0001`, `0002`), each of which represents a USB controller. Now, if you've ever upgraded the motherboard in your computer, you'll likely see a lot of subkeys here. Most represent controllers no longer installed on your system; only the last couple (with the highest numbers) are likely still active. To find out which ones are currently active, cross-reference the names (in the `DriverDesc` value) with the USB controllers that currently show up in Device Manager (*devmgmt.msc*). If in doubt, you can always repeat this procedure for all the subkeys displayed here.

Select a subkey for an active USB controller, and create a new DWORD value inside (**Edit → New → DWORD value**) called `IdleEnable`. Double-click the new value and set its data to `1`. (To undo this setting, just delete the `IdleEnable` value.) You'll need to restart Windows for this change to take effect.

system down—including shutting down your open applications, stopping any running services, and writing any pending cache data to the disk—can sometimes delay the shutdown procedure.

> In the course of using your computer, Windows sometimes postpones writing data to the disk to improve performance. This is called *write caching*, and as a consequence, Windows must take a few seconds before you shut down to make sure all data queued to be written is actually, physically written to the disk before power is lost. See the discussion of removable drives in Chapter 6 for a way to disable this feature.

The following solutions should help eliminate the sometimes-unnecessary delays that can accompany system shutdown.

Part 1: Reduce the hung application timeout

When shutting down, Windows attempts to stop all running tasks. If a task is not responding or refuses to shut down, there's a built-in delay before Windows will force the task to end. This delay is called the timeout, and it can be shortened if you're experiencing problems or unreasonable delays when shutting down your system:

1. Open the Registry Editor (described in Chapter 3).
2. Expand the branches to `HKEY_CURRENT_USER\Control Panel\Desktop`.
3. Double-click the `WaitToKillAppTimeout` value. This number controls the time to wait, in milliseconds, before unresponsive applications are forced to close. The default is `20000` (twenty seconds), but it can be decreased to any value; the minimum is 1 millisecond, although it's impractical to use any value smaller than about `2000` (two seconds) here.
4. Also in this key is the `HungAppTimeout` value, which does pretty much the same thing as `WaitToKillAppTimeout`; just enter the same number for both values.
5. Expand the branches to `HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Control`.
6. Double-click the `WaitToKillServiceTimeout` value. This works the same as the `WaitToKillAppTimeout` value described above, except that it applies to services instead of applications. See Chapter 7 for more information on services.
7. Close the Registry Editor when you're done. You'll have to restart Windows for the change to take effect.

These values also affect the timeouts at times other than just shutting down, such as when you click **End Process** in the Windows Task Manager.

Part 2: Use the User Profile Hive Cleanup Service

Occasionally, Windows has trouble unloading the hive containing the HKEY_CURRENT_USER branch of the Registry (see Chapter 3). If your system appears to repeatedly take a long time to log out and shut down, download and install Microsoft's UPHClean utility. See Microsoft Knowledge Base article #837115 (*http://support.microsoft.com/default.aspx?scid=kb;en-us;837115*) for details.

Part 3: Have Windows power down your computer automatically

You may have noticed that some computers—especially laptops—are able to power themselves off when you choose **Shut Down** from the Start Menu,

rather than displaying the "It's now safe to turn off your computer" screen. This is convenient and makes for faster shutdowns.

In order to configure your computer to behave this way, you'll need the following: if you're using a desktop (as opposed to a portable) computer, you must have an ATX-compliant case and motherboard. You can tell an ATX system from the power button; if it's a momentary pushbutton (that doesn't stay in when you press it), you've likely got an ATX case. The difference is that power switches in ATX systems send a "shut down" command to the motherboard, rather than simply cutting power. All new computers are ATX-compliant, as is any machine that is likely to be capable of running Windows XP.

Secondly, you must have Advanced Power Management (APM) enabled in your system BIOS. Enter your system BIOS setup screen when first starting your computer (usually by pressing the **Del** key), and make sure any options labeled "Advanced Power Management," "APM," or "APM-aware OS" are enabled. See Appendix B for more information on BIOS settings, and the previous section for more details on APM troubleshooting.

If these two conditions are met, Windows should automatically power down your system the next time you shut down.

Eliminate Unwanted Windows Components

In addition to the settings and tweaks described elsewhere in this chapter, a common and effective technique for removing the bottlenecks in Windows is to eliminate the programs and Windows components you don't use.

Most optional Windows components can be removed by double-clicking on the Add or Remove Programs icon in Control Panel, clicking **Add/Remove Windows Components**, and unchecking any unwanted components. Single programs may not seem to make much of a difference, but they do add up. Note, however, that not all optional components are listed here. To add unlisted Windows components to your Control Panel, follow these steps:

1. Start Notepad (or your favorite plain-text editor), and open *\Windows\ Inf\Sysoc.inf*.

2. The structure of this file is that of an *.ini* file, discussed in Chapter 3. The [Components] section lists the components shown in the Windows Components Wizard. Each entry in this section has this format:

    `name=options`

    where *options* is a list of parameters, separated by commas. The second to last parameter is the one that interests us. If it's empty (nothing between the surrounding commas), the corresponding entry will appear

in the Windows Components Wizard. Otherwise, if the parameter is hide, the entry will not appear. To "unhide" the entry, simply delete the hide keyword. For example, the entry for Windows Messenger looks like this:

```
msmsgs=msgrocm.dll,OcEntry,msmsgs.inf,hide,7
```

To add Windows Messenger to the list, allowing you to remove the component, simply change the line so it reads:

```
msmsgs=msgrocm.dll,OcEntry,msmsgs.inf,,7
```

3. When you're done, save the file, and reopen the Windows Components Wizard to see the new entries.

Get the Most Out of Your Games, Speed-Wise

Dude, don't tell me only kids play games. I know you play Freecell more often than you check your email. The catch, of course, is that Freecell spends much more time waiting for you to move a card than it spends on any calculations. Speed is primarily a concern with the more processor-intensive games, such as 3D games or anything with full-screen animation.

Improving game performance, as with improving performance in any other application, involves removing software bottlenecks and upgrading hardware where necessary. However, games are unique in that they can benefit greatly from certain types of hardware, such as 3D accelerators and sound cards with digital signal processors. Games also suffer the most from background applications and out-of-date drivers. Here are some ways to improve performance in the more processor-intensive games:

- Most high-end games rely on DirectX, essentially a set of optimized video, sound, and game input drivers supported by Microsoft. Make sure you have the latest DirectX drivers by using the Windows Update feature (see Chapter 6) or going to *http://www.microsoft.com/directx/*.

- Many games are also optimized to work with specific types of video and sound hardware. For example, a particular game's setup screen might allow you to choose between Direct3D and OpenGL for the video output; sometimes you even need to choose a particular video chipset (e.g., nVidia GeForce4). Your 3D accelerator might support several standards, but a given game might run better using the DirectX drivers, and another game might prefer the OpenGL setting.

- The speed at which a video card can draw to your screen is somewhat dependent on the current color mode and resolution. If your games are running slowly, try reducing the color depth and resolution—either globally in Windows or in a particular game's setup screen (if it supports

it)—to increase the speed. It's funny, though—I've seen some games run smoother in 24-bit mode than 16-bit mode, even though in theory the extra colors should cause a performance hit. Better video cards will not show any performance hit when run at higher resolutions or color depths.

- Games are highly optimized for speed, which tends to make them finicky—a game might run beautifully with one video card but horribly with another. Check the documentation (manual, readme file, online FAQs) released by the game manufacturer for details that may affect you. Also look for updates to the game software that can fix performance issues, as well as add features and even new levels. Check the web sites of both the video card manufacturer and the game manufacturer for tips and patches.

- Most 3D accelerators and even some games allow you to modify or disable certain 3D features, such as 8-bit palletized textures, gamma adjustment, zbuffer, and bilinear filter. In most cases, you'll probably just end up leaving these alone. However, some games might have conflicts with some hardware, and fiddling with these settings may make one or more of your games run smoother. Game fan web sites and discussion boards are the best places to find recommended settings relating to particular games and hardware.

- Any unnecessary background applications should be disabled, either temporarily or permanently. Each program that runs invisibly or in your system tray takes precious CPU cycles away from the processor-intensive games and can make the difference between 20 frames per second and 30 frames per second. See "Speed Up System Startup" elsewhere in this chapter for details.

- If a game runs off a CD or DVD, the Windows Autorun feature, which continually polls the CD drive, can sometimes interrupt data transfer. Symptoms include hiccups in video clips and music and slow loading of levels. See "Curb AutoPlay for CDs and DVDs" in Chapter 4 for details. Note that old CD drives can also cause problems like this. Also, try gently rubbing the disk against a soft, clean cloth (or barring that, your shirt) to remove dust and fingerprints.

- If you're playing a network game, either on a local network or over the Internet, you can improve performance by optimizing your network settings. See Chapter 7 for details.

- Lastly, the performance of high-end games is extremely dependent on game hardware, such as 3D accelerators and sound cards. High-end video and sound cards not only will add features, but also will handle

many of the calculations themselves, freeing up your processor significantly. A good 3D accelerator does more than just make 3D performance acceptable at high resolutions; it can even make the renderings look better, too. Your gaming system will actually benefit much more from a fast 3D card than from a doubling of processor power. Likewise, a good sound card with 3D environmental audio and a good digital signal processor (DSP) can add background sounds that will bring any game alive, without eating up processor cycles. I'm not trying to sell you any hardware, but don't overlook the value of dedicated hardware if you're serious about gaming.

Hard Disk

Your hard disk is more than just a storage device; it's used to hold your operating system and to supplement your system's memory. The speed and health of your hard disk is a major factor in your computer's performance, not to mention its reliability and security. The following topics all deal with different aspects of your hard disk and how effectively Windows uses it.

Inevitably, the storage in your computer will need to be expanded, either to make room for a newer version of Windows, or to make room for all your stuff after installing Windows. Later in this section, you'll find tips on upgrading and repartitioning your hard disk, allowing you to keep your disk and its data in tip-top shape.

A Defragmentation Crash-Course

The best way to ensure maximum performance from your drive is to regularly (weekly or biweekly) defragment it (also called optimizing). Figure 5-5 shows how frequent use of the hard drive can cause files to become fragmented (broken up), which can slow access and retrieval of data on the drive, as well as increase the likelihood of lost data.
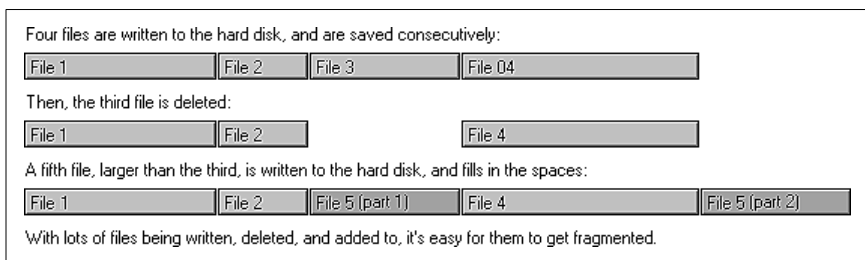

Figure 5-5. File fragmentation on your hard disk can slow performance and decrease reliability

To defragment your drive, run the Disk Defragmenter (*dfrg.msc*), which rearranges the files on your hard disk to make them contiguous (not broken into pieces). It also defragments the free space, and optionally places the files you access more frequently (such as programs and recently modified documents) at the start of the drive and less frequently accessed files at the back of the drive.

If you find that Disk Defragmenter is having trouble completing its job, either continually restarting, or simply defragmenting your drive only partially, the culprit may be either of the following:

- To avoid corrupting data, Disk Defragmenter stops what it's doing and restarts whenever it detects that another process has written to the drive. To allow Disk Defragmenter to do its job, make sure to close all nonessential programs and background processes. Also, if necessary, disable the Disk Indexing service by right-clicking the drive icon in Windows Explorer, selecting **Properties**, and turning off the **Allow Indexing Service to index this disk for fast file searching** option.

- If the amount of free disk space is low (less than 15% of the size of the drive), Disk Defragmenter may refuse to run. You can force it to defragment your drive by opening a Command Prompt window (Chapter 10) and typing defrag *c:* /F, where *c:* is the drive letter of the hard drive you want to defragment. Better yet, delete some files (see "Increasing Disk Space (or What to Throw Away)") and try again.

If you're compulsive about disk defragmentation, superior alternatives to Disk Defragmenter include Norton Speed Disk (included with Norton Utilities, *http://www.symantec.com*) and Diskeeper (*http://www.executive.com/*).

Enable automatic boot defragments

Here's a funny little setting in the Registry that seems as though it's supposed to instruct Windows to defragment your hard disk automatically each time it starts:

1. Open the Registry Editor (described in Chapter 3).
2. Expand the branches to HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Dfrg\BootOptimizeFunction.
3. Double-click the Enable value, and type Y for its data (or type N to disable it).

The funny part is that this setting is probably already enabled on your system (it's enabled by default on most XP systems). Now, have you ever seen Windows run Disk Defragmenter at startup?

The reason you don't see it is because it isn't a full defragment. Instead, it's only a boot defragment, which only affects the files registered with the Windows Prefetch feature (see the "Keeping an Eye on Prefetch" sidebar) and listed in the *Layout.ini* file (not a standard INI file). You can perform this boot defragment at any time by opening a Command Prompt window (see Chapter 10) and typing `defrag c: -b`.

Keeping an Eye on Prefetch

Prefetch is a new feature, introduced in Windows XP, that stores specific data about the applications you run, in order to help them start faster. Prefetch is an algorithm that helps anticipate cache misses (times when Windows requests data that isn't stored in the disk cache), and stores that data on the hard disk for easy retrieval.

This data is located in *\Windows\Prefetch*, and, as the theory goes, periodically clearing out the data in this folder (say, once a month) will improve performance. As new applications are subsequently started, new prefetch data will be created, which may mean slightly reduced performance at first. But with older entries gone, there will be less data to parse, and Windows should be able to locate the data it needs more quickly. Any performance gains you may see will be minor (if you see any at all), but those wishing to squeeze every last CPU cycle out of their computer will want to try this one.

Note that deleting Prefetch data may increase boot time slightly, but only the next time you boot Windows. Each subsequent boot should proceed normally, since the prefetch data will already be present for the programs Windows loads when it boots.

If you want to disable Prefetch, open your Registry Editor (Chapter 3), navigate to `HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Control\Session Manager\Memory Management\PrefetchParameters`, and change the `EnablePrefetcher` value to `0`. (Other supported values: `1` to Prefetch applications only, `2` to Prefetch boot processes, and `3` to Prefetch both.)

Increasing Disk Space (or What to Throw Away)

Parkinson's law states that work expands so as to fill the time available for its completion. Along the same lines, it's safe to say that files will quickly expand to fill the amount of available disk space.

Low disk space doesn't just make it harder to store files, however; without ample room for virtual memory (discussed earlier in this chapter), Windows performance will slow to a crawl. Less disk space also increases file fragmentation, as Windows scrambles to find places to place the data; this,

in turn, greatly lowers performance. Keeping a healthy amount of free disk space is vital to a well-performing system.

Additionally, removing drivers and applications that are no longer used clears more memory and processor cycles for your other applications, which can substantially improve overall system performance.

> If your PC is low on disk space, try enabling NTFS compression.[*] Right-click any folder, select **Properties**, click **Advanced**, and turn on the **Compress contents to save disk space** option. Note that this can degrade performance slightly, so you'd be wise to only use it for data that you don't access or modify often.

Even before you install your first application, your hard disk is littered with files from the Windows installation that you most likely don't need. The standard installation of Windows XP puts about 10,000 files in more than 600 folders, consuming more than a gigabyte of disk space.

Whether you need a particular file can be subjective; the 2.5 MB of *.wav* files that one person might consider excessive might be valued by another. Naturally, it makes sense to be cautious when removing any files from your system. The removal of certain files can cause some applications, or even Windows itself, to stop functioning. It's always good practice to move any questionable files to a metaphorical purgatory folder before committing to their disposal. And I don't have to tell you that routinely backing up your entire hard disk (see Chapter 6) is very important. What follows are some tips to help you identify the more common files and folders that can be safely removed, as well as those that should be left alone.

Windows XP files that can be deleted

The following tips apply to files located in your Windows folder or a subfolder thereof. Select **Search** and then **For Files or Folders** from the Start Menu, type `c:\windows` in the **Look in** field (assuming Windows is installed on drive *c:*), and type the filename as described later in the **Search for files or folders named** field. For example, to search for all files with the *.tmp* filename extension, you would use the asterisk wildcard character, like this: `*.tmp`.

Note that this is only a guideline; I'm not instructing you to delete all of these files (okay, maybe I am a little). If you're in doubt about a specific file,

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[*] This feature is only available on NTFS-formatted drives. See "Choosing the Right Filesystem," later in this chapter, for details. It's also mutually exclusive of the **Encrypt contents to secure data** option discussed in Chapter 8.

Disable Disk Cleanup

When your PC starts running out of disk space, Windows will prompt you to run the Disk Cleanup Wizard, which presents a list of some of the files you can delete to recover free disk space (the solutions in this book are much more comprehensive).

To disable this annoying warning, open the Registry Editor (see Chapter 3) and expand the branches to HKEY_CURRENT_USER\Software\Microsoft\Windows\CurrentVersion\Policies\Explorer. If it's not already there, create a new DWORD value (**Edit → New → DWORD value**) called `NoLowDiskSpaceChecks`. Double-click the new value and type 1 for its data. The change will take effect immediately.

---

see the "If in doubt" section that follows for details on finding out what's inside of most types of files. The following files are typically safe to delete:

- Any file with the filename extension: *.log*, *.old*, *.- - -*, *.bak*, and *.000*, *.001*, *.002*, and so on.

- Any files with the extensions *.bmp* (bitmap files), *.wav* (sound clips), and *.avi* (video clips). These can take up a great deal of space and are usually superfluous.

- In the Windows folder only, there are a ton of text files (*.txt*), which are essentially "Readme" and log files and can be safely deleted. Double-click any text file to view its contents.

- Any files or folders found in your *\Windows\Temp* folder. You won't be able to delete some files in this folder, because they will be in use by whatever applications you may have open. But applications in previous Windows sessions may not have deleted files there, and those types of files tend to accumulate very rapidly. It's not uncommon to find dozens of megabytes of useless files here. If you find files in your *Temp* folder that have a date and time *earlier* than the last time you started your computer, you can safely delete them. See "Mirror a Folder with Folder Shortcuts" in Chapter 4 for more information on the *Temp* folder.

- The following file dates are common to older versions of Windows (releases other than the American English editions may have different dates); some files with these dates may still be around if you've upgraded to Windows XP:

July 11, 1995, 9:50 AM	Windows 95
August 2, 1996, 1:30 AM	Windows NT Workstation 4.0

August 12, 1996, 3:50 PM	Windows 95 OSR2
May 11, 1998, 8:01 PM	Windows 98
April 23, 1999, 10:22 PM	Windows 98 Second Edition
December 7, 1999, 5:00 AM	Windows 2000 Professional
June 8, 2000, 5:00 PM	Windows Me

- See "Mirror a Folder with Folder Shortcuts" in Chapter 4 for more information on all the extra empty folders that Windows won't let you delete.

Files found elsewhere on your system

In addition to those files in your Windows folder, there are plenty of files elsewhere that you can consider deleting:

- There are some unnecessary files in the root directory of your boot drive (usually *c:*); these include files with the extensions **.txt*, **.prv*, **.log*, **.old*, and **.- - -*. Most files with the **.dos* extension (except for *Bootsect.dos*—see "Files NOT to delete" later in this chapter) are also safe to delete.

- Other files that can be deleted include *Mscreate.dir*, an absolutely useless, empty, hidden file created by older Microsoft application installers. There may be hundreds of these empty files on your hard disk.

- Folders named *~Mssetup.t*, *msdownld.tmp*, *WUTemp*, or something similar are temporary folders created when some applications or Windows updates are installed. They can all be removed, as long as you've restarted your computer since said installation took place.

- If you're trying to create more disk space, you can also delete application help files (**.hlp* and **.chm*) you may never need (as a last resort). Also, many applications include bitmaps (**.bmp*), sound clips (**.wav*), and video clips (**.avi*, **.mov*, and **.mpg*), which take up enormous amounts of disk space for virtually no reason. To view a video clip before deleting it, just double-click the file icon.

Files NOT to delete

In your travels, you may encounter some of the following files, all of which should be left alone:

- Any files in your root directory not mentioned earlier should be left alone. This includes *Bootsect.dos*, *Boot.ini*, *Ntldr*, and *Ntdetect.com*, all parts of the Boot Manager (discussed in Chapter 1). You may also see *Io.sys*, *Msdos.sys*, and *Command.com*, if you've set up a dual-boot system with Windows 9x/Me.

- Be extremely careful with anything in the *Windows*, *Windows\System*, and *Windows\System32* folders, as these files may be vital Windows support files.
- Your Registry hive files, discussed in Chapter 3, should never be moved or deleted.
- Any files and folders in your *Program Files* or *Windows\MSAPPS* directories that have names like *Microsoft Shared* and *Common Files*. These files can be used by several applications simultaneously, which is why they haven't been placed in the folders of the applications that put them there.

If in doubt

Before you delete any questionable file, there are several things you can do to get a better idea of what the file contains:

- Start by double-clicking a suspicious file to open it in its default application. If you then see the **Open With** dialog box, it means the specific filename extension has not yet been registered. In that case, your best bet is to drag-drop the file into an open Notepad window.
- Right-click the file, and select **Properties**. If the file has a **Version** tab, it's likely an application, driver, DLL, or other support file. Choose it to view the manufacturer, copyright date, and possibly the application it accompanies.
- If you're not sure if something should be deleted but want to try anyway, move it to another directory first to see if everything works without it for a week or so. If all is clear, toss it.
- Check the file's **Last Accessed** date (right-click it, and select **Properties**). The more recent the date, the more likely it's still being used. For information on removing a particular application, contact the manufacturer of that application or refer to the application's documentation.

Special consideration: hidden files

Some files on your hard disk are hidden files—files that, by default, can't be seen in Explorer. To configure Explorer to show hidden files, go to **Control Panel → Folder Options → View** tab, and select the **Show hidden files and folders** option. All hidden files will become visible, but their icons will remain somewhat transparent.

Most hidden files have been hidden to protect them from deletion. If you see a hidden file, think twice before deleting it for this reason. On the other hand, some hidden files are truly unnecessary and are hidden only to reduce

the clutter they would otherwise generate. An example is the temporary hidden file Microsoft Word creates alongside every open document.

To hide or unhide a file, right-click its icon and select **Properties**. Check or uncheck the **Hidden** option as desired, and click **OK**.[*]

Special consideration: System File Protection and System Restore

When I first installed Windows XP, I proceeded to delete the superfluous *Internet Connection Wizard* folder,[†] as I do whenever I install a new version of Windows. This time, I was in for a surprise—seconds after I deleted it, I saw it reappear as though Windows was telling me, "Just kidding!"

It turned out to be the System File Protection feature, which continually scans your system, replacing system files as it sees fit. Unfortunately, this approach creates several problems, not the least of which is the 12% of your hard drive's total capacity it consumes. See "Working with Restore Points" in Chapter 6 for more information on this feature, as well as on the related feature, System Restore.

If you do decide to disable System File Protection, you can then safely delete the Internet Connection Wizard.

Optimize Virtual Memory and Cache Settings

One of the most frustrating and irritating things about Windows is the way that it can seize up for several seconds with seemingly random, pointless disk activity. This is caused by the way that Windows handles disk virtual memory by default.

Normally, Windows loads drivers and applications into memory until it's full and then starts to use part of your hard disk to "swap" out information, freeing up more memory for higher-priority tasks. The file that Windows uses for this type of "virtual memory" is the paging file (aka swapfile), *pagefile.sys*, and is stored in the root folder of your hard disk.

Because your hard disk is so much slower than physical memory, the more Windows does this swapping, the slower your computer will be. Naturally, adding more memory will reduce Windows's appetite for virtual memory.

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[*] The *Attrib* command in DOS is used to list the attributes of files (e.g., Hidden, Read-only), as well as to turn those attributes on or off. It's also the only way to turn on or off a file's System attribute. See Chapter 10 for details.

[†] Windows runs the Internet Connection Wizard once: the first time you try to access the Internet after installing Windows XP, regardless of whether you already have a dial-up Networking connection configured. In some cases, you'll see this useless wizard appear again and again.

But regardless of the amount of installed physical memory in your system, there are always things you can do to improve virtual memory performance.

Windows's defaults here are rather conservative and can fortunately be modified for better performance. It's important to realize, though, that some experimentation may be required to achieve the best configuration for your setup. Different hardware, software, and work habits require different settings; those with ample hard disks, for instance, can afford to devote more disk space to virtual memory, while others may simply wish to place a cap on the disk space Windows consumes.

Part 1: Virtual memory settings

One of the reasons the default settings yield such poor performance is that the swapfile grows and shrinks with use, quickly becoming very fragmented (as illustrated by Figure 5-5, earlier in this chapter). The first step is to eliminate this problem by setting a constant swapfile size.

Note that making the swapfile constant will also result in a more constant amount of free disk space. If your hard disk is getting full, consider this solution to restrict Windows from using up every bit of free space:

1. Double-click the System icon in the Control Panel, choose the **Advanced** tab, and click **Settings** in the **Performance** section. Choose the **Advanced** tab here, and then click **Change**. You'll see the Virtual Memory window, shown in Figure 5-6.

2. The virtual memory settings are set for each drive in your system independently. If you have only one drive, virtual memory will be enabled for that drive. If you have more than one drive, virtual memory will be enabled, by default, only on the drive on which Windows is installed.

   For each drive, you have three choices, all of which should be pretty self-explanatory. The total disk space for all drives is shown at the bottom of the window.

   Important: after you've made a change for any drive, click **Set** to commit the change before moving onto another drive or clicking **OK**.

3. To specify a constant size, select **Custom size**, and then type the same value for both **Initial size** and **Maximum size**.

   The size, specified in megabytes, is up to you. I typically use three times the amount of installed RAM (e.g., 1536 MB of virtual memory for 512 MB of physical memory), but you may wish to experiment with different sizes to find the one that works best for you.
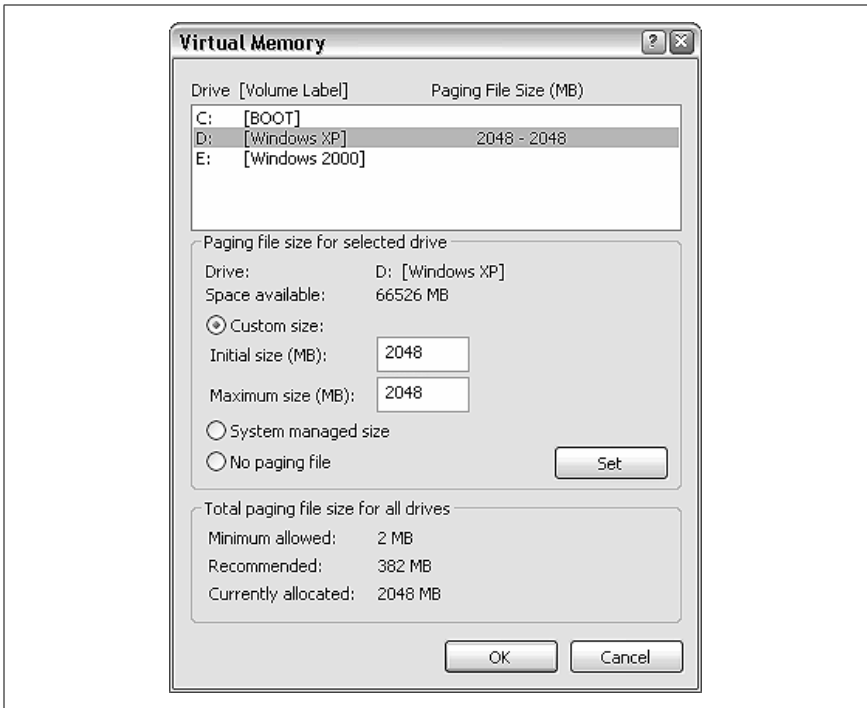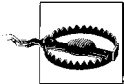
Figure 5-6. Change the way Windows handles virtual memory to improve overall system performance

Some users have had limited success disabling virtual memory altogether, although I wouldn't recommend it. The theory is that if there's enough physical memory installed, and virtual memory is completely disabled, Windows will access the hard disk much less often. It may be worth a try if you have at least 512 MB of physical memory, but you may find that certain programs won't run without at least some virtual memory. It's even possible that eliminating the swapfile will prevent Windows from loading altogether.

4. Press **OK** on each of the three open dialogs. If you have only resized your swapfile, you won't have to restart. However, if you've added (or removed) a swapfile on a different drive, Windows will prompt you to restart at this point.

Part 2: Defragment the paging file

Part 1 will eliminate the possibility of your swapfile becoming fragmented, but it won't defragment an already fragmented swapfile. You'll need to

defragment it at least once for it to remain that way in the future. See Figure 5-5, earlier in this chapter, for details on file fragmentation. Note that this is not an easy task if you don't have the right tools. Here are several ways to accomplish this:

- If you have Norton Utilities (*http://www.symantec.com*), you'll be able to optimize the swapfile fairly easily using its Speed Disk utility. Speed Disk is also able to move your swapfile to the physical beginning of your partition, which can also theoretically improve performance. The Disk Defragmenter utility that comes with Windows XP (*dfrg.msc*) is actually a scaled-down version of Norton Speed Disk, but it is not capable of defragmenting the swapfile.

- If you don't have software capable of defragmenting your swapfile, there are two alternatives. If you have more than one partition or hard disk in your system, start by moving your swapfile to a different drive letter (see the previous section for details). Then, run Disk Defragmenter (*dfrg.msc*) on the partition you wish to hold the swapfile permanently, which will set aside a large chunk of contiguous free space. Lastly, move the swapfile back to the original partition, making sure its size is set constant.

- If you don't have a second partition, your other choice is to disable virtual memory temporarily by clicking **No paging file** and then **Set** in the Virtual Memory window (see Figure 5-6). After restarting Windows, run Disk Defragmenter (*dfrg.msc*) to set aside a large chunk of contiguous free space. When you're done, go back to the Virtual Memory window, and re-enable the paging file, making sure to set a constant size.
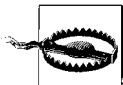
> Note that if you have fewer than 256 MB of physical memory, there is a risk that Windows may not boot properly without a paging file. If this happens, you should be able to load Windows in Safe Mode and re-enable your swapfile. See "What to Do when Windows Won't Start" in Chapter 6 for details.

Part 3: Clear the paging file on shutdown

It's possible to have Windows delete your paging file whenever you shut down Windows. There are three reasons you might want to do this:

- If you have a multiboot system, as described in Chapter 10, each operating system on your computer will have its own virtual memory settings. If the paging file from one OS is present while the other is running, it may cause a conflict and will certainly waste a lot of disk space.

- If your paging file becomes corrupted or highly fragmented, Windows may load more slowly (or not at all). Deleting the paging file will force

Windows to re-create it the next time it starts, which may alleviate this problem.

- If you're concerned about the security of your data, it is theoretically possible for a hacker to extract sensitive information from your paging file.

Naturally, if you've gone through the steps to defragment your paging file, as described earlier in this topic, you probably won't want it to be deleted (lest it become fragmented when it is re-created).

Here's how to do it:

1. Open the Local Security Settings console (*secpol.msc*). See Chapter 7 for more information on the settings in this window.

2. Navigate to Security Settings\Local Policies\Security Options.

3. Double-click the **Shutdown: Clear virtual memory pagefile** entry on the right.

4. Select **Enabled** and then click **OK**. You'll need to restart Windows for the change to take effect.

Part 4: Advanced settings for the adventurous

Like virtual memory settings, disk cache settings in Windows XP aren't necessarily optimized for the best performance, but rather for the best compromise between performance and compatibility with older computers.

Each of these settings, as described here, will typically benefit only those with large amounts of physical memory (at least 384 MB). Those with less memory (under 256 MB) may not see any performance increase; in fact, some of these settings may actually degrade system performance if your system has too little RAM. Essentially, you'll want to experiment with different values until you find ones that work best for your system.
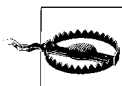
> Entering incorrect values for some of these settings can render Windows inoperable. Make sure you have a recent backup before you continue, not only of your system, but of the specific Registry key discussed (using a Registry patch, explained in Chapter 3).

Start by opening the Registry Editor (described in Chapter 3) and expanding the branches to HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Control\Session Manager\Memory Management. Some of the more interesting values in this key include the following:[*]

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[*] If any of the keys listed here are not present, they can be added by going to **Edit → New → DWORD Value** and then typing the name exactly as shown.

DisablePagingExecutive

> Values: `0` = disabled (default), `1` = enabled

> Enabling this setting will prevent Windows from paging certain system processes to disk, which effectively will keep more of the operating system in the faster physical memory, which, in turn, will make Windows much more responsive.

IoPageLockLimit

> Values: *varies*

> This value, in bytes, specifies the maximum amount of memory that can be used for input/output operations. Since this setting deals with the transfer of data into and out of your computer, it will be of the biggest benefit to those running servers and those who use their network or Internet connections most heavily.

> The default value is 512 KB (524,288 bytes), but increasing it should improve performance. This value is specified in bytes (not MB) and must be entered in Hexadecimal mode.* Recommended values, based on the amount of physical memory in your system, are shown in Table 5-1.

Table 5-1. Recommended values for the IoPageLockLimit setting

Amount of physical RAM	Recommended value	Maximum value
128 MB	4194304 bytes (4 MB)	physical RAM minus 16MB
256 MB	10485760 bytes (10 MB)	physical RAM minus 32MB
512 MB or more	41943040 bytes (40 MB)	physical RAM minus 64MB

LargeSystemCache

> Values: `0` = standard (default), `1` = large

> By default, Windows uses only 8 MB of memory for the filesystem cache. Enabling this option will allow Windows to use all but 4 MB of your computer's memory for the filesystem cache. This will improve Windows performance, but potentially at the expense of the performance of some of your more memory-intensive applications.

> This option can also be changed by going to **Control Panel → System → Advanced** tab, clicking **Settings** in the **Performance** section, and then choosing the **Advanced** tab. The Memory usage section has two

---

* When editing DWORD Values in the Registry, you can choose the **Base** to use (**Hexadecimal** or **Decimal**). If you use the incorrect base, the value you type will have a different meaning. See Chapter 3 for details.

settings: **Programs** and **System cache**, which correspond to the 0 and 1 values here.

Other values in this key include PagingFiles, which is more easily set in the Virtual Memory window described in "Part 1: Virtual memory settings" and ClearPageFileAtShutdown, more easily set in the Local Security Settings console, as described in "Part 3: Clear the paging file on shutdown."

Choosing the Right Filesystem

The filesystem is the invisible mechanism on your hard disk that is responsible for keeping track of all the data stored on the drive. Think of the filesystem as a massive table of contents, matching up each filename with its corresponding data stored somewhere on the disk surface. Windows XP supports three different filesystem types:[*]

FAT (File Allocation Table, 16-bit)
> FAT is used for all drives under 512 MB, including floppy and ZIP disks. The largest drive supported by the FAT filesystem is 2GB, which is why older drives larger than 2GB were often divided into several partitions.

FAT32 (File Allocation Table, 32-bit)
> Designed to overcome the 2 GB partition limit of the FAT system, FAT32 is supported by newer operating systems. In addition to the support for larger drives, it also supports smaller file clusters (described later), so it's more efficient than FAT.

NTFS (NT Filesystem)
> NTFS was designed from the ground up to completely replace FAT/FAT32. It supports encryption, compression, and robust security,[†] and is typically more reliable than FAT/FAT32 as well.

If Windows XP is the only operating system on your computer, you should be using NTFS—no question. The only compelling reason to use another filesystem is if you have a dual-boot setup with an earlier version of Windows, in which case you'd need to choose a filesystem recognized by all operating systems on your computer. See the "Filesystems and Multiple Drives" sidebar for more information. Table 5-2 shows which filesystems are supported by recent versions of Microsoft Windows.

[*] There's actually a fourth type, CDFS, used by CD-ROMs.

[†] The encryption and security features of NTFS are discussed in Chapter 7. NTFS compression is discussed in "Increasing Disk Space (or What to Throw Away)" earlier in this chapter.

Table 5-2. Filesystems supported by recent versions of Windows

	FAT	FAT32	NTFS
Windows XP	✓	✓	✓
Windows 2000	✓	✓	✓
Windows Me, 98, and 95 ORS2	✓	✓	
Windows NT 4.0	✓		✓
Windows 95	✓		

To find out which filesystem is currently being used by a particular drive, just right-click the drive in Explorer (or My Computer), and select **Proper-ties**. Figure 5-7 shows the drive-properties window for an NTFS partition. You can also open the Disk Management utility (*diskmgmt.msc*) to see an overview of all of your drives.
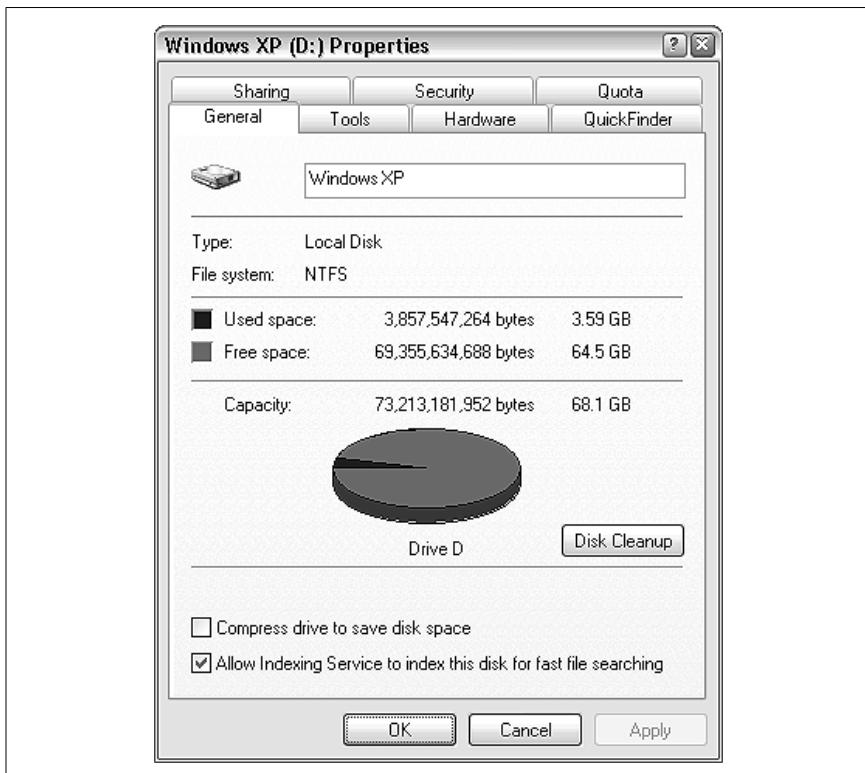

Figure 5-7. Use a drive's properties sheet to see which filesystem it's currently using

Note that some of the elements on the drive-properties window won't be present for non-NTFS drives, such the **Security** and **Quota** tabs and the **Compress drive** and **Allow Indexing** options.

Filesystems and Multiple Drives

If you have more than one drive on your system, whether they're separate physical drives or separate partitions of the same drive, they can have different filesystems. This is common on multiboot systems (discussed in Chapter 1), where each OS will reside on a different partition. Just keep in mind the filesystem compatibility shown in Table 5-2; if you have Windows 98 on a FAT32 partition and Windows XP on an NTFS partition, the XP partition will be invisible to the 98 installation but both drives will be visible and accessible from the XP installation.

Convert your drives to NTFS

If you're not using NTFS on your drive and you don't need to support FAT/FAT32 for compatibility with other operating systems, you can convert your drive to NTFS quite easily, and without harming your data. For example, if you've upgraded to Windows XP from Windows 9x/Me, and you didn't elect to convert your drive(s) to NTFS during setup, you are likely still using FAT32.

Windows XP comes with the FAT to NTFS Conversion Utility (*convert.exe*), which is used as follows. To convert drive *c:*, for example, just open a command-prompt window (*cmd.exe*) and type the following:

```
convert c: /fs:ntfs
```

The following options are also available for this utility:

/v

Run in verbose mode (provide more information).

/cvtarea:*filename*

Specifies a contiguous file, *filename*, in the root directory as the placeholder for NTFS system files.

/nosecurity

Include this parameter if you want the initial security privileges for all files and folders on the newly converted volume to be set so the files and folders are accessible by everyone.

/x

Forces the volume to dismount first, if necessary closing any opened files on the volume. Use this option if you're on the network and there's concern that other users may attempt to access the drive during the conversion process.

Note that this is a one-way conversion, at least when using the software included with Windows XP. If you need to convert an NTFS drive to FAT32 for some reason, you'll need a third-party utility such as PartitionMagic (*http://www.symantec.com/partitionmagic/*).

Understanding cluster sizes

Clusters are the smallest units into which a hard disk's space can be divided. A hard disk formatted with the traditional FAT system, found in Windows 95 and all previous versions of Windows and DOS, can have no more than 65,536 clusters on each drive or partition. This means that, the larger the hard disk, the larger the size of each cluster. The problem with large clusters is that they result in a lot of wasted disk space. Each cluster can store no more than a single file (or a part of a single file); if a file does not consume an entire cluster, the remaining space is wasted. For example, a 2 GB drive would have a cluster size of 32 KB; a 1 KB file on a disk with a 32 KB cluster size will consume 32 KB of disk space; a 33 KB file on the same drive will consume 64 KB of space, and so on. The extra 31 KB left over from the 33 KB file is called *slack space*, and it can't be used by any other files. With thousands of files (especially those tiny shortcuts littered throughout a Windows installation), the amount of wasted slack space on a sizeable hard disk can add up to hundreds of megabytes of wasted space.

The NTFS and FAT32 filesystems supported by more recent versions of Windows can handle over four billion clusters,[*] resulting in much smaller cluster sizes. The same 2 GB drive formatted with FAT32 or NTFS will have only a 4 KB cluster size. Figure 5-8 illustrates the slack space created by files stored on a traditional FAT system versus the same files stored on a FAT32 or NTFS drive.

You can see how much space is wasted by any given file by right-clicking on the file icon, selecting **Properties**, and comparing the **Size** value with the **Size on disk** value. The same works for multiple selected files and folders; highlight all the objects in your root directory to see the total amount of wasted space on your drive. To find the current cluster size of your drive, just open the properties sheet for a small file you know will only consume a single cluster (such as a Windows Shortcut); its **Size on disk** will be equal to the size of one cluster.

---

[*] Four billion clusters, at 4 KB each, results in a maximum partition size of 14.9 terabytes (15,259 GB) for FAT32 and NTFS volumes. Of course, if this drive were commercially available, its manufacturer would contend that 1 terabyte is equal to 1,000,000,000,000 bytes, and advertise the unit as a 16.4 TB (16,384 GB) drive.
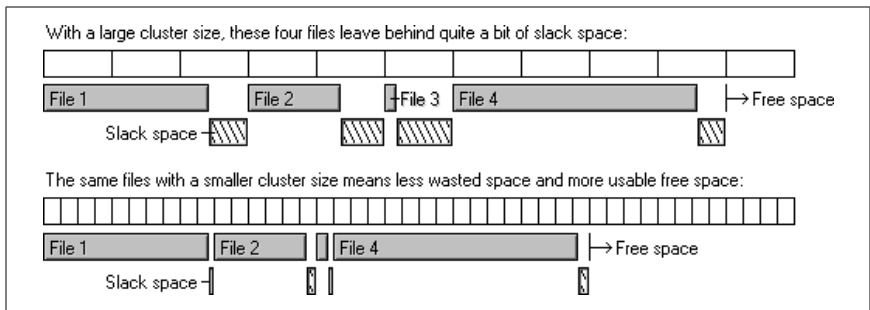
Figure 5-8. FAT32 stores files more efficiently by allowing smaller cluster sizes

So, what does this all mean? It means that if you convert a drive from FAT to FAT32, you will definitely reclaim some wasted space. But, since FAT32 and NTFS drives have the same cluster size (4 KB), there is no slack-space incentive to convert to NTFS. In fact, the extra features of NTFS (discussed earlier in this section) have slightly more overhead, and thus a conversion from FAT32 to NTFS will most likely result in slightly *less* overall free disk space.

Advanced NTFS Settings

As mentioned in the last section, the extra features of the NTFS filesystem come at a price: a small amount of disk space and performance overhead. The following settings allow you to fine-tune NTFS to squeeze the most performance out of your NTFS drive; experiment with these settings to find the configuration that works best for you.

Note that these settings will have no effect for non-NTFS drives. See "Choosing the Right Filesystem," earlier in this chapter, for more information.

Start by opening the Registry Editor (described in Chapter 3), and expanding the branches to `HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Control\Filesystem`. There are three values here that concern us:[*]

`NtfsDisable8dot3NameCreation`

> Values: `0` = enabled (default), `1` = disabled

> Early versions of Windows and DOS did not support long filenames, but rather allowed only eight-character filenames followed by three-letter filename extensions. Although Windows 95 and all subsequent versions of Windows eliminated this restriction,[†] an eight-dot-three version

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[*] If any of the keys listed here are not present, they can be added by going to **Edit → New → DWORD Value**, and then typing the name exactly as shown.

[†] Long filenames can be practically as long as you like, and can, for example, include spaces.

of the filename was always generated to maintain compatibility with older applications. For example, the file, *A letter to Mom.wpd* would also be referenced as *alette~1.wpd*. If you don't use older 16-bit programs, either on your computer or on your network, you can disable Windows XP's creation of these 8.3 aliases by changing this value to 1 (the default is zero).

NtfsDisableLastAccessUpdate

Values: 0 = enabled (default), 1 = disabled

Windows keeps a record of the time and date every file and folder on your hard disk was created, as well as when it was last modified and last accessed. You can stop Windows from updating the "last accessed" date for folders every time they're opened by changing the value to 1 (the default is zero), which should improve drive performance. This setting has no effect on files.

NtfsMftZoneReservation

Values: 1 = small (default), 2 = medium, 3 = large, 4 = maximum

The core of the NTFS filesystem is the master file table (MFT), a comprehensive index of every file on the disk (including the MFT itself). Since disk defragmenters can't defragment the MFT (also known as *$mft*), Windows reserves a certain amount of extra space for it to grow, in an effort to reduce its eventual fragmentation. The more fragmented the MFT gets, the more it will hamper overall disk performance.[*]

You can determine the current size and fragmentation level of the MFT on any drive by opening Disk Defragmenter (*dfrg.msc*). Select a drive from the list, click **Analyze**, and then **View Report** (see Figure 5-9). The numbers relating to the MFT are shown at the end of the **Volume Information** report. Probably the most interesting statistic here, though, is **Percent MFT in use**. The higher the number, the less space the MFT has to grow (and it will).[†]

The NtfsMftZoneReservation setting allows you to increase the space reserved for the MFT. Although the default is 1, values of 2 or 3 are probably better for most systems with large hard disks; the maximum value of 4 is good for very large drives with a lot of small files. Specify too small of a value here, and the MFT will become fragmented more quickly as it grows; too large of a value, and it will consume (waste) too much disk space.

---

[*] See "A Defragmentation Crash Course," earlier in this chapter, for more information.

[†] For example, a 40 MB MFT file with 88 percent in use has 4.8 MB of empty space reserved for it, which means roughly 4,800 more files can be added to the volume before Windows increases the MFT, probably creating more fragments.
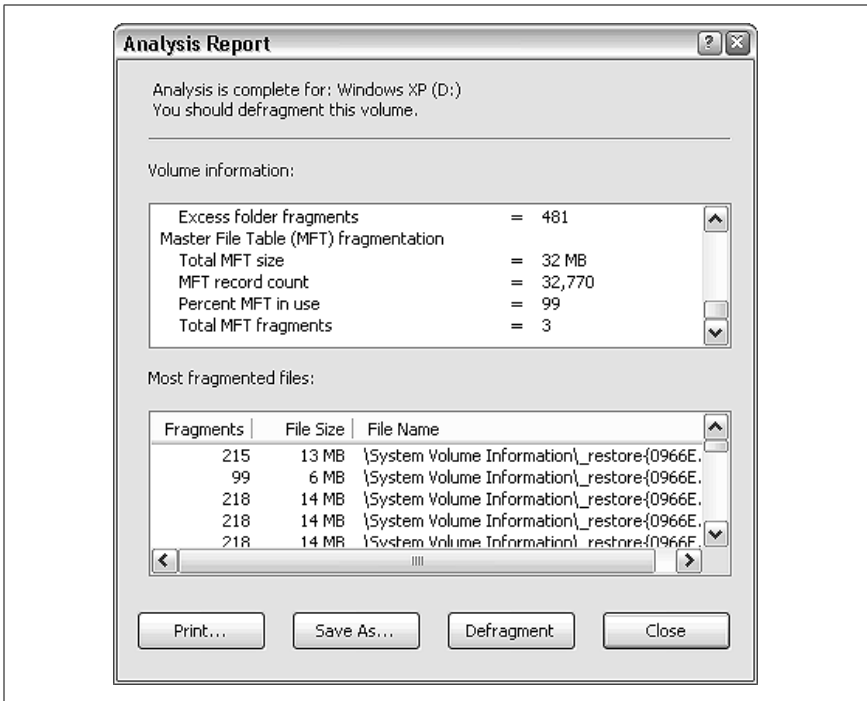
Figure 5-9. Find the size and fragmentation of the Master File Table (MFT) by viewing Disk Defragmenter's report for NTFS volumes

The problem is that changing this setting will not result in any modification of the current MFT, but rather only influence its future growth. For this reason, the earlier this value is increased in the life of a disk, the better. Unfortunately, the only way to defragment or rebuild the MFT is to format the drive.

You'll need to restart Windows for any of these changes to take effect.

What to Look for in a New Hard Disk

The speed of your hard disk is a major factor of your system's overall performance. After all, the faster it's able to find data and transfer it to your system's bus, the faster Windows will load, the faster your virtual memory will be, and the faster you'll be able to copy files.

If you're thinking of upgrading your hard disk (see "Transfer Windows to Another Hard Disk or System" in Chapter 5), there are several measures of speed that you should scrutinize when choosing a drive:

Seek time (measured in milliseconds)
> The seek time (or access time) is the average length of time required to find a piece of information; lower times are faster. There are a few variants, such as *track-to-track* and *full stroke*, and there are often separate measurements for reading and writing data. But the *average* seek time is the one that is most often advertised; don't settle for anything slower than about 9 ms.

Transfer rate (measured in megabytes per second)
> This is the amount of data the drive can transfer to your motherboard's data bus in a second; higher transfer rates are faster. Although the maximum *burst* transfer rate is the one most often advertised (typically in the hundreds of megabytes per second), the maximum *sustained* transfer rate is probably the more important of the two.

RPM (measured in revolutions per minute)
> This is the speed at which the disk spins; higher numbers are faster. Cheaper drives spin at 5400 rpm, but don't settle for anything less than 7200 rpm. If you're serious about performance, look for a more expensive 10,000 rpm (10k) or 15,000 rpm (15k) drive.

Buffer (measured in megabytes)
> The buffer is memory (RAM) installed in the drive's circuitry, allowing it to accept data from your computer faster than it is able to physically write to the disk surface, and read data from the disk surface faster than it's able to transfer data to your computer. A larger buffer is better; don't settle for less than 8 megabytes.

Whether you're shopping for a new hard drive or just trying to determine if your existing drive is as fast as it should be, these measurements should give you enough to go on. If your drive seems excessively slow, you can either replace it or try some of these solutions:

- Add more RAM (see "Memory" earlier in this chapter).

- Get more free space. Either delete some files or replace your hard disk with a larger one (or add another drive). Regardless of the amount of RAM you have, Windows will still need a substantial amount of space for virtual memory and temporary files. If you run out of space, Windows will slow down and will be more likely to crash.

- Defragment your hard disk by running Disk Defragmenter (*dfrg.msc*).

- Put your hard disk on its own controller, so it isn't sharing the cable with any other drives. For instance, if your hard disk is connected to

your primary IDE controller, plug your CD/DVD drive into your secondary IDE controller.

Scan your system for spyware, discussed at the beginning of this chapter.

Transfer Windows to Another Hard Disk or System

With the release of an operating system as large and power-hungry as Windows XP, it shouldn't be surprising that many users need to upgrade their hard disks—or even their entire systems—just to accommodate the new version.

Either way, some or all of the files on the old hard disk will need to be transferred to the new hard disk, and this can be a difficult task. Sure, you can simply install Windows XP from scratch and then proceed to reinstall all your applications, configure all your settings, and rewrite all your documents, but that's not exactly the most practical solution. Besides, your Freecell statistics would be lost forever.

You can transfer the data from one drive to another (or one system to another) in several ways, explained in the following solutions. The one you choose depends on your available hardware and specific needs. If you just purchased a new hard disk, you need to prepare it by partitioning and formatting it before you continue. See "Working with Partitions," later in this chapter, for details.

Solution 1: Using a disk-cloning utility

The following procedure is probably the most pain-free solution of those in this section, at least in terms of the amount of interaction and work involved. However, you will need to crack open your case and fuss with cables (something you'll have to do anyway if you're only upgrading your hard disk, versus the entire system). Also, it requires that you purchase a third-party utility, although the aggravation and time it saves can offset the cost (even if you only use it this once). Note also that any data on the new hard disk will be lost as it is replaced with the data on the old disk:

1. Obtain a disk-cloning utility such as Norton Ghost (*http://www. symantec.com*).[*]

   > If you purchased the product online and have only the downloadable edition, you may have to create a bootable diskette as described in the documentation included with the product you're using.

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[*] Now-defunct alternatives to Norton Ghost include the excellent DriveCopy and Drive Image utilities from PowerQuest (now Symantec). Although they're not commercially available anymore, if you can find XP-compliant versions of either tool (in your closet or perhaps on eBay), they're worth a try.

2. Connect both your old hard disk and your new hard disk to the same computer simultaneously. If you're upgrading to a new system, it usually doesn't matter which computer you use for this process. However, drive configurations in the following list are usually required by this type of utility (see the software's documentation for details):

   - If you're using IDE drives, the old hard disk should be connected as "master" and the new hard disk should be connected as "slave."

   - If you're using SCSI drives, configure the SCSI controller BIOS to boot off the old drive.

   - If you're using one IDE and one SCSI drive, the configuration shouldn't matter.

3. If your disk controller doesn't have enough free ports, just temporarily disconnect a CD drive or other storage device to make room for the new drive.

4. Insert the boot disk from the disk-cloning utility you're using and boot your computer. The program should start up and walk you through the rest of the process. Just be careful when choosing the "from" and "to" drives.

While this sounds complicated, it's actually quite fast, as data transfer between two hard disks on the same system is much faster than over a network or using removable media.

The particular procedure from this point forward depends on the type of disk-cloning utility you chose. There are typically two types:

- The more traditional disk-cloning programs simply copy all data on one drive, byte for byte, to another drive. Any partitions (discussed later in this chapter) are duplicated as well but are expanded proportionally. For example, if you have a 10 GB drive with two 5 GB partitions, and you transfer the data to a 60 GB drive, you'll end up with two 30 GB partitions (which can later be combined, if desired, with the solutions found later in this chapter).

- Newer "image" utilities take a slightly different approach. Instead of copying data between drives, these programs start by creating an *image* of the old drive, which is essentially a single, enormous file that contains every byte of data on the drive. The new drive is then reconstructed from the image.

> This can be especially useful if you need to create several exact copies of a single drive, a common practice for network administrators who don't want to spend days individually configuring a bunch of otherwise identical computers.

The problem with this intermediate step is that you need somewhere to store this image file. If you're creating an image of a 10 GB drive with 8 GB of data on it, there will only be 2 GB of free space, which won't be enough to store an 8 GB image file. Since you won't be able to store the image file on the target (new) disk, you'll actually need a *third* hard disk to hold the image.

Solution 2: Use a backup device

If you have a tape drive or other large-capacity backup device, another thing you can do is back up your entire system and then restore it to the new drive. Here's how to do it:

1. Back up your entire system, making sure to include every file on your hard disk. See Chapter 6 for more information on backup devices and procedures.

2. If you're only upgrading your hard disk, shut down your computer, remove the old hard disk, and install the new hard disk. Then, install Windows using the "Installing on a New (Clean) System" procedure in Chapter 1.

   If you're upgrading to an entirely new machine, you'll need to install your backup device on the new system.

3. Install the backup software (the same as the one you used in Step 1) onto the new drive or new system.

4. Restore the files from the backup media onto the new drive, but make sure you restore the entire tree of files into a temporary folder, rather than into the root directory. For example, if your temporary folder is named *Old Hard Disk*, then the path to the restored *Documents and Settings* folder will actually be *Old Hard Disk\Documents and Settings*. This prevents errors you may encounter trying to replace files and folders in use by the current installation of Windows.

5. When the restore process is complete, selectively (one-by-one) drag the old folders out of your *Old Hard Disk* folder and into the root directory of your new hard disk.

   In the cases of your Windows folders (such as the *Windows*, *Program Files*, and *Documents and Settings* branches), you won't be able to drag them if they're replacing existing in-use folders. Instead, you have two options: either don't copy every folder (instead, only move selected files and folders) or use the following workaround.

Here are the optional additional steps to replace your Windows folders:

1. Start by renaming the three conflicting folders, all still located in the *Old Hard Disk* folder, as follows:

   - *Windows* becomes *oldwin*
   - *Program Files* becomes *oldprogs*
   - *Documents and Settings* becomes *olddocs*

2. Drag the three folders into your root directory, so they're right alongside the folders they're intended to replace.

3. Restart the computer and load the Windows Recovery Console (described later in this chapter).

4. After logging in, issue the commands in the following list:

   ```
   ren Windows newwin
   ren "Program Files" newprogs
   ren "Documents and Settings" newdocs
   ren oldwin Windows
   ren oldprogs "Program Files"
   ren olddocs "Documents and Settings"
   ```

   See Chapter 10 for more information on the `ren` command. Note the use of quotation marks to accommodate the folder names with spaces.

5. Restart your computer when you're done. The old installation of Windows will now be used to start your computer. If you're upgrading to an entirely new computer, Windows will detect a bunch of new hardware the first time it starts.

   The new, temporary Windows installation is now stored in the *newwin*, *newprogs*, and *newdocs* folders, which can be deleted or stored as you see fit.

Alternate Method of Shuffling Restored Files

While we're at it, another way to accomplish all of this is to divide your new drive into two partitions (as discussed later in this chapter). When installing the new copy of Windows, put it on the second partition (usually *D:*). Then, restore the backed-up files onto the first partition (usually *C:*). Since the restore process will replace the *boot.ini* file in the root directory of drive *C:* with the one from your backup, your computer will boot to the restored Windows installation on drive *C:* the next time you restart. You'll then be able to delete the extraneous, temporary second partition. (See "Set up a Dual-Boot System" in Chapter 1 for more information on the *boot.ini* file.)

Solution 3: Transferring data manually

Although the previous two solutions are preferred, since they allow you to move a great deal of data from one drive to another, they're also more involved than the following solution. If you don't really need to move everything from the old drive to the new one, but instead only wish to copy personal documents and perhaps some settings, consider the following tips:

- The File and Settings Transfer Wizard is included with Windows XP for the specific purpose of transferring files from one computer to another. Unfortunately, it doesn't work very well, and can even end up being more trouble than it's worth. Essentially, everything it does can be accomplished manually with a network connection or removable media storage device.

- Be careful when installing two drives in the same computer, as Windows XP has a tendency of permanently changing drive letters in a way that is difficult to undo. For example, if you have two drives, each known as *C:* in their respective computers, and you install both in the same computer, the secondary (or slave) drive will be changed so that it shows up as *D:*, so as not to conflict with the existing drive *C:* that has priority. If you then remove the drive and put it back in the original computer, it will still think of itself as drive *D:*, and may not boot because of it. For this reason, only put the "old" drive in this position, so you don't risk the "new" drive getting "re-lettered." See "Working with Partitions," later in this chapter, for more information on this paradox.

- If you have two separate computers, transferring the files over your network may be the best way to avoid the complexities of hooking up both drives to the same machine. Although the network connection will be slower, it's easier and less risky. See Chapter 7 for more information on networking.

- Since Windows XP won't let you copy certain system files that are in use, you won't be able to copy your Windows Installation simply by dragging and dropping files in Explorer, whether you're using a network connection or removable media drive. To do this, you'll have to use one of the first two solutions in this section. The alternative is to install Windows on the new drive and then find a way to be satisfied copying only some files.

- You can copy user profiles from one computer to another. User profiles are stored in the *Documents and Settings* folder, and include the Desktop, Start Menu, and many personal settings. However, you won't be able to overwrite the user profile in use by the currently logged-in user.

See "Backing Up the Registry" in Chapter 3 for more information user settings, and all of Chapter 7 for more information on user accounts.

- To copy selected settings, such as application toolbars and other personal preferences, you can use Registry patches, as described in Chapter 3.

Working with Partitions

Most hard disks are known by a single drive letter, usually *C:*. However, any hard disk can be divided into several drive letters, known as *partitions*.

For example, if you have an 240 GB hard disk, you may wish to have three 80 GB partitions, or perhaps a 100 GB partition and two 70 GB partitions. There are several reasons why you might want to do something like this:

Organization
> Use multiple partitions to further organize your files. For example, put Windows on one drive, work documents on another, games on another, and music and other media on yet another.

Isolation of system and data
> Partitions can be used to isolate your programs from your data. For example, place Windows on drive *C:*, your personal documents on drive *D:*, and use drive *E:* for your swapfile. This gives you the distinct advantage of being able to format your operating system partition and reinstall Windows without touching your personal data. (See Chapter 8 for help relocating personal folders, such as *My Documents*.)

Performance
> As illustrated in "A Defragmentation Crash Course," earlier in this chapter, your hard drive can become fragmented very quickly, which can decrease performance and increase the chances of data corruption. Because files cannot become fragmented across partition boundaries, splitting your drive into several partitions will isolate groups of files and thus help curb their fragmentation. Plus, in the event that a single partition becomes significantly fragmented, its smaller size will mean it can be defragmented in much less time.
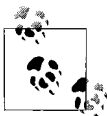
> Isolate your swapfile on its own partition to allow it to grow and shrink as needed, without becoming fragmented as it would if it shared a drive with other files. See "Optimize Virtual Memory and Cache Settings," earlier in this chapter, for details.

Dual-boot

> To set up a dual-boot partition, described in Chapter 1, you'll want to create a separate partition for each operating system you wish to install.

Multiple users

> If you have several users, you can isolate their personal data from the operating system by creating a separate partition for each user.

Web Server

> If you're setting up a web server (or other type of network file server) or if you're participating in peer-to-peer file sharing, it's good practice to put the publicly accessible folders on their own partition. This not only helps to secure the operating system from unauthorized access, but allows the OS to be upgraded or replaced without disrupting the shared folders and programs.

Consolidation

> If you're using an older computer that has been upgraded to Windows XP, your hard disk may have been partitioned to work around a limitation in the earlier version of Windows (described in "Choosing the Right Filesystem," earlier in this chapter). Using the tools discussed in this section, you can consolidate those drives into a single partition and possibly make more efficient use of your free space.

The Disk Management tool

Windows XP comes with an all-encompassing utility, Disk Management (*diskmgmt.msc*), which is used to view the partition table of any drive on your system, as well as create and delete partitions and even change the drive letters for existing drives.[*]

The main Disk Management window, as shown in Figure 5-10, is divided into two parts. You can change the arrangement of the panes in this window by going to **View → Top** or **View → Bottom**.

There are three possible views, each displaying some redundant and some unique information, but by default, only the Volume List and Graphical View are shown (in the top and bottom positions, respectively):

Volume List

> Use this view to show a summary of all the currently mounted logical drives on your system. This includes all active partitions on all hard disks, as well as any media currently inserted into your removable drives

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[*] Disk Management effectively replaces the FDISK utility, used in some earlier versions of Windows to prepare a hard disk before installing the operating system.
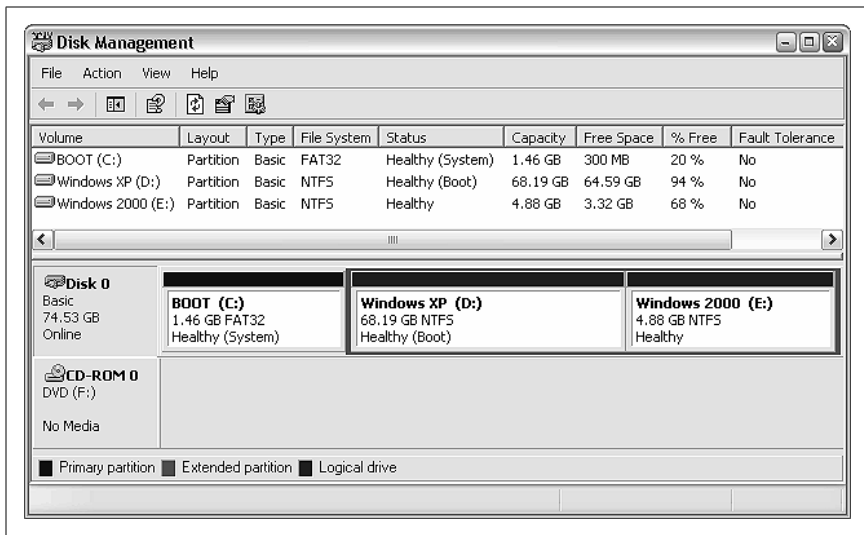
Figure 5-10. Open the Disk Management utility to add or remove partitions, shuffle drive letters, and even change the way volumes are mounted

(which include CD and DVD drives, memory card readers, and removable cartridge drives). Removable drives without media (e.g., an empty CD drive) will not show up here, as these volumes are not mounted. See the subsequent discussion for more information on mounting drives.

This view is called the Volume List because it lists volumes, not disks. The term *volume* is essentially another word for partition. A single disk can contain several volumes (such as the one shown in Figure 5-10), although most hard disks (and all CDs, for instance) only contain a single volume. The way that each volume is accessed in Explorer (usually with a drive letter) is determined by how the volume is mounted (explained below).

Graphical View

Probably the most useful view in Disk Management, the Graphical View lists a single entry for each physical drive in your system. Then, next to each device is shown all of the currently mounted volumes associated with the respective disk.

By default, the boxes representing multiple partitions (volumes) are not sized proportionally to their size (i.e., a 2 GB partition will appear to be roughly the same size as a 10 GB partition). To fix this, go to **View** → **Settings** → **Scaling** tab, and choose the **According to capacity, using linear scaling** option in both sections. You can also customize the colors used in the Graphical View by choosing the **Appearance** tab in this dialog.

Disk List

The Disk List is similar to the Graphical View but abandons the display of the volumes for each disk in favor of additional technical information about each disk. The only information displayed here that is not available in the Graphical View is the Device Type (e.g. IDE, SCSI, USB) and Partition Style.[*]

Hidden

Select this option to turn off the lower pane (it's not available for the upper pane), leaving the remaining selection to consume the entire window.

Press **F5** or go to **Action → Refresh** to refresh all views, necessary if you've inserted or removed a CD, for example. Use **Action → Rescan Disks** for a more thorough refresh.

Feel free to customize the view of this window, but be aware that Disk Management won't save your customization settings, unless you first create a custom console file, described as follows.

Customizing Disk Management

The Disk Management tool is actually what Microsoft calls a "snap-in" for the Microsoft Management Console (MMC) application.[†] Other snap-ins include Disk Defragmenter, Device Manager, and the Group Policy Editor. The *.msc* file you launched to open the Disk Management tool is not actually the program, but rather just a small *console* file, which contains only the settings for the current view. The following procedure not only shows how to create a new console file that you can customize in a way that be saved, but shows how to create custom console files for all sorts of purposes.

1. Open the Microsoft Management Console (*mmc.exe*). A new, blank "Console Root" window will appear in the MMC window.

2. Go to **File → Add/Remove Snap-in**, and then click **Add**.

3. Select **Disk Management** from the **Available Standalone Snap-ins** list, and then click **Add**.

4. Another window will appear, giving you a choice between **This Computer** and **The following computer**. Although it's possible to view the partition table to another computer using a network connection, you'll want to choose **This Computer** for the time being.

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[*] For nearly all disks on a Windows system, the Partition Style will be MBR (Master Boot Record). The exception is GPT (GUID partition table) drives, used by Windows XP 64-Bit Edition.

[†] For more information on the Microsoft Management Console, as well as the available snap-ins, see *Windows XP in a Nutshell* (O'Reilly).

5. You can add other snap-ins at this point, or simply click **Close** when you're done. Finally, click **OK** to close the Add/Remove Snap-in window.

6. Highlight the Disk Management entry in the tree in the left pane, and then go to **View → Customize** and turn off the **Console tree** option to simplify this window. You won't want to hide the console tree if you added more than one snap-in in the previous step. Figure 5-11 shows a custom console file with a bunch of useful snap-ins, all accessible from the same window.
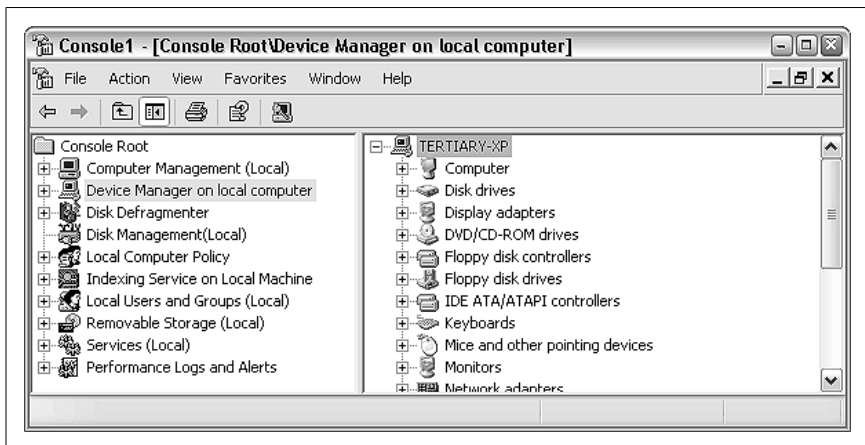

Figure 5-11. If you find yourself using Disk Management or other MMC snap-ins frequently, you can create your own custom console file to provide quicker access to your favorite tools

7. You can further customize this window as you see fit. When you're done customizing, go to **File → Save** to save your custom console view into a new *.msc* file.

The next time you use the Disk Management tool, just open your custom *.msc* file instead of the *diskmgmt.msc* file included with Windows XP.

Mounting volumes

As stated in the previous section, a hard disk can have one partition or many. Other types of storage devices, such as CD drives, only have single partitions. These partitions, regardless of the nature of the physical device on which they're located, are all recognized as *volumes* by the Disk Management tool and by Windows Explorer.

Mounting is the method by which a volume is made accessible to Explorer and all your applications. In most cases, each volume has its own drive

Alternatives to the Disk Management Tool

The Disk Management utility is not your only choice when it comes to repartitioning drives, but as far as the tools included with Windows XP are concerned, it's the best one.

One alternative is the DiskPart utility (*diskpart.exe*), a way of viewing, adding, and removing partitions from the command prompt. DiskPart is essentially the command-line equivalent to the Disk Management tool, although it has a few extra features (see "Resizing and moving partitions," later in this section). The biggest advantage to DiskPart is that it can also be run from the Windows Recovery Console, discussed later in this chapter. This allows you to modify your boot and system partitions, as well as work on your partition table when Windows XP won't start.

The other alternative is the disk partitioning tool built into Windows Setup. It's quick and simple, but it's only available while installing Windows XP. See "Installing the Operating System" in Chapter 1 for more information.

Finally, PartitionMagic (*http://www.symantec.com/partitionmagic/*) is a third-party utility, discussed in other parts of this chapter, that allows you to resize existing partitions on the fly, and without erasing the data they hold—something Disk Management can't do.

letter, such as *C:* or *D:*. But a volume can also be accessed through a folder on a different volume, called a mount point (NTFS only). Finally, there can be volumes on your system that aren't mounted at all, typically including volumes with filesystems* not recognized by Windows XP and volumes simply not currently in use. Such unmounted drives will be shown in the Disk Management window but won't appear in Windows Explorer.

You can change how any volume on your system is mounted,† except for the system volume (the one containing your boot files) and the boot volume (the one on which Windows is installed).‡ This is one of the reasons I like to partition my disks into several partitions: so I can more easily make changes to

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* See "Choosing the Right Filesystem" in for more information on filesystems. Examples of filesystems not supported by Windows XP include Linux and Unix partitions

† In some earlier versions of Windows, the drive letters of hard disks were controlled by DOS, but in Windows XP, you have much more control. See the "Designate Drive Letters" solution in any of my earlier *Annoyances* books for more information on the limitations involved in the assignment of drive letters in Windows 9x/Me systems.

‡ Note that the naming of the boot and system volumes is counterintuitive. The DiskPart utility, described later in this section, can be used to operate on the boot and system volumes.

my *other* drives as needed. With all my data on the same volume as Windows, I would have very little flexibility in this area.

In most cases, changing how a volume is mounted involves changing the drive letter. The easiest way to start is to change the drive letter of a removable or CD drive, and since applications are typically not installed on removable drives, there shouldn't be any adverse effects. For example, Figure 5-10, shown earlier in this chapter, shows a system with a DVD drive set to *F:*, a recordable CD drive set to *R:*, and a digital camera memory card reader set to *X:* (drives *R:* and *X:* are not shown).

To change the drive letter of any volume on your system, start by right-clicking any volume in the Graphical View or Volume List, and select **Change Drive Letter and Paths**. The Change Drive Letter and Paths dialog, as shown in Figure 5-12, lists the mount points for the selected volume. A volume can have as many mount points as you like, but only one of them can be a drive letter. (A volume can also have no drive letter or even no mount points at all.)
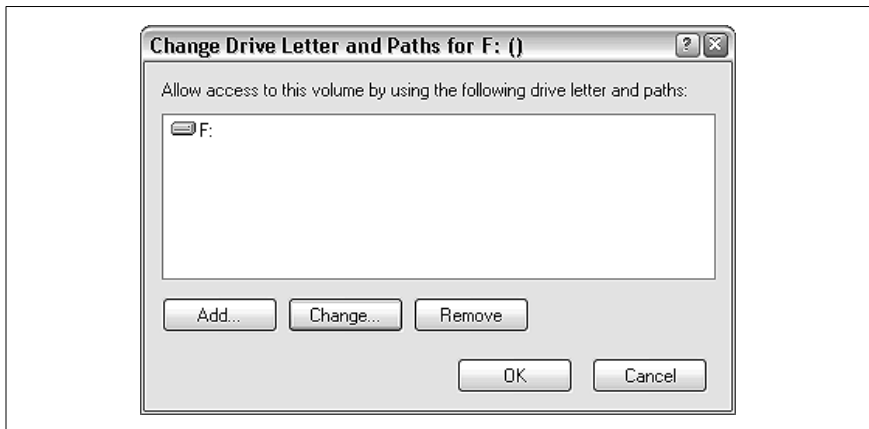

Figure 5-12. You can change the drive letter for any device, as well as as mount the volume as a folder on another drive, using the Change Drive Letter and Paths dialog

Click **Add** to display the Add Drive Letter or Path dialog. Here, you'll have two choices:

Assign the following drive letter
> Select this option and then choose an unused drive letter from the list to mount the drive using the selected letter. If the selected volume already has a drive letter, this option will be grayed out, and you'll have to select the drive letter in the previous dialog and select either **Change** or **Remove**.

The only roadblock you may encounter when trying to change a drive letter is when one or more applications are installed on the drive in question. You should still be able to change the drive letter, but said application(s) may no longer work on the newly lettered drive.

Mount in the following empty NTFS folder

This option is used to link up the volume with a folder on a different drive. For example, say the current volume already is using the drive letter *E:*. If you were to mount the volume in the folder *d:\backdoor*, then the contents of *E:* would be identical to the contents of *d:\backdoor*, and *e:\some folder* would be the same as *d:\backdoor\some folder*.

Any drive on your system can be mounted in this way, but the mount point (the target folder) must be on an NTFS drive (discussed in "Choosing the Right Filesystem," earlier in this chapter) and must be empty. You can even mount a CD in a folder on your desktop. You can view all of the drives mounted in folders by going to **View → Drive Paths**.

There are a few reasons why you might want to do this. For example, if your hard disk is running low on space, and you don't wish to take the time to replace it and transfer all your data over (as described in "Transfer Windows to Another Hard Disk or System," earlier in this chapter), you can install a new drive and mount it in, say, your *Documents and Settings* folder. That way, the role of storing all personal files will be assumed by the new drive, and the old drive should regain a great deal of disk space.

Features similar to this one include network-drive mapping, explained in Chapter 7, and Folder Shortcuts, explained in Chapter 4.

Creating and deleting partitions

Every hard disk must be partitioned before it can be used, even if that disk is to have only a single partition.

During the installation process, explained at the beginning of this chapter, the disk-partitioning utility included with Setup allows you to partition the drive on which Windows is to be installed before the files are copied. From within Windows, the Disk Management tool is used to create and delete partitions. The following procedure shows how to create and delete partitions with Disk Management, although the methodology applies to either tool.

1. Open the Disk Management tool (*diskmgmt.msc*). Make sure the Graphical View, explained in the previous section, is visible.

2. Select the physical drive you wish to partition. Any existing partitions (volumes) for the current drive will be shown to the right. At this point, you can delete or add partitions, or change the drive letters (as explained previously).

3. To delete a partition, right-click the blue box representing the partition and select **Delete Partition** or **Delete Logical Drive**.

   This option will be grayed out if you're trying to delete the system volume (the one containing your boot files) or the boot volume (the one on which Windows is installed).[*]
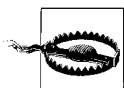
   > If you delete a partition, all the data on that volume will be permanently lost. This happens immediately, and there is no undo. Data on other partitions of the same drive, however, won't be affected. If you wish to make a partition smaller or larger without erasing the data, see the "Resizing and moving partitions," which follows.

4. To create a new partition, right-click the green box representing the remaining free space on the drive, and select **New Partition** or **New Logical Drive**.

5. A wizard will appear, asking several questions about the new volume, including how much space to use, what kind of volume to create, and which filesystem to use.

   When choosing the size of the volume, you can specify any size you want, from only a few megabytes to the total amount of contiguous free space on the drive. As for the filesystem, you'll want to use the NTFS filesystem in most cases (see "Choosing the Right Filesystem" earlier in this chapter).

   The type of volume to create is probably the most confusing setting here. The three volume types,[†] as illustrated in Figure 5-13, are explained in the following list.

   Primary partition

   The first partition on a drive should always be a primary partition. If all your partitions are to be used by Windows, then there should never be more than one primary partition on a drive. The exception is when you're setting up a dual-boot system, as described later in

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[*] Note the counterintuitive naming of the boot and system volumes. You can use the DiskPart utility, described later in this section, to operate on the boot and system volumes.

[†] There are actually other partition types, but such types are only available with dynamic disks, which are beyond the scope of this topic.
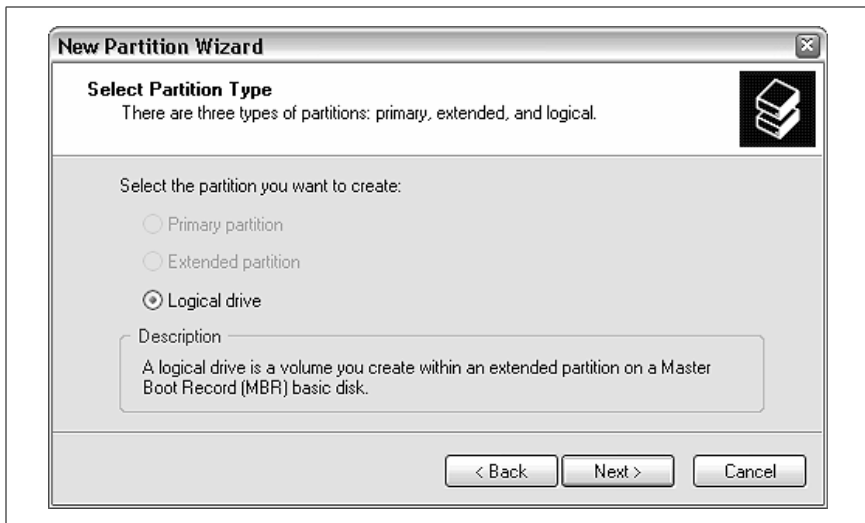
Figure 5-13. There are three basic types of partitions, each used under a specific circumstance

this chapter, where each non-Windows OS will need it's own primary partition. You can have up to four primary partitions on a drive, or up to three primary partitions and one extended partition.

If you have more than one drive, each drive should have one primary partition. Additional partitions should be defined as "logical drives."

Primary partitions are, by default, shown in dark blue.

Extended partition

The extended partition does not actually contain data; it only encapsulates the logical drives (below). A drive can contain only one extended partition.

The extended partition is, by default, shown in green, and only appears as a thick stripe surrounding any defined logical drives.

Logical drive

If you want more than one partition on a drive, the second, third, fourth, and so on, should all be defined as logical drives (since the first is a primary partition). You must define an extended partition before you can create any logical drives.

Logical drives are, by default, shown in light blue, and appear within the green box representing the extended partition.

For example, to create three 10 GB partitions on a 30 GB drive, you would create one 10 GB primary partition, followed by one 20 GB

extended partition. Then, you'd create two 10 GB logical drives in the extended partition.

6. Disk Management will typically format new partitions as they're created (a required step if you wish to store data on them). However, you can format any volume (which will erase any data currently stored on it) by right-clicking and selecting **Format**.

7. In most cases, newly created or deleted partitions will appear (or disappear) in Explorer immediately, although you may be required to reboot for Windows to recognize some drive types.

Resizing and moving partitions

You may encounter a situation when you need to resize a partition, either to consume the space left over from another deleted partition, or to make a partition smaller to make room for a new one. Unfortunately, support for this type of partition manipulation is extremely limited with the tools included with Windows XP.

Now, the simplest way to resize a partition is to delete it and then create a new one. Unfortunately, this has the rather undesirable side effect of completely erasing any data stored on the volume.

There is, however, one case where you can resize a partition in Windows XP without erasing the data contained therein. Say you have three 10 GB partitions on a 30 GB drive (just like the example in the previous section). If you delete the third partition, it's possible to "extend" the second one so that it will consume the newly available free space. Note that a volume can only be extended to the "right"—using the paradigm employed by the Graphical View in the Disk Management tool. (If you haven't yet deleted the extraneous volume, do so now using Disk Management.):

1. Open a Command Prompt window (*cmd.exe*), and type `diskpart` at the prompt to start the DiskPart utility.[*]

2. At the `DISKPART>` prompt, type:

       list disk

   to display all the drives on your computer. Each disk will have a disk number, starting with 0 (zero). Unless you have only one drive, you'll have to tell DiskPart which drive you wish to modify. Do this by typing:

       select disk *n*

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[*] For some reason, the "extend" feature is not available in the Disk Management tool, which is why we must use the other disk partitioning tool included with Windows XP, DiskPart.

where *n* represents the number of the disk you wish to modify. For example, type select disk 0 to select the first disk.

3. Next, at the DISKPART> prompt, type:

        list volume

to display all the volumes on the selected disk. Each volume will have a volume number, starting with 0 (zero). Even if you have only one volume on this drive, you'll have to tell DiskPart which volume to extend by typing:

        select volume *n*

where *n* represents the number of the volume you wish to modify. For example, type select volume 2. Remember, there must be free space immediately *after* the selected volume for this to work (double-check this by using Disk Management's Graphical View).

Why It's Difficult to Resize Partitions

When it comes to resizing partitions, the disk partitioning tools in Windows XP are only able to make them larger, and then only in specific circumstances. But why the limitation?

The reason for this is fairly simple. Open Disk Defragmenter (*dfrg.msc*), select a volume with a lot of files on it, and click **Analyze**. You'll then see a map— labeled **Estimated disk usage before defragmentation**—showing how the files are physically distributed on the selected volume. Notice how they appear to be scattered throughout the volume from beginning to end (left to right, respectively)? Using Disk Defragmenter (see "A Defragmentation Crash Course") will reduce the scatter somewhat, but it's designed mainly to rearrange files to improve performance, rather than prepare a partition to be resized.

The process to "extend" a volume, explained in this section, simply involves moving the partition boundary to the right, and as long as it doesn't hit another partition (or the end of the drive), there should be no problem.

In order to make a partition smaller, however, Windows would have to rearrange the files so that sufficient free space is grouped into a single, contiguous block at the very end of the partition. That way, the partition boundary could be moved to the *left*, making the partition smaller, without losing any file data. Unfortunately, neither the Disk Management or DiskPart tools are capable of this advanced manipulation, which is why you'll need another tool, such as PartitionMagic, to accomplish this.

4. When you're ready, type

    extend

   to extend the volume. The extend command takes no options and displays no warning message or confirmation. The process begins immediately after pressing the Enter key and should take only a few seconds.

5. When it's done, type exit to quit the DiskPart utility, and then type exit again to close the Command Prompt window.

Unfortunately, resizing a partition in the opposite direction (i.e., shrinking a volume)—without erasing its data—is not supported by Disk Management or the DiskPart utility. For this, you'll need the PartitionMagic utility (available at *http://www.symantec.com/partitionmagic/*), which can not only expand and shrink partitions, but move them as well—all without erasing the data they contain. PartitionMagic can even be used to make changes to the system and boot volumes, something that neither Disk Management nor DiskPart will let you do.

System Hardware

Not every performance problem can be fixed from within Windows. Here are some things you can do to your hardware to improve performance.

Managing IRQ Priority

Most components directly attached to your motherboard, including PCI slots, IDE controllers, serial ports, the keyboard port, and even your motherboard's CMOS, have individual IRQs assigned to them. An IRQ, or interrupt request line, is a numbered hardware line over which a device can interrupt the normal flow of data to the processor, allowing the device to function. Windows XP allows you to prioritize one or more IRQs (which translate to one or more hardware devices), potentially improving the performance of those devices:

1. Start by opening the System Information utility (*msinfo32.exe*) and navigating to System Summary\Hardware Resources\IRQs to view the IRQs in use on your system.

2. Next, open the Registry Editor (see Chapter 3) and navigate to HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Control\PriorityControl.

3. Create a new DWORD value in this key, and call it IRQ#Priority, where # is the IRQ of the device you wish to prioritize (e.g., IRQ13Priority for IRQ 13, which is your numeric processor).

4. Double-click the new value, and enter a number for its priority. Enter `1` for top priority, `2` for second, and so on. Make sure not to enter the same priority number for two entries, and keep it simple by experimenting with only one or two values at first. Some users have gotten good results prioritizing IRQ 8 (for the system CMOS) and the IRQ corresponding to the video card.

5. Close the Registry Editor and reboot your computer when you're done.

Overclock Your Processor

The processor is the highest-profile component (at least where marketing is concerned), as a fast processor often translates into a fast overall computer, especially with respect to games. But processors also become obsolete the fastest, and given how expensive they can be, it's often smart *not* to buy the fastest processor available.

Now, a processor's clock speed is just one of several factors upon which overall system speed is dependent. For example, jumping from a 1.5 GHz CPU to a 3 GHz unit will *not* double the speed of the computer. In fact, clock speed can be very misleading; a dual 800-Mhz system may outpace a 1 Ghz system, and a 1.4 GHz Pentium-III may outpace a 1.4 GHz Pentium-4. So keep this in mind when deciding how to spend your time and money on performance enhancements. That said, you may be able to squeeze a little more life out of your existing CPU at a fraction of the cost of a new one.

Overclocking is the process of instructing your processor to run at a higher clock speed (MHz) than its rated speed.[*] For example, you may be able to overclock a 900 MHz chip to run at 950 MHz, or even faster. Supposedly, Intel and other chip makers have taken steps to prevent overclocking (theoretically prompting purchases of faster CPUs instead), but some motherboard manufacturers have found ways to do it anyway. Settings allowing you to overclock your CPU can be found in your BIOS setup (see Appendix B), assuming your motherboard supports it.

Now, over-overclocking a CPU (overclocking past the point where it's stable) can cause it to overheat and crash your PC frequently. The most important aspect of overclocking your system involves cooling; make sure you beef up your computer's internal cooling system if you plan on messing around with overclocking. (Obviously, your options will be limited here if you're using a laptop.)

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[*] There's also the lesser-known practice of under-clocking a CPU. While this may seem silly, it's done to decrease power consumption and increase battery life on portable computers.
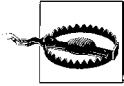
Increase your CPU's speed in stages, if possible; don't start off with the fastest setting, or you may end up with a fried processor and lightly singed eyebrows.

If you feel that your system isn't adequately cooled, don't be afraid to add more fans. Some fans connect directly to special plugs on your motherboard, and are activated when internal thermometers detect too high of a temperature; these do a good job of cooling your system without generating excessive noise. Fans that connect to your power supply's drive cables run all the time, and will make more noise, but will do a better job of cooling your system. Peltier cooling units (also known as thermoelectric heat pumps) will do a great job without making any noise, but they are expensive and a little hard to find.