

## Windows 7® Inside Out

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# Chapter 21

## Performing Routine Maintenance

Your personal computer is a curious combination of digital data and temperamental machinery. To keep your system running smoothly, it pays to perform some regular maintenance tasks. In particular, it's important to do the following on a regular basis:

- Download and install the latest updates from Microsoft. These updates ensure that your hardware and software will remain stable and secure.
- Download and install the latest versions of drivers used by your system's devices.
- Check your disks for file system and media errors.
- Defragment your hard disks to optimize file access.
- Perform regular backups of data and system files.

In Windows 7, many of the essential maintenance tools run automatically—or will do so after you have performed some essential setup steps. We describe most of those setup chores, and the options associated with them, in this chapter. Backup, because it is particularly vital and because it presents a more extensive set of configuration choices, is discussed separately in Chapter 11.

### **What's In Your Edition?**

The features described in this chapter are available in all editions of Windows 7.

## Introducing Action Center

By default, Windows monitors your system and notifies you if any security or maintenance issues merit your attention. Immediately after the system has detected a noteworthy event, you might see a balloon message in the notification area—near the lower right corner of your screen in the default screen layout. For example, if a backup fails for lack of space on the target disk, you might see a balloon notification to that effect. Clicking the balloon gives you a chance to take immediate action, typically by means of a troubleshooting dialog box like this:



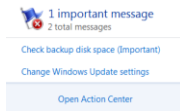
Balloon messages alerting you to important security and maintenance issues are generated by Action Center, a new feature in the Windows 7 landscape. If you overlook or ignore the balloon, you can deal with the problem later by means of the Action Center icon, also in the notification area. When it's happy, the Action Center icon looks like this:



When it's not, it changes to look like this:



Clicking the icon in its troubled state reveals the nature of the problem (or problems, if more than one has accumulated) and tells you what you can do:



You can take corrective action by clicking an imperative statement in the middle of this message (for example, Check Backup Disk Space), or you can learn more about the condition of your system by clicking Open Action Center. Figure 21-1 illustrates what you might see if you open Action Center.

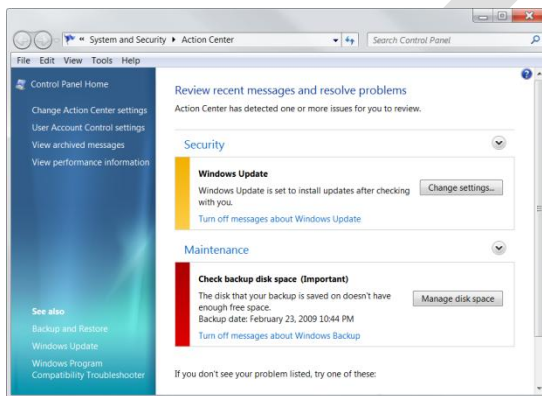


Figure 21-1. Action Center identifies potential security and maintenance problems and suggests corrective steps.

If Action Center has an important message to deliver, that message is flagged with a prominent red bar, and a button or link provides you with the means to address the problem. In Figure 21-1, for example, a red bar alerts you to a backup problem, and clicking the Troubleshoot button leads you to the Windows Backup Troubleshooting Options dialog box. Less important messages, such as the one concerning Windows Update in Figure 21-1, are flagged with a yellow bar. Below the alert text in all cases, you'll also find a link that allows you to suppress subsequent messages on the same topic. So, for example, if you prefer not to see messages relating to the status of your virus protection, you can turn that form of monitoring off.



Action Center, which you may also reach via the System And Security section of Control Panel, is both a troubleshooting and a maintenance tool. It lets you review and address any current issues affecting the security or stability of your system. It also provides links to Backup And Restore, Windows Update, and various troubleshooters.

Messages served by Action Center fall under two broad headings, Security and Maintenance. You can expand and collapse each of these headings by means of controls at the right. Figure 21-2 shows the Maintenance section expanded. (For information about security issues, see Chapter 15, “Security Essentials.”)

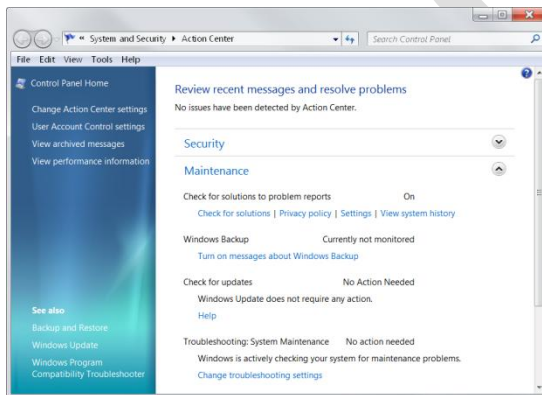


Figure 21-2. The Maintenance section of Action Center deals with problem reports, backup, Windows Update, and troubleshooting.

For information about the problem reports, system history and configuring Action Center’s troubleshooting behavior, see Chapter 23, “Troubleshooting Windows Errors and Crashes.” For information about Windows Backup, see Chapter 11, “Backup and Restore.” In the following section, we discuss Windows Update.

## Keeping Your System Secure with Windows Update

Windows Update is a service that provides online updates for Windows 7. With it, you can obtain updates to Windows that include security updates, performance improvements, and

support for new devices. If you're coming to Windows 7 from Windows XP, you'll find Windows Update completely overhauled. It's now a Control Panel application (in the System And Security section of Control Panel) instead of using a web-based interface. (Of course, it still requires an active internet connection.) As before, it can be opened from the All Programs menu or the Tools menu in Internet Explorer as well as from Control Panel. You'll also find a Windows Update link in the left pane of Action Center.

### Note

Keeping Windows up to date is an absolutely essential step in maintaining a secure computer and avoiding malware. In recent years, the most widely exploited vulnerabilities in Windows have been patched quickly—usually *before* these issues became widespread problems. Windows users who installed the updates promptly were able to avoid infection, whereas legions of others (who failed to keep their systems updated) fell victim.

Depending on how you have Windows Update configured, you might not need to visit the Windows Update window at all, as it does its work quietly in the background, keeping your computer up to date with the latest fixes and improvements. (It's still a good idea to check the list of available updates at least once a month, to find optional updates such as hardware drivers and nonessential fixes to Windows components you use regularly.) You can view its current settings, see what it has been up to, and find out what else it has in store for you by starting at its main window, shown in Figure 21-3. The top part of the window displays the current status and alerts you to any actions you should take.

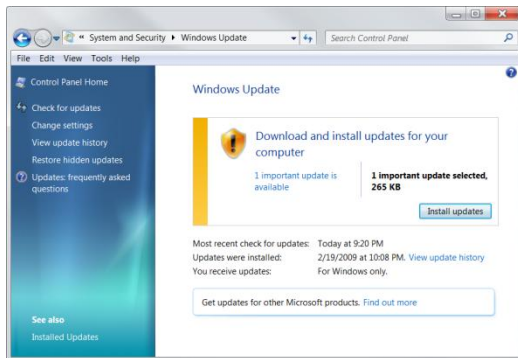


Figure 21-3. Windows Update lets you know if important updates are available to download and install.

## INSIDE OUT

### Get updates for other Microsoft products

By default, Windows Update can download and install updates for Windows 7 and major applications, such as Internet Explorer, included with the operating system. You can also merge the functionality of Microsoft Update, a service for managing updates to Microsoft Office and several other Microsoft products, into Windows Update so that you no longer need to visit Office Online to get updates. If you do not already have Windows Update integrated with Microsoft Update, you will see the message Get Updates For Other Microsoft Products on the Windows Update home page, as shown in Figure 21-3. To enable checking of other products, click Find Out More, beside this message. This action takes you to the Microsoft Update website for some quick installation steps. (You only need to do this once. Thereafter, the Windows Update home page indicates that you receive updates “for Windows and other products from Microsoft Update.”)

Windows Update classifies updates into three categories: important (which includes security and critical performance updates), recommended (typically, updates to signed drivers that affect performance or reliability, as well as fixes to noncritical bugs), and optional (updated drivers that don't affect reliability or performance, interesting but unnecessary enhancements,

and so on). Security updates—the most important of the important category—are routinely released on the second Tuesday of each month (informally known as “patch Tuesday”). Other updates are not distributed on a regular basis; instead, they’re published when the need arises, such as when a fix is developed for a newly discovered problem. You can make a habit of regularly visiting Windows Update to see what’s new, but there’s an easier way: install updates automatically. To review in greater detail (and modify, if you wish) your current Windows Update settings, click Change Settings. The page that appears (shown in Figure 21-4), lets you specify the degree of automation you desire.



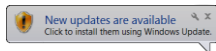
Figure 21-4. The Change Settings dialog box lets you specify how much automation you want from Windows Update.

The drop-down controls under Important Updates lets you specify how and when you want those vital updates downloaded and installed. Under the recommended setting, Windows Update downloads and installs important updates for you, at the time you specify (for example, every day at 3 am). With this option selected, Windows Update will also reboot your system if an update requires it. If you don’t want this level of automation, you can choose to have updates downloaded but not installed until you give the go-ahead. Or you can opt simply to be notified when updates are available, allowing you to both download and install them on demand. The Important Updates drop-down also gives you the not-recommended option of calling the whole thing off.

If you select the check box below Recommended Updates, Windows Update applies the same level of automation to recommended updates that it applies to important updates. Regardless of your setting for important updates, Windows Update refrains from downloading optional updates. Instead, provided you have selected the check box under Featured Update Notifications, Windows Update notifies you when potentially interesting updates become available.

If you use the Install Updates Automatically (Recommended) option and your computer is in a low-power “sleep” state at the specified update time *and* if your computer is connected to AC power, Windows Update wakes the computer to perform the installation. If your computer is off or asleep but not plugged in, Windows Update waits until the next scheduled installation time.

If you have either the “download, but don’t install” or “check, but don’t download or install” options selected, Windows Update notifies you with a pop-up message when new updates are available for your review.



Click the message to open Windows Update. If you miss the pop-up message, the information awaits you the next time you open Windows Update. When you arrive there, click Install Updates to finish installing all updates or, if you want to review them first, click View Available Updates. As Figure 21-5 shows, Windows Updates presents a list of the updates that are ready to install. You can read about each update in the panel to the right.

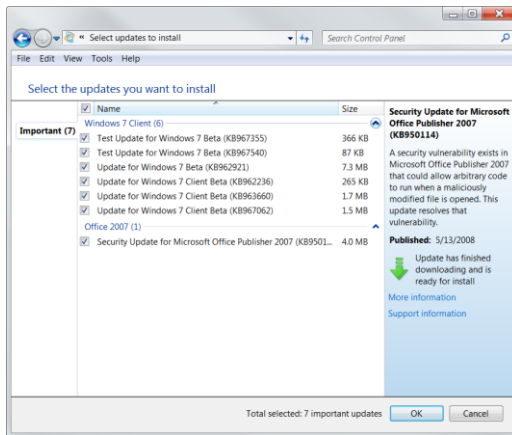


Figure 21-5. Clear the check box for any updates you do not want before you click Install.

## INSIDE OUT

### Hide updates that you don't ever want to install

If you choose not to download and install an update, it's available for you the next time you visit Windows Update...and the next time, and the time after that as well. You might have a good reason for not accepting a particular update—perhaps it makes improvements to a Windows component you never use—and there's no reason it should clutter your list of available updates. To remove an item from the list without installing it, you hide it. But the trick for hiding updates in the list is itself somewhat hidden.

In the list of updates (shown in Figure 21-5), right-click any update that you don't want to see again, and choose Hide Update. If you later change your mind—or if you just want to see a list of the updates you've chosen to hide—on the main Windows Update page, click Restore Hidden Updates.

## Troubleshooting

### **Windows Update fails to download and install updates**

When Windows Update fails, it displays an error code on its home page, along with a link to get help about the problem. The first place to start solving the problem, of course, is with the Get Help link. Sometimes that doesn't work either.

In that case, check your internet connection. If it's not working, that not only accounts for the failure of Windows Update, but also for the failure of the link to additional help.

## Updating Device Drivers

Windows Update can deliver updated drivers for many commonly used devices, either as recommended updates (if the drivers are considered to affect system stability) or optional updates (if they are not). If your devices meet the standards imposed by Microsoft's Windows Logo certification program (Microsoft is a trade name when it refers to the company (i.e., Microsoft Corporation) and a trademark when it represents the brand name, which refers to the product or product line (e.g., Microsoft® Office Word), you can generally rely on Windows Update to keep their drivers current. Some device drivers are not ordinarily supplied by Windows Update, however; to get updates for such devices, you will need to visit either the device vendor's website or, in some cases, your computer vendor's website. In certain cases, when hardware vendors make particularly large update downloads available, Windows Update may choose to alert you with a message and a link to the vendor's website, rather than offer the download directly.

## Using Windows Update Manually

Whether you choose one of the automatic update options or choose the "never check" option, you can always manually check for updates to Microsoft products. To check for updates to Windows 7, open Windows Update and click Check For Updates (in the left pane).

## Removing an Update

If you find that a particular update creates a problem, you can try removing it. Not all updates can be removed, however. (In particular, security-related updates usually cannot be removed. In addition, updates upon which other updates or other components are dependent cannot be removed.) To find out if an update can be removed—and to go ahead and do the deed, if you choose—in Windows Update, click Installed Updates (in the left pane). Doing so takes you to a page within the Programs section of Control Panel that lists all uninstalleable updates.

### Note

The installed updates page might lead you to believe that no updates have been installed. (For some reason, the “No updates are installed on this computer” message gives people that impression.) In fact, this page lists only the updates that can be uninstalled. To see a list of all updates that have been installed, return to Windows Update and click View Update History.

## Updating More Than One Computer

The simplest way to keep all the computers on your network up to date is to enable automatic updating on each computer. If you have a small network in a home environment, go to each computer, open Windows Update, click Change Settings, and be sure it's set to download and install automatically.

But that's not always practical or efficient. If you have a dial-up connection to the internet, for example, you'll spend a lot of time connected as each computer independently downloads large updates. And in larger networks, even those with lightning-fast internet connections, administrators might want to control which updates get installed (and when) rather than leaving it up to individual users.

Microsoft provides the following ways to manage updates in situations where setting Windows Update to automatic on all computers is impractical:



- Microsoft Update Catalog ([vista-io.com/1018](http://vista-io.com/1018)) is a website that offers standalone installable versions of each update for Windows. Microsoft Update Catalog offers updates for all currently supported versions of Windows, which means you can also use this service to find updates for computers on your network that are not running Windows Vista. You can search for updates based on keywords, and then sort by the product (including Windows 7), date of most recent update, classification, and size. After you find the updates of interest, download them once and store them in a shared network folder, where they can be installed from any computer.
- Administrators of large networks can use Windows Server Update Services (WSUS) to manage and deploy updates throughout an organization. The WSUS server, which runs on a computer running Windows Server 2003 or Windows Server 2008, manages downloading updates from Microsoft. Computers on the network then obtain updates from the WSUS server instead of directly from Microsoft's update servers. For details about WSUS, visit [vista-io.com/1017](http://vista-io.com/1017).

## Checking Disks for Errors

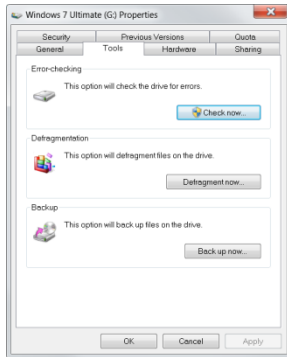
Errors in disk media and in the file system can cause a wide range of Windows problems, ranging from an inability to open or save files to blue-screen errors and widespread data corruption. Windows is capable of recovering automatically from many disk errors, especially on drives formatted with NTFS.

To perform a thorough inspection for errors, you can manually run the Windows Check Disk utility, Chkdsk.exe. Two versions of this utility are available—a graphical version that performs basic disk-checking functions, and a command-line version that provides a much more extensive set of customization options.

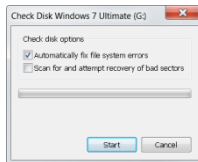
To check for errors on a local disk, follow these steps:

1. Open Computer, right-click the icon belonging to the drive you want to check, and then choose Properties from the shortcut menu.

2. On the Tools tab, click the Check Now button. (If you're using a standard account, you'll need to supply credentials for an account in the Administrators group to execute this utility.)



3. In the Check Disk dialog box, shown next, select from the following options:

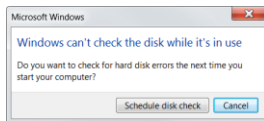


- **Automatically Fix File System Errors** This option, which is enabled by default, configures Windows to automatically repair any errors it detects in the file system. If this option is not selected, Check Disk reports any errors it finds but does not correct them. This option is the equivalent of running the Chkdsk command with the /F switch, as described later in this section.
- **Scan For And Attempt Recovery Of Bad Sectors** Select this option to perform an exhaustive check of the entire disk, locate bad sectors, and recover readable information stored in defective locations. Note that selecting this option automatically repairs file system errors as well, even if the previous option is cleared. This option is the equivalent of running the Chkdsk command with the /R switch.

If you simply want to see a report of file system errors without making any changes to disk structures, leave both boxes unselected.

4. Click Start to begin the disk-checking process. The green progress bar provides feedback as the error-checking tool goes through several phases.

If you select the Automatically Fix File System Errors option on a drive that currently has open files, Windows is unable to run the utility immediately. In that case, you see the message shown here:



Click Schedule Disk Check to configure Windows startup so that the disk check utility runs the next time the computer is started. The disk check occurs early in the startup sequence, before Windows shifts into graphical mode; during this period, your computer is not available for you to perform any other tasks. When your computer starts, Windows notifies you that it's about to perform a scheduled disk check; by default, you have 10 seconds to cancel the operation and boot normally instead.

After Check Disk completes its operation, it reports its results. If the disk check turns up no errors, you see a Disk Check Complete dialog box. If Check Disk uncovers any errors, it writes a message to the System event log and displays a dialog box listing the errors it found and the repairs it made.

## Caution!

Although Check Disk is a useful tool and sometimes a lifesaver, it can cause you headaches if used without some planning. Once started, the Check Disk operation cannot be stopped except by pressing your computer's power switch. On large drives (hundreds of gigabytes or more), the full disk check can take hours or even days to complete.

Check Disk runs automatically after an abnormal shutdown only if a specific bit in the registry is set, indicating that the file system is “dirty”—that is, that some pieces of data were not properly written to the disk when the system was shut down. If the file system wasn’t doing anything when the system shut down, the dirty bit will not be set. Because NTFS volumes keep a journal of all disk activities, they are able to recover and remain clean even if you shut down in the middle of a disk write. Check Disk is most likely to run automatically at startup only on FAT32 volumes, after an unexpected shutdown.

## INSIDE OUT

### Cancel checks with Chkntfs

Two additional and well-hidden Windows commands are crucial to the operation of the Check Disk utility. The first of these, Autochk.exe, runs automatically any time you specify that you want to schedule a disk check to run at startup; it cannot be run interactively. The second, Chkntfs, is especially useful if you change your mind and decide you want to cancel a scheduled check. At a command prompt, type **chkntfs /x d:** (where *d* is replaced by a drive letter) to exclude the drive specified. Chkntfs has another nifty trick: it can tell you whether a disk is dirty. At a command prompt, simply type **chkntfs d:**. For more details about these commands, see Knowledge Base article 218461, “Description of Enhanced Chkdsk, Autochk, and Chkntfs Tools in Windows 2000” ([vista-io.com/2001](http://vista-io.com/2001)) and Knowledge Base article 160963, “CHKNTFS.EXE: What You Can Use It For” ([vista-io.com/2002](http://vista-io.com/2002)).

The command-line version of Check Disk gives you considerably more options. It also allows you to set up regular disk-checking operations using the Task Scheduler (as described in “Using the Windows 7 Task Scheduler” on page 24xx). To run this command in its simplest form, open a Command Prompt window using the Run As Administrator option, and then type **chkdsk** at the prompt. This command runs Chkdsk in read-only mode, displaying the status of the current drive but not making any changes. If you add a drive letter after the command (**chkdsk d:**, for instance), the report applies to that drive.

You can use any combination of the following switches at the end of the command line to modify its operation:

- `/F` Instructs Chkdsk to fix any errors it detects. This is the most commonly used switch. The disk must be locked. If Chkdsk cannot lock the drive, it offers either to check the drive the next time you restart the computer or to dismount the volume you want to check before proceeding. Dismounting is a drastic step; it invalidates all current file handles on the affected volume and can result in loss of data. You should decline the offer. When you do, Chkdsk will make you a second offer—to check the disk the next time you restart your system. You should accept this option. (If you're trying to check the system drive, the only option you're given is to schedule a check at next startup.)
- `/V` On FAT32 volumes, `/V` displays verbose output, listing the name of every file in every directory as the disk check proceeds. On NTFS volumes, this switch displays cleanup messages (if any).
- `/R` Identifies bad sectors and recovers information from those sectors if possible. The disk must be locked. Be aware that this is a time-consuming and uninterruptible process.

The following switches are valid only on NTFS volumes:

- `/I` Performs a simpler check of index entries (stage 2 in the Chkdsk process), reducing the amount of time required.
- `/C` Skips the checking of cycles within the folder structure, reducing the amount of time required.
- `/X` Forces the volume to dismount, if necessary, and invalidates all open file handles. This option is intended for server administrators. Because of the potential for data loss, it should be avoided.
- `/L[:size]` Changes the size of the file that logs NTFS transactions. If you omit the `size` parameter, this switch displays the current size. This option is intended for server administrators. Because of the potential for data loss, it also should be avoided in normal use.

- /B Reevaluates bad clusters.

## Troubleshooting

### **When you run Chkdsk in the Windows Recovery Environment, some options are not available**

The Chkdsk command used when you boot to the Windows Recovery Environment is not the same as the one used within a full Windows session. Only two switches are available for this version:

- /P Performs an exhaustive check of the current disk
- /R Repairs damage on the current disk

If your system is able to boot to Windows either normally or in Safe Mode and you suspect that you have disk errors, you should use the full Chkdsk command. For more details, see “Making Repairs with the Windows Recovery Environment” on page 23xx.

## Defragmenting Disks for Better Performance

On a relatively new system with a speedy processor and plenty of physical memory, hard disk performance is the single biggest bottleneck in everyday operation. Even with a zippy hard disk, it takes time to load large data files into memory so that you can work with them. The problem is especially noticeable with movies, video clips, DVD-burning projects, databases, ISO image files, and virtual hard disks, which can easily take up multiple gigabytes, sometimes in a single file.

On a freshly formatted disk, files load fairly quickly, but over time, performance can degrade because of disk fragmentation. To understand how fragmentation works, it helps to understand the basic structure of a hard disk. The process of formatting a disk divides it into *sectors*, each of which contains space for 512 bytes of data. The file system combines groups of sectors into *clusters*, which are the smallest units of space available for holding a single file or part of a file.

On any NTFS volume greater than 2 GB in size, the cluster size is 4 KB. Thus, when you save a 200-MB video clip, Windows divides the file into roughly 50,000 pieces. When you save this file for the first time on a freshly formatted, completely empty hard disk, Windows writes it in contiguous clusters. Because all the clusters that hold individual pieces of the file are physically adjacent to one another, the mechanical components of the hard disk can work very efficiently, scooping up data in one smooth operation. As a bonus, the hard disk's onboard cache and the Windows disk cache are able to anticipate the need for data and fetch nearby clusters that are likely to contain other parts of the file, which can then be retrieved from fast cached memory rather than from the relatively slow disk.

Unfortunately, hard disks don't stay neatly organized for long. When you add data to an existing file, the file system has to allocate more clusters for storage, typically in a different physical location on the disk. As you delete files, you create gaps in the once-tidy arrangement of contiguously stored files. As you save new files, especially large ones, the file system uses all these bits of free space, scattering the new files over the hard disk in many noncontiguous pieces. The resulting inefficiency in storage is called *fragmentation*; each time you open or save a file on a badly fragmented disk, disk performance suffers, sometimes dramatically, because the disk heads have to spend extra time moving from cluster to cluster before they can begin reading or writing data.

The Disk Defragmenter in Windows 7 improves on earlier versions in many ways, not the least of which is you shouldn't need to do anything to benefit from it. Disk Defragmenter runs as a low-priority background task that kicks off once a week, in the middle of the night, without requiring any attention from you.

## Using Disk Defragmenter

The Disk Defragmenter utility improves performance by physically rearranging files so that they're stored in contiguous clusters. In addition to consolidating files and folders, the utility also consolidates free space, making it less likely that new files will be fragmented when you save them. The Disk Defragmenter process (Dfrgntfs.exe or Dfrgfat.exe, for disks in the NTFS and FAT32 formats, respectively) starts according to a schedule that you can adjust. To view the current settings, click the Disk Defragmenter shortcut (in the System Tools subfolder of

the Accessories folder on the All Programs menu), or right-click any drive icon in the Computer window and click Defragment Now on the Tools tab.

Figure 21-6 shows the simple Disk Defragmenter interface. The Schedule section of the dialog box shows whether scheduled defragmentation is on or off and when the next run is to occur. The Current Status section shows date and time of each disk's most recent defragmentation. Buttons let you reconfigure the schedule, analyze a selected disk to see how fragmented it might be, and perform an immediate defragmentation.

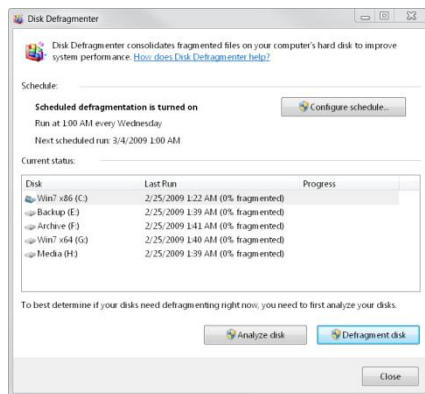


Figure 21-6 The Disk Defragmenter dialog box lets you see at a glance when the utility is set to run and when it last performed.

Click Configure Schedule to change when Disk Defragmenter runs automatically. By default, the utility runs weekly, at 1:00 A.M. each Wednesday. You can schedule operation to be daily, weekly (you pick the day of the week), or monthly (you pick the date), and you can choose the time of day (round numbers only), as shown in Figure 21-7.



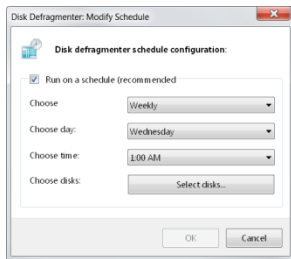


Figure 21-7 Pick a daily, weekly, or monthly schedule for Disk Defragmenter to begin running as a background task.

*For details about managing scheduled tasks, see “Using the Windows 7 Task Scheduler” on page 24xx.*

If your computer is off at the appointed time, Disk Defragmenter will run at the first idle time after it’s back up again. If your computer is nearly always either off or in use at 1 am, you might want to reconfigure the schedule. Choose a time when the machine is usually on but not in use—a regular lunch break, for example.

If your computer has more than one hard disk (more precisely, more than one *volume*, as each hard disk can be partitioned into multiple volumes), you can specify which ones you want Disk Defragmenter to act upon. Click Select Disks to display the dialog box shown in Figure 21-8, in which you can remove the check mark from any volumes you don’t want to defragment.

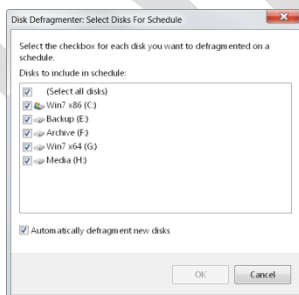


Figure 21-8 Selecting Automatically Defragment New Disks causes Disk Defragmenter to include any hard disks you add to your system in its routine.

## INSIDE OUT

### **Do you need a more powerful defragmenter?**

Through every previous Windows version, Disk Defragmenter has been a bare-bones utility, sufficient for average users but frustratingly incomplete for power users. As a result, a thriving if specialized market in third-party disk utilities sprang up, led by Diskeeper Corporation's Diskeeper 2009 ([diskeeper.com](http://diskeeper.com)), a full-featured version of the Defragmenter utility bundled with Windows 7. The Norton SystemWorks package ([vista-io.com/2003](http://vista-io.com/2003)) also includes a capable disk defragmenter, as does Raxco's PerfectDisk ([raxco.com](http://raxco.com)). JkDefrag ([vista-io.com/12302](http://vista-io.com/12302)) provides a well-respected open source alternative. Given the improvements in the Windows Vista Disk Defragmenter, are these third-party tools still necessary? Third-party versions include features such as continuous real-time defragmentation; more flexible scheduling; an information-rich user interface; more efficient and more thorough defragmentation, including defragmentation of files that Disk Defragmenter in Windows 7 won't touch; and after-the-fact reporting. None of these features is essential to maintaining computer health, but the third-party tools do provide some real (albeit marginal) differences from the built-in defragmenter.

## INSIDE OUT

### **Dedicate a partition for CD or DVD burning**

The best way to avoid disk fragmentation is to start with a completely clean slate. If you routinely work with CD images, for instance, consider creating a separate partition that's big enough to temporarily hold the files you're working with. A 2-GB partition, for instance, is big enough to hold a CD image and all temporary files associated with it. (You'll need roughly 10 GB for a DVD-burning partition.) Keep that drive empty except when you plan to create a CD, at which time you can copy files to it for burning. Using this strategy, you can be certain that fragmentation won't have a deleterious impact on your CD-burning performance.

## Running Disk Defragmenter from a Command Line

The command-line version of Disk Defragmenter allows you to exercise fine-grained control over the defragmentation process and uses the exact same program code as the scheduled version. To use this command for a specific drive, type **defrag d:** in an elevated Command Prompt window, where *d* is the drive letter or mount point of an existing volume. (For an explanation of mount points, see “Mapping a Volume to an NTFS Folder” on page 26xx.) To see the full range of the defrag utility’s capabilities, type **defrag /?**. Among the more useful switches are the following:

- **-c** Defragments all volumes on the computer; use this switch without specifying a specific drive letter or mount point.
- **-a** Analyzes the specified volume and displays a summary of the analysis report.
- **-f** Consolidates the free space on the specified volume, reducing the likelihood that large new files will be fragmented.
- **/r** Defragments multiple volumes in parallel. If your volumes are on physically separate disks, you might save a bit of time by using this switch.
- **-v** Displays complete (verbose) reports. When used in combination with **-a**, this switch displays only the analysis report. When used alone, it displays both the analysis and defragmentation reports.
- **-w** Performs a full defragmentation by consolidating all file fragments, regardless of size.

In addition to the documented switches listed, the command-line Defrag utility includes this useful but undocumented switch:

- **-b** The **-b** switch optimizes boot files and applications while leaving the rest of the drive undisturbed.

The command-line Disk Defragmenter does not provide any progress indicator except for a blinking cursor. To interrupt the defragmentation process, click in the Command Prompt window and press Ctrl+C.

## Troubleshooting

### The Disk Defragmenter utility does not fully defragment the drive

A volume must have at least 15 percent free space before Disk Defragmenter can completely defragment the volume. If you have less free space available, the operation will run, but only partial defragmentation will result. From a Command Prompt window, run Defrag with the `-a` switch to see statistics (including free space) regarding the specified volume.

You cannot defragment a volume that Windows has marked as possibly containing errors. To troubleshoot this possibility, enter **chkdsk d: /f** at any command prompt, substituting the letter of the drive in question. Chkdsk will report and repair any file-system errors it finds (after restarting, in the case of a system or boot volume).

Disk Defragmenter does not defragment files in the Recycle Bin. Empty the Recycle Bin before defragmenting.

Additionally, Disk Defragmenter does not defragment the following files: Bootsect.dos, Safeboot.fs, Safeboot.csv, Safeboot.rsv, Hiberfil.sys, and Memory.dmp. In addition, the Windows page file is never defragmented. (See the text following this sidebar to learn how to work around this issue.)

Disk Defragmenter ignores fragments that are more than 64 MB in size, both in its analytical reports and in operation. According to Microsoft's benchmarks, fragments of this size (which already consist of at least 16000 contiguous clusters) have a negligible impact on performance. Thanks to disk latency, a large file divided into 10 fragments of 64 MB or greater in size will not load measurably slower than the same file in a single unfragmented location; under those circumstances, it's best to leave the fragments alone.

Disk Defragmenter will pass over any files that are currently in use. For best results, shut down all running programs before running the utility. For even better results, log off and log back on (using an account in the Administrators group) before continuing.

## **INSIDE OUT**

### **Defragmenting particular files**

Do you still want to defragment files larger than 64 MB, despite Microsoft's assurance that those files don't need defragmenting? Mark Russinovich's contig utility, a free download from Microsoft's Sysinternals website (<http://technet.microsoft.com/en-us/sysinternals/bb897428.aspx>) will do the job. Contig is a file-specific defragmenter. You can use it to analyze and defragment individual files or groups of files meeting wildcard specifications.

## **Defragmenting Solid-State Media**

Because flash disks and other solid-state media don't employ moving parts to save and retrieve data, file fragmentation on these drives is likely to impose a smaller performance penalty than it does on rotating media. For this reason, as well as to avoid decreasing performance lifespan, Disk Defragmenter does not perform scheduled defragmentation of solid-state drives. You can still defragment a solid-state drive if you choose, but only on an ad-hoc basis. To do this, run Disk Defragmenter, select the disk you want to defragment, and then click either Analyze Disk or Defragment Disk.

## **Managing Disk Space**

In the digital era, Parkinson's Law has an inescapable corollary: data expands to fill the space allotted to it. Gargantuan hard disks encourage consumption, and digital media files (not to mention Windows itself) supply plenty of bits to be consumed. It's surprisingly easy to run low on disk space, and the consequences can be deleterious to your system. If you run low on storage, Windows might not have enough room to expand its page file, or it might be unable to create temporary files. In addition, essential features such as Windows Search and System

Restore might stop working properly. At that point, you start seeing ominous error messages and (possibly) degraded performance.

To pare down on disk space consumption, you can do any or all of the following:

- Clear out temporary files that you no longer need.
- Uninstall programs you don't need.
- Uninstall Windows components you don't need.
- Delete documents you don't need.

## Cleaning Up with Disk Cleanup

The simplest way to make room on any drive is with the help of the Disk Cleanup utility, Cleanmgr.exe. If you click a "low disk space" warning, this tool opens automatically. To begin working directly with a single local drive, right-click the drive icon in the Computer window, choose Properties from the shortcut menu, and then click Disk Cleanup on the General tab of the properties dialog box. Alternatively, you can click All Programs on the Start menu, then Accessories, then System Tools, then Disk Cleanup.

Disk Cleanup begins by calculating the amount of space it can recover. Then it presents its findings, categorized, in a dialog box similar to the one shown in Figure 21-9.

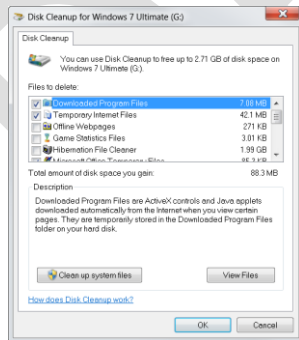


Figure 21-9 Disk Cleanup displays the categories of files it can delete and the amount of space per category that it can reclaim.

You can see at a glance how much space you can recover by deleting a category of files. If you're not sure what's included in a file category, select it in the list and read the descriptive text. For some file categories, a View Files button is available; click that to open a folder containing the file category.

With the assistance provided by the Description box, Disk Cleanup options are fairly self-explanatory. For the most part, these options merely consolidate functions already scattered throughout the Windows interface. For instance, you can empty the Recycle Bin, clear out the Temporary Internet Files folder, and purge files from the Temp folder. (Avoid cleaning out the Downloaded Program Files folder, which contains generally useful ActiveX and Java add-ins.) Removing the Hibernation file can save a large amount of disk space—an amount equal to the amount of RAM installed on your computer; choose this option only if you never hibernate your system.

### Caution!

Disk Cleanup includes one confusing option that can leave an inordinate amount of wasted space on your hard disk if you don't understand how it works. When you run Disk Cleanup, one of the available options offers to delete Temporary Files; the accompanying Help text explains that these are unneeded files in the Temp folder. Unfortunately, this option might display a value of 0, even if your Temp folder contains hundreds of megabytes of useless files. The reason? Although the Help text hints at the answer, it doesn't clearly explain that this value lists only files in your Temp folder that are more than one week old. If you want to completely clean out this folder, you'll need to do so manually. Close all running programs and type **%temp%** in the Run dialog box; from the resulting Windows Explorer window, delete everything you find. You might discover that some files are not available for deletion until you restart your computer.

## Cleaning Up System Files

Provided you have administrative credentials, you can add a few potentially large file categories to the initial list of deletable items by clicking Clean Up System Files. For example, if you performed a clean install of Windows 7 on a partition that you previously used for an earlier version of Windows, you might be able to reclaim gigabytes of disk space by eliminating the Windows.old folder. These files appear under the heading Previous Windows Installation(s). If you upgraded Windows Vista to Windows 7 (as opposed to performing a clean install), you may be able to recover a sizeable chunk of disk space by deleting files under the heading Files Discarded By Windows Upgrade.

Clicking Clean Up System Files also adds a More Options tab to the Disk Cleanup dialog box, as shown in Figure 21-10.

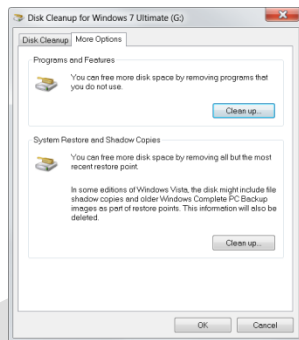


Figure 21-6 The More Options tab appears only if you click Clean Up System Files.

The Clean Up button under Programs And Features takes you to the Uninstall Or Change A Program page in Control Panel, where you can remove Windows components and programs. (For details, see “Finishing Your Windows 7 Installation” on page 2xx and “Uninstalling Programs” on page 5xx.) The Clean Up button under System Restore And Shadow Copies lets you remove all but the most recent System Restore checkpoints, shadow copies (previous file versions), and Complete PC Backup images. This option can recover a significant amount of space, but you should choose it only if you’re certain you won’t need to restore a backup or roll back your configuration to one of the saved versions you’re about to delete.



While getting rid of programs you no longer use is always a good idea, the option to eliminate all but the most recent restore point should be considered a desperate measure. Restore points can sometimes provide a way to restore stability to a system that has become unruly. Keep them if you can.

*For information about using restore points, see "Making Repairs with the Windows Recovery Environment" on page 23xx. For information about shadow copies, see "Restoring Previous Versions of Files and Folders" on page 8xx.*

## Cleaning Up at the Command Line

Disk Cleanup offers some cool command-line switches that are documented only in a pair of obscure Knowledge Base articles. Through the use of these switches, you can save your preferences and rerun the cleanup process automatically using those settings. To do so, you need to use the following switches with Cleanmgr.exe:

- `/Sageset:n` Opens a dialog box that allows you to select Disk Cleanup options, creates a registry key that corresponds to the number you entered, and then saves your settings in that key. Enter a number from 0 through 65535 in place of *n*.
- `/Sagerun:n` Retrieves the saved settings for the number you enter in place of *n* and then runs Disk Cleanup without requiring any interaction on your part.

To use these switches, follow these steps:

1. Open a Command Prompt window and type the command **cleanmgr /sageset:200**. (The number after the colon is completely arbitrary; you can choose any other number from 0 through 65535 if you prefer.) You must supply credentials from a member of the Administrators group to begin this task.
2. In the Disk Cleanup Settings dialog box, shown in Figure 21-11, choose the options you want to apply whenever you use these settings. (Note that the options in this dialog box are not the same as those shown in Figure 21-9.)

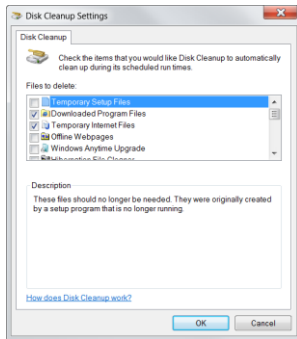


Figure 21-11 When you use the /Sageset switch, you can work with an expanded set of options that are not available interactively.

3. Click OK to save your changes in the registry.
4. Open Task Scheduler from Control Panel, and start the Create Basic Task wizard. Follow the wizard's prompts to name the task, and schedule it to run at regular intervals. When prompted to select the program you want Windows to run, enter **cleanmgr.exe** in the Program/Script box and enter **/sagerun:200** in the Add Arguments box.
5. Repeat steps 1–4 for other Disk Cleanup options you want to automate.

## INSIDE OUT

### Make the most of Disk Cleanup shortcuts and tasks

Disk Cleanup shortcuts can be tremendously useful for routine maintenance. For instance, you might want to create a shortcut for Cleanmgr.exe with a saved group of settings that automatically empties the Temporary Internet Files folder and Recycle Bin and another that purges installation files and system dump files. If you create a shortcut that empties the Recycle Bin, it's best not to add it to your list of Scheduled Tasks, where it can inadvertently toss files you later discover you wanted to recover; instead, save this shortcut and run it as needed.