DIGITAL STORAGE: Preserving Content Locally and on the Cloud

8

Users have a variety of storage options available.

"I use cloud storage for all my homework files. I transfer my digital photos from an SD card to my laptop's hard drive, which has plenty of extra space for my music. Weekly, I back up files from my computer to an external hard drive. What more do I need to know about storage?"

While you may be familiar with some of the content in this chapter, do you know how to . . .

- Share media?
- Defragment a hard disk?
- Decide between a hard disk and an SSD?
- Transfer files from one internal hard drive to another?
- Encrypt data and files?
- Safely remove a portable flash memory storage device?
- Evaluate cloud storage providers?
- Fix a scratch on a CD or DVD?
- Use your own device to access company data responsibly?
- Protect your credit card?
- Limit data breaches when using NFC technology?
- Create a backup plan?
- Determine how much data a company should keep?

In this chapter, you will discover how to perform these tasks along with much more information essential to this course. For additional content available that accompanies this chapter, visit the free resources and premium content. Refer to the Preface and the Intro chapter for information about how to access these and other additional instructor-assigned support materials.

Objectives

After completing this chapter, you will be able to:

1. Differentiate between storage and memory
2. Describe the characteristics of internal hard disks
3. Describe the benefits of solid-state drives
4. Identify uses of external hard drives and RAID
5. Differentiate among various types of memory cards and USB flash drives
6. Discuss the benefits and uses of cloud storage
7. Describe characteristics of and differentiate among types of optical discs
8. Explain types of enterprise storage: RAID, NAS, SAN, and tape
9. Identify uses of magnetic stripe cards, smart cards, RFID tags, and NFC tags

Storage

A storage medium, also called *secondary storage*, is the physical material on which a computer keeps data, information, programs, and applications. Examples of storage media include hard disks, solid-state drives (both of which can be internal or external), memory cards, USB flash drives, optical discs, network attached storage devices, magnetic stripe cards, smart cards, RFID tags, and NFC tags. Another storage option is cloud storage, which keeps information on servers on the Internet. Because the user accesses files on cloud storage through a browser using an app from the storage provider, the actual media on which the files are stored are transparent to the user. Figure 8-1 shows a variety of storage options.

In addition to programs and apps, users store a variety of data and information on storage media in their computers and mobile devices or on cloud storage. For example, many users store digital photos, appointments, schedules, contacts, email messages, and tax records. A home user also might store budgets, bank statements, a household inventory, stock purchase records, homework assignments, recipes, music, and videos. In addition or instead, a business user stores reports, financial records, travel records, customer orders and invoices, vendor payments, payroll records, inventory records, presentations, quotations, and contracts. Business and power users store diagrams, drawings, blueprints, designs, marketing literature, corporate newsletters, and product catalogs.

A **storage device** is the hardware that records and/or retrieves items to and from storage media. **Writing** is the process of transferring data, instructions, and information from memory to a storage medium. **Reading** is the process of transferring these items from a storage medium into memory. When storage devices write on storage media, they are creating output. Similarly, when storage devices read from storage media, they function as a source of input. Nevertheless, they are categorized as storage devices, not as input or output devices.

CONSIDER THIS

Does the amount of storage on a computer or mobile device affect the speed at which it operates?
Although the amount of storage does not directly affect the speed of a processor in a computer or mobile device, storage capacity (discussed next) could indirectly affect the overall performance. For example, a computer or mobile device with extra available storage may perform faster because the unused space can be used to hold temporary files while you browse the web and for virtual memory, discussed later in this chapter. Storage access times are discussed in more depth later in this chapter.

Figure 8-1 A variety of storage options.

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Storage Capacity

Capacity is the number of bytes (characters) a storage medium can hold. Table 8-1 identifies the terms manufacturers may use to define the capacity of storage media. For example, a storage medium with a capacity of 750 GB can hold approximately 750 billion bytes.

Storage requirements among users vary greatly. Home users, small/home office users, and mobile users typically have much smaller storage requirements than enterprise users. For example, home users may need 1 to 2 TB (terabytes, or trillions of bytes) of storage for all of their digital content, while enterprises may require 20 to 40 PB (petabytes, or quadrillions of bytes) of storage.

Table 8-1 Terms Used to Define Storage

Storage Term	Approximate Number of Bytes	Exact Number of Bytes
Kilobyte (KB)	1 thousand	2^{10} or 1,024
Megabyte (MB)	1 million	2^{20} or 1,048,576
Gigabyte (GB)	1 billion	2^{30} or 1,073,741,824
Terabyte (TB)	1 trillion	2^{40} or 1,099,511,627,776
Petabyte (PB)	1 quadrillion	2^{50} or 1,125,899,906,842,624
Exabyte (EB)	1 quintillion	2^{60} or 1,152,921,504,606,846,976
Zettabyte (ZB)	1 sextillion	2^{70} or 1,180,591,620,717,411,303,424
Yottabyte (YB)	1 septillion	2^{80} or 1,208,925,819,614,629,174,706,176

CONSIDER THIS

What can a gigabyte store?

The total number of items that can be stored in a gigabyte will vary, depending on file size, quality of media, and a variety of other factors. As a general guide, though, a gigabyte can hold approximately 500,000 pages of text, 600 medium-resolution photos, 250 songs (2 to 3 minutes each), 4 hours of low-resolution video, or 15 minutes of high-definition video.

Storage versus Memory

Items on a storage medium remain intact even when you turn off a computer or mobile device. Thus, a storage medium is nonvolatile. Most memory (i.e., RAM), by contrast, holds data and instructions temporarily and, thus, is volatile. Figure 8-2 illustrates this concept of volatility.

CONSIDER THIS

How do storage and memory interact?

When you turn on a computer or mobile device, it locates the operating system on its storage medium and loads the operating system into its memory (specifically, RAM). When you issue a command to run an application, such as a browser, the operating system locates the application on a storage medium and loads it into memory (RAM). When you are finished using the application, the operating system removes it from RAM, but the application remains on the storage medium.

A storage medium is similar to a filing cabinet that holds file folders, and memory is similar to the top of your desk. When you want to work with a file, you remove it from the filing cabinet (storage medium) and place it on your desk (memory). When you are finished with the file, you remove it from your desk (memory) and return it to the filing cabinet (storage medium).

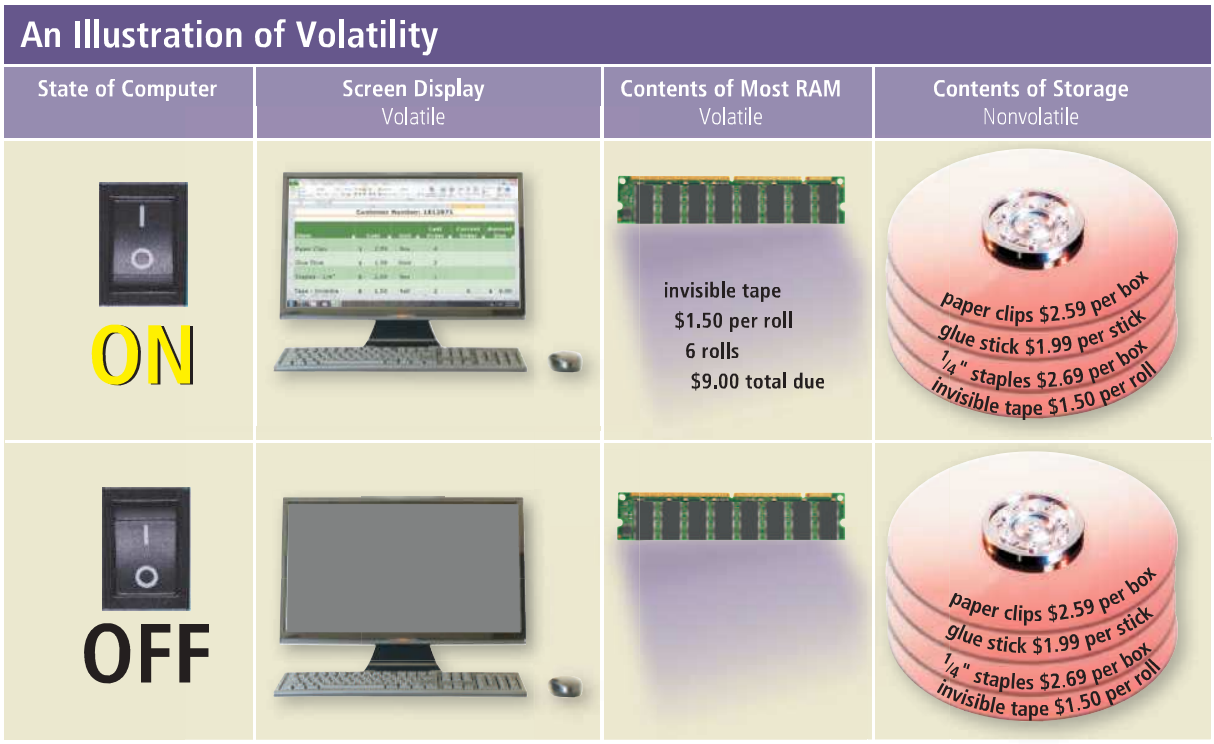

Figure 8-2 A screen display is considered volatile because its contents disappear when power is removed. Likewise, most RAM is volatile. That is, its contents are erased when power is removed from a computer or mobile device. Storage, by contrast, is nonvolatile. Its contents remain when power is off.

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Storage Access Times

The speed of storage devices and memory is defined by access time. **Access time** measures (1) the amount of time it takes a storage device to locate an item on a storage medium or (2) the time required to deliver an item from memory to the processor. The access time of storage devices is slow, compared with the access time of memory. Memory (chips) accesses items in billionths of a second (nanoseconds). Storage devices, by contrast, access items in thousandths of a second (milliseconds) or millionths of a second (microseconds).

Instead of, or in addition to, access time, some manufacturers state a storage device's transfer rate because it affects access time. *Transfer rate* is the speed with which data, instructions, and information transfer to and from a device. Transfer rates for storage are stated in *KBps* (kilobytes per second), *MBps* (megabytes per second), and *GBps* (gigabytes per second).

Numerous types of storage media and storage devices exist to meet a variety of users' needs. Figure 8-3 shows how different types of storage media and memory compare in terms of transfer rates and uses. This chapter discusses these and other storage media.

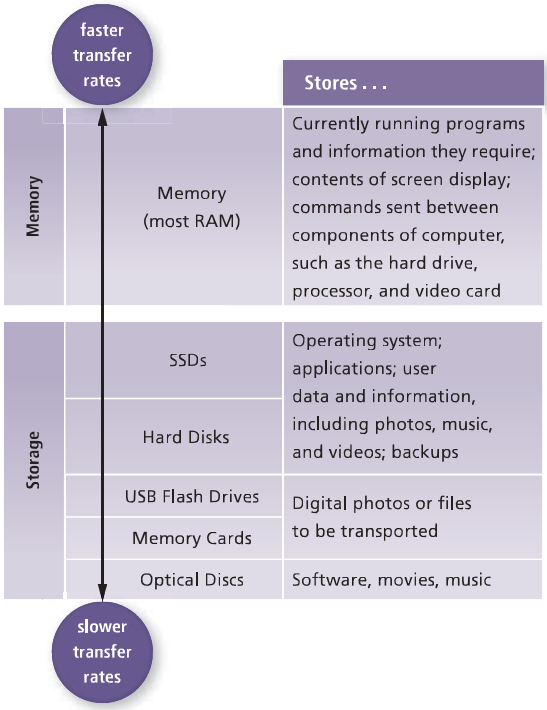

Figure 8-3 A comparison of different types of storage media and memory in terms of relative speed and uses. Memory is faster than storage but is expensive and not practical for all storage requirements. Storage is less expensive but is slower than memory.

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Mini Feature 8-1: Media Sharing

Users often want to share photos, videos, and music they have stored on computers and mobile devices with others using social media. Read Mini Feature 8-1 to learn about sharing media.

MINI FEATURE 8-1

Media Sharing

Online services offer a host of tools for sharing photos, video, and music with friends and family. When researching locations to share media files, ask yourself the following questions:

- **Where do my original files need to reside?** Can I upload from my computer, mobile device, or camera? Can I send via text message or email?
- **What is the cost?** Is the service free, or must I pay a monthly or annual fee? What happens to my files if I miss a payment or cancel my account?
- **How do I access and share the files safely?** Is the service password protected? Can I use Facebook, Twitter, blogs, and email to share the files?
- **What privacy rights are available?** Can I determine who can access the files and see my profile? Can I use a *geotag*, which is geographical data that can pinpoint where a photo was taken?
- **Can I annotate my media?** Does the service allow me to add notes, tags, and locations?
- **Are online reviews of the services available?** What experiences have other people had using the websites? Are they generally pleased or displeased with the service's reliability and ease of use?
- **What help and website support are available?** Does the service have an extensive Help section? Are FAQs, tutorials, and user forums posted?

Photos

Some photo sharing sites have millions of images to view and possibly download. When deciding which websites to use, consider the following factors:

- **Services:** Many services allow users to print the images. They also offer photo-customizing products.
- **Tools:** Owners can create webpages and keep photos organized by using albums, titles, and tags. They also can join forums to share experiences.
- **Features:** It is efficient if you can upload many files simultaneously in one batch. Many websites allow visitors to write comments on uploaded photos.
- **Storage space:** Some services offer unlimited storage, while others may limit members to a maximum number of stored photos or limit the total storage space.

Video

With video recording available on most smartphones and cameras, virtually anyone who owns these devices can produce videos to distribute. The following features are found on popular video sharing sites:

- **Video creation:** Editing tools allow special effects, editing, titles, and descriptions.
- **Audience interaction:** On-screen and keyboard controls allow viewers to play, pause, fast-forward, and stop the videos. Audience members can rate the videos and browse specific categories.
- **Features:** Most services accept files saved in a variety of file formats, but the maximum file size may be restricted or limited.
- **Genre:** Some websites accept a wide variety of content, while others require original work.

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Music

Online social networks and personal radio stations are popular sources of music. Some of these services are for listening only, while others sell songs to download. The following features are found on music sharing sites:

- **Playlists:** Musicians and listeners can organize the songs and albums into specific categories, such as by artist or genre. In a playlist, each song can be played sequentially or shuffled to play in random order.
- **Compatibility:** Some file types will not play on specific mobile devices, so check permissible formats before attempting to upload or download songs.
- **Features:** Services show the album cover, list artist information, and provide song previews.
- **Titles:** Musicians use music hosting websites as a convenient method of distributing their works.


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Protecting Your Rights to Files You Share

When you post your files on many media sharing sites, you can give permission to people who want to use or republish your photos, documents, or other digital content for a variety of purposes. *Creative Commons* is a nonprofit organization that provides standard licensing options that owners of creative works may specify when granting permission for others to use their digital content. When posting and downloading media files, ensure you are not infringing on copyright protection. Creative Commons simplifies the process of asking for permission to reuse online content.

Discover More: Visit this chapter's free resources to learn more about photo, video, and music sharing sites, Creative Commons, and copyright protection.

Consider This: Have you used photo, video, or music sharing sites? If so, which ones? How did you decide the services to use? If not, would you like to try uploading or viewing one of these websites?

BTW

Technology Innovators

Discover More: Visit this chapter's free resources to learn about the bookmarking site Pinterest and its founder, Ben Silbermann.


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Hard Drives

The term, **hard drive**, refers collectively to hard disks and SSDs. Hard drives can be internal or external. That is, they can reside inside a computer or mobile device, or they can be an external device that connects to a computer or some mobile devices. The following sections discuss the characteristics of internal and external hard disks and SSDs.

Hard Disk

A **hard disk**, also called a **hard disk drive** (**HDD**), is a storage device that contains one or more inflexible, circular platters that use magnetic particles to store data, instructions, and information. Depending on how the magnetic particles are aligned, they represent either a 0 bit or a 1 bit. Recall from Chapter 7 that a bit (binary digit) is the smallest unit of data a computer can process. Thus, the alignment of the magnetic particles represents the data.

Desktops and laptops often contain at least one hard disk. The entire hard disk is enclosed in an airtight, sealed case to protect it from contamination (Figure 8-4). Read Ethics & Issues 8-1 to consider whether governments should be able to confiscate computers and mobile devices to search the content of hard drives and other media.

BTW

Technology Innovators

Discover More: Visit this chapter's free resources to learn about the storage solutions company, Seagate, and storage pioneer, Al Shugart.

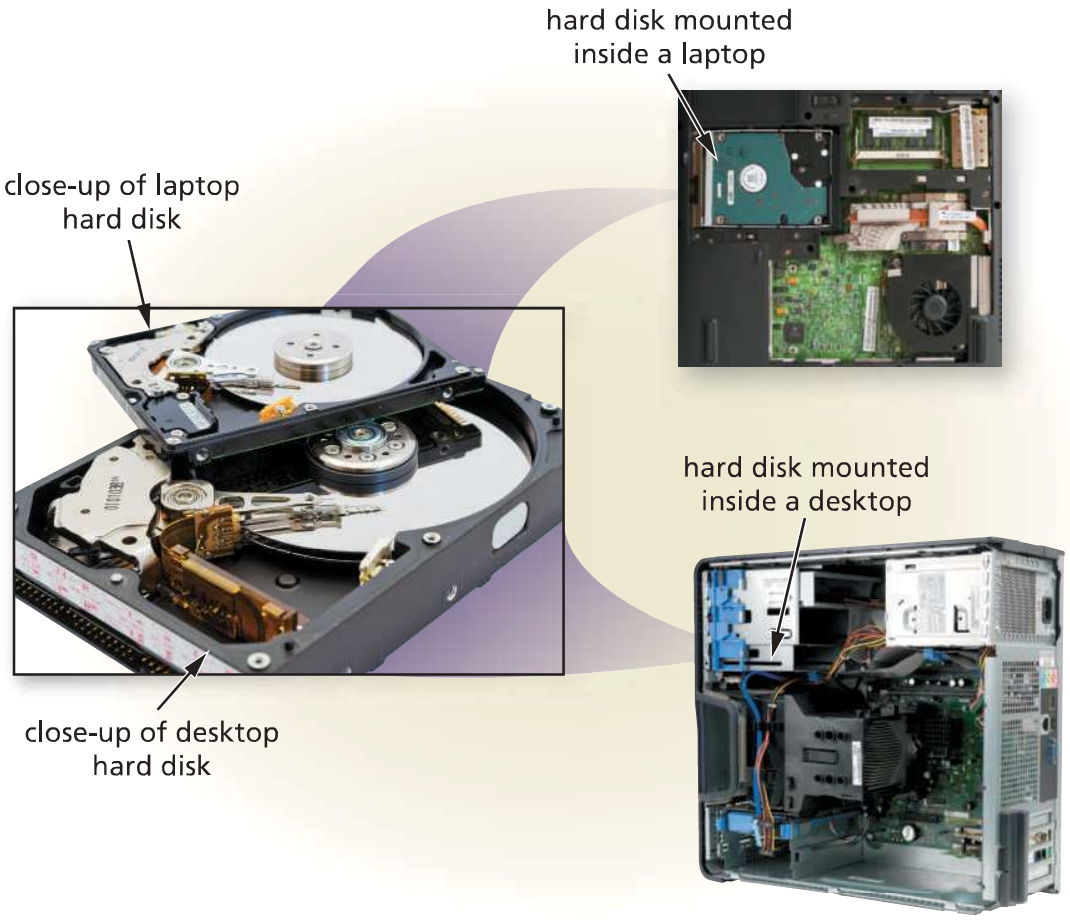

Figure 8-4 The hard disk in a personal computer is enclosed inside an airtight, sealed case. In these photos of the desktop and laptop hard disks, the top plate is removed for illustration purposes. The laptop hard disk is much smaller than the desktop hard disk.

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ETHICS & ISSUES 8-1

Is Government Search and Seizure of Computers Ethical?

In the interest of national security, the Department of Homeland Security may search and seize any computer or mobile device belonging to anyone arriving in the United States. Authorities can conduct the sometimes random searches without a warrant or even a reason. Additionally, the government has taken computers from schools and libraries in a similar manner. Authorities who confiscate computers and mobile devices for an off-site inspection may hold them for any amount of time.

The Fourth Amendment protects against unreasonable search and seizure. Yet sometimes, authorities do not return the devices and provide little or no reason for the seizure. At airports and other points of entry to the country, the government considers computers and mobile devices to be containers, just as a piece of luggage is a container. Authorities, therefore, can search and seize computers and mobile devices without reasonable suspicion, just as they can with luggage.

Opponents claim that users may be unaware of some of the contents of a hard drive, such as with a shared or repurposed computer or device. Users also may not realize that the media on the computer or mobile device contains Internet search history, access to cloud storage, online social network activity, deleted email messages and documents, and drafts of email messages or documents that they never sent or saved. Opponents also claim that the government should be able to inspect the hardware but not the contents of memory or a hard drive. Librarians and school administrators have stated that the government is invading the privacy of patrons and students. Privacy experts warn that, even without physically inspecting a computer or device, the government may still be able to access digital content you save, search for, or post.

Consider This: Is government search and seizure of computers without a warrant ethical? Why or why not? Do you believe a government employee should have the power to inspect the data on your mobile computer or device? Why or why not? If memories or thoughts someday are decipherable by a computer at a security checkpoint, should it be legal for the government to scan them? Why or why not?

Internet Research

What is the largest storage capacity available today for hard disks?

Search for: largest hard disk

The storage capacity of hard disks varies and is determined by the number of platters the hard disk contains, the composition of the magnetic coating on the platters, whether it uses longitudinal or perpendicular recording, and its density.

- A *platter* is made of aluminum, glass, or ceramic and has a thin coating of alloy material that allows items to be recorded magnetically on its surface.
- *Longitudinal recording* aligns the magnetic particles horizontally around the surface of the disk. With *perpendicular recording*, by contrast, hard disks align the magnetic particles vertically, or perpendicular to the disk's surface, making much greater storage capacities possible.
- *Density* is the number of bits in an area on a storage medium. A higher density means more storage capacity.

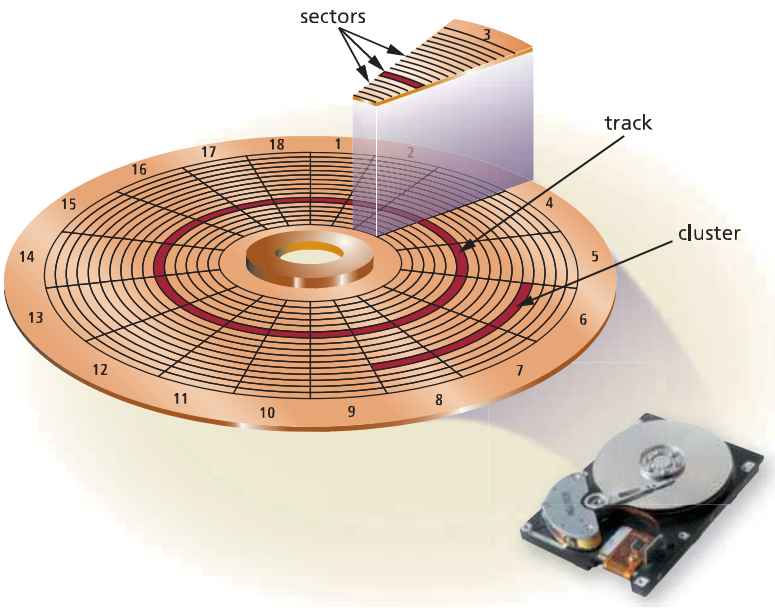


Figure 8-5 Tracks form circles on the surface of a hard disk. The disk's storage locations are divided into wedge-shaped sections, which break the tracks into small arcs called sectors. Several sectors form a cluster.

Hard disks are read/write storage media. That is, you can read from and write on a hard disk any number of times. Before any data can be read from or written on a hard disk, however, the disk must be formatted. *Formatting* is the process of dividing the disk into tracks and sectors (Figure 8-5) so that the operating system can store and locate data and information on the disk. A *track* is a narrow recording band that forms a full circle on the surface of the disk. The disk's storage locations consist of wedge-shaped sections, which break the tracks into small arcs called *sectors*. On a hard disk, a sector typically stores up to 512 bytes of data. Sometimes, a sector has a flaw and cannot store data. When you format a disk, the operating system marks these bad sectors as unusable.

On desktops, the platters most often have a form factor (size) of approximately 3.5 inches in diameter. On laptops, mobile devices, and some servers, the form factor is 2.5 inches or less. A typical hard disk has multiple platters stacked on top of one another. Each platter has two read/write heads, one for each side. A **read/write head** is the mechanism that reads items and writes items in the drive as it barely touches the disk's recording surface. A head actuator on the hard disk attaches to arms that move the read/write heads to the proper location on the platter (Figure 8-6).

While the computer is running, the platters in the hard disk rotate at a high rate of speed. This spinning, which usually is 5,400 to 15,000 *revolutions per minute* (*rpm*), allows nearly instant access to all tracks and sectors on the platters. The platters may continue to spin until power is removed from the computer, or more commonly today, the platters stop spinning or slow down after a specified time to save power. The spinning motion creates a cushion of air between the platter and its read/write head. This cushion ensures that the read/write head floats above the platter instead of making direct contact with the platter surface. The distance between the read/write head and the platter is about two-millionths of one inch.

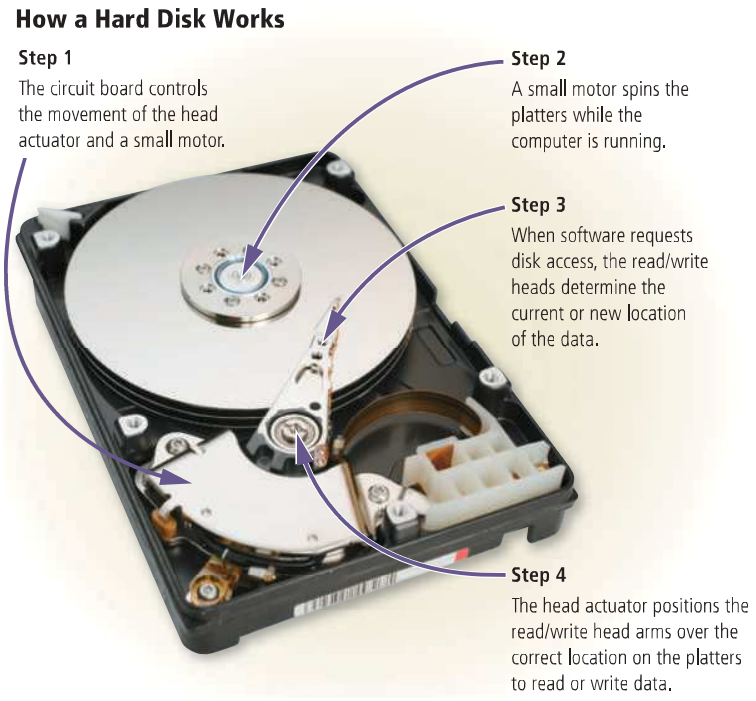


Figure 8-6 This figure shows how a hard disk works.

CONSIDER THIS

What happens if dust touches the surface of a platter on a hard disk?

Because of the close clearance between the read/write head and the platter on a hard disk, dust, dirt, hair, smoke, or any other contaminant could cause a disk to crash (Figure 8-7). A *head crash* occurs when a read/write head touches the surface of a platter, usually resulting in a loss of data or sometimes loss of the entire disk.

Although current internal hard disks are built to withstand shocks and are sealed tightly to keep out contaminants, head crashes occasionally still do occur. Thus, it is crucial that you back up a hard disk regularly.

Internet Research

Can you recover data after a disk crash?

Search for: disk crash recovery

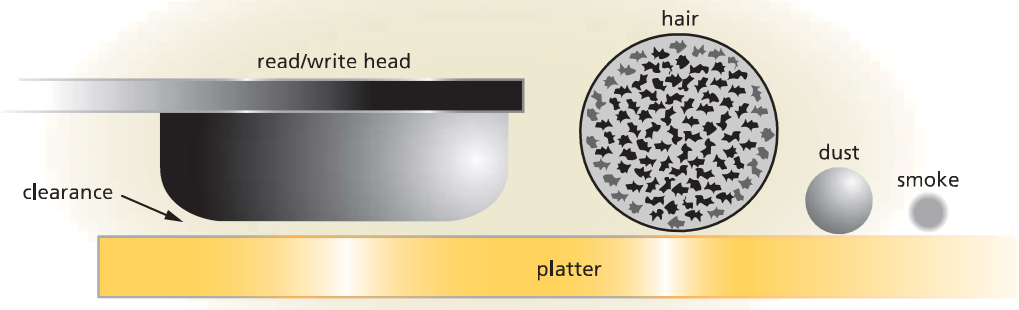


Figure 8-7 The clearance between a hard disk read/write head and the platter is about two-millionths of an inch. Any contaminant could render the disk unusable.

BTW
High-Tech Talk
Discover More: Visit this chapter's free resources to learn how data is recovered.

Most manufacturers guarantee their hard disks to last approximately three to five years. Many last much longer with proper care. To prevent the loss of items stored on a hard disk, you regularly should perform preventive maintenance such as defragmenting or scanning the disk for errors. Read How To 8-1 for instructions about defragmenting a hard disk.

Discover More: Visit this chapter's free resources to learn more about adding a second hard drive to a computer, hard disk storage capacity, sectors, read/write heads, and disk cache.

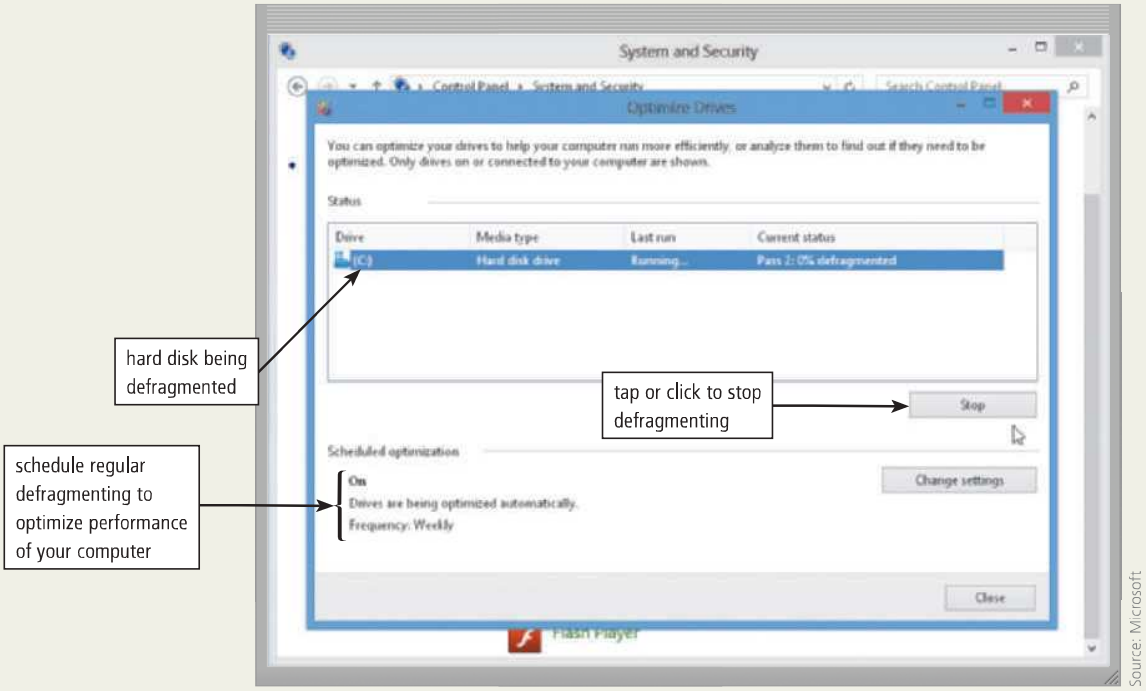
HOW TO 8-1

Defragment a Hard Disk

As discussed in Chapter 4, defragmenting a hard disk can improve your computer's performance by storing all related files for a particular program together. This can reduce the amount of time it takes the hard disk to locate and access the files necessary for programs to run. Windows has a built-in tool to defragment a computer's hard disk. Because the Mac OS defragments files automatically and writes smaller files closer together, Mac users generally do not have to defragment their hard disks. The following steps describe how to defragment a hard disk using the Windows operating system.

1. Open the Control Panel window.
2. Tap or click the Control Panel link on the Settings menu to display the Control Panel.
3. Tap or click the 'System and Security' link.
4. If necessary, scroll to display the 'Defragment and optimize your drives' link.
5. Tap or click the 'Defragment and optimize your drives' link.
6. Tap or click the hard disk you wish to defragment.
7. Tap or click the Optimize button to begin defragmenting the selected hard disk. This process may take from several minutes to more than one hour.

Consider This: What other tools can help optimize the performance of your computer?



Source: Microsoft

Internet Research
What is the largest storage capacity available today for SSDs?
Search for: largest ssd

SSDs

An **SSD** (**solid-state drive**) is a flash memory storage device that contains its own processor to manage its storage (Figure 8-8). As discussed in Chapter 6, flash memory is a type of nonvolatile memory that can be erased electronically and rewritten. Flash memory chips are a type of *solid-state media*, which means they consist entirely of electronic components, such as integrated circuits, and contain no moving parts. The lack of moving parts makes flash memory

storage more durable and shock resistant than other types of media, such as magnetic hard disks or optical discs.

SSDs may be in the form of flash memory chips installed directly on a motherboard or an adapter card. They also may be housed in a separate casing that attaches to the motherboard, as shown in Figure 8-8, which are available in a variety of form factors including 3.5 inches, 2.5 inches, and 1.8 inches. SSDs are used in all types of computers, including servers, desktops, laptops, tablets, and a variety of mobile devices, such as portable media players and DV cameras. Some computers have both a hard disk and an SSD. Read How To 8-2 for instructions about transferring files from one internal hard drive to another.

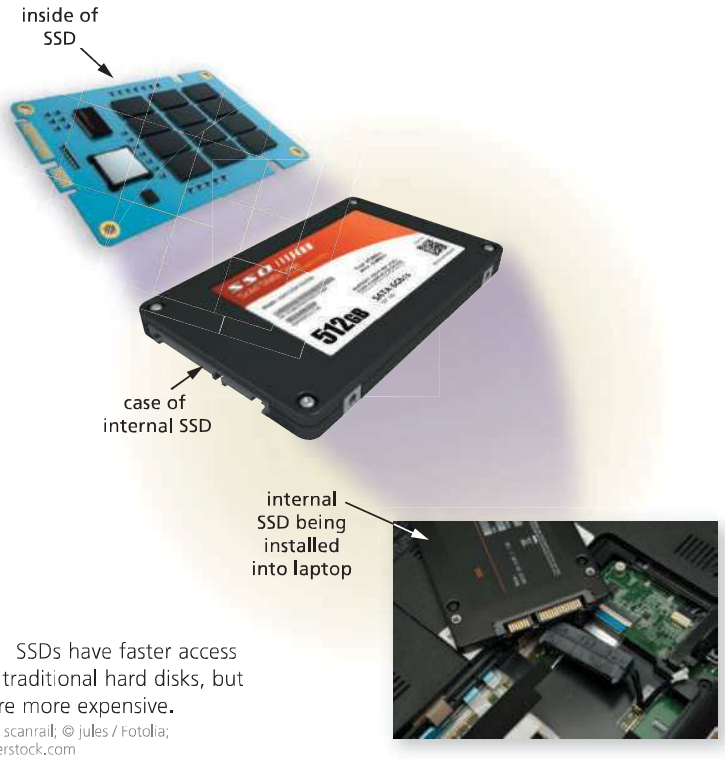


Figure 8-8 SSDs have faster access times than traditional hard disks, but they also are more expensive.

HOW TO 8-2

Transfer Files from One Internal Hard Drive to Another

If you are replacing an existing internal hard drive (hard disk or SSD), you may want to transfer the files from one internal hard drive to another one. The following list describes ways to transfer files from one internal hard drive to another.

- Connect the new internal hard drive as a second internal hard drive in your computer (refer to your computer's documentation to learn more about how to purchase and install a hard drive). When the operating system finishes loading, use the file manager in the operating system to drag the files you want to transfer from the original internal hard drive to the second one.
- Use a docking station or an external enclosure to connect the second internal hard drive to the computer that contains the original internal hard drive. (An enclosure is a case that contains the same adapters found on a motherboard with which to connect the internal hard drive. The enclosure usually connects to a computer through a USB port. Be sure to select an enclosure that matches the dimensions and connections of your hard drive.) Use the file manager in the operating system to move or copy files from the original internal hard drive to the new one.

Xigmatek

- Move or copy the files you want to transfer from the original internal hard drive to a separate storage device, such as a USB flash drive, or to a cloud storage provider. Next, connect the second internal hard drive and then move or copy the files from the storage device or cloud storage provider to the second internal hard drive.
- Install and run a program designed to transfer files from an old internal hard drive to a new one. Some programs not only will transfer files but also may transfer programs and settings.

Consider This: If you are purchasing a new internal hard drive, what types of files might you want to transfer from your existing internal hard drive? What types of files would you not transfer? Why?

SSDs have several advantages over traditional (magnetic) hard disks, including the following:

- Faster access times (can be more than 100 times faster)
- Faster transfer rates
- Quieter operation
- More durable
- Lighter weight
- Less power consumption (leads to longer battery life)
- Less heat generation
- Longer life (more than 10 times longer)
- Defragmentation is not required

Internet Research
Where might you buy a hard drive enclosure?
Search for: purchase hard drive enclosure

BTW
SSD Access Times
You do not need to defragment an SSD because the location of the stored data has no impact on its access times.

CONSIDER THIS

Why do SSDs have faster access times than hard disks?
Access time on a hard disk depends on the location of the data. That is, the data on the platter near the read/write head is accessed faster. The data on an SSD, by contrast, can be accessed almost instantly wherever it is located because the drive contains no moving parts.

The disadvantages of SSDs are that they typically have lower storage capacities than hard disks, data recovery in the event of failure can be more difficult than for traditional hard disks, and their cost is higher per gigabyte. In order to keep the price of a laptop affordable, laptops with SSDs usually have a lower storage capacity than laptops with a traditional hard disk.

CONSIDER THIS

Which should you use, a hard disk or SSD?
You may want to opt for a hard disk if you are looking for a looking for the lowest-cost option, use the computer or mobile device only for basic tasks at one location, or if you require a large amount of storage space on a hard drive, such as for high-end media. If you transport the computer or mobile device frequently, want faster access to stored items, need a quieter drive (such as for audio recording), you may want to choose an SSD. Another option is a dual-drive computer, that is, one that includes both a hard disk and SSD, so that you can take advantage of the benefits of both drives.

Discover More: Visit this chapter's free resources to learn more about SSDs.

External Hard Drives

An **external hard drive** is a separate freestanding storage device that connects with a cable to a USB port or other port on a computer or mobile device (Figure 8-9). Both hard disks and SSDs are available as external hard drives.

Sizes and storage capacities of external hard drives vary, with some having greater capacities than internal hard drives. Smaller external hard drives are portable and enable mobile users to transport photos and other files from one computer to another easily. As with an internal hard drive, an entire external hard drive is enclosed in an airtight, sealed case. External hard drives units can include multiple hard drives that you can use for different purposes, if desired.

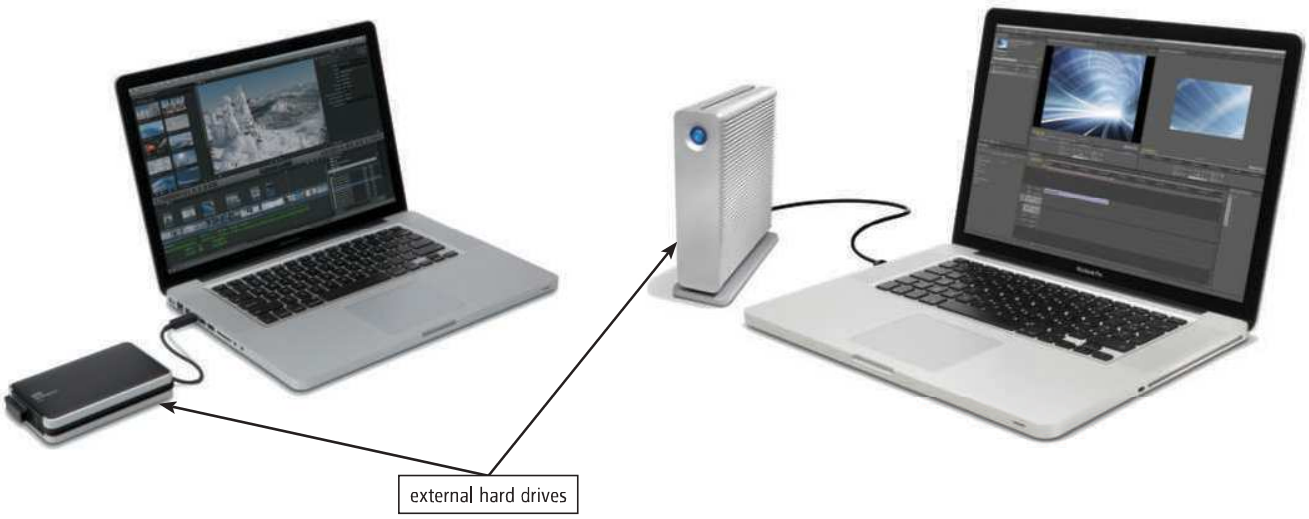


Figure 8-9 Examples of external hard drives.
Courtesy of Western Digital; Courtesy of LaCie

CONSIDER THIS

Why would you use an external hard drive instead of a second internal hard drive?
Although the transfer rate of external hard drives usually is slower than that of internal hard drives, external hard drives do offer many advantages over internal hard drives:

- Transport a large number of files.
- Back up important files or an entire internal hard drive (most external hard drive models include backup software).
- Easily store large audio and video files.
- Secure your data; for example, at the end of a work session, you can relocate or lock up an external hard drive, leaving no data in a computer. Read Secure IT 8-1 for instructions about encrypting files or drives to protect data.
- Add storage space to a mobile computer, such as a laptop or tablet.
- Add storage space to a desktop without having to open the case or connect to a network.

SECURE IT 8-1

Encrypting Data and Files on Storage Devices

Hard drives and other storage devices are necessary tools for keeping, backing up, and transporting data and files. If they fall into the wrong hands, however, the data may be unprotected and subject to unrestricted access. Encryption encodes the data so that only authorized people can access the data.

Some operating systems provide a feature allowing users to encrypt individual files, folders, or the entire contents of a hard drive or external storage device. In addition, third-party programs are designed to encrypt data. While each program may use a different method of encrypting files, they all use the process of cryptography. Mathematical functions, called algorithms, scramble the data. A password generally is needed to decrypt, or reassemble, this data. If this password is lost, the program or operating system's documentation may identify a procedure that allows users to access the encrypted files. In some cases, however, the software will not decrypt the files without the password, so people might reconsider encryption if they anticipate great risk when losing access to these files.

Encrypted files offer security, but users might notice that the operating system may require more time to open and access encrypted files. While no encryption program is infallible, security experts recommend using this process to protect individual files, folders, or entire storage media with personal or sensitive information.

Consider This: What types of files would you encrypt on media in or attached to your computer or mobile device? Would you consider not using encryption in the chance that you might lose the password?

Figure 8-10 An example of RAID for the home or small business user.
Courtesy of LaCie

RAID

Some personal computer manufacturers provide a hard drive configuration that connects multiple smaller hard disks or SSDs into a single unit that acts like a single large hard drive. A group of two or more integrated hard drives is called a **RAID** (redundant array of independent disks). RAID is an ideal storage solution in situations where uninterrupted access to the data is critical (Figure 8-10). Because enterprises often use RAID, the characteristics of these devices are discussed in more depth in the enterprise storage section of this chapter.

Internet Research
How much does RAID cost for the home user?
Search for: raid home storage

CONSIDER THIS

How do drives connect to a computer?

A *controller*, formerly called a disk controller, consists of a special-purpose chip and electronic circuits that control the transfer of data, instructions, and information from a drive to and from the system bus and other components in the computer. The controller may be part of a drive, may be on the motherboard, or may be a separate adapter card inside the computer.

In personal computer advertisements, vendors usually state the type of interface supported by the controller. In addition to USB, which can function as an interface for an external hard drive, four other types of interfaces for use in personal computers are EIDE, SCSI, SAS, and SATA.

BTW
Serial versus Parallel
With serial transfers, data is sent one bit at a time. Parallel transfers, by contrast, send several bits at once.

- *EIDE* (Enhanced Integrated Drive Electronics) is an interface that uses parallel signals to transfer data, instructions, and information. EIDE interfaces provide connections for hard disks, SSDs, RAID, optical disc drives, and tape drives.
- Like EIDE, *SCSI* (Small Computer System Interface) also uses parallel signals, but can support up to 8 or 15 peripheral devices. Supported devices include hard disks, SSDs, RAID, optical disc drives, tape drives, printers, scanners, network cards, and more.
- *SAS (serial-attached SCSI)* is a type of SCSI that uses serial signals to transfer data, instructions, and information. Advantages of SAS over parallel SCSI include thinner, longer cables; reduced interference; lower cost; support for many more connected devices at once; and faster speeds. SAS interfaces support connections to hard disks, SSDs, RAID, optical disc drives, printers, scanners, digital cameras, and other devices.
- *SATA* (Serial Advanced Technology Attachment) uses serial signals to transfer data, instructions, and information. The primary advantage of SATA interfaces is that their cables are thinner, longer, more flexible, and less susceptible to interference than cables that use parallel signals. SATA interfaces support connections to hard disks, SSDs, RAID, and optical disc drives. External drives can use the *eSATA* (external SATA) interface, which is much faster than USB.

Discover More: Visit this chapter's free resources to learn more about drive interfaces.

NOW YOU SHOULD KNOW

Be sure you understand the material presented in the sections titled Storage and Hard Drives, as it relates to the chapter objectives.
Now you should know …

- When you would use storage and when you use memory (Objective 1)
- What type of internal hard drive you would find in a desktop or laptop (Objective 2)
- Why you would use an SSD (Objective 3)
- Why you would use an external hard drive or RAID (Objective 4)

Discover More: Visit this chapter's premium content for practice quiz opportunities.

Portable Flash Memory Storage

In addition to SSDs discussed in the previous section, two other widely used types of flash memory storage include memory cards and USB flash drives. Users opt for memory cards and USB flash drives because they are portable.

BTW
Technology Innovator
Discover More: Visit this chapter's free resources to learn about SanDisk (maker of flash memory products).

Memory Cards

Memory cards enable mobile users easily to transport digital photos, music, videos, or other files to and from mobile devices and computers or other devices. As mentioned in Chapter 1, a **memory card** is a removable flash memory storage device, usually no bigger than 1.5 inches in height or width, that you insert in and remove from a slot in a computer, mobile device, or card reader/writer (Figure 8-11).

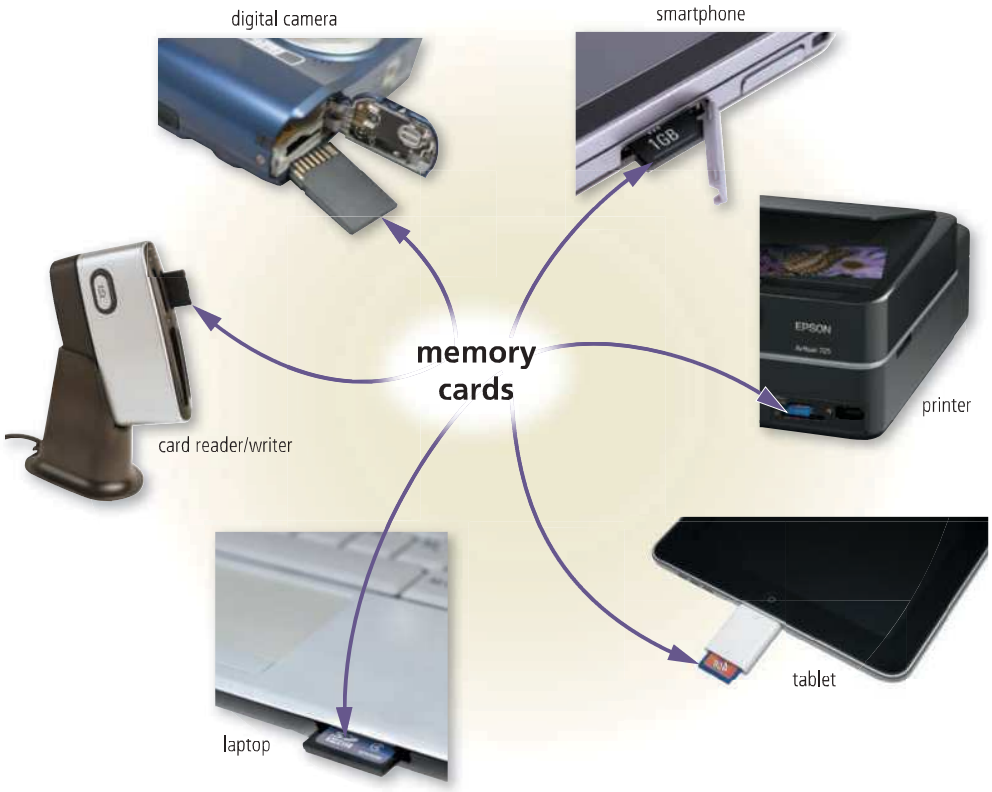


Figure 8-11 Many types of computers and devices have slots for memory cards.
© iStockphoto / Tomasz Zajaczkowski; Courtesy of Epson America Inc; © Verisakeet / Fotolia; © Thejipen / Dreamstime.com; © iStockphoto/Brian Balster; © Cengage Learning; © iStockPhoto/hanibaram

Common types of memory cards include **SDHC** (**Secure Digital High Capacity**), **SDXC** (**Secure Digital Expanded Capacity**), **miniSD, microSDHC**, **microSDXC**, **CF** (**CompactFlash**), **xD Picture Card**, **Memory Stick PRO Duo**, and **M2** (**Memory Stick Micro**). Capacities of memory cards vary. A slot on a computer or device often accepts multiple types of cards. For example, an SD slot will accept an SDHC and SDXC card. To read a mini or micro card in a computer, you insert it in an adapter that fits in a standard-sized slot on the computer or device (shown in Figure 8-1 at the beginning of this chapter).

If your computer or printer does not have a built-in card slot, you can purchase a *card reader/writer*, which is a device that reads from and writes on memory cards. Card reader/writers usually connect to the USB port on a computer. The type of card determines the type of card reader/writer needed. Some accept multiple types of cards; others accept one type. Figure 8-12 shows how one type of memory card works with a card reader/writer.

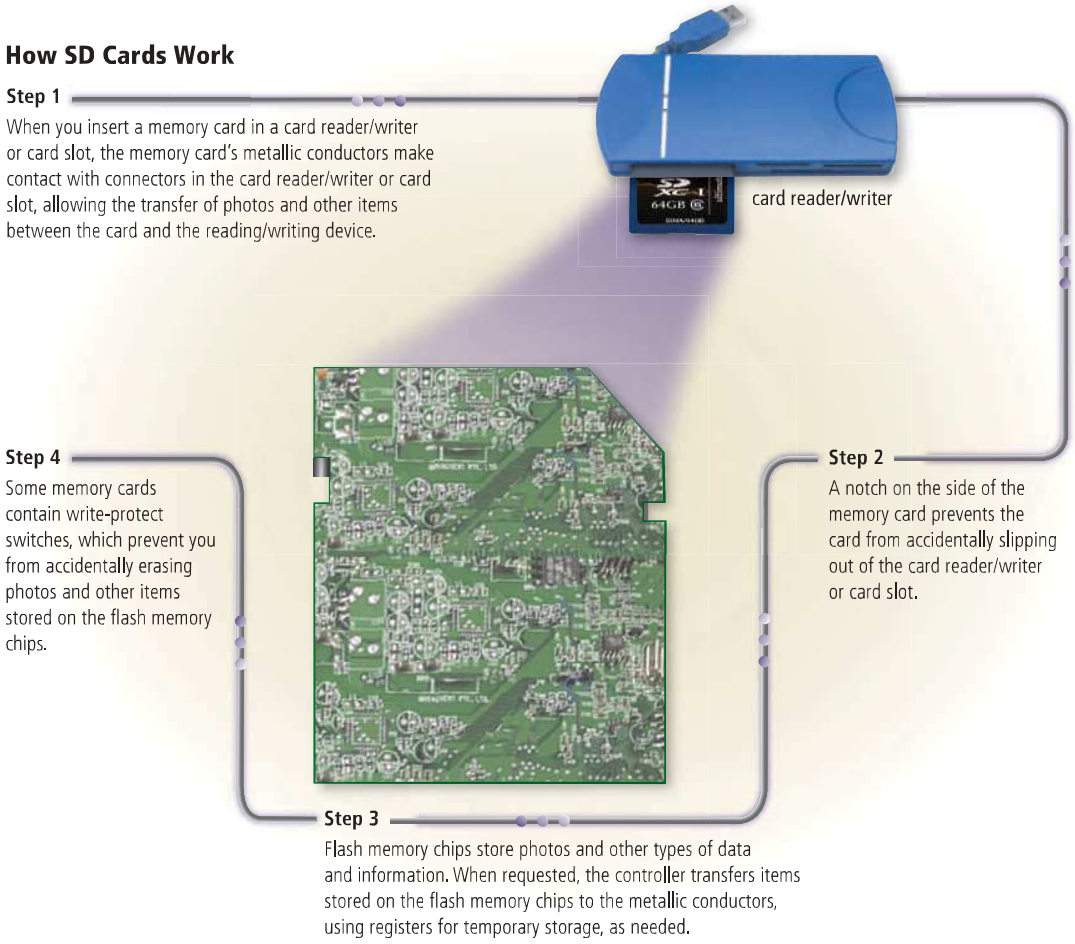


Figure 8-12 This figure shows how an SD card works.

CONSIDER THIS

What is the life span of a memory card?

Depending on the card, manufacturers claim their media can last from 10 to 100 years with proper care, including the following:

- Do not bend the card.
- Avoid dropping the card.
- Keep cards away from direct sunlight.
- Do not expose cards to extreme temperatures.
- Do not remove the card while data is transferring to or from it.

Internet Research
Which memory cards are best?
Search for: memory card reviews

Discover More: Visit this chapter's free resources to learn more about memory cards.

USB Flash Drives

Internet Research
What is the largest USB flash drive storage capacity available today?
Search for: largest usb flash drive

As mentioned in Chapter 1, a **USB flash drive**, sometimes called a *thumb drive*, is a flash memory storage device that plugs in a USB port on a computer or mobile device (Figure 8-13). USB flash drives are convenient for mobile users because they are small and lightweight enough to be transported on a keychain or in a pocket. With a USB flash drive, users easily transfer documents, photos, music, and videos from one computer to another. Storage capacities of USB flash drives vary. Read Secure IT 8-2 for pointers about safely removing a USB flash drive and other media.

Discover More: Visit this chapter's free resources to learn more about USB flash drives.

Figure 8-13 A close-up of the flash memory and circuitry inside a USB flash drive.

SECURE IT 8-2

Safely Remove Media

If you are using portable flash memory storage with your computer or mobile device, you should not remove the device or media while it is in use. Likewise, you should not remove a smartphone, digital camera, or portable media player that actively is connected to your computer. Although you might not be accessing files, the operating system still might be accessing the device, and disconnecting it may damage the files.

Operating systems typically provide an option to remove or eject the device or media safely and then will notify you when the device or media no longer is in use and can be removed. To remove or eject removable storage media, follow these steps:

1. Close any files or exit any programs that are open or running on the media.
2. Open the window displaying all the drives and media connected to your computer or mobile device and then select the drive or media you want to remove safely.
3. Tap or click the command to safely remove or eject the removable storage media. (If you are unable to locate this command, you may need to press and hold or right-click the icon representing the device or media to display a shortcut menu and then tap or click the command to remove or eject the device or media safely.)
4. When the notification appears stating that the device or media is safe to remove or eject, disconnect or remove it from your computer. If a notification does not appear, you can disconnect or remove the device or media once it no longer appears in your operating system as connected to your computer.

These guidelines generally apply to all types of portable flash memory storage, including USB flash drives, memory cards, and solid-state drives. When handling these storage devices, do not subject them to extreme temperatures, moisture, dust, or static electricity. Store them in cases, and try to avoid dropping them.

Consider This: Do you follow the guidelines described here before disconnecting portable flash memory storage, smartphones, digital cameras, and portable media players from your computer? If not, have you encountered damaged files on your storage devices? Should storage companies provide instructions on their packaging materials about how to remove media safely?

Cloud Storage

Some users choose cloud storage in addition to storing data locally on a hard disk, SSD, or other media. As discussed in previous chapters, **cloud storage** is an Internet service that provides storage to computer or mobile device users.

Cloud storage is available for home and business users, with various levels of storage services available. Cloud storage fee arrangements vary, depending on the user's storage requirements.

Internet Research
Which cloud storage providers are the best?
Search for: cloud storage reviews

CONSIDER THIS

What are some advantages of cloud storage?

Users subscribe to cloud storage for a variety of reasons:

- To access files on the Internet from any computer or device that has Internet access
- To store large audio, video, and graphics files on the Internet instantaneously, instead of spending time downloading to a local hard drive or other media
- To allow others to access their files on the Internet so that others can listen to an audio file, watch a video clip, or view a photo — instead of sending the file to them via an email message
- To view time-critical data and images immediately while away from the main office or location; for example, doctors can view X-ray images from another hospital, home, or office, or while on vacation
- To store off-site backups of data
- To provide data center functions, relieving enterprises of this task

CONSIDER THIS

What is a personal cloud?

Some hard drive manufacturers sell networked hard drives that make your data available on a cloud that exists within your home or office. That is, the networked hard drive connects directly to your router, creating a *personal cloud* that allows you to access its files over the Internet. With a personal cloud, you maintain the storage device on which the files are located versus a cloud storage provider where your files are stored on servers on the Internet that a cloud storage provider configures, maintains, and backs up.

BTW
Technology Innovators
Discover More: Visit this chapter's free resources to learn about Amazon, and its founder, Jeff Bezos.

Mini Feature 8-2: Services Offered by Cloud Storage Providers

Cloud storage provides access to your files across many devices. Read Mini Feature 8-2 to learn about services provided by cloud storage providers.

MINI FEATURE 8-2

Services Offered by Cloud Storage Providers

Microsoft OneDrive, Google Drive, Apple's iCloud, Amazon Cloud Drive, Dropbox, and Box are among the many options that consumers consider for cloud storage. These and other cloud storage providers enable you to synchronize files, write documents, back up files on your computer or mobile device, share project work, stream music, post photos, and play games online. Many offer a limited amount of free storage and make additional storage available for a fee.

© iStockPhoto/Aaltazar

Synchronize Files

Many cloud storage providers place a folder on your computer with contents you can synchronize across multiple devices. Other providers allow you to upload files for storage online, and download them via a web app or mobile app. Cloud storage providers often retain previous versions of your files, in case you need to revert to an earlier one.

Write Documents

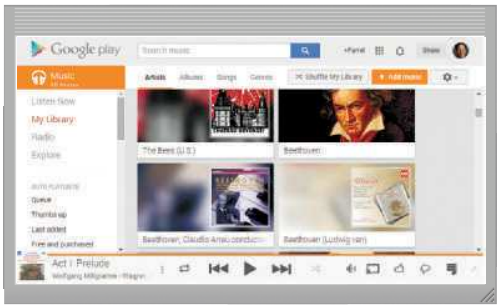
Google Drive and OneDrive provide integrated web apps to edit documents in a browser and store them on the cloud. Some third-party tools such as Evernote, an online note taking application, synchronize your notes with popular cloud storage providers.

Back Up Files

Storing files on the cloud is an easy way to back them up in case the hard drive on your computer fails or your mobile device is lost, stolen, or damaged. Some cloud backup services, such as Carbonite, automatically copy a computer or mobile device's new or changed files to the cloud, freeing users of performing backups themselves. Backup providers generally do not synchronize files across a user's multiple devices, but only provide capabilities to store and retrieve files on the cloud.

Stream Music

You can play music and videos stored offline (i.e., on your computer or mobile devices) in places without Internet access. Many people also store their media files on the cloud, so as not to use up the limited internal storage available on mobile devices. Some services, such as Google Play, support streaming music stored on the cloud to Android, iOS, and other devices.



Courtesy of Farrel Buchinsky; Source: Google, Inc.

Post Photos

Photo sharing sites and online social networks provide apps that support uploading photos taken with a smartphone or tablet to the cloud.

Play Games

Internet-connected game consoles enable you to save games in progress. Because game information is stored on the cloud, you can continue playing where you left off, regardless of whether you are using your own or another's game console.

Evaluating Providers

With so many providers offering free and paid cloud storage services, it is important to compare features to take advantage of the capabilities that each offers. Criteria to consider include the amount of free storage offered, the cost to purchase more if needed, and the maximum file size that each service allows you to upload. Keep the files you use most on the service on which you have the most storage space; use services that support streaming to store and play media files. Photos, songs, and videos take longer to upload than smaller text or webpage files, so it is important to select a provider whose servers have sufficient bandwidth to support large file transfers.

It also is important to read a cloud storage provider's privacy policy and terms of agreement to which you must consent before using its services. Some cloud storage providers may not guarantee the protection of the files you upload, so you still should keep a backup of the files you stored on the cloud. Read How To 8-3 to learn about selecting a cloud storage provider and deciding what to upload.

Discover More: Visit this chapter's free resources to learn more about cloud storage providers and their offerings.

Consider This: What are advantages of storing your files on the cloud? When does it make sense to use physical storage media, such as a USB flash drive, to store your files? Storing files on the cloud encourages collaboration and sharing. How can you share files stored on the cloud with your team members? Are you concerned about the security of your files when stored on the cloud? What information, if any, would you not store on the cloud?

HOW TO 8-3

Select a Cloud Storage Provider and Decide What to Upload to the Cloud

Many people are choosing to back up data to the cloud in addition to, or instead of, backing up to storage media such as external hard drives and optical discs. Cloud storage providers enable you to synchronize data on your computers and mobile devices effortlessly to one or more servers in remote locations. Various cloud storage providers exist, and it is important to select one that adequately meets your needs. In addition to selecting a cloud storage provider, you also should decide what to upload to the cloud.

Selecting a Cloud Storage Provider

Consider the following guidelines when selecting a cloud storage provider:

- Verify the company is reputable and has been in business for an extended period of time.
- Choose a provider that encrypts your files.
- Make sure the company has not fallen victim to major security breaches.
- Determine whether the provider's service is compatible with your computer(s) and mobile device(s).
- Compare the price of various storage plans and choose a provider that offers competitive pricing.
- Verify the cloud storage provider will support the types of files you want to back up. For example, some cloud storage providers might allow you only to back up photos, so they would not be a good choice to back up your personal files, such as documents and spreadsheets.
- If desired, choose a cloud storage provider that allows you to share selected files with others.
- Consider whether the provider offers a mobile app that you can use to access your files using a mobile device.

Deciding What to Upload to the Cloud

Consider the following guidelines when determining what to upload to the cloud. Before ultimately deciding what to upload, make sure the cloud storage provider you choose will adequately protect your files.

- Consider uploading files that you cannot afford to lose, such as financial documents or scanned copies of insurance paperwork.
- Upload files that might have sentimental value, such as photos and video. In the unlikely event of a disaster that ruins your computer, mobile device, and backups you possess, the cloud storage provider will retain these files.
- Do not back up programs and apps if you have access to the installation media or files.
- If your cloud storage provider offers only a limited amount of storage space, back up only the files you are sure you will need again in the future.
- Routinely review the files you have stored on the cloud storage provider and remove files you no longer need.

Consider This: Which of your files would you back up to the cloud? Why? After reviewing at least three cloud storage providers, which one would you choose? Why?

Optical Discs

An **optical disc** is a type of storage medium that consists of a flat, round, portable disc made of metal, plastic, and lacquer that is written and read by a laser. Optical discs used in computers typically are 4.75 inches in diameter and less than 1/20 of an inch thick. Game consoles and mobile devices, however, may use a *mini disc* that has a diameter of 3 inches or less; mini discs also work in standard-sized optical disc drives. Three widely used types of optical discs are CDs (compact discs), DVDs (digital versatile discs or sometimes digital video discs), and Blu-ray Discs.

Figure 8-14 An optical disc in a disc drive.

On some computers, you push a button to slide out a tray, insert the disc, and then push the same button to close the tray; others are slot loaded, which means you insert the disc in a narrow opening on the drive (Figure 8-14). When you insert the disc, the operating system automatically may run a program, play music, or start a video on the disc. Desktops and traditional laptops usually have an optical disc drive. Ultrathin laptops, tablets, and mobile devices typically do not have an optical disc drive.

Many different formats of optical discs are available today. Some are read only, meaning users cannot write (save) on the media. Others are read/write, which allows users to save on the disc just as they save on a hard drive. With most discs, you can read and/or write on one side only. Manufacturers usually place a silk-screened label on the top layer of these single-sided discs. You insert a single-sided disc in the drive with the label side up.

Characteristics of Optical Discs

Optical discs store items by using microscopic pits (indentations) and lands (flat areas) that are in the middle layer of the disc (Figure 8-15). A high-powered laser light creates the pits. A lower-powered laser light reads items from the disc by reflecting light through the bottom of

How a Laser Reads Data on an Optical Disc

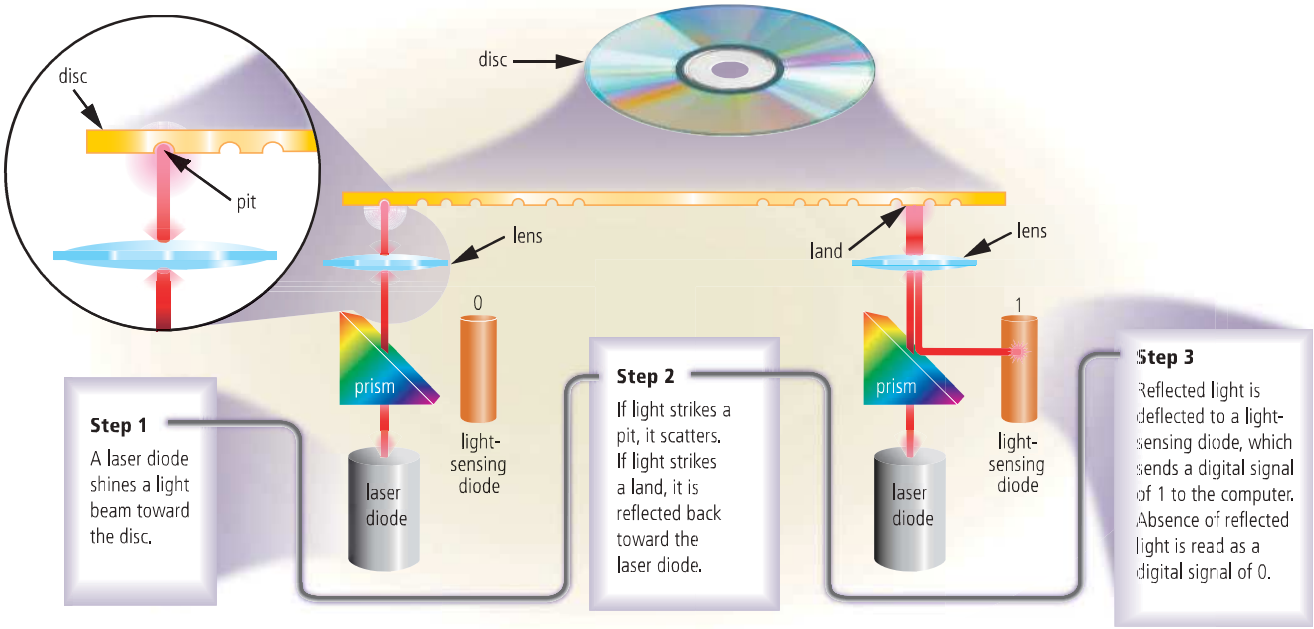


Figure 8-15 This figure shows how a laser reads data on an optical disc.

the disc. The reflected light is converted into a series of bits the computer can process. A land causes light to reflect, which is read as binary digit 1. Pits absorb the light; this absence of light is read as binary digit 0.

Optical discs commonly store items in a single track that spirals from the center of the disc to the edge of the disc. As with a hard disk, this single track is divided into evenly sized sectors on which items are stored (Figure 8-16).

Discover More: Visit this chapter's free resources to learn more about optical disc formats.

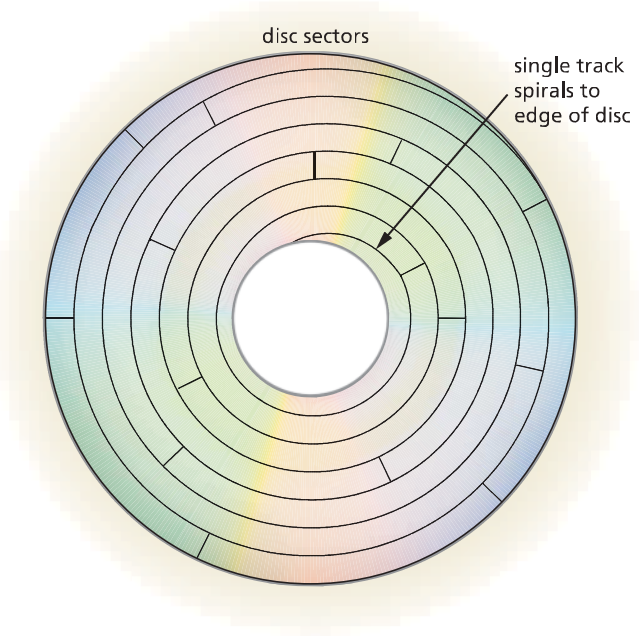


Figure 8-16 An optical disc typically stores data, instructions, and information in a single track that spirals from the center of the disc to the edge of the disc.

CONSIDER THIS

What is the life span of an optical disc?

Manufacturers claim that a properly cared for, high-quality optical disc will last 5 years but could last up to 100 years. Tips for proper care of optical discs include the following:

- Never bend a disc; it may break.
- Do not expose discs to extreme temperatures or humidity. The ideal temperature range for disc storage is 50 to 70 degrees Fahrenheit.
- Stacking discs, touching the underside of discs, or exposing them to any type of contaminant may scratch a disc. Read How To 8-4 for instructions about cleaning and fixing scratches on a disc.
- Place an optical disc in its protective case, called a *jewel case*, when you are finished using it, and store it in an upright (vertical) position.

HOW TO 8-4

Clean an Optical Disc and Fix Scratches

If you are having trouble accessing programs and files on an optical disc, such as a CD or DVD, you may need to clean the disc or fix scratches on its surface. To avoid the risk of not being able to access a disc because it is dirty, you should clean a disc when you first notice dirt on its surface. The following steps describe how to clean or fix scratches on an optical disc:

Cleaning an Optical Disc

1. While holding the disc by its edges, use compressed air to blow excess dust off of its surface. Hold the can of compressed air upright while using it.
2. Use a soft, nonabrasive cloth to gently wipe debris off of the disc's surface. Wipe the disc from the center out to its edges.
3. If any dirt remains on the disc, dip a soft cloth or cotton ball in isopropyl alcohol (or a cleaner designed for optical discs) and then gently wipe the soiled areas.
4. Use a soft cloth to dry the disc's surface or allow it to air dry. You never should insert a wet disc in a computer.

Fixing Scratches on an Optical Disc

1. Complete the previous Steps 1 – 4 to clean the disc. If it still contains scratches, follow the remaining steps.
2. As with any maintenance you perform, risks are associated with attempting to fix scratches on an optical disc. For this reason, if possible, you should back up the data on the disc before attempting to fix a scratch.
3. Place a very small amount of rubbing compound (available at a hardware store) on a soft, nonabrasive cloth and rub the compound on the disc from its center outward at the location of the scratch. If rubbing compound is not available, place a small amount of toothpaste (not a gel) on the scratched area and rub from the inside of the disc outward.
4. Test the disc. If you still are experiencing problems because of the scratch(es), consider having a professional remove the scratch.

Consider This: What other household products can be used to clean or fix scratches on an optical disc?

CDs

CDs are available in three basic formats: read-only, recordable, and rewritable.

- A **CD-ROM** (CD-read-only memory) is a type of optical disc that users can read but not write on (record) or erase — hence, the name read-only. Manufacturers write the contents of standard CD-ROMs and distribute them to consumers. A standard CD-ROM is called a *single-session disc* because manufacturers write all items on the disc at one time. Software manufacturers sometimes distribute their programs using CD-ROMs. The term, *photo CD*, sometimes is used to refer to CDs that contain only photos.
- A **CD-R** (CD-recordable) is an optical disc on which users can write once, but not erase, their own items, such as text, graphics, and audio. Because a CD-R can be written on only one time, the format of these discs sometimes is called *WORM* (write once, read many). Some CD-Rs are *multisession*, which means you can write on part of the disc at one time and another part at a later time — if the disc has free space.
- A **CD-RW** (CD-rewritable) is an erasable multisession disc users can write on multiple times. CD-RW overcomes the major disadvantage of CD-R because it allows users to write and rewrite data, instructions, and information on the CD-RW disc multiple times — instead of just once. Reliability of the disc tends to drop, however, with each successive rewrite.

BTW
Burning and Ripping
The process of writing on an optical disc is called *burning*. The process of copying audio and/or video data from a purchased disc and saving it on your own media is called *ripping*.

A popular use of CD-RW and CD-R discs is to create audio CDs. For example, you can record your own music and save it on a CD, purchase and download songs from the web, or rearrange tracks on a purchased music CD.

CONSIDER THIS

Can all CD drives read all CD formats?

A CD-ROM drive or a CD player may be able to read only CD-ROMs and sometimes CD-Rs. Because audio CDs and CD-ROMs use the same laser technology, you may be able to use a CD-ROM drive to listen to an audio CD while using the computer.

Most CD-R drives can read audio CDs, CD-ROMs, CD-Rs, and sometimes CD-RWs. Most CD-RW drives can read audio CDs, CD-ROMs, CD-Rs, and CD-RWs. To write on a CD-R disc, you must have a CD-R drive. Similarly, to write on a CD-RW disc, you must have a CD-RW drive.

DVDs

DVD quality for storing videos far surpasses that of CDs because items are stored in a slightly different manner, which enables DVDs to have greater storage capacities and higher resolutions than CDs. The first storage technique involves making the disc denser by packing the pits closer together. The second involves using two layers of pits. This technique doubles the capacity of the disc because the lower layer of pits is semitransparent, which allows the laser to read through it to the upper layer. Finally, some DVDs are double-sided. A more expensive DVD format is **Blu-ray**, which has a higher capacity and better quality than standard DVDs, especially for high-definition audio and video.

As with CDs, DVDs are available in three basic formats: read-only, recordable, and rewritable.

BTW
DVD/CD-RW
Some drives, called DVD/CD-RW drives, are combination drives that read and write on DVD and CD media. Current computers that include optical drives often use these combination drives.

- A **DVD-ROM** (DVD-read-only memory) is a high-capacity optical disc that users can read but not write on or erase. Manufacturers write the contents of DVD-ROMs and distribute them to consumers. DVD-ROMs store movies, music, music videos, huge databases, and applications you install on a computer.
- **DVD-R** and **DVD+R** are competing DVD-recordable WORM formats, on which users can write once but not erase their own items, including video, audio, photos, graphics, and text.
- **DVD-RW**, **DVD+RW**, and **DVD+RAM** are competing DVD-rewritable formats that users can write on multiple times.

CONSIDER THIS

Can all DVD drives read all DVD formats?

No. In addition to DVD-ROMs, most DVD-ROM drives also can read audio CDs, CD-ROMs, CD-Rs, and CD-RWs. Recordable and rewritable DVD drives usually can read a variety of DVD and CD media. Blu-ray Disc (BD) drives and players are backward compatible with DVD and CD formats. Before investing in equipment, check to be sure it is compatible with the media on which you intend to record.

NOW YOU SHOULD KNOW

Be sure you understand the material presented in the sections titled Portable Flash Memory Storage, Cloud Storage, and Optical Discs, as it relates to the chapter objectives.

Now you should know …

- Whether you should use a memory card or a USB flash drive (Objective 5)
- Why you would use cloud storage (Objective 6)
- Which optical disc format is best suited to your needs (Objective 7)

Discover More: Visit this chapter's premium content for practice quiz opportunities.

Enterprise Storage

Enterprise hardware allows large organizations to manage and store data and information using devices intended for heavy use, maximum efficiency, and maximum availability. The availability of hardware to users is a measure of how often it is online. Highly available hardware is accessible 24 hours a day, 365 days a year. To meet these needs, enterprise hardware often includes levels of *redundancy*, which means that if one component fails or malfunctions, another can assume its tasks.

Some organizations manage an enterprise storage system in-house. Others elect to offload all (or at least the backup) storage management to an outside organization or a cloud storage provider, a practice known as *outsourcing*. Enterprises use a combination of storage techniques to meet their large-scale needs, including cloud storage and some of the other previously discussed methods, along with RAID, network attached storage, storage area networks, and tape. Read Ethics & Issues 8-2 to consider issues with employees bringing their own devices into an enterprise.

BTW

Technology Trend

Discover More: Visit this chapter's free resources to learn about how organizatons are digitizing nondigital media, such as microfilm and microfiche.

ETHICS & ISSUES 8-2

Are Businesses Vulnerable when Employees Use Their Own Devices to Access Company Data?

BYOD (bring your own device) strategies enable employees to access company data from a personal smartphone, tablet, or laptop. Companies might adopt or allow a BYOD policy to save money on the cost of buying and maintaining devices. Employers might increase productivity by allowing employees to work in the environment in which they are most comfortable.

BYOD raises many privacy and security concerns. IT managers, security experts, and human resource directors work together to create and enforce a BYOD policy. BYOD guidelines should balance securing company data and preventing unauthorized network access with ensuring personal autonomy and privacy over employees' personal data. IT managers express concern over the potential need to service many different types of devices, if the company policy requires it to troubleshoot or secure employee devices. A company's security team must protect company data. In some cases, employees must install a tool to remotely wipe data, including personal data, if the device is lost, damaged, or stolen. Human resource directors help devise guidelines regarding cost-sharing and how to protect employees' private data and activities. Some industries may not be able to allow BYOD, as it may violate data privacy laws.

Many companies ban certain apps, such as gaming or file sharing, because of concerns over malware risks. In many cases, employees must agree to back up data. Employees should protect the device with a password or biometric security feature. Some companies employ a *geofence*, which is a virtual perimeter or boundary, to disable certain apps or cameras in secure areas, such as labs or meeting rooms.

Consider This: If you use your own device for work, would you be willing to give some control over the device to your company? Why or why not? Should companies be able to punish employees who violate BYOD policies? Why or why not?

Enterprise storage often uses *Fibre Channel* (*FC*) technology as the interface that connects the devices to the network because FC technology has much faster transmission rates than SCSI and other previously discussed interfaces.

Discover More: Visit this chapter's free resources to learn more about FC technology.

Figure 8-17 Shown here is a rack-mounted RAID chassis, including many integrated hard disks.

RAID

For applications that depend on reliable data access, users must have the data available when they attempt to access it. Some manufacturers provide a type of hard drive system that connects several smaller drives into a single unit that acts like a single large hard drive. As mentioned earlier in this chapter, a group of two or more integrated hard drives is called a RAID (Figure 8-17). Although RAID can be more expensive than traditional hard drives, it is more reliable. Computers and enterprise storage devices often use RAID.

RAID duplicates data, instructions, and information to improve data reliability. RAID implements this duplication in different ways, depending on the storage design, or level, being used. The simplest RAID storage design is *level 1*, called *mirroring*, which writes data on two drives at the same time to duplicate the data (Figure 8-18a). A level 1 configuration enhances storage reliability because, if a drive should fail, a duplicate of the requested item is available elsewhere within the array of drives.

BTW

High-Tech Talk

Discover More: Visit this chapter's free resources to learn more about how RAID levels optimize capacity, reliability, performance, and availability of data.

Other RAID levels use a technique called *striping*, which splits data, instructions, and information across multiple drives in the array (Figure 8-18b). Striping improves drive access times, but does not offer data duplication. For this reason, some RAID levels combine both mirroring and striping.

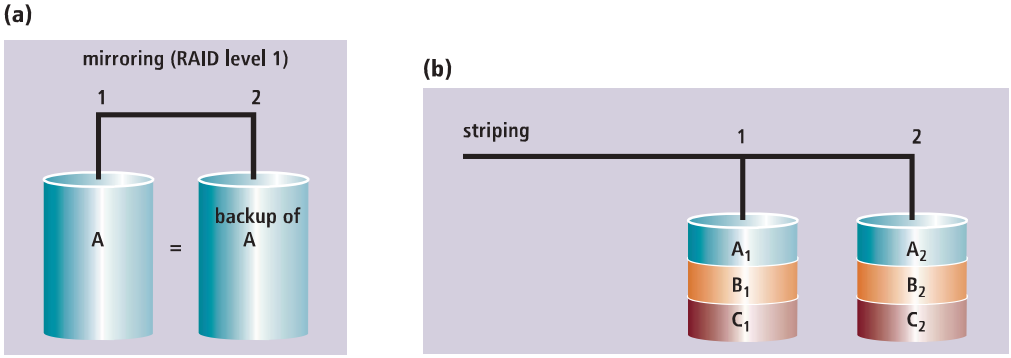


Figure 8-18 In RAID level 1, called mirroring, a backup disk exists for each drive. Other RAID levels use striping; that is, portions of each drive are placed on multiple drives.

NAS and SAN

Network attached storage (NAS) is a server that is placed on a network with the sole purpose of providing storage to users, computers, and devices attached to the network (Figure 8-19). A network attached storage server, often called a *storage appliance*, has its own IP address, usually does not have a keyboard or display, and contains at least one hard drive, often configured in a RAID. Administrators can add storage to an existing network quickly by connecting a network attached storage server to a network.

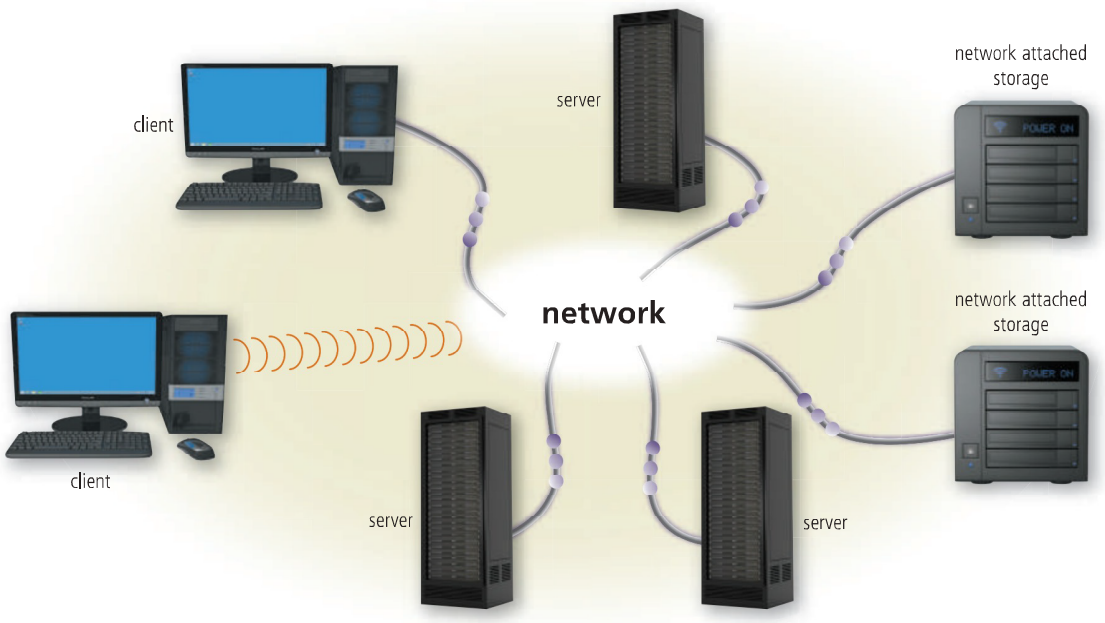


Figure 8-19 An example of how network attached storage connects on a network.

A **storage area network (SAN)** is a high-speed network with the sole purpose of providing storage to other attached servers (Figure 8-20). In fact, a storage area network includes only storage devices. High-speed fiber-optic cable usually connects other networks and servers to the storage area network, so that the networks and servers have fast access to large storage capacities. A storage area network can connect to networks and other servers that are miles away using high-speed network connections.

Both network attached storage and storage area network solutions offer easy management of storage, fast access to storage, sharing of storage, and isolation of storage from other servers. Isolating the storage enables the other servers to concentrate on performing a specific task, rather than consuming resources involved in the tasks related to storage. Both storage solutions include disk, optical disc, and magnetic tape types of storage.

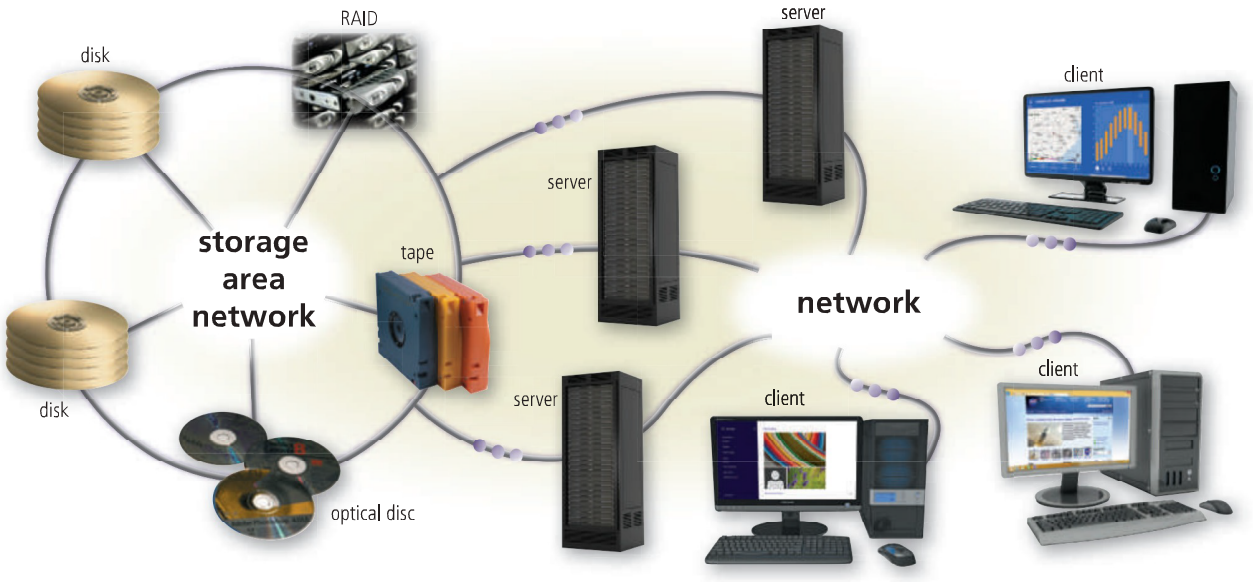


Figure 8-20 A storage area network provides centralized storage for servers and networks.

CONSIDER THIS

Which do enterprises typically use, network attached storage or storage area networks?

Enterprises sometimes choose to implement both network attached storage and storage area network solutions. A network attached storage server is better suited for adding storage to an existing network, such as a department's file server. A company typically implements a storage area network solution as central storage for an entire enterprise.

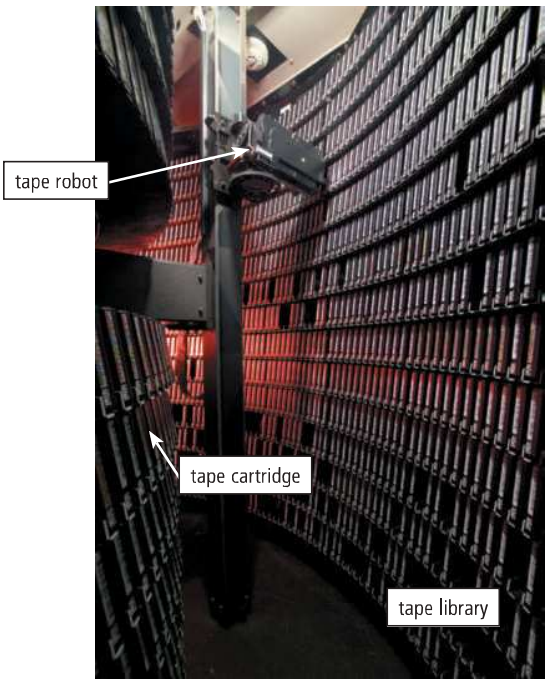


Figure 8-21 A tape robot retrieves tape cartridges.
Courtesy of Oak Ridge National Laboratory

Magnetic Tape

One of the first storage media used with enterprise computers was tape. **Tape** is a magnetically coated ribbon of plastic that is capable of storing large amounts of data and information at a low cost. Before the use of digital music players became widespread, cassette tapes were a popular medium to store music. Tape no longer is used as a primary method of storage. Instead, businesses use tape most often for long-term storage and backup.

Comparable to a cassette recorder, a *tape drive* reads from and writes on a magnetic tape. Although older computers used reel-to-reel tape drives, today's tape drives use tape cartridges. A *tape cartridge* is a small, rectangular, plastic housing for tape. Enterprises typically use a *tape library*, where individual tape cartridges are mounted in a separate cabinet. Often, a tape robot automatically retrieves tape cartridges (Figure 8-21), which are identified by location or bar code.

CONSIDER THIS

Is tape as fast as other storage techniques?

No. Tape storage requires *sequential access*, which refers to reading or writing data consecutively. In much the same way you would find a specific song on a cassette tape or videotape, you must forward or rewind to a specific position to access a specific piece of data. On a tape, for example, to access items ordered A, B, C, and D, you must pass through items A, B, and C sequentially before you can access item D.

Hard drives, flash memory storage, and optical discs all use direct access. *Direct access*, also called *random access*, means that the device can locate a particular data item or file immediately, without having to move consecutively through items stored in front of the desired data item or file. When writing or reading specific data, direct access is much faster than sequential access.

BTW
Technology Trend
Discover More: Visit this chapter's free resources to learn about how RECAPTCHAs are used to digitize media.

Other Types of Storage

In addition to the previously discussed types of storage, other options are available for specific uses and applications. These include magnetic stripe cards, smart cards, RFID tags, and NFC chips and tags. Read Ethics & Issues 8-3 to consider the ramifications of devices not secured after product development.

ETHICS & ISSUES 8-3

Should Manufacturers Be Required to Close Back Doors after Product Development?

As discussed in Chapter 5, a back door is a program or set of instructions that allows users to bypass security controls when accessing a program, computer, or network. Software developers often include a back door during product development to modify program code when troubleshooting. In these instances, a back door is necessary. What happens, though, when a hacker finds or creates a back door?

Hackers look for known security issues in software to access a computer or mobile device through a back door. If a hacker is unable to find and use a back door, they use trojan horses (previously discussed in Chapter 5) to deliver a payload that creates a back door. Hackers use back doors to gain control over a computer or mobile device so that they can use its resources to mount further malware attacks or to send spam. Using an unsuspecting user's resources to distribute spam or malware enables the hacker to avoid detection from and identification by authorities.

Back doors pose a serious security risk because they allow unauthorized access to your computer or mobile device's resources, files, and network whenever you are on the Internet. Not only can hackers control your computer or mobile device, but they can look through your files to find and steal your personal information. Users often are unaware of a back door's existence and do not know when it is breached. If your computer acts strangely or performance decreases, you may have been the victim of a hacker. Do not connect to the Internet until you run an antivirus program.

Consider This: Should software developers close back doors created during product development? Why or why not? Has your computer or device ever been hacked using a back door? If so, how did you detect and resolve the issue?

Magnetic Stripe Cards

A **magnetic stripe card** is a credit card, entertainment card, bank card, or other similar card with a stripe that contains information identifying you and the card (Figure 8-22). The card issuer, such as a financial organization, encodes information in the stripe. The information in the stripe often includes your name, account number, and the card's expiration date. When you swipe the card through a magstripe reader, discussed in the previous chapter, it reads information stored on the stripe.

Figure 8-22 The magnetic stripe on the back of credit cards and other ID cards contain information that identifies you and the card.

© iStockphoto/Ryan Warnick

Smart Cards

A **smart card**, which is an alternative to a magnetic stripe card, stores data on an integrated circuit embedded in the card (Figure 8-23). Two types of smart cards, also called *chip cards*, are contact and contactless. When you insert a contact smart card in a specialized card reader, the information on the smart card is read and, if necessary, updated. Contactless smart cards communicate with a reader using a radio frequency, which means the user simply places the card near the reader.

Internet Research

Which credit cards are smart cards?

Search for: credit card chips

Figure 8-23 Examples of contact and contactless smart cards and their readers.

© iStockphoto/oytun karadayi; © iStockphoto/alexander kirch

CONSIDER THIS

What are some uses of smart cards?

Uses of smart cards include storing medical records, vaccination data, and other health care and identification information; tracking information, such as employee attendance or customer purchases; storing a prepaid amount of money, such as for student purchases on campus or fares for public transportation; and authenticating users, such as for Internet purchases or building access. In addition, a smart card can double as an ID card or credit card. Read Secure IT 8-3 for tips about protecting your credit cards.

SECURE IT 8-3

Using Credit Cards Safely

Consumers in the United States own more than 775 million credit and debit cards, and the average cardholder has multiple cards available to use. With this widespread use, the potential for theft is high.

The newest smart cards have embedded RFID tags that allow vendors to obtain the account number without physically touching the card. While this technology is convenient for both the merchant and consumer, it also enables thieves with remote scanners to capture the card's information without the owner's knowledge.

Thieves also use a handheld device to swipe the card and then obtain and store account details. This action, called *skimming*, is prevalent at gas stations, restaurants, and lounges, where unscrupulous employees sell the information to criminals who then spend your money or steal your identity.

Follow these tips to help keep your credit card account safe:

Do

- Use a card with added security features, such as a photo.
- Draw a line through blank areas on restaurant charge slips. If you have left a cash tip on the table, write the words, On Table, in the slip's tip amount section.
- Cover the keypad when entering a PIN.
- Save charge receipts and check them against monthly statements or online postings.
- Keep a record in a safe place of all your credit card numbers, expiration dates, and toll-free numbers to call if you need to report a lost or stolen card.
- Purchase an RFID-proof wallet to shield smart cards from remote readers.
- Shred new credit account mail solicitations.
- Look for skimmers, which can capture a credit card number. (Read Secure IT 3-2 in Chapter 3 for information about skimmers at ATMs and other self-service stations.)

Do Not

- Reveal your account number during a phone call unless you have initiated the call.
- Write your PIN on the card or on the protective envelope.
- Sign a blank charge slip.
- Carry extra cards, especially when traveling to unfamiliar locations.
- Let your card out of sight. While you may not be able to follow this advice at a restaurant when you hand the card to a server, you can be observant of employees' behaviors.

Consider This: Do you know anyone who has been a victim of credit card theft? What steps will you take to use credit cards more safely after reading this information?

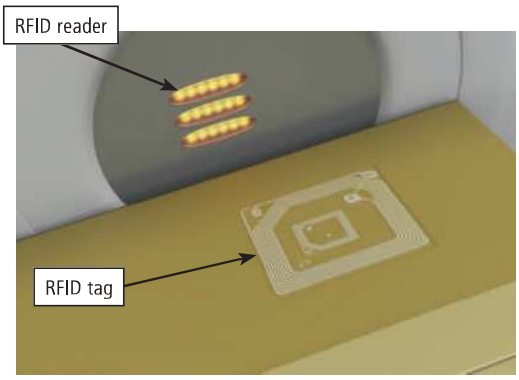


Figure 8-24 An RFID reader reads radio signals from an RFID tag that is affixed to this box.

RFID Tags

Recall that RFID is a technology that uses radio signals to communicate with a tag placed in or attached to an object, an animal, or a person. The **RFID tag** consists of an antenna and a memory chip that contains the information to be transmitted via radio waves (Figure 8-24). An RFID reader reads the radio signals and transfers the information to a computer or computing device.

RFID tags are either passive or active. An active RFID tag contains a battery that runs the chip's circuitry and broadcasts a signal to the RFID reader. A passive RFID tag does not contain a battery and, thus, cannot send a signal until the reader activates the tag's antenna by sending out electromagnetic waves. Because passive RFID tags contain no battery, these can be small enough to be embedded in skin.

CONSIDER THIS

How do RFID tags differ from contactless smart cards?

The physical size of the chip and storage capacities in an RFID tag typically are much smaller than the chips in contactless smart cards. The chips in RFID tags usually are read only, whereas the chips in contactless smart cards can function as a processor. Also, RFID tags often are not as secure as contactless smart cards. Thus, credit cards that contain RFID tags, called RFID-enabled credit cards, may not be as secure as those that use contactless technology.

NFC Chips and Tags

Recall that NFC is a technology (based on RFID) that uses close-range radio signals to transmit data between two NFC-enabled devices or an NFC-enabled device and an NFC tag. NFC-enabled devices include smartphones, digital cameras, computers, televisions, and terminals. An NFC-enabled

device, such as a smartphone, contains an NFC chip (Figure 8-25). Other objects, such as credit cards and tickets, can contain an NFC chip. An *NFC tag*, similar to RFID tag, contains a chip and an antenna that contains information to be transmitted (shown in Figure 8-1 at the beginning of the chapter). Most NFC tags are self-adhesive, so that they can be attached to any location.

When a user places the NFC-enabled device close to another NFC-enabled device or an NFC tag, radio waves enable communications between the chips in the NFC-enabled devices or the chip in the NFC-enabled device and the NFC tag. Uses of NFC communications includes using a mobile device to pay for goods or services, displaying a webpage, making a phone call, sending a text message, or exchange contact information. Read Secure IT 8-4 for how to secure NFC transactions.

Discover More: Visit this chapter's free resources about uses of NFC technology.

Figure 8-25 This NFC-enabled phone communicates with the NFC reader to send a mobile payment.

SECURE IT 8-4

Keeping NFC Transactions Safe

NFC-enabled phones offer convenience when making contactless payments at the point of sale. A user simply waves his or her smartphone above a reader attached to a register, and money is deducted from a credit card or account that is registered when the NFC application is installed. The security of this technology, however, raises major issues.

Eavesdropping is one concern. The phones and the merchant's receivers need to be less than 8 inches apart to communicate with each other and complete the wireless data transfer, but even this short distance leads to vulnerabilities that allow cyberthieves to steal financial and other personal data. Attackers can stand near the sales counter to intercept the smartphone's signals or use antennas to extend the signal's range. Another issue is data corruption and modification, when the high-tech criminals change or delete communications between the devices. Customers also are uneasy when the technology allows merchants to load coupons, advertisements, and other adware on the phone during the NFC transaction without the shopper's permission.

Hardware manufacturers and software engineers are working to improve security between the smartphones and the readers that receive the signals, but consumers need to exercise common sense and be proactive in protecting their sensitive information. They should follow these procedures in an attempt to avoid security breaches:

- Use a strong passcode on the phone and a PIN for the NFC transaction.
- Lock the phone when it has not been used for several minutes.
- Install antivirus software.
- Install an app that takes a photograph of a person trying to access a phone without permission and then sends a message to another mobile device when the phone has been stolen, or uses the phone's GPS to track its locations.
- Turn off Bluetooth discoverable status when not using this feature.

Consider This: Have you used NFC transactions? If so, did you take any precautions to keep your data safe? If not, would you consider using NFC technology to pay for goods and services? Why or why not?

Mini Feature 8-3: Backup Plans

To protect against data loss, users should back up the contents of their storage devices regularly. Read Mini Feature 8-3 to learn about backup plans.

MINI FEATURE 8-3

Backup Plans

Data loss or corruption can cause many issues. A user who accidentally misplaces a mobile device may lose contact information. A small business owner whose hard drive is infected with a virus may lose financial data, making billing and tax preparation difficult. A power user whose office floods and ruins a desktop not only may lose work completed on complex projects but also may need to replace expensive software. The best method for protecting against data loss from these types of unforeseen circumstances is to back up data.

A backup plan specifies a regular schedule for copying and storing important data, information, apps, and programs. Organizations should state their backup plans clearly, document them in writing, and follow them consistently. Home and small business users can use a calendar app or other reminder to keep a backup schedule for their computers or mobile devices, or use a program or app that performs automatic backups. Backup plans should weigh the time and expense of performing a backup against the value of the data, information, apps, and programs. For example, a small business may perform one type of backup daily, while a home user may find that monthly backups are sufficient. Read Ethics & Issues 8-4 to consider storage requirements for public companies.

As briefly discussed in Chapter 5, business and home users can use four methods for backup: full, differential,

incremental, or selective. Typically, only large enterprises uses a fifth type, continuous data protection. Cloud backup services, a sixth option, provide continuous data protection capabilities at a lower cost. Users can choose to backup to external media, or, as increasingly more are choosing to do, to the cloud.

- A *full backup*, sometimes called an *archival backup*, provides the best protection against data loss because it copies all program and data files. Generally, users should perform a full backup at regular intervals, such as at the end of each week and at the end of the month.
- Between full backups, you can perform differential or incremental backups. A *differential backup* copies only the files that have changed since the last full backup. An *incremental backup* copies only the files that have changed since the last full or last incremental backup.
- A *selective backup*, sometimes called a *partial backup*, allows the user to choose specific files to back up, regardless of whether or not the files have changed since the last incremental backup.

Backup software enables you to schedule backups, select the appropriate backup type, and choose the storage media for the backup. Traditional storage media includes CDs or DVDs, external hard drives, or removable SSDs, including USB flash drives or memory cards. Whichever storage media you choose, it should be stored separately from the device you are backing up to ensure it is available in case of theft or disaster. When choosing storage media, consider price and reliability. A USB flash drive may be inexpensive, but it also could be corrupted or lost easily. Cloud storage may be more expensive, but your data will be in a remote location and accessible from anywhere at any time.

Many smartphones and other mobile devices include services that sync data to a computer or to a cloud service. To sync data to a computer, the mobile device either requires cables to connect via a USB port or uses wireless methods, such as Wi-Fi or Bluetooth. Many mobile apps sync data to web apps automatically, which means you may not need to schedule a procedure to back up items on a mobile device, such as contacts, calendars, email messages, notes, and apps. For additional protection, however, some users still back up certain mobile data for easy retrieval if the device is lost or corrupted.

December

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SAT/SUN
28 DAILY INCREMENTAL BACKUP	29 DAILY INCREMENTAL BACKUP	30 END OF MONTH FULL BACKUP	1 DAILY INCREMENTAL BACKUP	2 WEEKLY FULL BACKUP	3/4
5 DAILY INCREMENTAL BACKUP	6 DAILY INCREMENTAL BACKUP	7 DAILY INCREMENTAL BACKUP	8 DAILY INCREMENTAL BACKUP	9 WEEKLY FULL BACKUP	10/11
12 DAILY INCREMENTAL BACKUP	13 DAILY INCREMENTAL BACKUP	14 DAILY INCREMENTAL BACKUP	15 DAILY INCREMENTAL BACKUP	16 WEEKLY FULL BACKUP	17/18
19 DAILY INCREMENTAL BACKUP	20 DAILY INCREMENTAL BACKUP	21 DAILY INCREMENTAL BACKUP	22 DAILY INCREMENTAL BACKUP	23 WEEKLY FULL BACKUP	24/25
26 DAILY INCREMENTAL BACKUP	27 DAILY INCREMENTAL BACKUP	28 DAILY INCREMENTAL BACKUP	29 DAILY INCREMENTAL BACKUP	30 END OF MONTH FULL BACKUP	31/1

Discover More: Visit this chapter's free resources to learn more about continuous data protection, incremental backups, backup software, and syncing data.

Consider This: Do you have a backup plan for your mobile device and/or computer? Why or why not? How often do you think you need to back up your devices? Why? What storage media is best suited for your backup needs? Why?

ETHICS & ISSUES 8-4

How Much Data Should Companies Be Required to Keep?

More than a decade ago, after a string of corporate scandals, lawmakers enacted the *Sarbanes-Oxley (SOX) Act*. SOX provides a myriad of financial reporting requirements and guidelines for publicly traded companies. A main focus of SOX is the retention of business records. Because of SOX, companies have been confronted with massive new data storage requirements. For example, a company must retain all of its email messages just as it would other business records. Deleting stored email messages can result in a destruction of evidence infraction. Employees face penalties of up to 20 years in prison for altering or destroying records or documents. IT departments must not only understand this complex law, but they also must ensure accuracy of financial data, determine policies for record retention, and provide storage capacity to hold all of the data.

Supporters of SOX state that it is essential to avoid corporate scandals caused by lack of accuracy in financial reporting. They also say that consumer confidence has increased because the financial statements are more transparent. Further, the financial costs for complying with SOX have decreased since companies have implemented plans. Opponents claim that the law is overreaching and costs too much for the added benefits. In addition, opponents blame the law for a decline in the number of IPOs (initial public offerings), as well as the transfer of several large companies to foreign countries. Recently, the U.S. government passed the Jumpstart Our Business Startup (JOBS) Act. Supported by technology companies, startup businesses, and venture capitalists, the JOBS Act aims to support smaller and emerging companies. By redefining the size of companies, as well as tiers of responsibilities related to SOX, supporters of the JOBS Act hope to help new businesses grow.

Consider This: Is the Sarbanes-Oxley Act an unfair burden on companies? Why or why not? Should the government distinguish between large and smaller companies? Why or why not? Are such laws necessary in order to protect the public? Why or why not?

NOW YOU SHOULD KNOW

Be sure you understand the material presented in the sections titled Enterprise Storage and Other Types of Storage, as it relates to the chapter objectives.
Now you should know …

- When you might use RAID, network attached storage, storage area network, and tape (Objective 8)
- Where you would use a magnetic stripe card, smart card, RFID tag, and NFC tag (Objective 9)

Discover More: Visit this chapter's premium content for practice quiz opportunities.

Chapter Summary

This chapter presented a variety of storage options. You learned about storage capacity and storage access times. The chapter discussed characteristics of hard disks, SSDs, external hard drives, and RAID. It discussed portable flash memory storage, including memory cards and USB flash drives. It presented advantages and various uses of cloud storage. Next, the chapter discussed characteristics of optical discs. Enterprise storage options were presented. You also learned about magnetic stripe cards, smart cards, RFID tags, and NFC chips and tags.

Discover More: Visit this chapter's free resources for additional content that accompanies this chapter and also includes these features: Technology Innovators: Pinterest/Ben Silbermann, Seagate/Al Shugart, SanDisk, and Amazon/Jeff Bezos; Technology Trends: Digitizing Nondigital Media and Digitizing Media with RECAPTCHAs; and High-Tech Talks: How Data Is Recovered and RAID Levels.

Test your knowledge of chapter material by accessing the Study Guide, Flash Cards, and Practice Test resources from your smartphone, tablet, laptop, or desktop.

TECHNOLOGY @ WORK

Automotive

The automotive industry plays a crucial role in today's society. To keep up with our growing population's increasing demand for transportation, organizations explore ways to streamline manufacturing processes in the automotive industry while simultaneously minimizing costs. These organizations often find that using technology in the manufacturing process requires fewer people-hours, and automobiles are manufactured with greater accuracy and less waste.

Automakers manufacture cars on an assembly line. In the early years of car manufacturing, people were involved at all stages of the manufacturing process. It was not uncommon to find hundreds or thousands of individuals working along the line. Although the assembly line allowed individuals to manufacture cars as quickly as they could, companies soon realized that computer-aided manufacturing (CAM) would increase output and decrease labor costs. In fact, CAM proved to be most effective when used in conjunction with computer-aided design (CAD). CAD designs an item, such as a car, to manufacture; CAM then manufactures the car according to the original design. Computers also determine the exact amount of material necessary to build the car, as well as the expected output.

Communications during the assembly process is critical. Computers automatically communicate with each other along the assembly line and provide alerts when factors arise that can interrupt the process. For example, running out of hinges that attach the door to the car's body will halt the line until someone replenishes the hinges. Computers, however, often alert individuals to low supplies before they run out and the assembly halts. Failure to detect the missing hinges might result in the machinery attempting to manufacture the car without hinges. This could result in damage to the door and/or the car's body further along the assembly line.

Today, technology helps create quality automobiles efficiently. Although some might argue that computers perform jobs that people once held, their introduction has helped to meet society's increased demand for products and desire for low prices.

Consider This: How else might computers and technology be used in the automotive industry?

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STUDENT ASSIGNMENTS

Study Guide

The Study Guide exercise reinforces material you should know for the chapter exam.

Discover More: Visit this chapter's premium content to **test your knowledge of digital content** associated with this chapter and **access the Study Guide resource** from your smartphone, tablet, laptop, or desktop.

Instructions: Answer the questions below using the format that helps you remember best or that is required by your instructor. Possible formats may include one or more of these options: write the answers; create a document that contains the answers; record answers as audio or video using a webcam, smartphone, or portable media player; post answers on a blog, wiki, or website; or highlight answers in the book/e-book.

1. Define the term, secondary storage. List types of storage media.
2. Differentiate between writing and reading data to storage media.
3. ___ refers to the number of bytes a storage medium can hold. Identify terms manufacturers use to determine this.
4. Differentiate between storage and memory and describe how they interact.
5. Explain what access time measures and how transfer rates are stated.
6. Identify questions to ask before deciding how to share media files.
7. Define the term, hard drive.
8. Explain the ethical issues surrounding government search and seizure of computers.
9. List characteristics and functions of a hard disk.
10. ___ is the process of dividing the disk into tracks and sectors.
11. Define the term, read/write head.
12. List steps to defragment a hard drive.
13. Define the term, SSD. List devices that use SSDs.
14. Describe how to transfer files from one internal hard drive to another.
15. List advantages and disadvantages of SSDs versus magnetic hard disks.
16. Define the term, external hard drive. Explain why you would use an external hard drive instead of a second internal hard drive.
17. Explain how to encrypt files.
18. RAID is an acronym for ___.
19. Explain the role of a controller for transferring data from a drive to the computer components.
20. In addition to USB, list four other types of interfaces for use in personal computers.
21. Describe memory cards and their uses. List types of memory cards.
22. Explain who might use a USB flash drive, and for what purpose.
23. Explain how to eject removable storage media safely.
24. Define the term, cloud storage. List advantages of cloud storage.
25. List uses of a personal cloud.
26. Name uses of cloud storage. Explain criteria for evaluating cloud storage providers.
27. Define the term, optical disc. List types of optical discs.
28. List characteristics of optical discs.
29. List steps for cleaning and fixing scratches on optical discs.
30. Differentiate among CD-ROM, CD-R, and CD-RW discs.
31. The process of writing on an optical disc is called ___. The process of copying audio and/or video data from a purchased disc and saving it on your own media is called ___.
32. Describe the storage techniques that make DVD storage higher capacity than CD storage.
33. Define the terms, redundancy and outsourcing, as they relate to enterprise computing.
34. Explain issues surrounding BYOD policies in the workplace.
35. List and describe the levels of RAID used in enterprises.
36. Differentiate between a network attached storage (NAS) and a storage area network (SAN).
37. Explain how enterprise computers use tape for storage.
38. Differentiate between sequential and direct access.
39. Explain issues surrounding the use of back doors in software development.
40. Define the terms, magnetic stripe card and smart card. Describe the uses of each.
41. List tips for using credit cards safely. ___ occurs when thieves use a handheld device to swipe the card and then obtain and store account details.
42. Differentiate between active and passive RFID tags.
43. Describe NFC technology and its uses.
44. List guidelines for conducting NFC transactions safely.
45. Describe types of backup used by business and home users. Explain considerations when creating a backup plan.
46. Explain the ethical issues surrounding the Sarbanes-Oxley Act.
47. Describe how technology is used in the automotive industry.

STUDENT ASSIGNMENTS

Key Terms

You should be able to define the Primary Terms and be familiar with the Secondary Terms listed below.

Discover More: Visit this chapter's premium content to **view definitions** for each term and to **access the Flash Cards resource** from your smartphone, tablet, laptop, or desktop.

Primary Terms

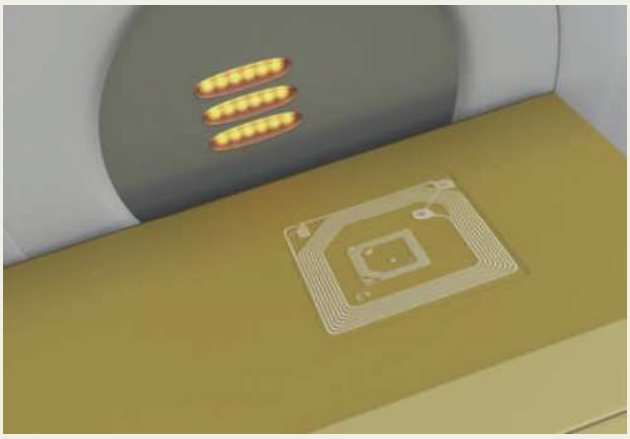
(shown in **bold-black** characters in the chapter)

access time (371)
Blu-ray (388)
capacity (370)
CD-R (388)
CD-ROM (388)
CD-RW (388)
CF (CompactFlash) (383)
cloud storage (383)
DVD-R (388)
DVD-ROM (388)
DVD-RW (388)
DVD+R (388)
DVD+RAM (388)
DVD+RW (388)
external hard drive (378)
hard disk (373)
hard disk drive (HDD) (373)
hard drive (373)
M2 (Memory Stick Micro) (381)
magnetic stripe card (393)
memory card (381)
Memory Stick PRO Duo (381)
microSDHC (381)
microSDXC (381)
miniSD (381)
network attached storage (NAS) (390)
optical disc (386)
RAID (380)
read/write head (375)
reading (368)
RFID tag (394)
SDHC (Secure Digital High Capacity) (381)
SDXC (Secure Digital Expanded Capacity) (381)
smart card (393)
SSD (solid-state drive) (376)
storage area network (SAN) (391)
storage device (368)
tape (392)
USB flash drive (382)
writing (368)
xD Picture Card (381)

Secondary Terms

(shown in *italic* characters in the chapter)

archival backup (396)
burning (388)
card reader/writer (381)
chip cards (393)
controller (380)
Creative Commons (372)
density (374)
differential backup (396)
direct access (392)
EIDE (380)
eSATA (380)
exabyte (EB) (370)
Fibre Channel (FC) (390)
formatting (374)
full backup (396)
GBps (371)
geofence (389)
geotag (372)
gigabyte (GB) (370)
head crash (375)
incremental backup (396)
jewel case (387)
KBps (371)
kilobyte (KB) (370)
level 1 (390)
longitudinal recording (374)
MBps (371)
megabyte (MB) (370)
mini disc (386)
mirroring (390)
multisession (388)
NFC tag (396)
outsourcing (390)
partial backup (396)
perpendicular recording (374)
personal cloud (384)
petabyte (PB) (370)
photo CD (388)
platter (374)
random access (392)
redundancy (389)
revolutions per minute (rpm) (375)
ripping (388)
Sarbanes-Oxley Act (SOX) (390)
SAS (serial-attached SCSI) (380)
SATA (380)
SCSI (380)
secondary storage (368)
sectors (374)
selective backup (396)
sequential access (392)
single-session disc (388)
skimming (394)
solid-state media (376)
storage appliance (390)
striping (390)
tape cartridge (392)
tape drive (392)
tape library (392)
terabyte (TB) (370)
thumb drive (382)
track (374)
transfer rate (371)
WORM (388)
yottabyte (YB) (370)
zettabyte (ZB) (370)



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RFID tag (394)

STUDENT ASSIGNMENTS

Checkpoint

The Checkpoint exercises test your knowledge of the chapter concepts. The page number containing the answer appears in parentheses after each exercise. The Consider This exercises challenge your understanding of chapter concepts.

Discover More: Visit this chapter's premium content to **complete the Checkpoint exercises** interactively; complete the **self-assessment in the Test Prep resource** from your smartphone, tablet, laptop, or desktop; and then **take the Practice Test.**

True/False

Mark T for True and F for False.

_____ 1. Storage devices can be categorized as input or output devices. (368)

_____ 2. A storage medium is volatile; that is, items stored on it remain intact even when you turn off a computer or mobile device. (370)

_____ 3. Compared with the access time of memory, the access time of storage devices is slow. (371)

_____ 4. On storage media, a higher density means less storage capacity. (374)

_____ 5. Because of current standards, head crashes no longer occur. (375)

_____ 6. The access time of a hard disk can be more than 100 times faster than an SSD. (378)

_____ 7. While encrypted files offer greater security than unencrypted files, an operating system may require more time to open and access encrypted files. (379)

_____ 8. While each program may use a different method of encrypting files, they all use the process of cryptography. (379)

_____ 9. With serial transfers, data is sent one bit at a time. (380)

_____ 10. When you are finished using a USB flash drive, simply remove it from the USB port. (383)

_____ 11. Mini discs require a separate mini disc drive; that is, they do not work in standard-sized optical disc drives. (386)

_____ 12. An active RFID tag contains a battery than runs the chip's circuitry and broadcasts a signal to the RFID reader; because they are so small, they can be embedded in skin. (394)

Multiple Choice

Select the best answer.

1. _____ measures the amount of time it takes a storage device to locate an item on a storage medium and/or the time required to deliver an item from memory to the processor. (371)
   a. Rpm(s)
   b. Transfer time
   c. Access time
   d. Clock speed

2. A(n) _____ is a storage device that contains one or more inflexible, circular platters that use magnetic particles to store data, instructions, and information. (373)
   a. hard disk
   b. SSD
   c. USB flash drive
   d. optical disc

3. Which of the following is *not* an advantage of SSDs over hard disks? (378)
   a. faster transfer time
   b. lighter weight
   c. more durable
   d. higher storage capacity

4. A group of two or more integrated hard drives is called a(n)_____. (380)
   a. RAID
   b. SSD
   c. HDD
   d. EIDE

5. A disc you can read but not write on or erase is a _____. (388)
   a. CD-RW
   b. CD-ROM
   c. multisession
   d. WORM

6. The process of copying audio and/or video data from a purchased disc and saving it on your own media is called _____. (388)
   a. ripping
   b. burning
   c. tearing
   d. formatting

7. Enterprise storage often uses _____ technology as the interface that connects the devices to the network because it has much faster transmission rates than SCSI. (390)
   a. SAS
   b. serial transfer
   c. Fibre Channel (FC)
   d. SATA

8. A selective backup sometimes is called a(n) _____ backup. (396)
   a. differential
   b. incremental
   c. partial
   d. archival

Checkpoint

Matching Match the terms with their definitions.

_____ 1. writing (368)
_____ 2. reading (368)
_____ 3. capacity (370)
_____ 4. perpendicular recording (374)
_____ 5. longitudinal recording (374)
_____ 6. solid-state media (376)
_____ 7. controller (380)
_____ 8. thumb drive (382)
_____ 9. network attached storage (390)
_____ 10. sequential access (392)

a. storage method in which the magnetic particles are aligned horizontally around a disk's surface
b. server whose sole purpose is providing storage to users, computers, and devices attached to the network
c. the number of bytes a storage medium can hold
d. special-purpose chip and electronic circuits that control the transfer of data, instructions, and information from a drive to and from the system bus and other components in the computer
e. flash memory chip type that consists entirely of electronic components, such as integrated circuits, and contains no moving parts
f. flash memory storage device that plugs in a USB port on a computer or mobile device
g. process of transferring data, instructions, and information from memory to a storage medium
h. storage method in which the magnetic particles are aligned vertically to a disk's surface, making much greater storage capacities possible
i. storage technique that reads or writes data consecutively
j. process of transferring data, instructions, and information from a storage medium into memory

Consider This Answer the following questions in the format specified by your instructor.

1. Answer the critical thinking questions posed at the end of these elements in this chapter: Ethics & Issues (373, 389, 393, 396), How To (376, 377, 385, 387), Mini Features (372, 384, 395), Secure IT (379, 383, 394, 395), and Technology @ Work (397).
2. In terms of storage devices, what is reading and writing? (368)
3. Is a screen display volatile or nonvolatile? (371)
4. What does access time measure? (371)
5. How does the access time of storage compare with the access time of memory? (371)
6. What does Creative Commons provide? (372)
7. How does longitudinal recording differ from perpendicular recording? (374)
8. What is a head crash? (375)
9. What are some disadvantages of SSDs? (378)
10. Why might you opt for a hard disk rather than an SSD? (378)
11. Why is it not necessary to defrag an SSD? (378)
12. What advantages does SAS have over SCSI? (380)
13. What is the life span of a memory card? (382)
14. How do optical discs store items? (386)
15. What is the life span of an optical disc? (387)
16. What are the differences among a CD-ROM, a CD-R, and a CD-RW? (388)
17. What does redundancy mean with respect to enterprise storage? (389)
18. What does the term, geofence, mean? (389)
19. How does mirroring differ from striping? (389)
20. How do businesses most often use tape? (392)
21. Which is faster: sequential or direct access? Why? (392)
22. Why would a developer include a backdoor in a program? (393)
23. What are the two types of smart cards? (393)
24. How do contactless smart cards communicate with a reader? (393)
25. What is skimming? (394)
26. What is contained in an NFC card? (395)
27. What are three types of backup plans? (396)

STUDENT ASSIGNMENTS

Problem Solving

The Problem Solving exercises extend your knowledge of chapter concepts by seeking solutions to practical problems with technology that you may encounter at home, school, or work. The Collaboration exercise should be completed with a team.

Instructions: You often can solve problems with technology in multiple ways. Determine a solution to the problems in these exercises by using one or more resources available to you (such as a computer or mobile device, articles on the web or in print, blogs, podcasts, videos, television, user guides, other individuals, electronics or computer stores, etc.). Describe your solution, along with the resource(s) used, in the format requested by your instructor (brief report, presentation, discussion, blog post, video, or other means).

Personal

1. **Unrecognized Storage Device** You have connected an external storage device to your new MacBook Pro, but the operating system is not recognizing the device's contents. Instead, it asks whether you want to format the device. Why might this be happening?
2. **Second Hard Drive Connection** While installing a second hard drive in your computer, you realize that your computer does not include a cable to connect the hard drive to the motherboard. How can you determine what type of cable to purchase?
3. **Incompatible Memory Card** While attempting to copy files from your digital camera to your laptop, you realize that the memory card from your camera does not fit in the memory card slot on your laptop. What other steps can you take to copy the photos from the camera to the laptop?
4. **Missing Files** You stored some files on a USB flash drive, but when you attempted to access them you noticed that they no longer were there. What might have happened, and what next steps will you take to attempt to recover these files?

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5. **Media Not Supported** You purchased a program that came on a DVD, but your laptop does not have an optical disc drive. What next steps can you take to install this program?

Professional

6. **Inaccessible Files** Your company requires you to store your files on a remote server so that you can access the files from any location within the company. When you sign in to another computer using your account, you cannot see your files. What might be causing this?
7. **Encrypted Storage Device** You have purchased an external storage device so that you can back up files on your office computer. The IT department in your company informs you that you must make sure the data on the device is encrypted. What are your next steps?
8. **Alternative to Tape Storage** Your company still uses tape storage to back up important files, but your manager has asked you to begin researching alternatives to the aging technology. What steps will you take to research current storage technologies that are suitable to store company backups?
9. **Faulty RFID Card** You use an RFID card to obtain access to your office. When you attempt to scan your card, the RFID reader acts like it does not recognize your card is nearby. What are your next steps?
10. **Files Not Synchronizing** You have saved files on the cloud from your home computer, but the files are not appearing on the computer in your office. What might have happened, and what steps can you take to retrieve the files?

Collaboration

11. **Technology in the Automotive Industry** Technology is used in the automotive industry to increase speed and efficiency. Your instructor would like everyone to realize the importance of technology in this industry and the different ways it is used. Form a team of three people. One team member should investigate how technology is used to build automobiles. Another team member should investigate how technology is used to help ensure the safety of individuals working in the automobile manufacturing process, and the last team member should research how technology is used to market and sell cars. Write a brief report summarizing your findings.

STUDENT ASSIGNMENTS

How To: Your Turn

The How To: Your Turn exercises present general guidelines for fundamental skills when using a computer or mobile device and then require that you determine how to apply these general guidelines to a specific program or situation.

Discover More: Visit this chapter's premium content to **challenge yourself with additional How To: Your Turn exercises**, which include App Adventure.

Instructions: You often can complete tasks using technology in multiple ways. Figure out how to perform the tasks described in these exercises by using one or more resources available to you (such as a computer or mobile device, articles on the web or in print, online or program help, user guides, blogs, podcasts, videos, other individuals, trial and error, etc.). Summarize your 'how to' steps, along with the resource(s) used, in the format requested by your instructor (brief report, presentation, discussion, blog post, video, or other means).

1 Determine Your Device's Storage Capacity

It may be necessary to determine your device's storage capacity before you decide to install a new operating system, program, or app, or if you want to transfer a large number of files to your computer or mobile device. For example, a new program you want to install may state that it requires a certain amount of storage capacity, so you should verify the storage capacity available on your device before deciding to purchase and install the program. One way to determine a device's total storage capacity is to review the documentation or specifications that were included with your computer or mobile device. The following steps guide you through the process of determining your device's storage capacity using other methods.

Computers

a. Open the window that shows the available storage devices on the computer.
b. Press and hold or right-click the drive for which you want to display the total storage capacity and then select the option to display the drive properties.
c. Navigate to the location showing the total storage capacity and available storage space.

or

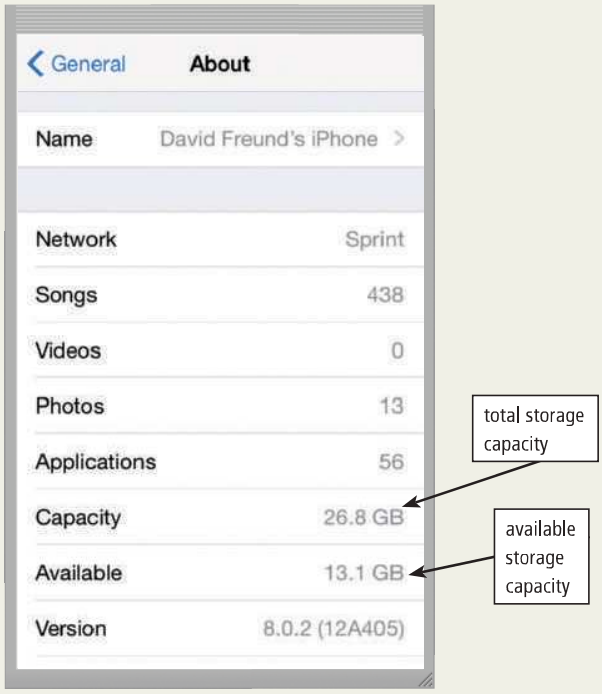
a. Some operating systems allow you to hover your pointer over the icon representing the drive for which you want to determine the storage capacity, and the storage information will appear.

Mobile Devices

a. Display the device settings.
b. Navigate to the storage settings.
c. If necessary, navigate to the screen showing the total storage capacity and available storage space.

Exercises

1. What are other reasons why you might need to determine the total storage capacity or available storage space on your computer or mobile device?
2. Does the total storage capacity displayed on your computer or mobile device match the exact amount advertised when you purchased your computer or mobile device? If not, what might cause the discrepancy?
3. How much storage space is available on your computer or mobile device? What steps can you take if the storage on your device is almost completely used?



Source: Apple, Inc.

2 Organize Files on a Storage Device Using Folders

Organizing the files on a storage device not only can improve your computer's performance, but it also can make your files easy to locate. If you are accustomed to saving files to your desktop or to a folder on your storage device, you should consider organizing the files by storing them in appropriate folders. The following steps guide you through the process of using folders to organize files on a storage device.

a. Review the types of files you currently store on your device.

STUDENT ASSIGNMENTS

How To: Your Turn

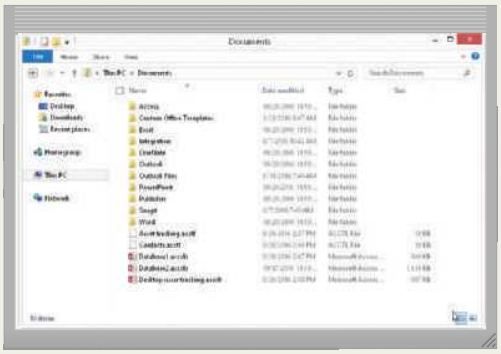
b. Current operating systems, such as Windows and Mac OS, include locations for storing different types of files, such as documents, music, video, and photos. Within these locations, however, you should create additional folders to further organize these file types. The method you use to organize each file type might vary.
   1. Create folders to store your documents by the type of content they contain. For example, you might create separate folders to store files related to academics, finances, and entertainment. Then, consider whether you should create folders within these folders. For instance, you might create additional folders within the Academics folder to organize your files by subject.
   2. Create folders to store your music by genre. Within each genre, create additional folders to sort your music by artist. If you have many songs for a particular artist, consider creating folders within the artist's folder to store the songs by album.
   3. Create folders to store your photos and videos either by date, event, or a combination of the two. For example, you could have a folder for a particular year, and then within that folder, create additional folders for all events that occurred within that year.

c. Although the desktop seems to be a convenient location to store files, it quickly can become cluttered. The only files you should store on the desktop are the ones you will need in the immediate future. If will not need a file again for at least several days, consider storing it in one of the folders mentioned previously.

d. Review the files on your storage device periodically and delete the ones you no longer need. Delete only the files you have placed on your storage device; be careful not to delete files that any programs or the operating system may need to run.

Exercises

1. Review the files and folders on your storage device. In your opinion, do you feel they are organized effectively? Why or why not?
2. How are the files and folders on your storage device organized?
3. When you take photos on a digital camera, the camera often generates a file name consisting of a generic prefix and sequential number. What are some ways to identify the photos easily on your digital camera's memory card?



Source: Microsoft

3 Copy Individual Files to Another Storage Device, and Copy Files to Cloud Storage

If you save a file on your computer or mobile device and later will need to access it on another device, you likely will have to copy the file to another storage device or to the cloud so that you can access the file on the other device. The following steps guide you through the process of copying files to another storage device or to the cloud.

Copying Files to Another Storage Device

a. Navigate to the location containing the file you want to copy. If the file is on an external storage device or memory card, connect the storage device to your computer or insert the memory card into your computer's card reader. Next, navigate to the location containing the file you want to copy.

b. Navigate to the location to which you want to copy the file. If the location to which you want to copy the file is on an external storage device or on a memory card, connect the external storage device to your computer or insert the memory card into your computer's card reader. Next, navigate to the location to which you want to copy the file.

c. Drag the file you want to copy to the destination location. After you drag the file, make sure the file exists both in the source and destination location.

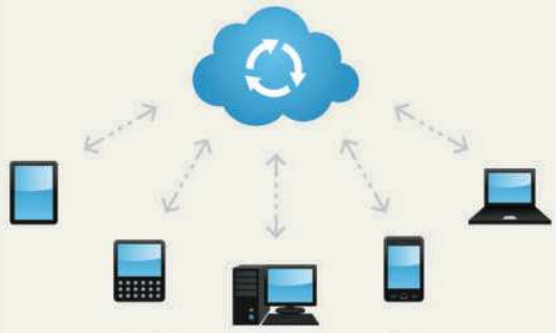
How To: Your Turn

Copying Files to the Cloud

a. If necessary, sign up for an account with an online service that can store your files. Some online services store only photos and videos, while other services store all types of files, such as documents and other media files.
b. Sign in to the online service and navigate to the page where you can upload files.
c. Tap or click the button or link to upload a file.
d. Navigate to and then tap or click the file you want to upload.
e. Tap or click the button or link to upload the file.

Exercises

1. What types of files might you want to copy to the cloud? Why would you copy files to the cloud instead of copying them to an external storage device?
2. What are at least three online services that allow you to store files? Are they free, or do they charge a fee? How much space do they provide? How do you obtain more storage space?
3. What steps would you take to copy a file from the cloud to your computer or mobile device?



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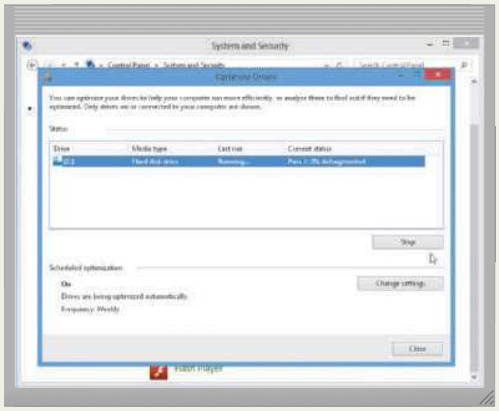
4 Manage Space on a Storage Device

As you use your computer or mobile device, chances are that you are storing more files and installing additional programs and apps. At some point, you might require additional space or need to improve performance on your storage device. While purchasing an additional storage device might seem like the best option, ways may be available to help you manage the space on your existing storage device so that an additional purchase is not necessary. The following steps guide you through the process of managing space on a storage device.

a. Review the files on your storage device and identify unused files you might be able to delete. Be careful not to remove files that the operating system, programs, or apps require to run properly.
b. View the list of programs and apps you have installed on your computer or mobile device. If you no longer need a program or app, uninstall it.
c. If you have files you may need in the future but not immediately, consider compressing them or copying them to an external storage device or to cloud storage. Verify the files have copied properly and then remove the files from your primary storage device.
d. If possible, defragment the storage device. If the storage device has not been defragmented recently, this process might improve performance significantly.
e. Search for and use any other tools that might be available in your operating system to maximize available space or improve performance. Note that some programs that claim to increase free space by compressing the files on your hard drive may slow your computer's performance.
f. If the above options do not increase performance enough or create sufficient free space, you might need to purchase an additional storage device.

Exercises

1. What files on your storage device might you consider deleting to save space? Why?
2. Does your computer or mobile device contain any programs or apps that you no longer need? How can you uninstall programs and apps from your computer or mobile device?
3. How does defragmentation help increase performance on your computer?



Source: Microsoft

STUDENT ASSIGNMENTS

Internet Research

The Internet Research exercises broaden your understanding of chapter concepts by requiring that you search for information on the web.

Discover More: Visit this chapter's premium content to **challenge yourself with additional Internet Research exercises**, which include Search Sleuth, Green Computing, Ethics in Action, You Review It, and Exploring Technology Careers.

Instructions: Use a search engine or another search tool to locate the information requested or answers to questions presented in the exercises. Describe your findings, along with the search term(s) you used and your web source(s), in the format requested by your instructor (brief report, presentation, discussion, blog post, video, or other means).

1 Making Use of the Web

Educational and Science

General reference websites, which include online encyclopedias, almanacs, and reference collections, are excellent sources of comprehensive, accurate, and organized facts on specific topics. For example, history and literary buffs can appreciate the websites that translate text, contain thousands of free books to download, and provide literary analyses. Among the more comprehensive websites are those sponsored by the American Library Association and the Library of Congress.

Answers to perplexing science questions and math problems are available on several educational websites that include practice tests, conversion tables, and current news articles. Environmental websites seek to educate and often persuade citizens to become aware of issues. The information helps consumers to make environmentally responsible purchasing decisions and urges people to become involved in solving global environmental problems. Scientists' research efforts extend beyond investigating this planet to exploring the great frontier of space. Their science websites contain information about current studies, conferences, and breakthroughs in such areas as biology, earth and ocean sciences, physics, and chemistry.

Research This: (a) Visit a general reference website and locate any free resources that you can download to your computer or mobile device. What materials are available to download? Which general topics are available? For which classes would you find the contents useful? Are you able to browse and search the collections? What types of current news articles are displayed? Are links to news stories or research articles shown? How often are they updated? Are previous stories archived so that you can research these events?

(b) Visit two environmental or science websites or apps, such as NASA, and browse their contents or download related apps. Which general topics are available for students? What types of current news articles are displayed? Are additional resources, such as videos and photos, available? Are online social network accounts listed to interact with scientists and researchers?

Source: NASA

2 Social Media

Digital footprints tracking your Internet activity are relatively easy to find. Maintaining online anonymity is difficult to achieve once you have established online social network accounts with your actual name. While deleting an online social network account is a fairly easy process, deleting all remnants of information relating to the account can be a more difficult task. Just because you no longer can sign in to the account does not mean your posts, photos, and personal information do not exist somewhere on a website.

If you desire to remove an Internet presence for security or personal reasons, begin by searching for your name or account user names. Remove your profiles from any online social network account that is displayed in the search results. Each of the online social network websites has a process to close an account, generally through the account's settings page. Next, contact the websites listed in the search results and ask that your name be removed. Many companies have a form to complete and submit. A third place to hunt for your information is on websites listing public records and people searches. Again, attempt to contact these companies and request that your personal information be removed. As a last resort, some services will perform these tasks for a fee.

Research This: Use a search engine to locate instances of your name or user names. Did the search results list these names? If so, which online social networks or companies have records of your name? Then, search for your name on at least two websites that have public records or people databases. Did you see your name on these websites? If so, do you want the details, such as a phone number or address, available for anyone to see? If not, attempt to remove this data and write a report of the steps you took and your success in deleting the personal information.

Internet Research

3 Search Skills

Image Search

An image search locates photos and images related to your search text or similar to other images. Tap or click the Images link on a search engine's home page and then type the search text describing images you would like to find. For example, type the search text, solid state drive, to find photos of solid state drives. Search engines allow you to narrow your results by specifying additional conditions on the images found. These may include size (icon, wallpaper, or dimensions in pixels), color, time taken (past day, week, or month), type (photo, clip art, face, animation, or drawing), shape (wide, tall, square), usage rights (whether a photo may be reused, and under what conditions), and safe search. Safe search filters content inappropriate for minors.

Some search engines allow you to upload or specify the web address for an image, so that the search engine can locate images with similar features. Searching for similar images can be effective if the image is of a well-known person, place, or object.

Image search results usually display an arrangement of thumbnail images; tap or click each thumbnail to see it in full size, download it, or obtain its web address from the browser's address bar.

Source: Yahoo!

Research This: Create search text using the techniques described above or in previous Search Skills exercises and then type it in a search engine to find these images: (1) an RFID tag, exactly 400 x 400; (2) an external DVD drive, with a transparent background; (3) an internal hard drive, labeled for noncommercial reuse; (4) a person holding an SD card; and (5) images similar to a photo of a laptop computer (take a photo of a laptop and upload it). How successful was your image search?

Create a document containing each image, its web address, and the name or web address of the website on which it appears.

4 Security

Permanently destroying files on storage media is recommended when donating or selling a computer. Federal laws have imposed strict requirements and penalties for data security, particularly regarding health and insurance records and credit transactions. While procedures exist to restore deleted files or erased media, often companies and individuals truly desire that the data never can be recovered. Sensitive medical and financial information, in particular, should be erased so that savvy criminals and digital forensics examiners cannot recover deleted files. The U.S. Department of Defense and the National Security Agency set standards for sanitizing magnetic media and specify that degaussing, or demagnetizing, is the preferred method in lieu of permanently destroying the storage medium.

Research This: What types of degaussers are available? How do they wipe a drive's contents? How are Gauss and Oersted ratings applied? What length of time is required to degauss a drive? Some companies offer degaussing services. What procedures do they use to ensure secure practices?

5 Cloud Services

Cloud Backups (IaaS)

Backing up files to the cloud provides a systematic way for organizations and individuals to create off-site copies of their files. Backing up files to the cloud is an example of infrastructure as a service (IaaS), a service of cloud computing which allows users to access and store files online.

Cloud backup providers offer continuous backup of new and changed files, transmitting them over a secure Internet connection. Like many cloud services, they offer a "pay as you go" pricing model, where customers subscribe to a service for a period, and pay for the features or storage they use. Many cloud backup providers offer web and mobile apps to access and restore files.

Cloud backup services differ from cloud storage services. Cloud backup services offer the software and infrastructure to back up and restore files only. They generally do not support synchronizing files across devices or sharing files with many users, which are common features of cloud storage services.

Research This: (1) Use a search engine to find two different cloud backup providers. Compare their pricing plans, storage offered, file types backed up, security features, and other services offered. (2) Why are cloud backup services attractive options for small to medium-sized businesses? (3) When is it practical to use cloud backup services, and when is it practical to use cloud storage?

STUDENT ASSIGNMENTS

Critical Thinking

The Critical Thinking exercises challenge your assessment and decision-making skills by presenting real-world situations associated with chapter concepts. The Collaboration exercise should be completed with a team.

Instructions: Evaluate the situations below, using personal experiences and one or more resources available to you (such as articles on the web or in print, blogs, podcasts, videos, television, user guides, other individuals, electronics or computer stores, etc.). Perform the tasks requested in each exercise and share your deliverables in the format requested by your instructor (brief report, presentation, discussion, blog post, video, or other means).

1. Increasing Storage Capacity

You are the office manager at a local boutique. The store needs to increase its storage capacity, and so decides to buy an external hard drive. Your boss asks you to research access times and storage capacities of various external hard drives.

Do This: Use the web to learn more about available hard drive options. What other factors should you evaluate when determining the appropriate hard drive to purchase? Analyze the advantages and disadvantages of using external hard drives for storage. Include in your discussion backup plans, costs, and alternate options. Recommend two hard drives to your boss. Include user reviews and any information by industry experts in your comparison between the two different hard drives. Which is the best option? Why? Compile your findings.

2. NFC

Your new smartphone includes NFC capabilities. You are curious about its uses but are concerned about potential risks. Before you enable NFC and install apps that can use this technology, you want to do some research.

Do This: Use the web to find and then list current and developing uses of NFC. If possible, find reviews or blog posts about these technologies. Describe any safety issues you found in your research. List ways you can protect yourself when using NFC technology. Locate apps that can use NFC. For what purposes can you use this new technology? What disadvantages and risks exist? How can you avoid any negative experiences and protect your data? Do any current laws govern or restrict the use of NFC for data collection? What are they? Can you provide additional potential uses for NFC at home, school, or work?

3. Case Study

Amateur Sports League You are the new manager for a nonprofit amateur soccer league. The board of directors has asked you to create a backup plan for the league's computers and devices. The employees in the league office have access to multiple shared laptops, a desktop, and a tablet. Several employees use their own smartphones and tablets for work, according to the league office's BYOD policy.

Do This: Use the web to find industry experts' recommendations for backing up data. Write a sample backup plan and schedule for the board, and include types of backups you will use. Describe each backup type you propose and why you recommend it. Is any special software required to back up the different devices? The board asked you to present reasons for using cloud storage as part of your backup plan. Research the benefits of using cloud storage over other backup methods. Why would you choose cloud storage? What are the cost differences? Compare three cloud storage providers, ranking them by cost and storage capacity.

Collaboration

4. Computers in Telemarketing

Your team is performing IT research for a magazine-subscription telemarketing company. The company's 150 telemarketers must make a minimum of 100 calls a day. If telemarketers do not meet the minimum number, they must finish the calls from home. The company must decide on the type of storage device to provide the telemarketers so that they can take the necessary data home. Management has narrowed the choice to three storage options: rewritable optical discs, cloud storage, or USB flash drives.

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Do This: Form a three-member team and assign an option to each member. Each team member should evaluate the advantages and disadvantages. Include features such as capacity, access time, durability of media, ease of transporting between home and office, and cost. Meet with your team, and discuss and compile your findings. Which method would you recommend? Why? What are the advantages of each? Share your findings with the class.