



ITEC102 – INFORMATION TECHNOLOGIES

LECTURE 3 – COMPUTER HARDWARE

EASTERN MEDITERRANEAN UNIVERSITY



SCHOOL OF COMPUTING AND TECHNOLOGY



Learning Objectives

1. Understand how data is represented to a computer.
2. Identify several types of input devices and explain their functions.
3. Explain the functions of the primary hardware components found inside the system unit, namely the motherboard, the CPU, and the memory.
4. List several output devices and explain their functions.



Learning Objectives

5. Understand the difference between storage and memory, as well as between a storage device and a storage medium.
6. Name several types of storage systems and explain the circumstances under which they are typically used.
7. Describe the purpose of communications hardware.
8. Understand basic software concepts and commands.



Overview

This chapter covers:

- What data is and how it is represented to a computer
- The hardware that makes up a computer system
- Various types of hardware used for input, processing, output, storage, and communications



Digital Data Representation

Digital computers are binary computers

- They understand only two states, on and off
- On and off states are represented by the numbers 0 and 1

All data processed by a binary computer must be in binary form

The computer translates input into the form needed by the computer and translates output into the form needed by the user

Digital Data Representation

Bits and Bytes

- Bit
 - Is a smallest unit of data a binary computer can recognize
 - Is typically represented by 1s and 0s
 - Is derived from the term “binary digits”
 - Is generally grouped together to form larger pieces of data
- Byte
 - Consists of eight bits
 - Is prefixes are used to represent larger amounts of data (KB, MB, etc.)

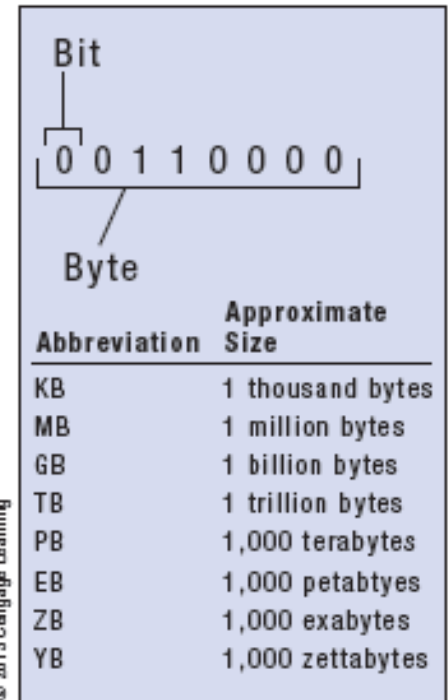


FIGURE 2-1

Bits and bytes.

Document size, storage capacity, and memory capacity are all measured in bytes.

Input Hardware

Input Device

- Defined as any piece of hardware used to perform data input to the system
- Keyboard
 - Used to type data into a computer
 - Can be integrated, wired, or wireless
 - Nearly always used with desktop and notebook computers
 - Many mobile phones have an integrated keyboard

FIGURE 2-4
Slide-out keyboards.



Photo courtesy of Nokia

Input Hardware

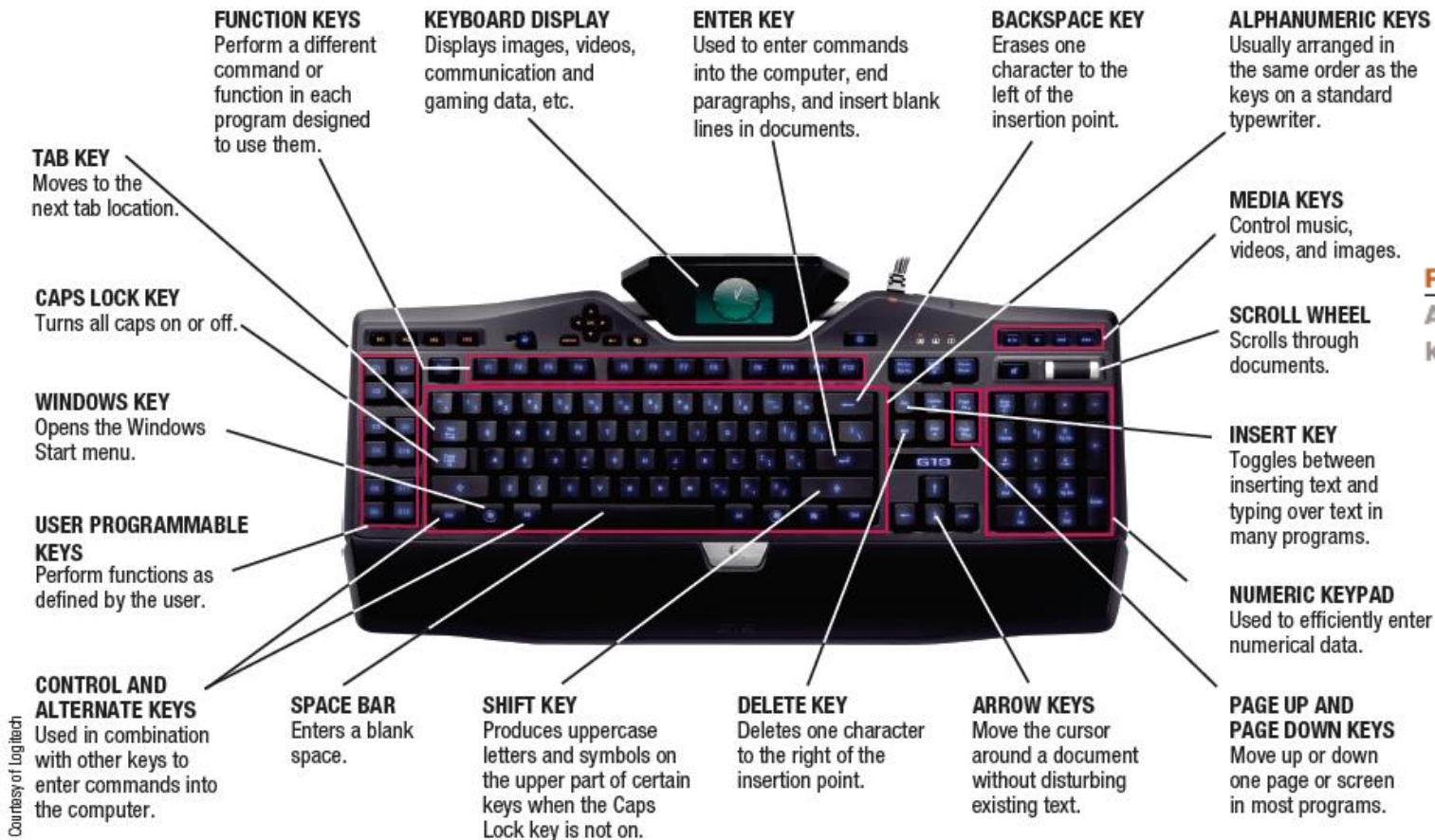


FIGURE 2-5
A typical desktop keyboard.

Courtesy of Logitech



Input Hardware

Pointing Devices

- Used to select objects, issue commands, etc. by pointing to and selecting objects
- Two most common are the mouse and the pen stylus
 - Mice
 - Nearly always used with desktop computers; can be used with notebook computers
 - Most are either optical or laser mice
 - They used to start programs; open, move around, and edit documents; draw or edit images

Input Hardware







<p>POINT Move the mouse until the mouse pointer is at the desired location on the screen.</p>		<p>DRAG-AND-DROP When the mouse pointer is over the appropriate object, press and hold down the left mouse button, drag the object to the proper location on the screen by moving the mouse, and then drop the object by releasing the mouse button.</p>	
<p>CLICK Press and release the left mouse button.</p>		<p>SCROLL WHEEL/BUTTON If your mouse has a wheel or button on top, use it to scroll through the displayed document.</p>	
<p>RIGHT-CLICK Press and release the right mouse button.</p>			
<p>DOUBLE-CLICK Press and release the left mouse button twice, in rapid succession.</p>			

FIGURE 2-6
Common mouse operations.

steammiller_blues/Shutterstock.com

Input Hardware

- Pens/Styluses

- Used to select items and/or write electronically on the screen
- Can be used with personal computers, mobile devices, and tablet computers
- Increasing used for photography, graphic design, animation, and document processing

FIGURE 2-7

Examples of digital pen use.



Stylus

MOBILE DEVICES



TABLET COMPUTERS



GRAPHICS TABLETS



SIGNATURE CAPTURE DEVICES



Input Hardware

- Touch Screens
 - Are becoming common with personal computers, mobile phones, and other mobile devices
 - They are also used in consumer kiosks and POS systems
 - Many are multi-touch
 - They are convenient for most users
 - They are not accessible for blind individuals and those with limited mobility
 - Other pointing devices
 - Control buttons and wheels, touch pads, and gaming devices

Input Hardware



Courtesy of Samsung



Courtesy, Hewlett-Packard Company

TOUCH SCREENS

Commonly found on mobile devices and are increasingly being used with many types of computers today.

FIGURE 2-8

Examples of other common pointing devices.



Courtesy of SanDisk Corporation

CONTROL BUTTONS

Commonly found on portable digital media players and other consumer devices.



Vladimir/Shutterstock.com

TOUCH PADS

Commonly found on notebook and netbook computers.

Input Devices

- Scanners and Readers
 - They used to capture data from a source document and input it into the computer
 - They are commonly called optical scanners
 - For readers documents input as a single graphical image
 - Editing text within the image requires the use of OCR software in conjunction with the scanner
 - Flat bed scanner is the most common
 - Portable scanners used to capture text and other data while on the go

Input Devices



Courtesy, Hewlett-Packard Company

FLATBED SCANNERS

Used to input photos, sketches, slides, book pages, and other relatively flat documents into the computer.



Courtesy of Motorola Solutions

PORTABLE BARCODE READERS

Used to read barcodes when portability is needed.

FIGURE 2-9

Scanners and readers transform data from physical form to digital form.



Courtesy, Intermac Technologies

RFID READERS

Used to read RFID tags, such as the portal RFID reader shown here that reads all of the RFID tags on a pallet at one time, as it passes between the readers.



© iStockphoto.com/Sami Sani

BIOMETRIC READERS

Used to control access to facilities or computer systems, such as to the notebook computer shown here.



Input Devices

- Barcode Readers
 - Reads barcodes, which are optical codes that represent data
 - Most common barcodes are UPC labels and ISBN numbers
 - Businesses and organizations can create custom barcodes for unique needs
 - FedEx, UPS, USPS
 - Hospitals, researchers, law enforcement

Input Devices

- **RFID (radio frequency identification) Readers**
 - RFID technology stores, reads, and transmits data found in RFID tags
 - RFID tags can be attached to many different types of objects and are read by radio waves
 - Data in the tags can be unique so that each item containing an RFID tag can be individually identified
 - Growth in retail industry has been slower than expected due to cost constraints and privacy/security issues

Input Devices

- **Biometric Readers**
 - They read biometric data (measurable biological characteristics)
 - Fingerprints, hand geometry, face, iris, voice
 - They can be stand alone or built into another piece of hardware
 - Other types of readers
 - Optical mark readers
 - Optical character readers
 - Magnetic ink character recognition readers

Processing Hardware and Other Hardware Inside the System Unit

System Unit

- It is the main case of the computer
- Components of the system unit
 - Processing hardware, storage devices
 - Power supply, cooling fan
 - Interfaces used to connect peripheral devices

The Motherboard

- It is the main circuit board inside the system unit
- All devices used with a computer connect in one way or another to the motherboard (directly, via port, etc.)

Processing Hardware and Other Hardware Inside the System Unit

Ports

- Connectors exposed through the exterior of the system unit case
- Either built into the motherboard or created via expansion card
- Used to connect external devices to the computer (monitors, keyboards, mice, printers, etc.)
- ExpressCard slots used with notebook computers

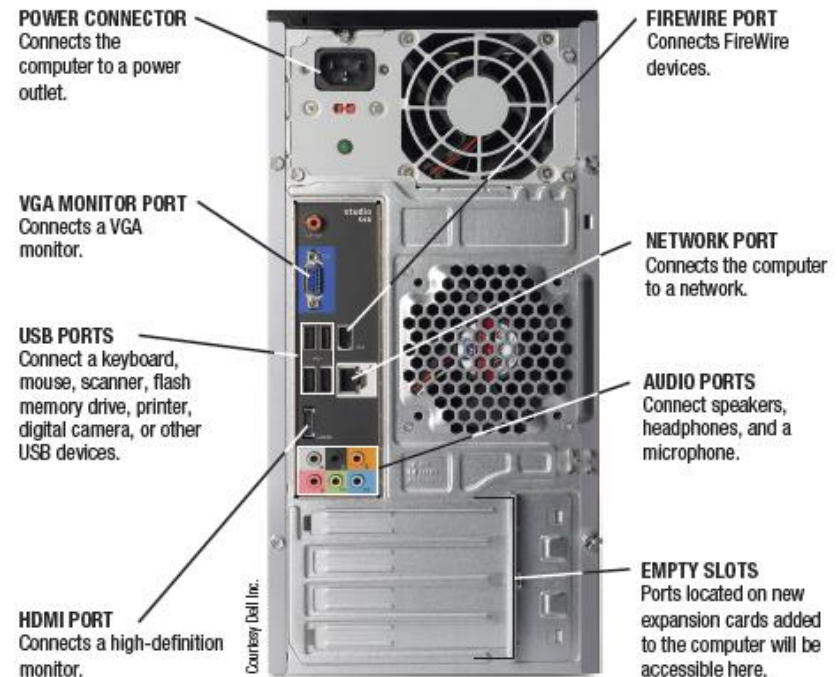


FIGURE 2-12
Ports are used to connect external devices to the motherboard.

Processing Hardware and Other Hardware Inside the System Unit

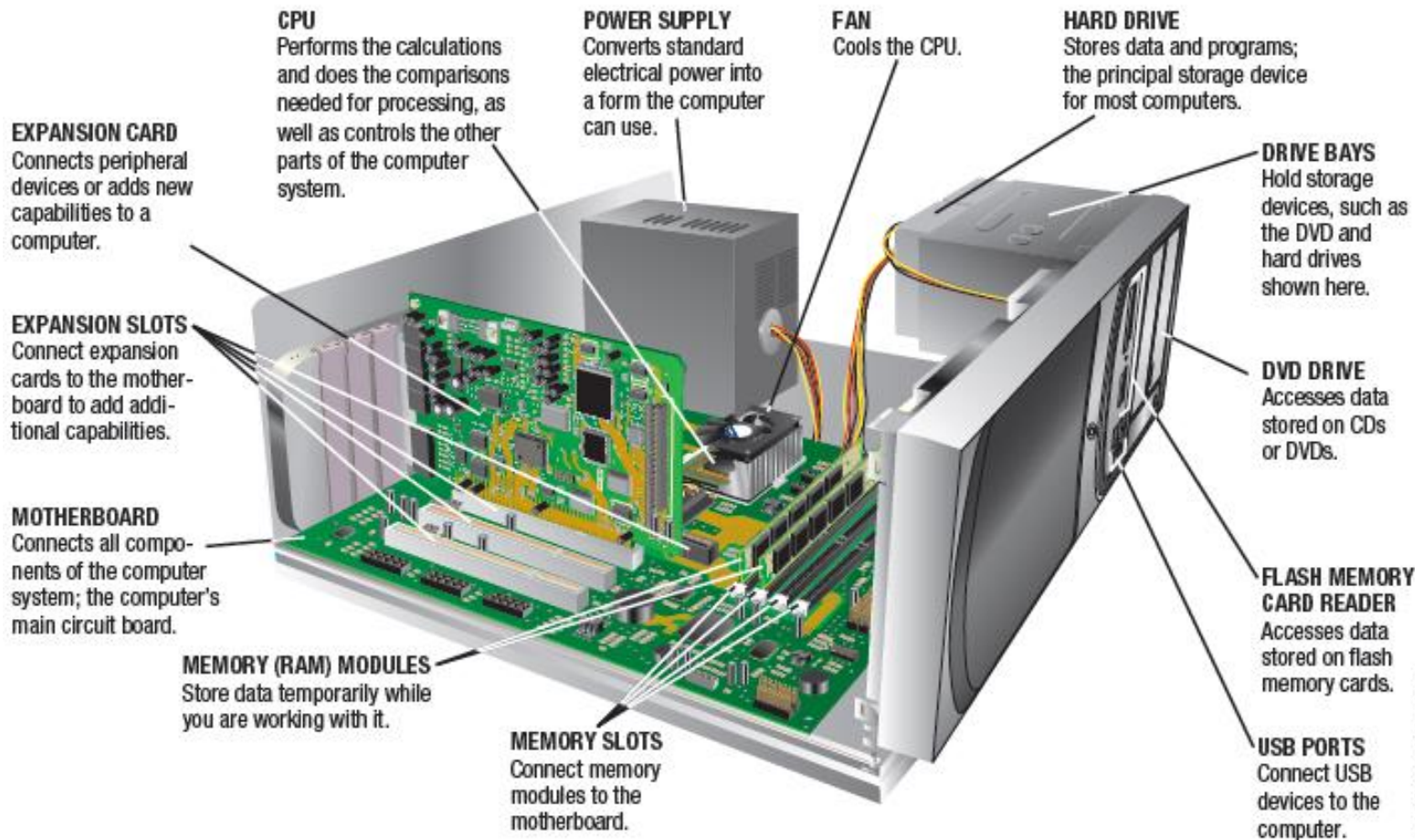


FIGURE 2-11
Inside a typical system unit. The system unit houses the CPU, memory, and other important pieces of hardware.

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Processing Hardware and Other Hardware Inside the System Unit

The Central Processing Unit (CPU)

- It consists of a variety of circuitry and components that are packaged together and connected directly to the motherboard
- It is also called a microprocessor or processor

- CPU has two principal parts
 - Arithmetic/logic unit
 - Performs arithmetic and logical operations
 - Control unit
 - Coordinates and controls the actions taking place within the CPU

Processing Hardware and Other Hardware Inside the System Unit

- Most personal computers today use CPUs manufactured by Intel or Advanced Micro Devices (AMD) and are multi-core
 - Dual-core CPU
 - Contains the processing components (cores) of two independent processors on a single CPU
 - Quad-core CPU
 - Contains four cores

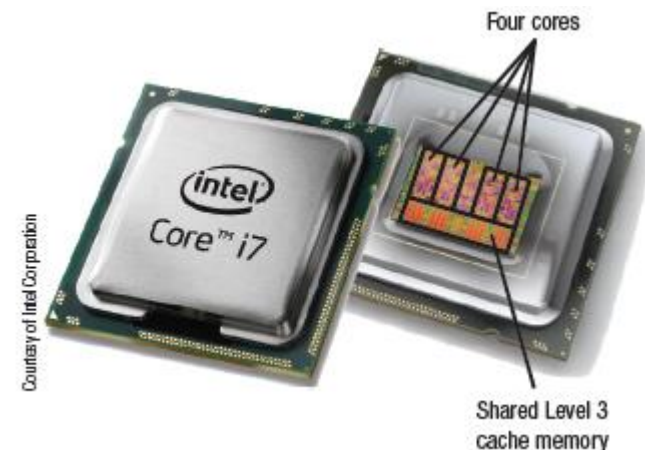


FIGURE 2-13
CPUs. CPUs today typically have multiple cores.



Processing Hardware and Other Hardware Inside the System Unit

- Measurements of CPU processing speed
 - CPU clock speed is measured in megahertz, MHz, or gigahertz, GHz
 - Higher clock speed means more instructions can be processed per second than the same CPU with a lower clock speed
 - Other factors can affect the overall processing speed of a computer. These are the
 - Number of cores
 - Amount of available memory
 - Speed of external storage devices

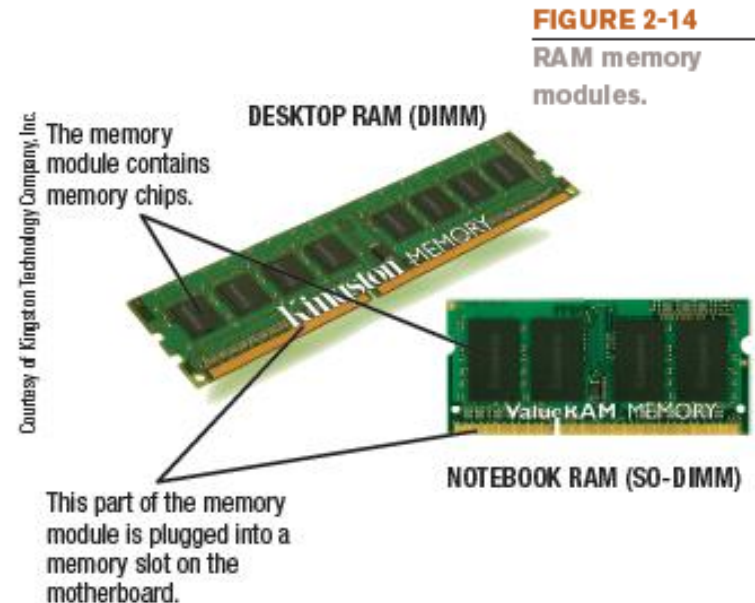
Processing Hardware and Other Hardware Inside the System Unit

Memory

- Refers to chip-based storage used by the computer – usually the amount of the computer’s main memory (random access memory or RAM)
- RAM
 - Temporary (volatile) storage used by the computer
 - Used to store essential parts of the operating system while computer is running
 - Stores the programs and data currently being used by the computer
 - Content is lost when computer is shut down
 - Data is deleted from RAM when it is no longer needed

Processing Hardware and Other Hardware Inside the System Unit

- Consists of circuits etched onto chips arranged onto circuit boards called memory modules
- Capacity is measured in bytes
- Computers must have enough RAM to run the necessary applications, as well as work efficiently
- More RAM allows more programs to run at one time
- Most PCs today come with at least 512 MB of RAM





Processing Hardware and Other Hardware Inside the System Unit

- Other types of computer memory
 - Cache memory
 - Used to speed up the processing speed by storing the data that may be needed next by the CPU in handy locations
 - Usually built into the CPU
 - Level indicates the order the cache memory is accessed (L1 = fastest and checked first, L2, L3)
 - Registers
 - Used by the CPU to temporarily store data and intermediary results during processing
 - Fastest type of memory



Processing Hardware and Other Hardware Inside the System Unit

- ROM
 - Read-only memory
 - It is nonvolatile chips that permanently store data or programs accessed by the computer
 - It is attached to the motherboard like RAM
 - Data and programs are retrieved by the computer when needed
 - Cannot be written over
 - Data is not erased when the computer is shut down



Processing Hardware and Other Hardware Inside the System Unit

- Flash memory
 - It is nonvolatile chips into which data can be stored and retrieved
 - Flash memory chips have begun to replace ROM for storing system information, as it can be updated as needed
 - Also used in flash memory storage systems

Output Hardware

Display Devices

- Most common type of output device
- Displays output on some type of screen
- Monitor
 - Display device for a desktop computer
- Display screen
 - Built-in display device
 - Used with notebook computers, mobile phones, etc.
 - Used with many consumer products

FIGURE 2-15

Many consumer products today, such as the mobile tablet shown here, have a display screen.



ES touchphoto.com/pressureUA

Output Hardware

- CRT monitor
 - These are the traditional monitor for desktop computers
 - Uses cathode-ray tube technology
 - Very large and bulky
 - Less common today
- Flat-panel displays
 - Form images by manipulating electronically charged chemicals or gasses sandwiched between panes of glass or other transparent surfaces

Output Hardware

- Take up less space and consume less power than CRT monitors
- Thinner and lighter than CRTs
- Used with most computers and in mobile phones and other electronic devices

The quality measure of the displays

- Pixel
 - Smallest colorable area in an electronic image
 - Number of pixels used on a display screen determines the screen resolution
 - With high resolution, more information can fit on the screen, but everything will be displayed smaller than with a lower resolution

Output Hardware



1,280 × 768



1,600 × 900

FIGURE 2-16

Screen resolution.

A higher screen resolution (measured in pixels) displays more content than a lower screen resolution, but everything is displayed smaller.

GarmondAlison/Shutterstock.com



Output Devices

Printers

- They Produce hard copy –a permanent copy of the output on paper

There are two types of printer

- Personal printers
 - Designed to be connected to a single computer
- Network printers
 - Designed to be shared by multiple users via a network

Output Devices

There are two types of printer in in terms of operation

- Impact printers
 - Strike paper to transfer ink to paper
- They are non-impact printers
 - Form images without touching the paper
 - They are the most common type of printer today
 - They are much quieter than impact printers
 - Produce higher quality images
- Can be color or black-and-white
- Printer quality is measured in dots per inch (dpi)
- Printer speed is measured in pages per minute (ppm)



Output Devices

- Laser Printers

- Standard for business documents
- Come in personal and network versions
- Can be color or black-and-white
- Faster and of better quality than ink-jet printers
- Use technology similar to photocopier machines (toner powder, lasers, heat, etc.)
- Resolutions are between 600 and 2,400 dpi
- Speeds for personal laser printers range from 15 to 35 ppm

Output Devices

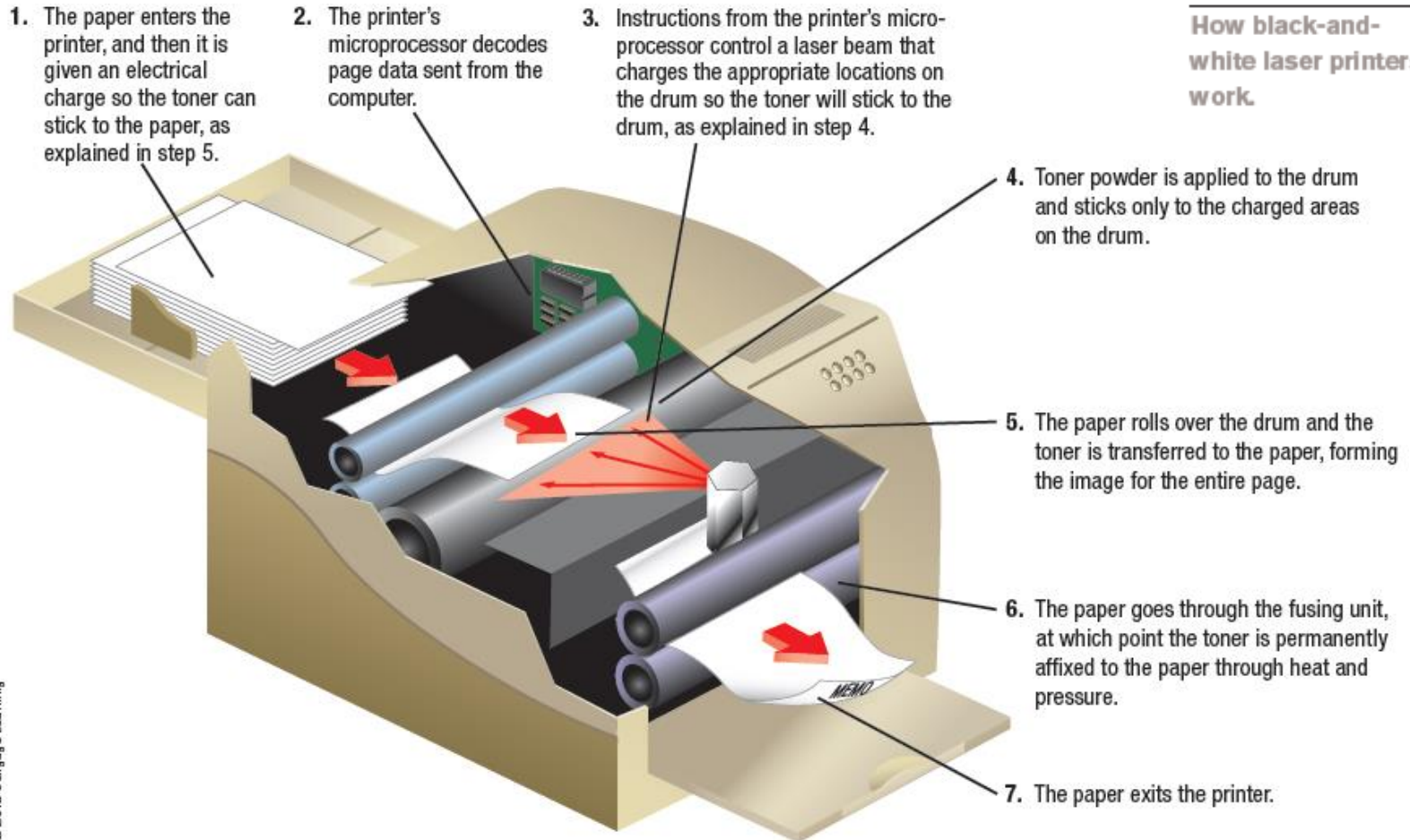


FIGURE 2-17
How black-and-white laser printers work



Output Devices

- Ink-jet Printers

- They spray tiny drops of ink onto the page, one printed line at a time
- Some print using different-sized ink droplets, multiple nozzles, and varying electrical charges for precision
- They are fairly inexpensive, although replacement ink cartridges can add up
- They can print in good quality and usually can print in color
- Printer of choice for home use
- With special paper, ink-jet printers can print photos

Output Devices



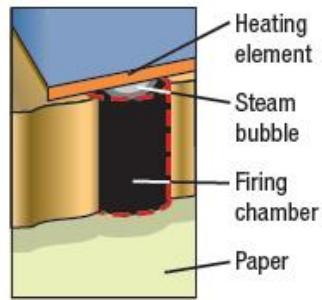
Each ink cartridge is made up of multiple tiny ink-filled firing chambers; to print images, the appropriate color ink is ejected through the appropriate firing chamber.



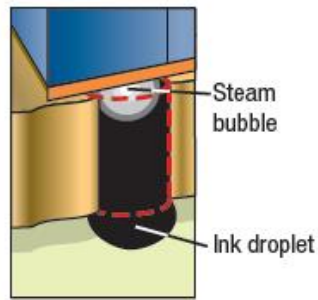
INK-JET PRINTER

Courtesy Epson America

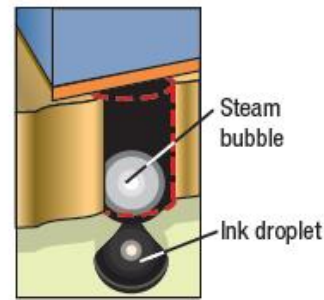
FIGURE 2-18
How ink-jet printers work.



1. A heating element makes the ink boil, which causes a steam bubble to form.



2. As the steam bubble expands, it pushes ink through the firing chamber.



3. The ink droplet is ejected onto the paper and the steam bubble collapses, pulling more ink into the firing chamber.

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Output Devices

- Special-Purpose Printers
 - Photo printers
 - Designed to print photographs
 - Barcode printers
 - Print barcodes
 - Portable printers
 - Designed to be carried with you to print while on the go
 - Plotters and wide-format ink-jet printers
 - Print large documents, such as blueprints and signs
 - 3D printers
 - Form a 3D replica of an object, typically using plastic powder



Output Devices

- Other Output Devices
 - Speakers
 - Headphones
 - Headsets
 - Earphones
 - Earbuds

Storage Hardware

Storage System

- They used to save documents for future use
- They are non-volatile devices

Storage System Characteristics

- Storage Media and Storage Devices
 - Storage Medium
 - Is the hardware where the data is actually stored
 - Exaples to storage media DVD, flash memory card, etc.

Storage Hardware

- Storage Devices
 - Is the device that reads data from or writes data to the storage medium
- There are two types of storage device
 - **Internal**
 - Located inside the system unit
 - **External**
 - Plugged into an external port on the system unit
 - **Remote**
 - Located on another computer, such as a network server

Storage Hardware



Image courtesy of Hamegam BMC company

PORTABLE HARD DRIVES (MAGNETIC)
Are about the size of a 3 by 5-inch index card, but thicker; this drive holds 1.5 TB.



Courtesy Transcend Information USA

EXPRESSCARD HARD DRIVES (SSD)
Fit into an ExpressCard slot; this drive holds 32 GB.

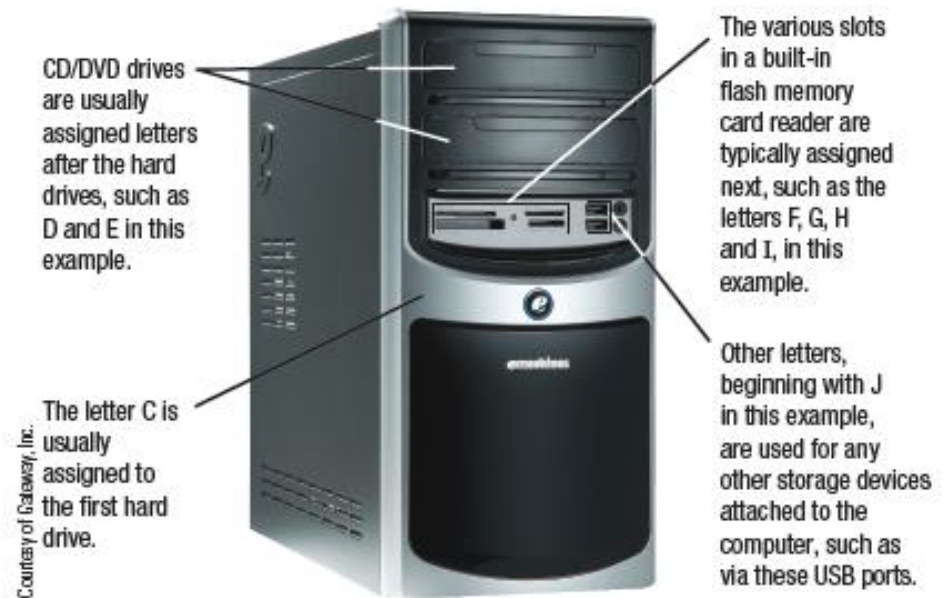
FIGURE 2-22
Portable hard drives.

Storage Hardware

- Storage medium and storage device are often two separate pieces of hardware
- Some systems are permanently sealed together
 - Hard drive
 - USB flash drives

FIGURE 2-19

Storage device identifiers. To keep track of storage devices in an unambiguous way, the computer system assigns letter of the alphabet or names to each of them.





Storage Hardware

- Types of Storage Technology Used
 - Data is usually stored magnetically or optically
 - Magnetic storage systems (hard drives) represent data using different magnetic alignments
 - Optical media, CDs and DVDs, use laser beams that burns permanent marks into the surface of the medium
 - Flash memory storage systems represent data using electrons

Storage Hardware

Hard Drives

- Used to store most programs and data

They are divided into two group according to the use

- Internal hard drives
 - They are not designed to be removed
- External hard drives
 - They connect to a computer using a USB or FireWire port
- Both are increasingly coming with built-in encryption

According to the manufacturing technology they can be separate in to three group

1. Magnetic Hard Drives

- Use metal hard disks or platters that are organized into tracks and sectors
- Use Read/write heads to store (write) and retrieve (read) data

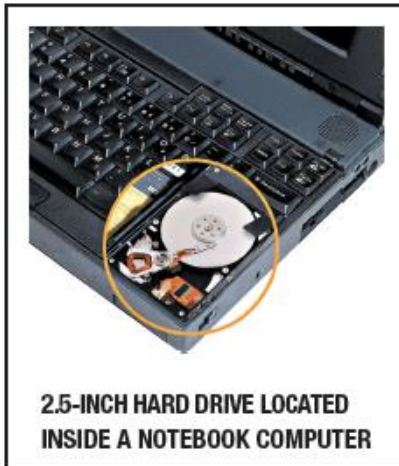
Storage Hardware

MOUNTING SHAFT

The mounting shaft spins the hard disks at a speed of several thousand revolutions per minute while the computer is turned on.

SEALED DRIVE

The hard disks and the drive mechanism are hermetically sealed inside a case to keep them free from contamination.



**2.5-INCH HARD DRIVE LOCATED
INSIDE A NOTEBOOK COMPUTER**



INSIDE A 3.5-INCH HARD DRIVE

READ/WRITE HEADS

There is a read/write head for each hard disk surface, and they move in and out over the disks together.

HARD DISKS

There are usually several hard disk surfaces on which to store data. Most hard drives store data on both sides of each disk.

ACCESS MECHANISM

The access mechanism moves the read/write heads in and out together between the hard disk surfaces to access required data.

FIGURE 2-20
Magnetic hard drives.

Courtesy of Hitachi Global Storage Technologies; Courtesy Western Digital



Storage Hardware

2. Solid-State Drives (SSDs)

- Use flash memory technology rather than spinning platters and magnetic technology
- Use less power and have no moving parts
- Not subject to mechanical failure
- More resistant to shock and vibrations
- Generate less heat
- Make no noise
- Operate faster
- Attractive option for portable computers and mobile devices



Storage Hardware

3. Hybrid Hard Drives

- Use a combination of flash memory and a magnetic hard drive
- Less expensive than an SSD
- Can extend the battery life of portable computers and mobile devices
- Can allow encryption and other security measures to be built into the drive

Storage Hardware

Optical Discs and Drives

- Data on optical disks (DVDs, CDs, Blue-Ray) is stored and read optically, using laser beams
- Data can be stored on one or both sides of the disc
- Discs are divided into tracks and sectors, but use a single grooved spiral track beginning at the center of the disc
- Lasers create and read marks created on the disc surface called pits and lands
 - With read-only discs, the pits are permanent
 - With recordable or rewritable discs, the pits are represented by changing the disc's reflectivity

Storage Hardware

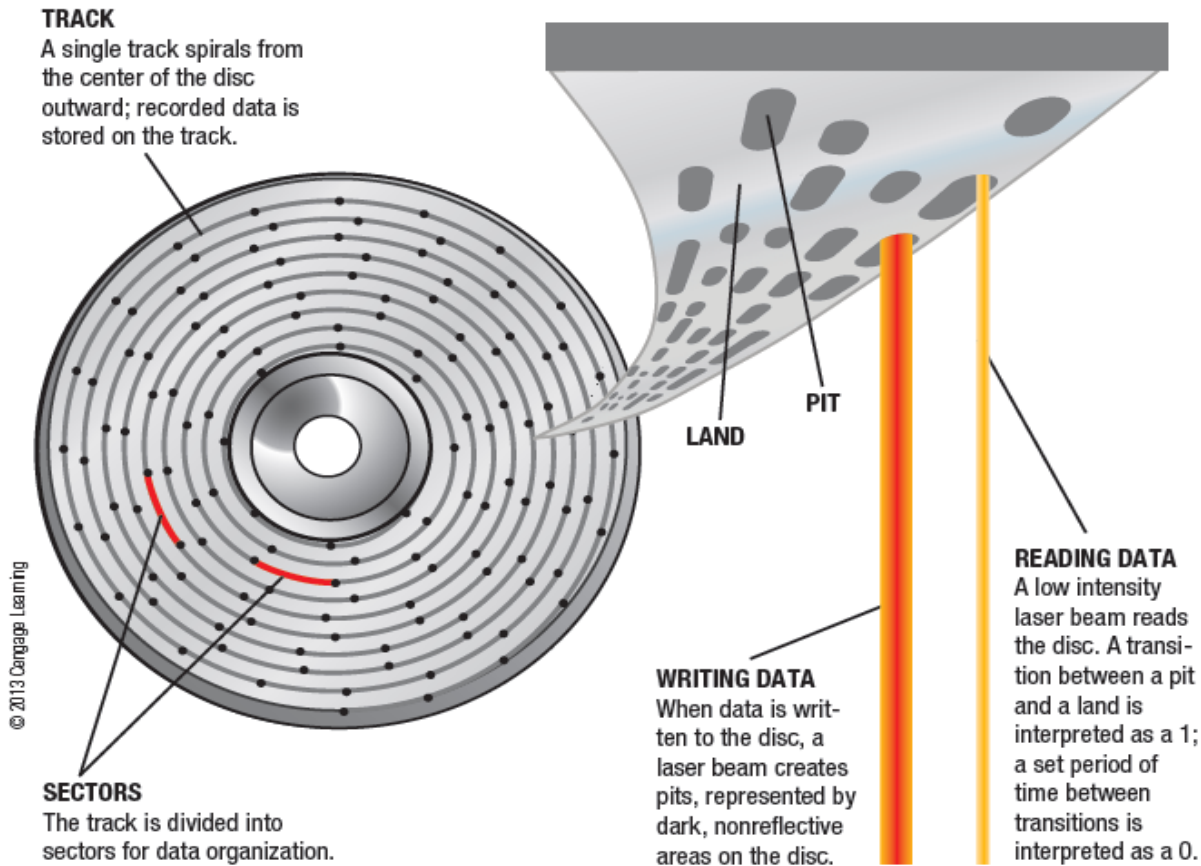


FIGURE 2-23
How recorded optical discs work.

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Storage Hardware

- Conventional CDs
 - Use infrared lasers
- Conventional DVDs
 - Use red lasers
- High definition blue-ray discs
 - Use blue-violet lasers
 - More information can be stored (HD movies, etc.)
 - Data is recorded more compactly
- Discs come in various sizes
- Capacity depends on format, as well as the number of sides and layers, used

Storage Hardware

FIGURE 2-24

Optical discs are available in a variety of sizes, appearances, and capacities.



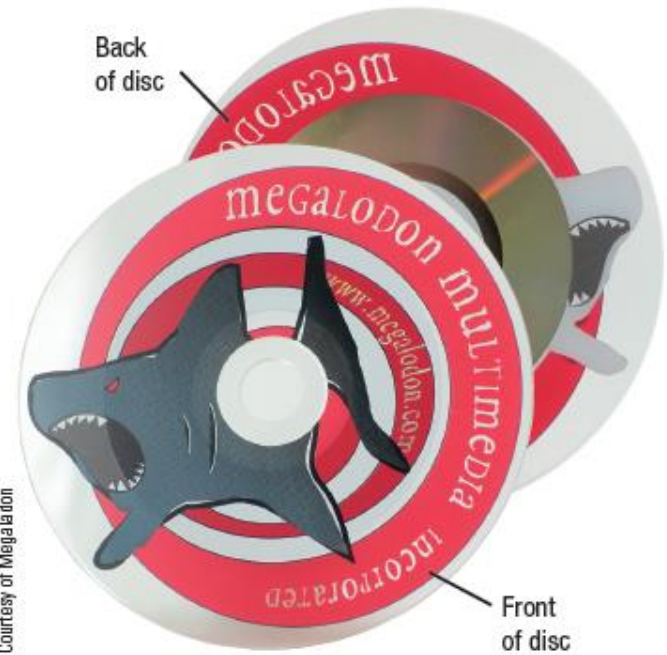
Courtesy of Adobe

STANDARD 120 MM (4.7 INCH) SIZED DISC



Courtesy Verbatim America LLC

MINI 80 MM (3.1 INCH) SIZED DISC



Courtesy of Megalodon

**MINI 80 MM (3.1 INCH) SIZED DISC
(with a clear background to be standard size)**



Storage Hardware

- Read-Only Discs: CD-ROM, DVD-ROM, and BD-ROM Discs
 - Come pre-recorded with commercial products
 - Data cannot be erased, changed, or added to
- Recordable Discs: CD-R, DVD-R, and BD-R Discs
 - Can be written to, but the discs cannot be erased and reused
 - Commonly used for:
 - Backing up files
 - Sending large files to others
 - Creating custom music CDs (CD-R)
 - Storing home movies, digital photos, multimedia files, etc. (DVD-R/+R)
 - Storing high-definition multimedia files (BD-R)

Storage Hardware

- Rewritable Discs: CD-RW, DVD-RW, DVD+RW, and BD-RE Discs
 - Can be written to, erased, and overwritten like magnetic disks
 - The correct drive must be used to write each type of disc
 - Used for similar purposes as recordable discs but are especially appropriate when data can later be erased and the disc reused

Storage Hardware

Flash Memory Storage Systems

- Chip-based storage medium that represents data using electrons
- No moving parts, so are not as subject to mechanical failure as optical and magnetic media
- Are more resistant to shock and vibration
- Consume less power
- Very small and quiet
- Rewritable
- Longer expected life than magnetic media
- More expensive per MB, but very convenient and widely used with computers, digital cameras, etc.

Storage Hardware

- Flash Memory Cards and Readers
 - Small card containing one or more flash memory chips, a controller chip, other electrical components, and metal contacts to connect the card to the device or reader
 - Read by flash memory card readers
 - Commonly used with:
 - Desktop and portable computers
 - Digital cameras
 - Portable digital media players
 - Mobile phones and other mobile devices
 - Come in a variety of formats (SD cards, CompactFlash cards, MemoryStick, etc.)

Storage Hardware

Courtesy of Kingston Technology Company, Inc.



FLASH MEMORY CARD READERS

Can be built-in or external and usually support several different types of flash memory media; external readers such as this one typically connect to a computer via a USB port.



Courtesy of Kingston Technology Company, Inc.

COMPACTFLASH (CF) CARDS



Courtesy of Sony Electronics Inc.

MEMORY STICKS

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SECURE DIGITAL (SD) CARDS



Courtesy of Olympus

XD PICTURE CARDS

FIGURE 2-26

Flash memory cards. Shown here are some of the most widely used types of flash memory cards and a multcard reader.



Storage Hardware

- USB Flash Drives
 - Flash memory media in self-contained unit that uses a USB interface
 - Also called USB flash memory drives, thumb drives, and jump drives
 - Are powered via the USB port
 - Very portable
 - Can be carried in a pocket or on a keychain
 - Can be carried in a pocket or on a keychain
 - Wide range of colors, sizes, appearances
 - Capacity ranges from 2 GB to 256 GB
 - Widely used to transfer files from one location to another

Storage Hardware



FIGURE 2-27

USB flash drives are often used to store data and transfer files from one computer to another.

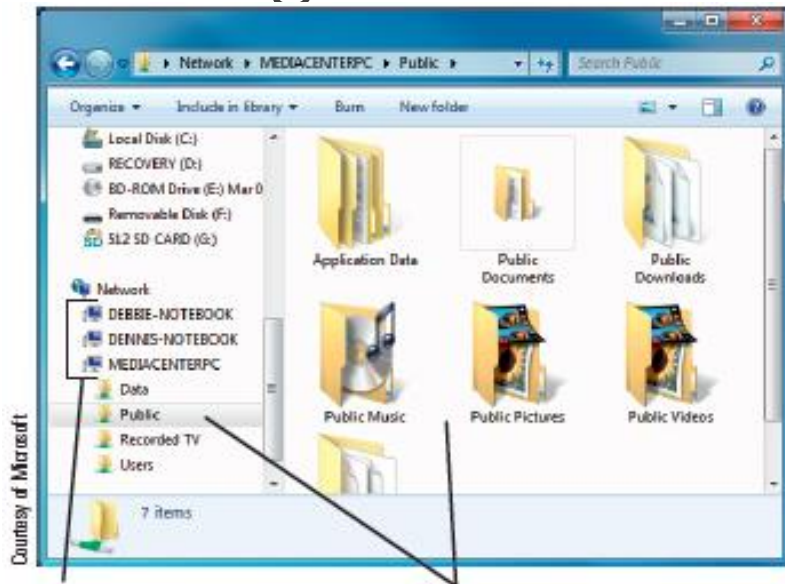
Storage Hardware

Other Types of Storage Systems

- Remote Storage Systems

- Use a storage device that is not connected directly to the user's computer
- Accessed through a local network or the Internet
- Often referred to as online storage or cloud storage
 - *Google Docs, Flickr, Facebook* provide online storage for these services
 - Windows Live *Skydrive* allows users to store documents online or “in the cloud”
 - Files can be accessed from anywhere an Internet-abled device is available

Storage Hardware

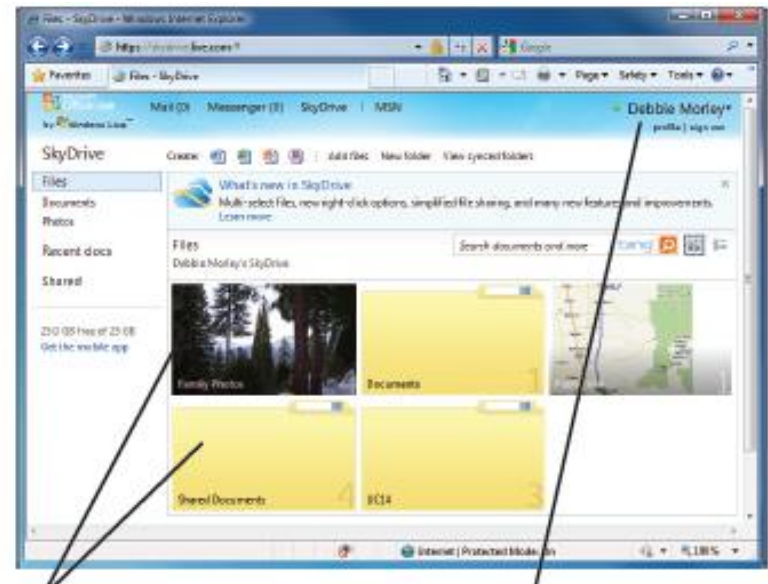


Computers on this network.

Items in the Public folder on the computer called MEDIACENTERPC.

NETWORK STORAGE

Shared folders on network computers appear and are accessed in a manner similar to local folders.



Folders and files can be private or shared with others.

Users log on to see their personal files stored on the site's server.

CLOUD STORAGE

Files and folders are stored and accessed online; this site provides 25 GB of free storage.

FIGURE 2-28

Remote storage.



Communications Hardware

Communications Hardware

- Enables the user to communicate with others over a network or the Internet

The type of communications device used depends on:

- The device being used (desktop computer, notebook, mobile phone, etc.)
- The communication standard being used (such as Ethernet for wired networks, Wi-Fi for wireless networks, Bluetooth for short-range wireless connections, or a cellular standard for mobile phones)

Communications Hardware

Network Adapters and Modems

- Network Adapter (network interface card (NIC))
 - Used to connect a computer to a network
 - The type of adapter used depends on the type of network and communications medium being used
- Modem
 - Used to connect a computer to another computer or to a network (typically the Internet) over phone lines
 - Also used to refer to any device that connects a computer to a broadband Internet connection, i.e., cable modem



Communications Hardware

- Each type of modem matches a particular type of Internet connection (conventional dial-up, cable, fixed wireless, DSL, etc.)
- Both network adapters and modems are available in internal and external versions and in a variety of formats (USB, ExpressCard, etc.)

Other Networking Hardware

- Hub, switch, or router
 - Central device used to connect devices in a wired network together

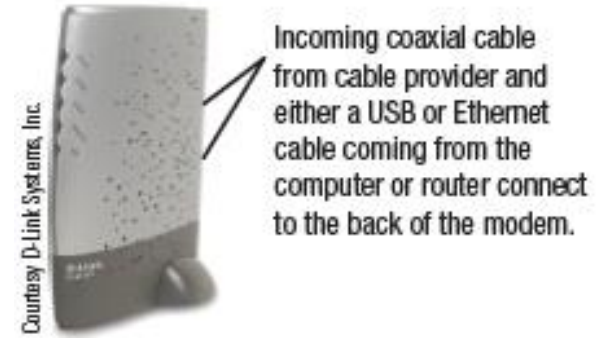
Communications Hardware



PCI EXPRESS GIGABIT ETHERNET ADAPTERS FOR DESKTOP COMPUTERS



USB WI-FI ADAPTERS FOR DESKTOP OR NOTEBOOK COMPUTERS



EXPRESSCARD WI-FI ADAPTERS FOR NOTEBOOK COMPUTERS



USB 4G CELLULAR MODEMS FOR DESKTOP OR NOTEBOOK COMPUTERS

FIGURE 2-30
Common types of communications hardware.

Communications Hardware

- Wireless access point or wireless router
 - Central device for wireless networks
- Repeaters, range extenders, antennas
 - Used to increase the range of a network
- Cabling
 - Connects wired devices
 - Twisted-pair, coaxial cable, fiber-optic cable

