Elk Technologies
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Chapter 1: Introduction to Personal Computer Hardware

IT Essentials 7.0

Cisco | Networking Academy®
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Chapter 1 - Sections & Objectives

- 1.1 Personal Computers
  - Explain how to keep personal computer components safe.
  - Explain components in a computer.
  - Explain electrical and ESD safety.
- 1.2 PC Components
  - Explain the features and functions of computer components.
  - Describe cases and power supplies.
  - Describe motherboards.
  - Describe CPUs.
  - Explain types of memory.

Chapter 1 - Sections & Objectives (Cont.)

- 1.2 PC Components (Cont.)
  - Describe adapter cards and expansion slots.
  - Describe hard disk drives and SSDs.
  - Describe optical storage devices.
  - Describe ports, cables and adapters.
  - Describe input devices.
  - Describe output devices.
- 1.3 Disassemble a PC
  - Explain the features & functions of each component in the tool kit.
  - Disassemble a computer.

1.1 PERSONAL COMPUTER

Computer Definition

- A computer can be defined as:
  1. A person who makes calculations, especially with a calculating machine.
  2. A programmable device that can store, retrieve, and process data.
  3. An electronic device that can retrieve, store, process, and output data, typically in binary form, according to instructions given to it in a variable program.
  4. A programmable electronic device designed to accept data, perform prescribed mathematical and logical operations, store data, and display the results of these operations.
     - Mainframes, desktop and laptop computers, tablets, smartphones, smartwatches, and IoT devices are some of the different types of computers.

Basic Personal Computer System

- A computer system consists of hardware and software components.
- Hardware is the physical equipment such as the case, storage drives, keyboards, monitors, cables, speakers, and printers.
- Software is the operating system and programs.
  - The operating system instructs the computer how to operate.
  - Programs or applications perform different functions.

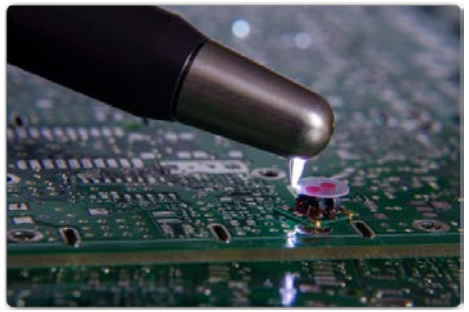
Electrical Safety

- Electrical devices have certain power requirements.
- AC adapters are manufactured for specific laptops.
  - Exchanging AC adapters with a different type of laptop or device may cause damage to both the AC adapter and the laptop.
- Some printer parts, such as power supplies, contain high voltage. Check the printer manual for the location of high-voltage components.

Follow electrical safety guidelines to prevent electrical fires, injuries, and fatalities.

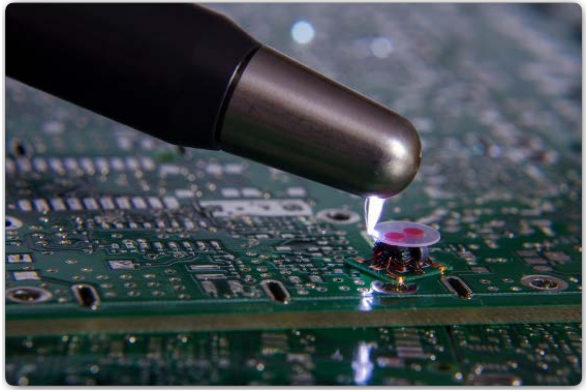
Electrical and ESD Safety

- Electrostatic discharge (ESD) can occur when there is a buildup of an electric charge that exists on a surface which comes into contact with another differently charged surface.
- ESD can cause damage to computer equipment if not discharged properly.
- At least 3,000 volts of static electricity must build up before a person can feel ESD.



Electrical and ESD Safety

- Follow these recommendations to help prevent ESD damage:
  - Keep all components in **antistatic bags** until you are ready to install them.
  - Use **grounded mats** on workbenches.
  - Use **grounded floor mats** in work areas.
  - Use **antistatic wrist straps** when working inside computers. Wrist strap should make contact with the skin.



1.2 PC COMPONENTS

Form Factor

- The size and layout of a case is called a **form factor**.
- Influences the motherboard and power supply form factor choice
- Must allow for good air flow
- Available in different sizes
- Provides protection and support for internal components.
- Should be durable, easy to service, and have enough room for expansion.

NOTE: Select a case that matches the physical dimensions of the power supply and motherboard.

Cases

- The case houses the internal components such as the power supply, motherboard, central processing unit (CPU), memory, disk drives, and assorted adapter cards.
- Many case manufacturers may have their own naming conventions, including super tower, full tower, mid tower, mini tower, cube case, and more.

Power Supplies

- Provides power to all computer components.
- Must be chosen based on current and future needs.
- Deliver different voltage levels to meet different internal component needs.
- Converts AC power from the wall socket into low voltage DC power.
- Must provide enough power for the installed components and future additions.
- Input voltage selector on the back of the power supply.
- Power supplies are measured in Wattage
- **Ohm's Law: W = V x A**

Four Basic Units of Electricity

- **Voltage (V)** is a measure of the force required to push electrons through a circuit. Voltage is measured in **volts (V)**. A computer power supply usually produces several different voltages.
- **Current (I)** is a measure of the amount of electrons going through a circuit. Current is measured in amperes, or **amps (A)**. Computer power supplies deliver different amperages for each output voltage.
- **Power (P)** is voltage multiplied by current. The measurement is called **watts (W)**. Watts is the work required to move electrons through a circuit multiplied by the number of electrons flowing through a circuit per second. Computer power supplies are rated in watts.
- **Resistance (R)** is the opposition to the flow of current in a circuit. Resistance is measured in **ohms (Ω)**. Lower resistance allows more current to flow through a circuit.

Ohm’s Law

- There is a basic equation that expresses how three of the terms relate to each other. It states that voltage is equal to the current multiplied by the resistance. This is known as **Ohm's Law V = IR**.
- In an electrical system, power (P) is equal to the voltage multiplied by the current **P = VI**.
- A power supply is rated (measured) in watts and is calculated by **W = A X V**.
  - A power supply should support 20 to 25 percent more wattage than all the attached components require.

Power Supplies

- Desktop computer power supply form factors include:
  - **Advanced Technology (AT)** – original power supply for legacy computer systems.
  - **AT Extended (ATX)** – updated version of the AT.
  - **ATX12V** – the most common power supply on the market today.
  - **EPS12V** – originally designed for network servers but is now commonly used in high-end desktop models.

Connectors

- A power supply includes several different connectors. They are used to power various internal components such as the motherboard and disk drives.
- The amount of connector vary based on the wattage of the power supply.
- Some examples are:
  - 20-pin or 24-pin mail power connector
  - SATA keyed connector
  - Molex keyed connector
  - Berg keyed connector
  - 4-pin to 8-pin auxiliary power connector
  - 6/8-pin PCIe power connector

Power Supply Voltage

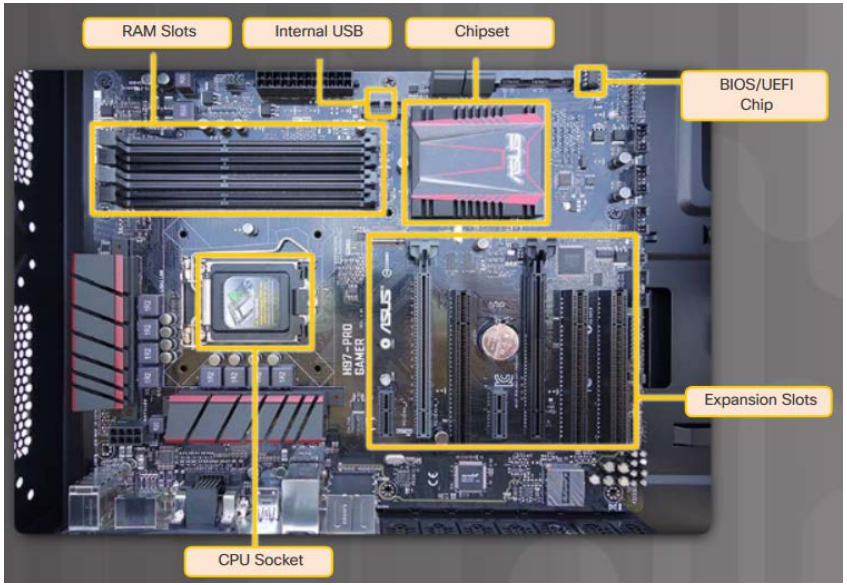
- The different connectors in a power supply also provide different voltages.
- The most common voltages supplied are 3.3 volts, 5 volts, and 12 volts.
  - The 3.3 volt and 5 volt supplies are typically used by digital circuits, while the 12 volt supply is used to run motors in disk drives and fans.
- Power supplies can also be single rail, dual rail, or multi rail.
  - A rail is the printed circuit board (PCB) inside the power supply to which the external cables are connected.
  - Known as a Modular Power Supply.
- A computer can tolerate slight fluctuations in power, but a significant deviation can cause the power supply to fail.

Motherboard

- Backbone of the computer.
- Interconnects computer components.
- The motherboard is the main printed circuit board.
- Contains the buses, or electrical pathways found in a computer.
- **Buses** allow data to travel among the various components.
- Accommodates CPU, RAM, expansion slots, heat sink/fan assembly, BIOS chip, chip set, sockets, internal and external connectors, various ports, and the embedded wires that interconnect the motherboard components.
- These components may be soldered directly to the motherboard, or added using sockets, expansion slots, and ports.
- Main power uses a 20 or 24-pin connector.

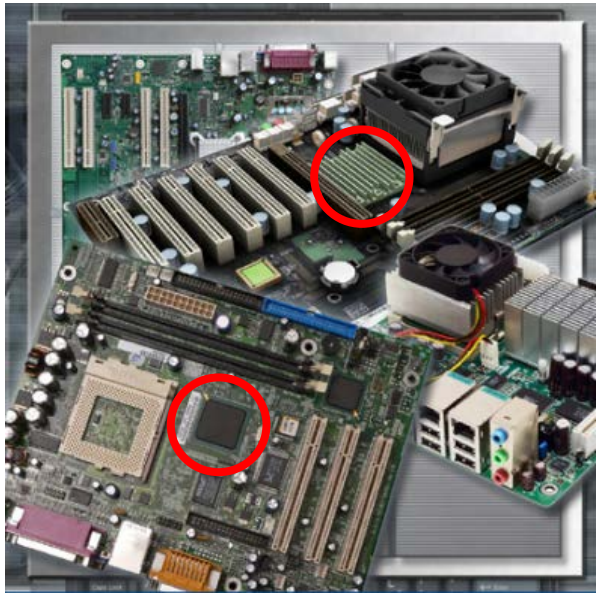
Motherboard Components

- Major components on a motherboard include:
  - Central Processing Unit (CPU)
  - Random Access Memory (RAM)
  - Expansion slots
  - Chipset
  - Basic input/output system (BIOS) chip and Unified Extensible Firmware Interface (UEFI) chip
  - SATA connectors
  - Internal USB connector



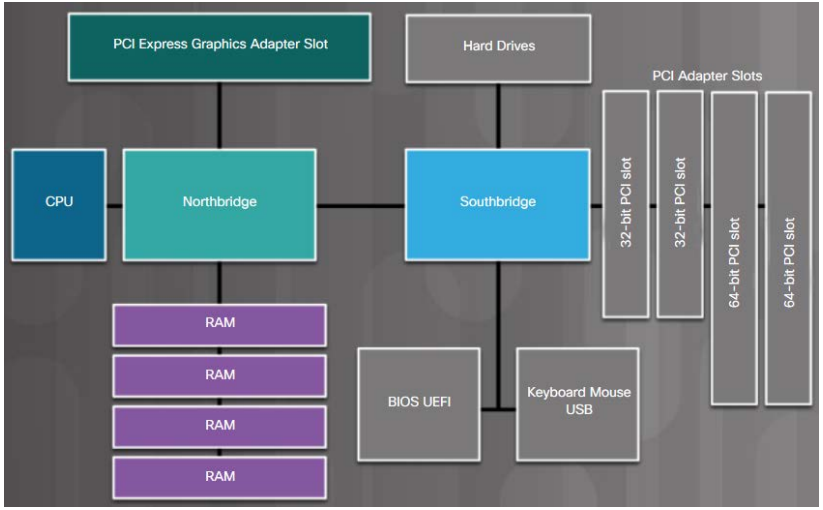
Motherboard Chipset

- **Chipset** consists of the integrated circuits on the motherboard that control how system hardware interacts with the CPU and motherboard.
  - System performance
  - System limitations
  - How much memory can be added to a motherboard



Motherboard Chipset

- Most chipsets consist of the following two types:
  - **Northbridge** controls
    - Access to the RAM
    - Access to video card
    - Access to the CPU
    - The speed the CPU can communicate
  - **Southbridge** controls
    - Communication between the CPU and the expansion ports (hard drives, sound card, USB ports, and other I/O ports)



Motherboard Form Factors

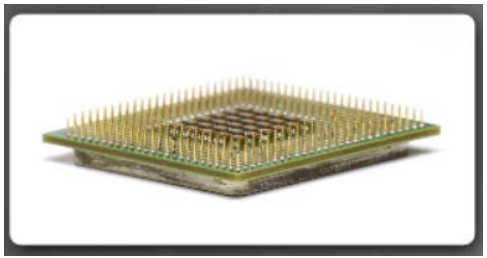
- The form factor of motherboards pertains to the size and shape of the board.
- There are three common motherboard form factors: Advanced Technology eXtended (ATX), Micro-ATX, and ITX.

Form Factor	Description
ATX	• Advanced Technology eXtended • Most popular form factor • 12 in X 9.6 in (30.5 cm X 24.4 cm)
Micro-ATX	• Smaller footprint than the ATX • Popular in desktop and small form factor computers • 9.6 in X 9.6 in (24.4 cm X 24.4 cm)
Mini-ITX	• Designed for small devices such as thin clients and set-top boxes • 6.7in X 6.7 in (17cm X 17 cm)
ITX	• Comparable form factor to Micro-ATX • 8.5 in X 7.5 in (21.5 cm X 19.1 cm)

- The choice of motherboard form factor determines how individual components attach to it, the type of power supply required, and the shape of the computer case.

What is CPU?

- The central processing unit (CPU) is responsible for interpreting and executing commands.
- The CPU is known as the brain of the computer.
- The CPU is a small microchip that resides within a CPU package.
- Two major CPU architectures related to instruction sets:
  - **Reduced Instruction Set Computer (RISC)**
  - **Complex Instruction Set Computer (CISC)**



CPU Connections

- The CPU socket is the connection between the motherboard and the processor.
- Modern CPU sockets and processor packages are built in following architectures:
  - **Pin Grid Array (PGA)** - the pins are on the underside of the processor package and is inserted into the motherboard CPU socket.
  - **Land Grid Array (LGA)** - the pins are on the socket instead of on the processor. Can have higher density.
  - **Ball Grid Array (BGA) –** the pins are soldered to the motherboard (Laptops, phone, tablets).

Central Processing Unit

- Some CPUs incorporate **hyperthreading** or **hypertransport** to enhance the performance of the CPU.
- The amount of data that a CPU can process at one time depends on the size of the processor data bus.
- Speed of the CPU is measured in cycles per second – megahertz (MHz) or gigahertz (GHz).
- **Overclocking** is a technique used to make a processor work at a faster speed than its original specification.

Central Processing Unit

- The latest processor technology has resulted in CPU manufacturers finding ways to incorporate more than one CPU core onto a single chip.
  - **Dual Core CPU** - Two cores inside a single CPU
  - **Triple Core CPU** - Three cores inside a single CPU
  - **Quad Core CPU** - Four cores inside a single CPU
  - **Hexa-Core CPU** - Six cores inside a single CPU
  - **Octa-Core CPU** - Eight cores inside a single CPU
  - Some as high as sixteen cores

Cooling Systems

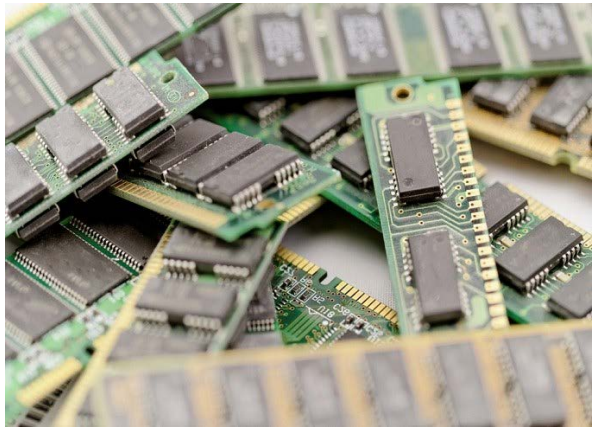
- Computer components perform better when kept cool.
- A **case fan** makes the cooling process more efficient.
- A **heat sink** draws heat away from the core of the CPU. A fan on top of the heat sink moves the heat away from the CPU.
- Fans can be dedicated to cool the **Graphics-processing unit (GPU)**.
- Computers are kept cool using **active** and **passive** cooling solutions.
  - Active solutions require power while passive solutions do not.
  - Passive solutions for cooling usually involve reducing the speed at which a component is operating or adding heat sinks to computer chips.
  - A case fan is considered as active cooling.

Passive Cooling

Active Cooling

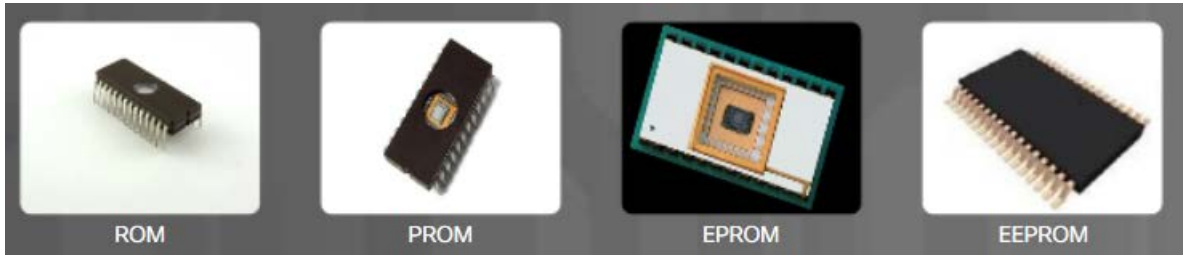
Types of Memory

- A computer might use different types of memory chips.
- All memory chips store data in the form of bytes.
  - A byte is a block of eight bits stored as either 0 or 1 in the memory chip.
- Read-Only Memory **(ROM)**
  - Basic instructions for booting the computer and loading the operating system are stored in ROM.
  - ROM chips retain their contents even when the computer is powered down.
  - Can’t be erased or rewritten.



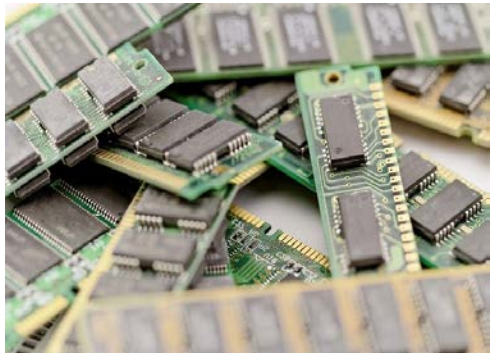
Types of ROM

- Types of Read-only Memory include:
  - Read-Only Memory (**ROM**) chips – Programmed at factory and can't be erased or rewritten.
  - Programable Read-Only Memory (**PROM**) chips – Manufactured blank and can be programmed only once.
  - Erasable Programable Read-Only Memory (**EPROM**) chips – Can be erased by exposing it to strong ultraviolet light.
  - Electrically Erasable Programable Read-Only Memory (**EEPROM**) chips – Can be reprogrammed while still in the computer.



Types of Memory

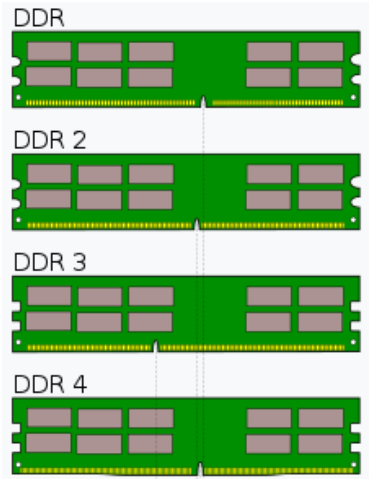
- Random-access memory **(RAM)**
  - RAM is temporary storage for data and programs that are being accessed by the CPU.
  - RAM is volatile memory, which means that the contents are erased when the computer is powered off.
  - All data moving in or out of the processor must be loaded into RAM first.
  - More RAM means more capacity to hold and process large programs and files, as well as enhance system performance.
  - The maximum amount of RAM that can be installed is limited by the motherboard (chipset).



Memory Modules

- Memory modules are memory chips that have been soldered on to a special circuit board for easy installation and removal.
- The speed of memory has a direct impact on how much data a processor can process because faster memory improves the performance of the processor. As processor speed increases, memory speed must also increase.
  - **Dual Inline Package (DIP)** is an individual memory chip with dual rows of pins.
  - **Single Inline Memory Module (SIMM)** is a small circuit board that holds several memory chips. Comes in 30- and 72-pin configurations.
  - **Dual Inline Memory Module (DIMM)** is a circuit board that holds SDRAM, DDR SDRAM, and DDR2 SDRAM chips.
  - **RAM Bus Inline Memory Module (RIMM)** is a circuit board that holds RDRAM chips.
  - **Small Outline DIMM (SODIMM)** is a smaller, more condensed version of DIMM which provides random access data storage that is ideal for use in laptops, printers, and other devices where conserving space is desirable.

Types of RAM

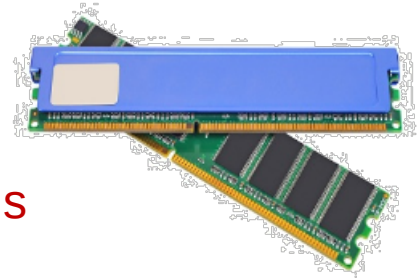


- Types of Random Access Memory (RAM) include:
  - **Static RAM (SRAM)** –
  - **Dynamic RAM (DRAM)** –
  - **Synchronous Dynamic RAM (SDRAM)** –
  - **Double Data Rate Synchronous Dynamic RAM (DDR SDRAM)**
  - **DDR2 Synchronous Dynamic RAM (DDR2 SDRAM)**
  - **DDR3 Synchronous Dynamic RAM (DDR3 SDRAM)**
  - **DDR4 Synchronous Dynamic RAM (DDR4 SDRAM)**
  - **GDDR Synchronous Dynamic RAM (GDDR SDRAM)** – Designed specifically for video graphics and use with a dedicated BPU

Name	Bus clock	Transfer rate	DIMM pins	SO-DIMM pins
DDR	100-200 MHz	200-400 MT/s	184	200
DDR2	200-533 MHz	400-1066 MT/s	240	200
DDR3	400-1066 MHz	800-2133 MT/s	240	204
DDR4	1066-2133 MHz	2133-4266 MT/s	288	256

Cache

- **SRAM** is used as cache memory to store the most frequently used data.
- SRAM provides the processor with faster access to the data than retrieving it from the slower DRAM, or main memory.
- The speed of memory has a direct impact on how much data a processor can process in a given period of time.
- The fastest memory is typically static RAM (SRAM) which is used as cache memory for storing the most recently used data and instructions by the CPU.
- The three most common types of cache memory are:
  - **L1** cache – integrated into the CPU
  - **L2** cache – was original mounted on the motherboard, but now integrated into the CPU
  - **L3** cache – used some high-end workstations and server CPUs

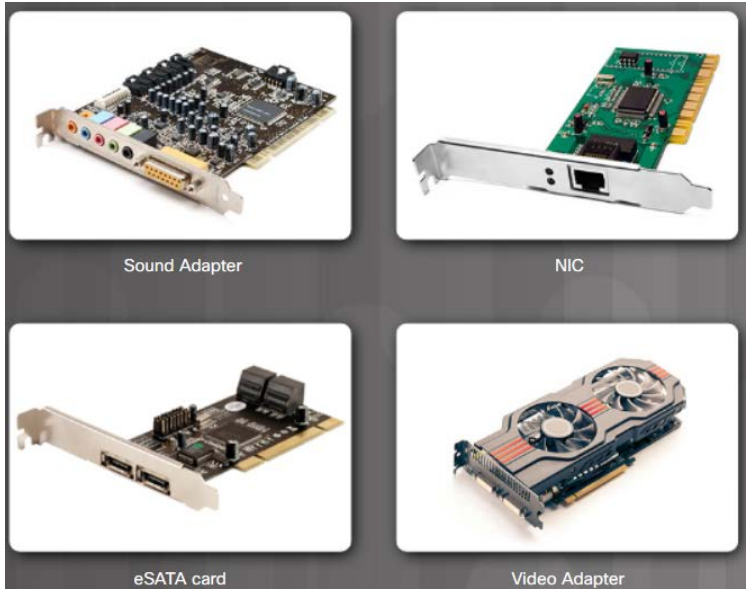


Error Checking

- Memory errors occur when the data is not stored correctly in the memory chips. The computer uses different methods to detect and correct data errors in memory.
- Different types of error checking methods include:
  - **Nonparity** – Nonparity memory does not check errors in memory.
  - **Parity** – Parity memory contains 8 bits for data and 1 bit for error checking.
  - **ECC** – Error Correction Code memory can detect multiple bit errors in memory and correct single bit errors in memory

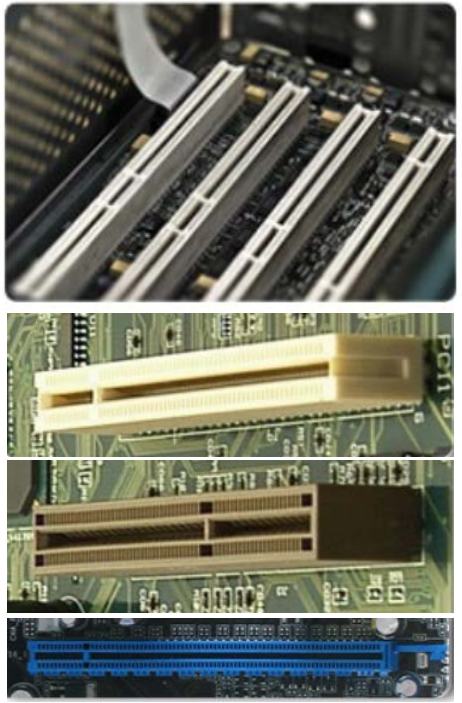
Adapter Cards

- Adapter cards increase the functionality of a computer by adding controllers for specific devices or by replacing malfunctioning ports.
- Common adapter cards include:
  - Sound adapter
  - Network Interface Card (NIC)
  - Wireless NIC
  - Video adapter or display adapter
  - Video capture card
  - TV tuner card
  - Universal Serial Bus (USB) controller card
  - eSATA card



Adapter Cards

- Computers have expansion slots on the motherboard to install adapter cards.
- The type of adapter card connector must match the expansion slot.
- Common expansion slots include:
  - Peripheral Component Interconnect (PCI)
  - Mini-PCI
  - PCI eXtended (PCI-X)
  - PCI Express (PCIe)
  - Riser card
  - Accelerated Graphics Port (AGP)



Types of Storage Devices

- Data drives provide non-volatile storage of data.
- Designed to permanently store user data, user applications and the Operating System.
- Can be internal or external to the computer.
- Some drives have fixed media, and other drives have removable media.
- Data storage devices can be classified according to the media on which the data is stored:
  - **Magnetic** – like hard disk drive and tape drive
  - **Solid state** – like solid state drive
  - **Optical** – like CD and DVD

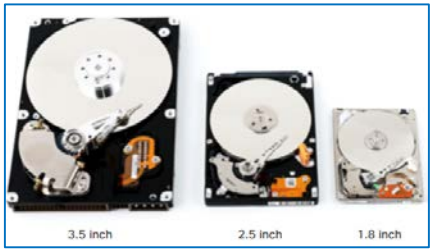
Storage Device Interfaces

- Storage devices inside a computer connect to the motherboard using Serial AT Attachment (SATA) connections. The legacy interface is Parallel ATA (EIDE).
- The interface standards define the way that data is transferred, the transfer rates, and physical characteristics of the cables and connectors.
- There are three main versions of the SATA standard: SATA 1, SATA 2, & SATA 3.
- The cables and connectors are the same, but the data transfer speeds are different.

ATA	Parallel (PATA)	IDE	8.3 Mb/s
		EIDE	16.6 Mb/s
	Serial (SATA)	SATA 1	1.5 Gb/s
		SATA 2	3.0 Gb/s
		SATA 3	6.0 Gb/s

Magnetic Media Storage

- This type of storage represents binary values as magnetized or non-magnetized physical areas of magnetic media.
- Common types of magnetic media storage drives:
  - **Hard Disk Drive (HDD)** – the traditional magnetic disk devices with storage capacity ranging from gigabytes (GBs) to terabytes (TBs).



  - Magnetic hard drives have drive motors designed to spin magnetic platters and move the drive heads.
  - Speed is measured in revolutions per minute.
    - Common speeds are 5400rpm, 7200rpm, 10,000rpm.

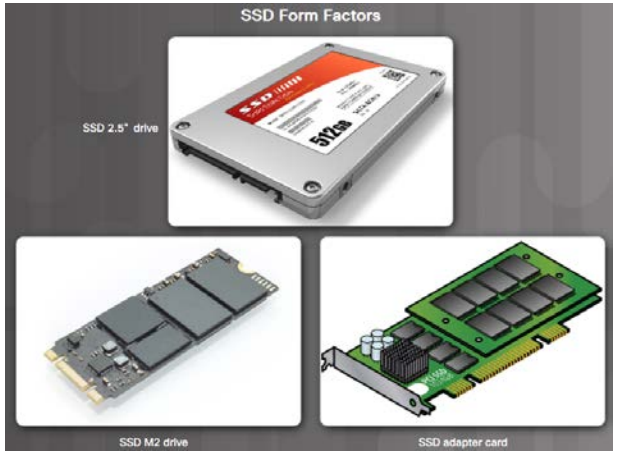
Magnetic Media Storage

- Common types of magnetic media storage drives:
  - **Tape Drive** – most often used for archiving data.
    - Tape drives use a magnetic read/write head and removable tape cartridge.
    - Common tape storage capacities vary between a few GBs to many TBs.

  - A **floppy disk drive (FDD)** is storage device that uses removable 3.5 inch floppy disks that can store up to 1.44 MB of data.

Semiconductor Storage

- **Solid-state drives (SSD)** store data as electrical charges in semiconductor flash memory. This results in faster access to data, improved performance, higher reliability, reduced power usage.
- SSDs have no moving parts, make no noise, are more energy efficient, not susceptible to vibrations, and produce less heat than HDDs.
- SSDs come in three form factors:
  - Disc drive form factor – similar to an HDD
  - Expansion cards – plugs directly into the motherboard and mounts in the computer case like other expansion cards
  - mSata or M.2 modules – these packages may use a special socket.
    - M.2 is a standard for computer expansion cards.



Semiconductor Storage

- The **Non-Volatile Memory Express** (**NVMe**) specification was developed specifically to allow computers to take greater advantage of the features of SSDs by providing a standard interface between SSDs, the PCIe bus, and operating systems.
- NVMe allows compliant SSD drives to attach to the PCIe bus without requiring special drivers.
- **Solid State Hybrid Drives** (**SSHD**s) are a compromise between a magnetic HDD and an SSD.
  - They are faster than an HDD but less expensive than an SSD.
  - They combine a magnetic HDD with onboard flash memory serving as a non-volatile cache.
- A **flash drive** is a removable storage device that connects to a USB port. A flash drive requires no power to maintain the data.

Types of Optical Storage Devices

- Optical drives are removable media storage devices that use lasers to read and write data on optical media.
- They were developed to overcome the storage capacity limitations of removable magnetic media such as floppy discs.
- There are three types of optical drives:
  - **Compact Disc (CD)** - audio and data
  - **Digital Versatile Disc (DVD**) - digital video and data
  - **Blu-ray Disc (BD)** - HD digital video and data

Types of Optical Storage Devices

- CD, DVD, and BD media can be pre-recorded (read only), recordable (write once), or re-recordable (read and write multiple times).
- DVD and BD media can also be single layer (SL) or dual layer (DL). Dual layer media roughly doubles the capacity of a single disc.

Optical Media	Description	Storage Capacity
CD-ROM	CD read-only memory media that is pre-recorded	700 MB
CD-R	CD recordable media that can be recorded one time	
CD-RW	CD rewritable media that can be recorded, erased, and re-recorded	
DVD-ROM	DVD read-only memory media that is pre-recorded	4.7 GB (Single-Layer) 8.5 GB (Dual-Layer)
DVD-RAM	DVD rewritable media that can be recorded, erased, and re-recorded	
DVD+/-R	DVD recordable media that can be recorded one time	
DVD+/-RW	DVD rewritable media that can be recorded, erased, and re-recorded	
BD-ROM	Blu-ray read-only media that is pre-recorded with movies, games, or software	25 GB (Single-Layer) 50 GB (Dual-Layer)
BD-R	Blu-ray recordable media that can be recorded one time	
BD-RE	Blu-ray rewritable media that can be recorded, erased, and re-recorded	

Ports and Cables

- Input/output (I/O) ports on a computer connect peripheral devices, such as printers, scanners, and portable drives.
- A computer may have other ports:
  - Personal System 2 (PS/2)
  - Audio and game port
  - Network
  - Parallel AT Attachment (PATA)
  - Serial AT Attachment (SATA)
  - External SATA (eSATA)
  - Small Computer System Interface (SCSI)
  - Universal Serial Bus (USB)
  - Integrated Drive Electronics (IDE)
  - Enhanced Integrated Drive Electronics (EIDE)

Internal Cables

- Power supply connectors- SATA, Molex, and Berg.
- Front panel cables connect the case buttons and lights to the motherboard.
- Data cables connect drives to the drive controller.
  - Floppy disk drive (FDD) data cable
  - PATA (IDE) data cable (40 conductor)
  - PATA (EIDE) data cable (80 conductor)
  - SATA data cable (internal)
  - eSATA data cable (external)
  - SCSI data cable

Ports and Cables

- Serial ports transmit one bit of data at a time.
  - Uses a DB-9 or DB-25 connector.

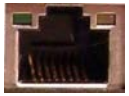
- USB is a standard interface for connecting hot-swappable peripheral devices to a computer. Some devices can also be powered through the USB port.

- FireWire is a high-speed, hot-swappable interface that can support up to 63 devices. Some devices can also be powered through the FireWire port. (IEEE-1394)

- A parallel cable is used to connect parallel devices, such as a printer or scanner, and can transmit 8 bits of data at one time. (IEEE-1284)

Ports and Cables

- A SCSI port can transmit data at rates in excess of 320 Mbps and can support up to 15 devices. SCSI devices must be terminated at the endpoints of the SCSI chain.
- A network port, also known as an RJ-45 port, connects a computer to a network. The maximum length of network cable is 328 ft (100 m).



- A telephone port (RJ11) is used to connect a modem to a telephone outlet.

- A BNC connects data networks over coaxial cable.
- A PS/2 port connects a keyboard or a mouse to a computer. The PS/2 port is a 6-pin mini-DIN female connector.

- An audio port connects audio devices to the computer.

- A video port connects a monitor cable to a computer.

Video Ports and Cables

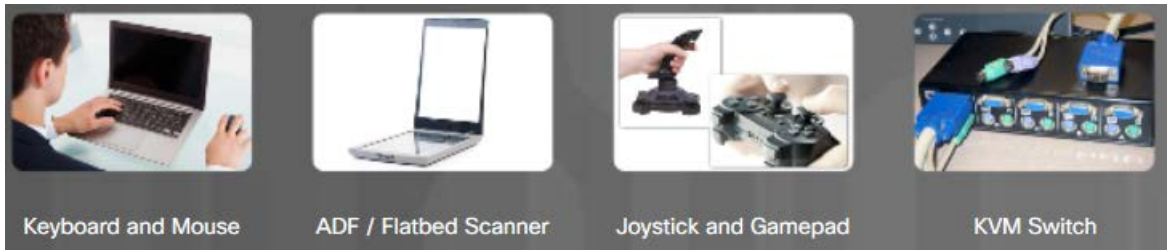
- A video port connects a monitor to a computer using a cable.
- Video ports and monitor cables transfer analog signals, digital signals, or both.
- Video ports and cables include:
  - Digital Visual Interface (DVI)
  - DisplayPort
  - High-Definition Multimedia Interface (HDMI)
  - Thunderbolt 1 or 2
  - Thunderbolt 3
  - Video Graphics Array (VGA)
  - Radio Corporation of America (RCA)

Adapters and Converters

- There are many connection standards in use today. These components are called adapters and converters:
  - **Converter** – performing the same function as an adapter but also translates the signals from one technology to the other.
  - **Adapter** – physically connecting one technology to another
- Example of adapters include:
  - DVI to VGA Adapter
  - USB to Ethernet adapter
  - USB to PS/2 adapter
  - DVI to HDMI adapter
  - Molex to SATA adapter
  - HDMI to VGA converter

The Original Input Devices

- Input devices all the user to communicate with a computer.
- Some of the first input devices include:
  - **Keyboard and Mouse** – these are the two most commonly used input devices
  - **ADF / Flatbed Scanner** – these devices digitize an image or document
  - **Joystick and Gamepad** – these devices are used for playing games
  - **KVM Switch** – a hardware device that can be used to control more than one computer while using a single keyboard, video (monitor), and mouse



New Input Devices

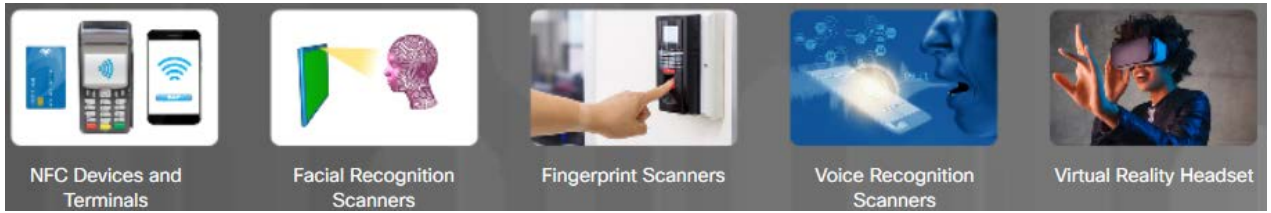
- Some new input devices include:
  - **Touch screen** – input devices with touch or pressure sensitive screens
  - **Stylus** – a type of digitizer that allows a designer or artist to create artwork by using a pen-like tool
  - **Magnetic strip reader** – a device that reads information magnetically encoded on the back of plastic cards
  - **Barcode scanner** – a device that reads the information contained in the barcodes affixed to products

More New Input Devices

- A few newer input devices:
  - **Digital camera** – devices that capture digital images and videos
  - **Webcams** – video cameras that can be integrated into a computer
  - **Signature pad**– a device that electronically captures a person's signature
  - **Smart card reader** – a device used on a computer to authenticate the user. A smart card may be the size of a credit card with an embedded microprocessor that is typically under a gold contact pad on one side of the card.
  - **Microphone** – a device that allows a user to speak into a computer and have their voice digitized

Most Recent Input Devices

- The newest input devices include:
  - **NFC devices and terminals** – Near Field Communication (NFC) tap to pay devices
  - Biometer Devices:
    - **Facial recognition scanners** – devices identifying a user based on unique facial features
    - **Fingerprint scanners** – devices identifying a user based on unique fingerprint
    - **Voice recognition scanners** – devices identifying a user based on unique voice



What are Output Devices?

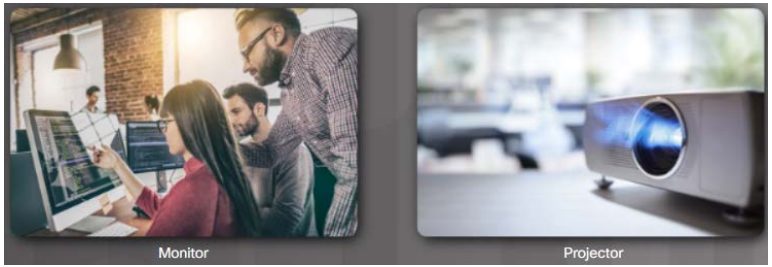
- An output device takes binary information from the computer and converts it into a form that is easily understood by the user.
- Examples of output devices include monitors, projectors, printers, speakers, headphones, and VR headsets.

Monitors and Projectors

- Most monitors use one of three types of technology:
  - **Liquid Crystal Display** (LCD) is commonly used in laptops and some projectors. LCD comes in two forms, active matrix and passive matrix.
  - A **Light-Emitting Diode** (LED) display is an LCD display that uses LED backlighting to light the display.
  - An **Organic LED** (OLED) display uses a layer of organic material that responds to electrical stimulus to emit light.
  - Several factors are involved in Monitor Resolution –Pixel, Dot Pitch, Contrast Ratio, Refresh rate, Interlace/Non-Interlace, Horizontal vertical color, Aspect ratio, Native resolution.
    - **Monitor Resolution** refers to the level of image detail that can be reproduced. Higher resolution settings produce better image quality.
    - **Contrast ratio** is the difference in the intensity of light between the brightest white and darkest black that can be displayed.

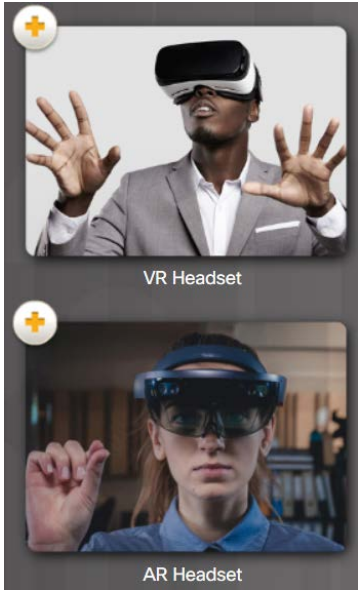
Monitors and Projectors

- **Plasma** - Plasma displays are another type of flat panel monitor
- Most video projectors use LCD or DLP technology.
  - DLP stands for Digital Light Processing
  - Different projectors have different numbers of lumens, which affects the level of brightness of the projected image.



VR and AR Headsets

- **Virtual reality headset** – used with computer games, simulators, and training applications with virtual reality functionalities.
  - **Virtual Reality (VR)** uses computer technology to create a simulated, three-dimensional environment.
  - A VR headset completely encases the upper portion of users' faces, not allowing in any ambient light from their surroundings.
- **Augmented Reality (AR)** uses similar technology but superimposes images and audio over the real world in real time.
  - AR can provide users with immediate access to information about their real surroundings.
  - An AR headset usually does not close off ambient light to users, allowing them to see their real life surroundings.



Printers

- Printers are output devices that create hard copies of files.
- A hard copy might be a on a sheet of paper. It could also be a plastic form created from a 3D printer.
- Different types of printers:
  - Inkjet, impact, thermal, laser, and 3D printers
- Printers use wired or wireless connections
- All printers require printing material (such as ink, toner, liquid plastic, etc.)
- Printers use a driver to communicate with OS

Speakers and Headphones

- **Speakers** are a type of auditory output device.
- Most computers and mobile devices have audio support either integrated into the motherboard or on an adapter card.
- **Headphones**, earbuds, and the earphones found in headsets are all auditory output devices.
- These may be wired or wireless. Some are Wi-Fi or Bluetooth-enabled.

1.3 COMPUTER DISASSEMBLY

Video Demonstration – Computer Disassembly

Video Demonstration: Disassemble a computer

- **Step 1**: Power off and disconnect the power supply..
- **Step 2**: Disconnect the mouse and keyboard.
- **Step 3**: Remove the case screws.
- **Step 4**: Remove the SATA power and data cables
- **Step 5**: Remove the hard drive.
- **Step 6**: Remove the optical drive.
- **Step 7**: Remove the adapter card.
- **Step 8**: Remove the power supply.
- **Step 9**: Remove front panel connectors.
- **Step 10**: Remove the RAM.

Lab – Disassemble a Computer

- Points to consider:
  - Use safe lab procedures
  - Use the proper tools
  - Use extreme care and follow all safety procedures
  - Familiarize yourself with the tools you will be using in this lab
  - Document how things come apart or go together
  - Place components it anti-static bags
  - Keep track of all screws and cables

1.4 CHAPTER SUMMARY

Chapter 1: Introduction to Personal Computer Hardware

- Explain how to keep personal computer components safe.
- Explain the features and functions of computer components.
- Disassemble a computer.

New Terms and Commands

- Electrostatic discharge (ESD)
- static electricity
- antistatic wrist straps
- alternating current
- direct current
- Advanced Technology (AT)
- AT Extended (ATX)
- ATX12V
- EPS12V
- SATA connector
- Molex connector
- Berg connector
- 4-pin to 8-pin auxiliary power connector
- 6/8-pin PCIe power connector
- printed circuit board (PCB)
- motherboard
- Central Processing Unit (CPU)
- Chipset
- Serially Attached SCSI (SAS)
- Northbridge chipset
- Southbridge chipset
- Universal Serial Bus (USB)
- Advanced Technology eXtended (ATX)
- Micro-ATX form factor
- Mini-ITX form factor
- ITX form factor
- Pin Grid Array (PGA)
- Land Grid Array (LGA)
- passive cooling
- active cooling
- Random Access Memory (RAM)
- Dual Inline Package (DIP)
- Single Inline Memory Module (SIMM)
- Dual Inline Memory Module (DIMM)
- Small Outline DIMM (SODIMM)
- L1 cache
- L2 cache
- L3 cache
- Parity
- Error Correction Code (ECC) memory

New Terms and Commands (Cont.)

- Sound adapter
- Network Interface Card (NIC)
- Wireless NIC
- Video adapter or display adapter
- Capture card
- TV tuner card
- Universal Serial Bus (USB) controller card
- eSATA card
- Peripheral Component Interconnect (PCI) slot
- Mini-PCI slot
- PCI eXtended (PCI-X) slot
- PCI Express (PCIe) slot

- Accelerated Graphics Port (AGP) slot
- Hard Disk drive
- Tape drive
- Solid State drive
- mSata or M.2 modules
- Solid State Hybrid Drives (SSHDs)
- Compact Disc (CD)
- Digital Versatile Disc (DVD)
- Blu-ray Disc (BD)
- DisplayPort
- Digital Visual Interface (DVI)
- High-Definition Multimedia Interface (HDMI)

- Thunderbolt
- Video Graphics Array (VGA)
- Radio Corporation of America (RCA)
- ADF / Flatbed Scanner
- Joystick and Gamepad
- KVM Switch
- Touch screen
- Stylus
- Magnetic strip reader
- Barcode scanner
- Signature pad
- Smart card reader
- NFC devices and terminals

New Terms and Commands (Cont.)

- Facial recognition scanners
- Fingerprint scanners
- Voice recognition scanners
- Virtual reality headset
- Liquid crystal display (LCD)
- Light-emitting diode (LED)
- Organic LED (OLED)
- Digital Light Processing (DLP)
- Virtual Reality (VR)
- Augmented Reality (AR)
- Basic input/output system (BIOS) chip
- Unified Extensible Firmware Interface (UEFI) chip

- Serial Advanced Technology Attachment (SATA)
- Enhanced Integrated Drive Electronics (EIDE)
- Small Computer System Interface (SCSI)
- Read-Only Memory (ROM)
- Programmable read-only memory chip (PROM)
- Erasable programmable read-only memory chip (EPROM)
- Electrically erasable programmable read-only memory chip (EPROM)

- Dynamic RAM (DRAM)
- Static RAM (SRAM)
- Synchronous Dynamic RAM (SDRAM)
- Double Data Rate Synchronous Dynamic RAM (DDR SDRAM)
- DDR2 Synchronous Dynamic RAM (DDR2 SDRAM)
- DDR3 Synchronous Dynamic RAM (DDR3 SDRAM)
- DDR4 Synchronous Dynamic RAM (DDR4 SDRAM)
- GDDR Synchronous Dynamic RAM (GDDR SDRAM)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