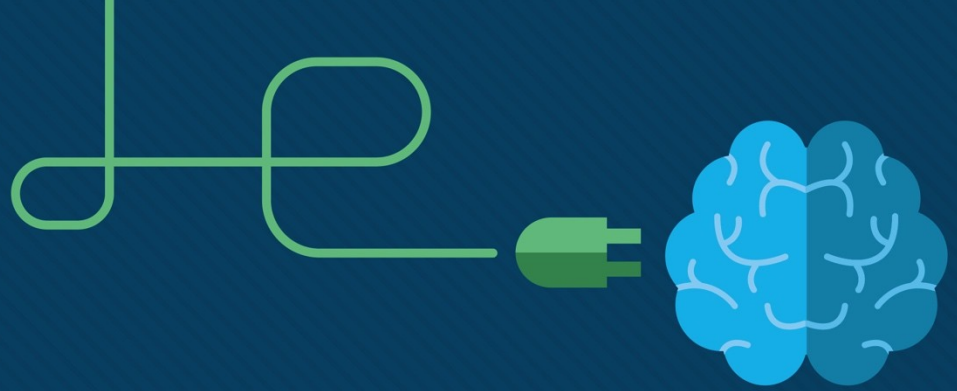


Chapter 3: Advanced Computer Hardware

IT Essentials 8.0

Chapter 3 - Sections & Objectives

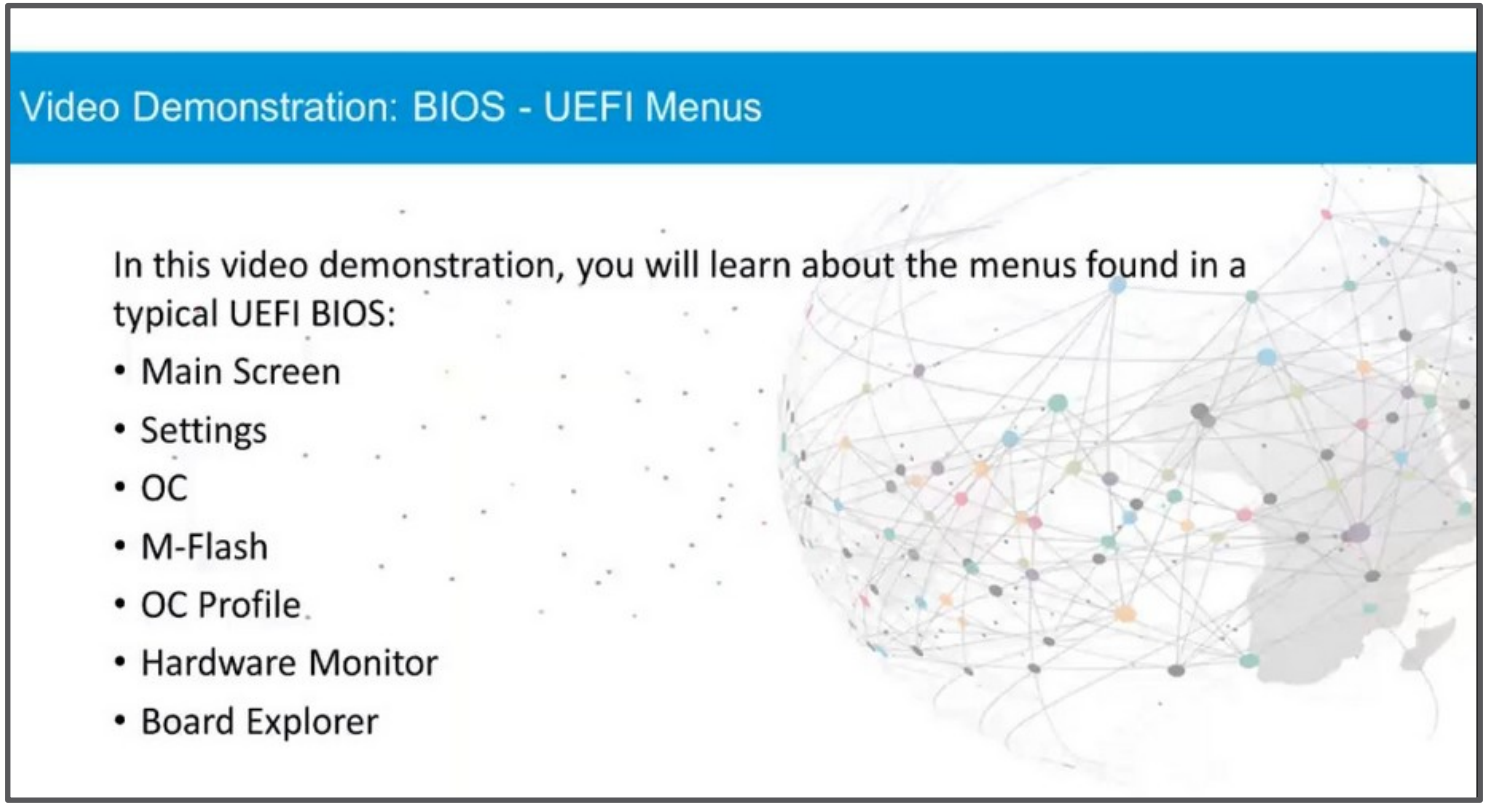
- 3.1 Boot the Computer
- Configure BIOS and UEFI Settings
  - Describe POST, BIOS, CMOS and UEFI.
  - Configure the computer firmware.
- 3.2 Electrical Power
- Explain electrical power
  - Describe wattage and voltage.
  - Explain power fluctuations and devices that protect against damage caused by fluctuations.

Chapter 3 - Sections & Objectives (Cont.)

- 3.3 Advanced Computer Functionality
- Explain computer functionality
  - Explain CPU architecture.
  - Describe RAID.
  - Describe common ports, cables, and connectors.
  - Describe monitor characteristics.
- 3.4 Computer Upgrade
- Select components to upgrade a computer to meet requirements
  - Select appropriate components to upgrade a computer.
  - Select components for specialized computers.
- 3.5 Protecting the Environment
- Explain safe disposal methods to protect the environment
  - Explain safe disposal methods.

3.1 Boot the Computer

Video Demonstration – BIOS – UEFI Menus

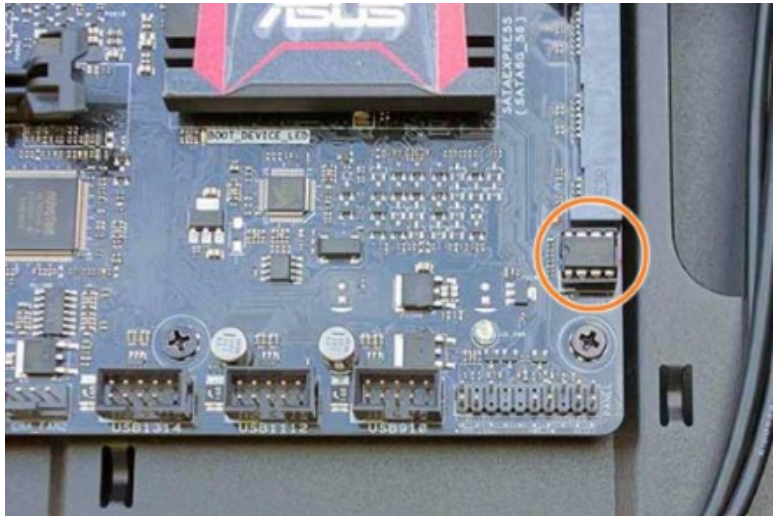


POST

- When a computer is booted, the basic input/output system (BIOS) performs a hardware check on the main components of the computer.
  - This check is called a power-on self-test (POST).
- If a device is malfunctioning, an error or a beep code alerts the technician of the problem.
- BIOS manufacturers use different codes to indicate different hardware problems.
  - Motherboard manufacturers may use different beep codes.
  - Always consult the motherboard documentation to get the beep codes for your computer.
- **Installation Tip**: To determine if POST is working properly, remove all the RAM modules from the computer and power it on.
  - The computer should emit the beep code for a computer with no RAM installed.
  - This will not harm the computer.

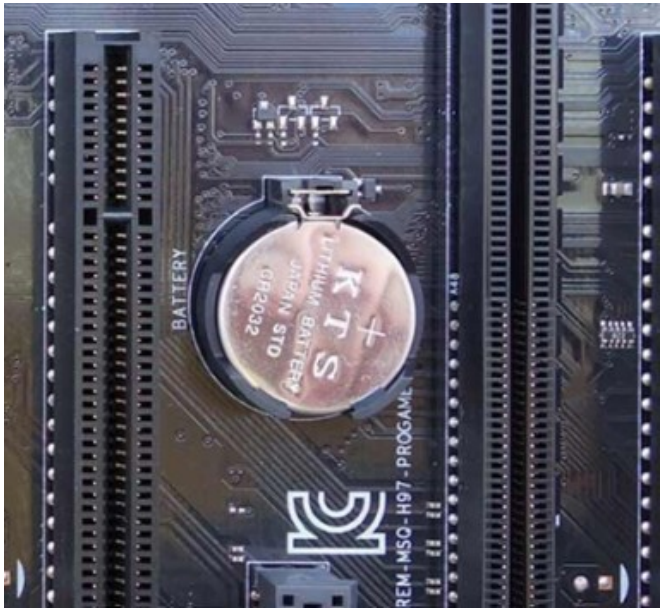
BIOS and CMOS

- All motherboards need a BIOS to operate.
- BIOS is a ROM chip on the motherboard that contains a small program that controls the communication between the operating system and the hardware.
- Along with the POST, BIOS also identifies:
  - Which drives are available
  - Which drives are bootable
  - How the memory is configured and when it can be used
  - How PCIe and PCI expansion slots are configured
  - How SATA and USB ports are configured
  - Motherboard power management features



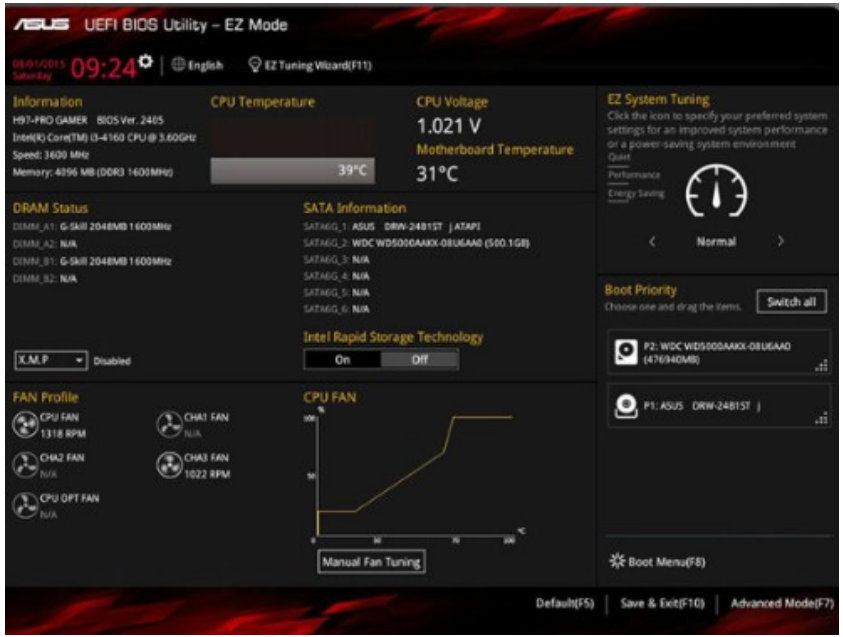
BIOS and CMOS (Cont.)

- The motherboard manufacturer saves the motherboard BIOS settings in a Complementary Metal Oxide Semiconductor (CMOS) memory chip.
- When a computer boots, the BIOS software reads the configured settings stored in CMOS to determine how to configure the hardware.
- The BIOS settings are retained by CMOS using a battery.
  - If the battery fails, important settings can be lost.
- **Installation Tip**: If the computer's time and date are incorrect, it could indicate that the CMOS battery is bad or is getting very low.



UEFI

- Most computers today run Unified Extensible Firmware Interface (UEFI).
- All new computers come with UEFI, which provides additional features and addresses security issues with legacy BIOS.
- UEFI can run on 32-bit and 64-bit systems, supports larger boot drives, and includes additional features such as secure boot.
  - Secure boot ensures your computer boots to your specified operating system.
  - This helps prevent rootkits from taking over the system.



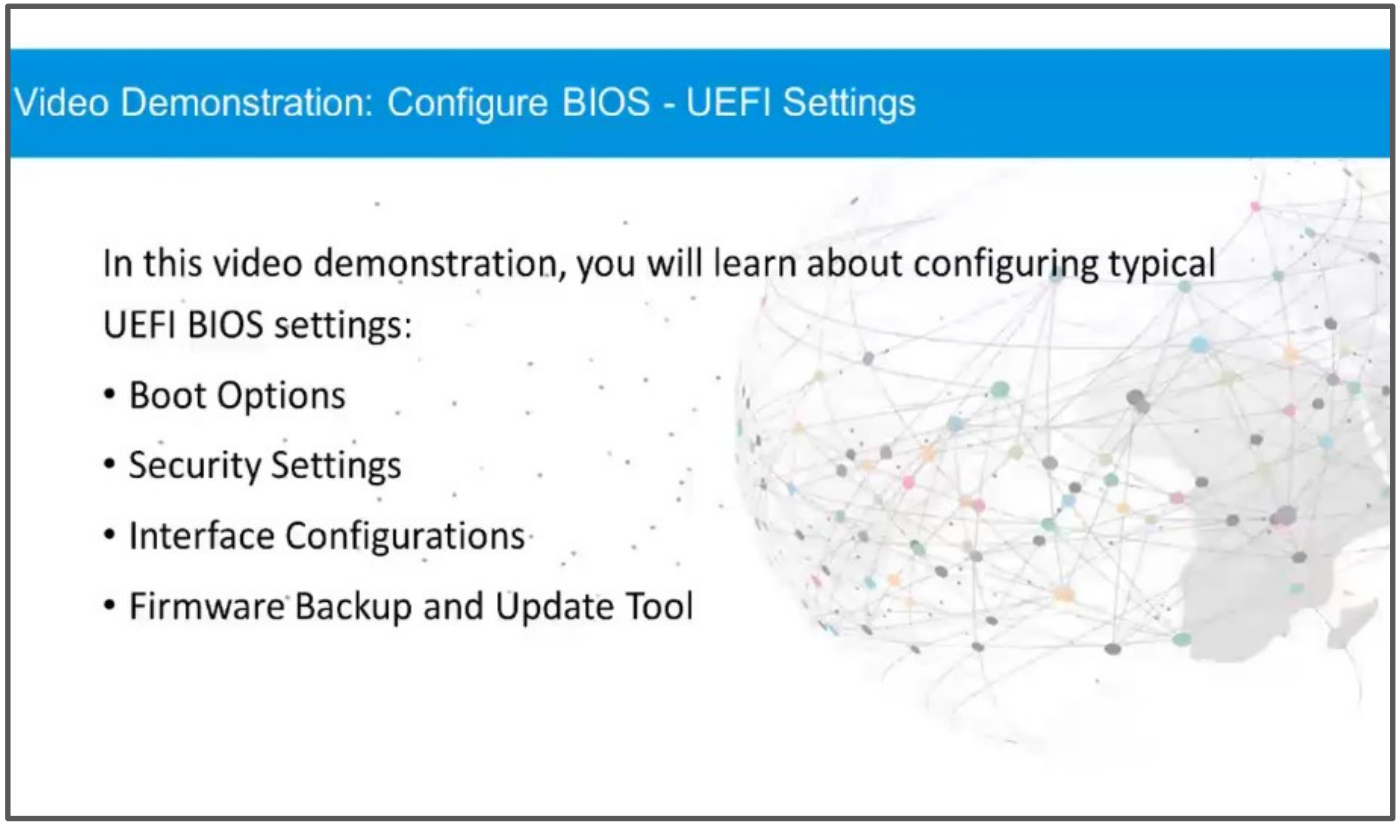
Lab – Investigate BIOS or UEFI Settings

In this lab, you will boot the computer, explore the firmware setup utility program, and change the boot order sequence.

Part 1: Enter BIOS or UEFI

Part 2: Explore the Settings

Video Demonstration – Configure BIOS – UEFI Settings



BIOS and UEFI Security

- The legacy BIOS supports some security features to protect the BIOS setting, however UEFI adds additional security features.
- Some common security features found in the BIOS/UEFI systems includes:
  - **Passwords** - Passwords allow for different levels of access to the BIOS settings.
  - **Drive encryption** - A hard drive can be encrypted to prevent data theft.
  - **LoJack** – This is a security feature that allows the owner to locate, lock, and delete the device.
  - **Trusted Platform Module (TPM)** – This is a chip designed to secure hardware by storing encryption keys, digital certificates, passwords, and data.
  - **Secure boot** - Secure Boot is a UEFI security standard that ensures that a computer only boots an OS that is trusted by the motherboard manufacturer.

Access Level	Level Description
Full Access	All screens and settings are available, except the supervisor password setting.
Limited Access	Changes can be made to certain settings only, for example, the time and date.
View Only Access	All screens are available, but no settings can be changed.
No Access	No access is provided to the BIOS setup utility.

Update the Firmware

- Motherboard manufacturers may publish updated BIOS versions to provide enhancements to system stability, compatibility, and performance.
- Early computer BIOS information was contained in ROM chips and to upgrade the BIOS information, the ROM chip had to be physically replaced.
- Modern BIOS chips are Electronically Erasable Programmable Read Only Memory (EEPROM) which can be upgraded by the user without opening the computer case.
  - This is called “flashing the BIOS”.
- To download a new BIOS, consult the manufacturer’s website and follow the recommended installation procedures.

Lab – Search for BIOS or UEFI Firmware Updates

In this lab, you will identify the current BIOS or UEFI version and then search for BIOS or UEFI update files.

Lab – Install Windows

In this lab, you will install Windows 10.

Lab – Install Third-Party Software in Windows

In this lab, you will install and remove a third-party software application supplied by your instructor. You will install the Packet Tracer Windows application.

3.2 Electrical Power

Wattage and Voltage

- There are four basic units of electricity that a computer technician must know:
  - **Voltage (V)** – Measured in Volts (V) – The measure of work required to move a charge from one location to another.
  - **Current (I)** – Measured in Amperes(A) – The measure of the amount of electrons moving through a circuit per second.
  - **Resistance (R)** – Measured in Ohms (O) – Refers to the opposition to the flow of current in a circuit.
  - **Power (P)** – Measured in Watts (W) –The measure of the work required to move electrons through a circuit multiplied by the number of electrons going through the circuit per second (current).
- A basic equation, known as Ohm's Law, expresses how voltage is equal to the current multiplied by the resistance: **V = IR**.
- In an electrical system, power is equal to the voltage multiplied by the current: **P = VI**.

Power Supply Voltage Settings

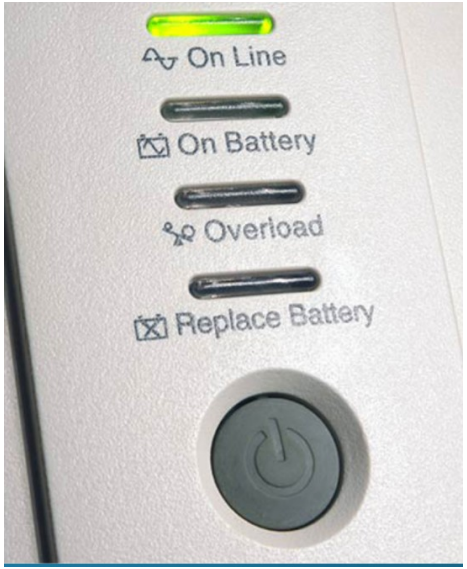
- On the back of some power supplies is a small switch called the voltage selector switch.
  - This switch sets the input voltage to the power supply to either 110V / 115V or 220V / 230V.
  - A power supply with this switch is called a dual voltage power supply.
  - If a power supply does not have this switch, it automatically detects and sets the correct voltage.
- The correct voltage setting is determined by the country where the power supply is used.

Lab – Ohm’s Law

In this lab, you will answer questions based on electricity and Ohm’s Law.

Power Fluctuation Types

- When the voltage in a computer is not accurate or steady, computer components might not operate correctly.
- The following types of AC power fluctuations can cause data loss or hardware failure:
  - **Blackout** - Complete loss of AC power.
  - **Brownout** - Reduced voltage level of AC power that lasts for a period of time.
  - **Noise** - Interference from generators and lightning.
  - **Spike** - Sudden increase in voltage that lasts for a short period and exceeds 100 percent of the normal voltage on a line.
  - **Power surge** - Dramatic increase in voltage above the normal flow of electrical current.



Uninterruptible power supply (UPS) device

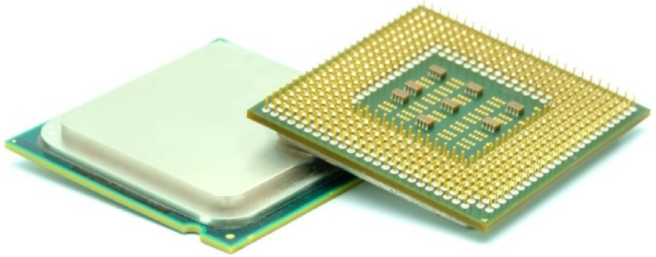
Power Protection Devices

- To help shield against power fluctuation problems, use devices to protect the data and computer equipment:
  - **Surge protector** - Helps protect against damage from surges and spikes.
    - A surge suppressor diverts extra electrical voltage that is on the line to the ground.
  - **Uninterruptible power supply (UPS)** - Helps protect against potential electrical power problems and provides a consistent quality of power when brownouts and blackouts occur.
  - **Standby power supply (SPS)** - Helps protect against potential electrical power problems by providing a backup battery that is on standby during normal operation.
    - This device is not as reliable as a UPS because of the time it takes to switch over to the battery.

3.3 Advanced Computer Functionality

CPU Architectures

- A program is a sequence of stored instructions and a CPU executes these instructions by following a specific instruction set.
- There are two distinct types of instruction sets that CPUs may use:
  - **Reduced Instruction Set Computer (RISC)** - This architecture uses a relatively small set of instructions. RISC chips are designed to execute these instructions very rapidly.
  - **Complex Instruction Set Computer (CISC**) - This architecture uses a broad set of instructions, resulting in fewer steps per operation.
- While the CPU is executing one step of the program, the remaining instructions and the data are stored nearby in a special, high-speed memory, called cache.



Enhancing CPU Operation

- Intel processors use Hyper-Threading to enhance the performance of some of their CPUs.
  - With Hyper-Threading, multiple pieces of code (threads) are executed simultaneously in the CPU so a single CPU performs as though there are two CPUs.
- AMD processors use HyperTransport to enhance CPU performance.
  - HyperTransport is a high-speed connection between the CPU and the Northbridge chip.

- The power of a CPU is measured by the speed and the amount of data that it can process.
  - The speed of a CPU is rated in cycles per second, such as millions of cycles per second, called megahertz (MHz), or billions of cycles per second, called gigahertz (GHz).
  - The amount of data that a CPU can process at one time depends on the size of the front side bus (FSB), also called the CPU bus or the processor data bus.

Enhancing CPU Operation (Cont.)

- Overclocking is a technique used to make a processor work at a faster speed than its original specification.
  - Overclocking is not a recommended way to improve computer performance and can result in damage to the CPU.
- The opposite of overclocking is CPU throttling.
  - CPU throttling is a technique used when the processor runs at less than the rated speed to conserve power or produce less heat.
- CPU virtualization is a hardware feature supported by AMD and Intel CPUs that enables a single processor to act as multiple processors.
  - With CPU virtualization multiple operating systems can run in parallel on their own virtual machines as if they were running on completely independent computers.

Multicore Processors

- Multicore processors have two or more processors on the same integrated circuit.
- Integrating the processors on the same chip creates a very fast connection between them.
  - Multicore processors execute instructions more quickly than single-core processors. Instructions can be distributed to all the processors at the same time.
  - RAM is shared between the processors because the cores reside on the same chip.
  - Multicore processors conserve power and produce less heat than multiple single-core processors, thus increasing performance and efficiency.

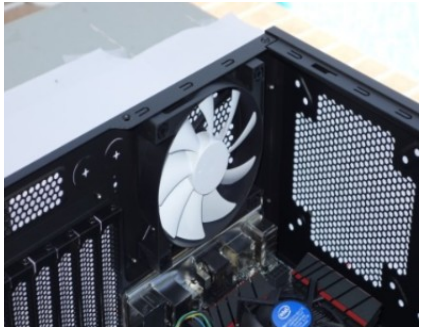
Number of Cores	Description
Single Core CPU	One core inside a single CPU that handles all the processing. A motherboard may have sockets for more than one single processor, providing the ability to build a powerful, multiprocessor computer.
Dual Core CPU	Two cores inside a single CPU in which both cores can process information at the same time.
Triple Core CPU	Three cores inside a single CPU. This is a quad-core processor with one of the cores disabled.
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.

Multicore Processors (Cont.)

- Another feature found in some CPUs is an integrated graphics processing unit or GPU.
- The GPU is a chip that performs the rapid mathematical calculations required to render graphics.
- A GPU can be integrated or dedicated.
  - Integrated GPUs are often directly embedded on the CPU and is dependent on system RAM while the dedicated GPU is a separate chip with its own video memory dedicated exclusively for graphical processing.
  - The benefit of integrated GPUs is cost and less heat dissipation.
  - Integrated GPUs are good at less complex tasks like watching videos and processing graphical documents but are not best suited for intense gaming applications.
- CPUs have also been enhanced using the NX bit, also called the execute disable bit. This feature can protect areas of memory that contain operating system files from malicious attacks by malware.

CPU Cooling Mechanisms

- **Case Fan**
  - A case fan is used to increase the air flow in the computer case and allows more heat to be removed.
  - Some cases have multiple fans with cool air being brought in, while another fan is blowing out hot air.



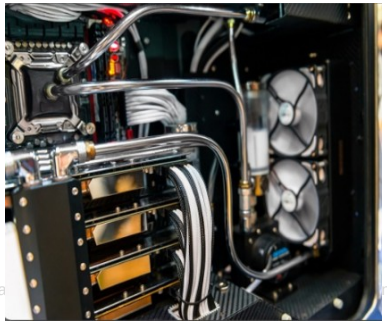
- **CPU Heat Sink**
  - A heat sink has a large surface area with metal fins in order to draw heat away from the CPU and dissipate it into the surrounding air.
    - Thermal compound is placed between the heat sink and the CPU to increase the efficiency of heat transfer.
  - A CPU heat sink without a fan is known as “passive cooling”.

CPU Cooling Mechanisms (Cont.)

- CPU Fan
  - It is common to install a fan on top or within a heat sink in order to move heat away from the metal fins.
  - A CPU heat sink with a fan is known as “active cooling”.

- Graphics Card Cooling System
  - Video adapter cards have a graphics=processing Unit (GPU) that generates excessive heat.

- Water Cooling System
  - A metal plate is placed over the processor and water is pumped over the top to collect the heat the processor generates.
  - The water is pumped to a radiator to disperse the heat into the air and then the water is recirculated.



RAID Concepts

- Computers can implement redundant array of independent disks (RAID) technology.
  - RAID provides a way to store data across multiple storage devices for availability, reliability, capacity, and redundancy and/or performance improvement
- The following terms describe how RAID stores data on the various disks:
  - **Striping** – enables data to be distributed across multiple drives with a significant performance increase, however the failure of a single drive means that all data is lost.
  - **Mirroring** – stores duplicate data on one or more other drives and provides redundancy so that the failure of a drive does not cause the loss of data.
  - **Parity** – provides basic error checking and fault tolerance by storing checksums separately from data and enables the reconstruction of lost data without sacrificing speed and capacity.
  - **Double Parity** – provides fault tolerance for up to two failed drives.

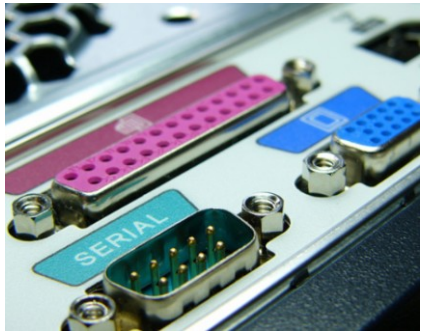
RAID Levels

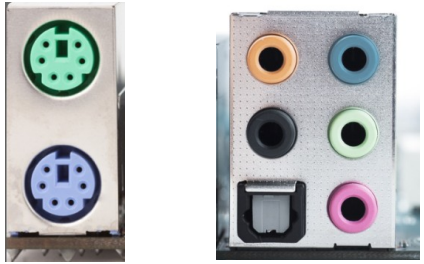
- There are several levels of RAID available.
  - These levels use mirroring, striping, and parity in different ways.
  - Higher levels of RAID, such as RAID 5 or 6, use striping and parity in combination to provide speed and to create large volumes.
  - RAID levels higher than 10 combine lower RAID levels.

RAID Level	Minimum Number of Drives	Features	Advantages	Disadvantages
0	2	Striping	Performance and Capacity.	All data is lost if one drive fails.
1	2	Mirroring	Performance and Reliability.	Capacity is half of total drive size.
5	3	Striping with parity	Performance, Reliability, and Capacity.	It takes time to rebuild array if a drive fails.
6	4	Striping with double parity	Same as RAID 5 but can tolerate the loss of two drives.	It takes time to rebuild array if one or more drives fails.
10 (0+1)	4	Mirroring and Striping	Performance, Capacity, and High Reliability.	Capacity is half of total drive size.

Legacy Ports

- Serial
  - Used for connecting various peripherals such as printers, scanners, modems, and console connections to network devices.
- Parallel
  - Used for connecting to various peripheral devices, commonly printers.
- Game
  - Used for connecting a joystick input
- PS/2
  - Used for connecting a keyboard and mouse. Purple for keyboard and green for the mouse.
- Audio ports
  - Analog ports were used for connecting stereo system, microphone and speakers/headphones.





Video and Graphic Ports

- VGA
  - An analog port and commonly the oldest graphics port still used on some PCs.
- DVI
  - Provides support for transmitting uncompressed digital video.
  - Includes DVI-A (analog), DVI-D (digital), and DVI-I (integrated).
- HDMI
  - Carries the same video information as DVI but is also capable of providing digital audio and control signals.
- DisplayPort
  - Designed to replace both DVI and VGA for computer monitors while including high bandwidth video and audio signals.

USB Cables and Connectors

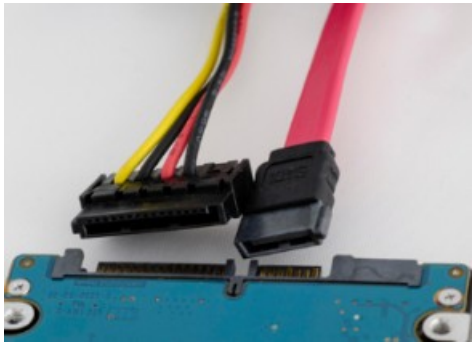
- Over the years, USB has evolved with various standards. (USB 1.0, USB 2.0, USB 3.0, and USB 3.2)
- USB Type-A
  - The typical rectangular connector found on almost all desktop and laptop computers, TVs, game consoles, and media players.
- Mini-USB
  - A rectangular connector with a small indention on each side that is being replaced with the micro-USB connector.
- Micro-USB
  - A common connector on smartphones, tablets and other devices.
  - This connector has two corners pushed in at an angle.

USB Cables and Connectors (Cont.)

- USB Type-B
  - This connector has a square shape with beveled exterior corners and an extra notch at the top.
  - Used to connect printers or external hard drives.
- USB Type-C
  - This connector is rectangular with four rounded corners and is the newest USB interface.
  - Used as a multipurpose cable to attach different kinds of peripheral devices to a PC.
- Lightning
  - This connector is a small proprietary 8-pin connector used by Apple mobile devices such as iPhones, iPads, and iPods for both power and data.

SATA Cables and Connectors

- SATA Cable
  - One end plugs into a SATA port on a motherboard and the other end into the back of an internal storage device.
  - The SATA data cable does not provide power so a SATA power cable is needed in addition to power the internal storage device.
  - SATA data and power cables are keyed so they can only be installed in one way.
- eSATA Cable
  - This cable is used to connect external SATA drives and is a keyed connector.
- eSATA Adapter
  - An expansion card is commonly used to provide eSATA ports.



Twisted Pair Cables and Connectors

- Twisted pair cable is used in wired Ethernet networks and older telephone networks.
- Twisted Pairs
  - Unshielded Twisted Pair (UTP) cabling is the most common form of twisted pair cabling and uses color-coded insulated copper wires.
  - Shielded Twisted Pair (STP) also uses color-coded insulated copper wires but includes foil or braiding as well.
- RJ-45
  - Each end of a UTP cable must be terminated with an RJ-45 connector so it can be plugged into an Ethernet port.
- RJ-11
  - Older telephone networks used a four-wire UTP cable terminated with an RJ-11 connector.

Coax Cables and Connectors

- Coax Cable Construction
  - Coaxial cable has an inner center conductor surrounded by insulating material.
  - The insulating material is surrounded by a foil shield which is used as an outer conductor and also shields against electromagnetic interference (EMI).
- RG-6
  - A heavy gauge cable with insulation and shielding for high-bandwidth, high-frequency applications (Internet, Cable TV, and Satellite TV)
- RG-59
  - A thinner cable similar to RG-6, used for low bandwidth and lower frequency applications (analog video and CCTV)
- BNC
  - An older connector, used with digital or analog audio or video.

SCSI and IDE Cables and Connectors

- Small Computer Systems Interface (SCSI) is a standard for connecting peripheral and storage devices in a daisy-chained format.
- External SCSI Cable
  - Used for connecting older external SCSI devices (scanners and printers).
- Internal SCSI Cable
  - Common SCSI connector for internal hard drives with 50 pins arranged in two rows and attached to a ribbon cable.
- IDE Cable
  - Visually similar to the internal SCSI cable, but commonly with three 40-pin connectors.
  - One connector connects to the IDE port on the motherboard and two for attaching IDE drives.

Monitor Characteristics

- There are many types of computer monitors available and they vary by use, size, quality, clarity, brightness and more.
- Computer monitors are usually described by:
  - **Screen size** – The diagonal measurement of the screen (i.e., top left to bottom right) in inches.
  - **Resolution** – Resolution is measured by the number of horizontal and vertical pixels. For example, 1920 x 1080 (i.e., 1080p) means it has 1920 horizontal pixels and 1080 vertical pixels.
  - **Monitor resolution** – This relates to the amount of information that can be displayed on a screen.
  - **Native resolution** – This identifies the best monitor resolution for the specific monitor.
  - **Native mode** – This term describes when the image sent to the monitor by the video adapter card matches the native resolution of the monitor.
  - **Connectivity** – Older monitors used VGA or DVI while newer monitors support HDMI and DisplayPort.

Monitor Terms

- **Pixel** – a tiny dot capable of displaying red, green, and blue.
- **Dot pitch** – The distance between pixels on the screen.
- **Brightness** – The luminance of a monitor, measured in candelas per square meter (cd/m2)
- **Contrast ratio** – The measurement of how white and how black a monitor can get.
- **Aspect ratio** – The horizontal to vertical measurement of the viewing area of a monitor.
- **Refresh rate** – The amount of seconds for your monitor to redraw the screen, measured in Hertz (Hz).
- **Response time** - The amount in time for a pixel to change properties (color or brightness)
- **Frame per second** (fps) - How many times the computer is creating each frame.
- **Interlaced** – Creates an image by scanning the screen two times. (Odd lines and then even lines)
- **Non-Interlaced** – Creates an image by scanning the screen one line at a time, from top to bottom.

Display Standards

- **CGA** – Color Graphics Adapter (320 x 200 resolution)
- **VGA** – Video Graphics Array (640 x 480 resolution)
- **SVGA** – Super Video Graphics Array (800 x 600 resolution)
- **HD** – High Definition (1280 x 720 resolution) – Also known as 720p
- **FHD** – Full High Definition (1920 x 1080 resolution) – Also known as 1080p
- **QHD** – Quad High Definition (2560 x 1440 resolution) – Also known as 1440p
- **UHD** – Ultra High Definition (3840 x 2160 resolution) – Also known as 4k

Using Multiple Monitors

- Adding monitors can increase your visual desktop area and improve productivity.
  - The added monitors enable you to expand the size of the monitor or duplicate the desktop so you can view additional windows.
- Many computers have built-in support for multiple monitors.
- To connect multiple monitors to a computer, you need to:
  - enable your computer to support multiple monitors
  - gather the appropriate display cables

3.4 Computer Configuration

Motherboard Upgrade

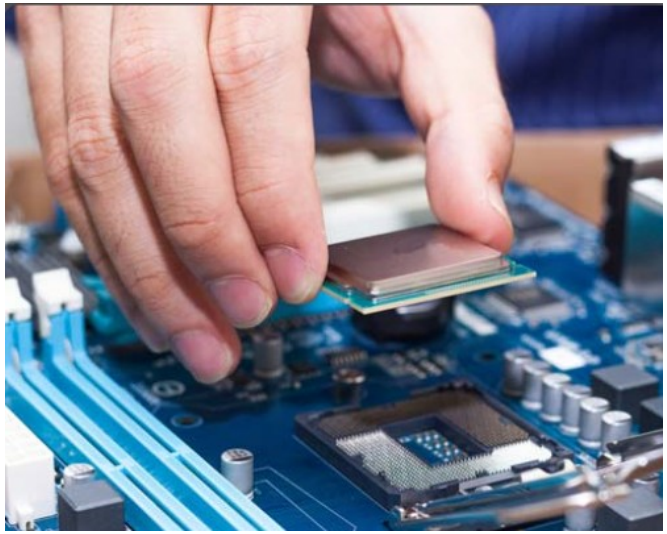
- Computers need periodic upgrades for various reasons:
  - User requirements change
  - Upgraded software packages require new hardware
  - New hardware offers enhanced performance
- If you upgrade or replace a motherboard, consider that you might have to replace other components including:
  - CPU
  - heat sink and fan assembly
  - RAM.
- A new motherboard must fit in the old computer case and the power supply must support it.

Steps to Upgrade a Motherboard

- To upgrade a motherboard from a computer case, follow these steps:
  - **Step 1.** Record how the power supply, case fans, case LEDs, and case buttons attach to the old motherboard.
  - **Step 2.** Disconnect the cables from the old motherboard.
  - **Step 3.** Disconnect and remove the expansion cards from the case.
  - **Step 4.** Record how the old motherboard is secured to the case.
  - **Step 5.** Remove the old motherboard from the case.
- **Step 6.** Identify where all of the connectors are such as power, SATA, fan, USB, audio, front panel connector, and any others on the new motherboard.
- **Step 7.** Replace the old I/O shield with the new I/O shield.
- **Step 8.** Insert and secure the motherboard into the case.
- **Step 9.** Connect the power supply, case fans, case LEDs, front panel, and any other required cables.
- **Step 10.** After the new motherboard is in place and the cables are connected, install and secure the expansion cards.

CPU Upgrade

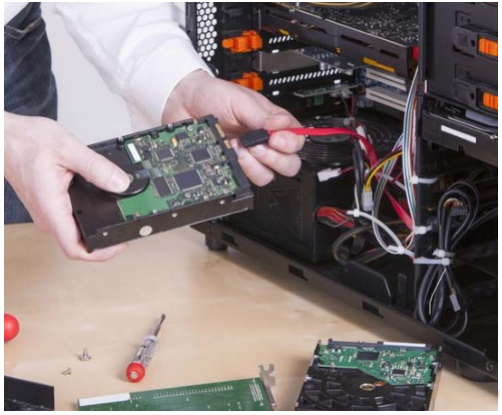
- One way to increase the power of a computer is to increase the processing speed by upgrading the CPU.
  - The new CPU might require a different heat sink and fan assembly.
  - The assembly must physically fit the CPU and be compatible with the CPU socket.
- It must also be adequate to remove the heat of the faster CPU by installing additional case fans.
- **CAUTION**: You must apply thermal compound between the new CPU and the heat sink and fan assembly.



Storage Device Upgrade

- Instead of purchasing a new computer to get faster speed and more storage space, you might consider adding another hard drive.
- There are several reasons for installing an additional drive:
  - Increase storage space
  - Increase hard drive speed
  - Install a second operating system
  - Store the system swap file
  - Provide fault tolerance
  - Back up the original hard drive

- After selecting the appropriate hard drive, follow these general guidelines during installation:
  - **Step 1.** Place the hard drive in an empty drive bay, and tighten the screws to secure the hard drive.
  - **Step 2.** Connect the drive to the motherboard using the correct cable.
  - **Step 3.** Attach the power cable to the drive.



Peripheral Upgrades

- Peripheral devices periodically need to be upgraded.
- For example, if the device stops operating or if you wish to improve performance and productivity, an upgrade might be necessary.
- These are a few reasons for upgrading a keyboard and/or a mouse:
  - Change the keyboard and mouse to an ergonomic design
    - Ergonomic devices are made to be more comfortable to use and to help prevent repetitive motion injuries.
  - Reconfigure the keyboard to accommodate a special task, such as typing in a second language with additional characters.
  - To accommodate users with disabilities.

Power Supply Upgrade

- Upgrading your computer hardware will most likely also change its power needs.
- If so, you may need to upgrade your power supply.
- You can find calculators on the internet to help you determine if you need to upgrade the power supply.
  - Search for “power supply wattage calculator”.

Lab – Research a Hardware Upgrade

In this lab, you will gather information about hardware components so you can upgrade your customer's hardware so they can play advanced video games.

3.5 Protecting the Environment

Safe Disposal Methods

- The proper disposal or recycling of hazardous computer components is a global issue.
- Make sure to follow regulations that govern how to dispose of specific items.
- Organizations that violate these regulations can be fined or face expensive legal battles.
- Regulations for the disposal of these items vary from state to state and from country to country:
  - Batteries
  - Monitors
  - Toner Kits, Cartridges, and Developers
  - Chemical Solvents and Aerosol Cans
  - Cell Phones and tablets

Safety Data Sheets

- A Safety Data Sheet (SDS), formerly known as a Material Safety and Data Sheet (MSDS), is a fact sheet that summarizes information about material identification, including hazardous ingredients that can affect personal health, fire hazards, and first-aid requirements.
- The SDS contains chemical reactivity and incompatibility information.
- It also includes protective measures for the safe handling and storage of materials and spill, leak, and disposal procedures.
- To determine if a material is classified as hazardous, consult the manufacturer's SDS which in the U.S. is required by OSHA when the material is transferred to a new owner.
- The SDS explains how to dispose of potentially hazardous materials in the safest manner.

3.6 Chapter Summary

Chapter 3: Advanced Computer Hardware

- Configure BIOS and UEFI settings
- Explain electrical power
- Explain computer functionality
- Describe monitor characteristics.
- Explain safe disposal methods to protect the environment