

Computer Systems

Lecture 1 : Introduction To The Personal Computer



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.



Computer Cases and Power Supplies

Computer case

- Provides protection and support for internal components.
- Should be durable, easy to service, and have enough room for expansion.
- The size and layout of a case is called a **form factor**.
- **NOTE:** Select a case that matches the physical dimensions of the power supply and motherboard.

Power supply

- Converts AC power from the wall socket into DC.
- Must provide enough power for the installed components and future additions.

Internal Components

- Identify the names, purposes, and characteristics of:
 - Motherboards
 - CPUs
 - Cooling systems
 - ROM and RAM
 - Adapter cards
 - Storage drives
 - Internal cables

Motherboards

- 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.



Motherboard Form Factors

- The form factor of motherboards pertains to the size and shape of the board.
- It also describes the physical layout of the different components and devices on the motherboard.
- Various form factors exist for motherboards.

Form Factors	
AT	Advanced Technology
ATX	Advanced Technology Extended
Mini-ATX	Smaller footprint of Advanced Technology Extended
Micro-ATX	Smaller footprint of Advanced Technology Extended
LPX	Low-Profile Extended
NLX	New Low-Profile Extended
BTX	Balanced Technology Extended
Mini-ITX	Smaller than the Micro-ATX format
Nano-ITX	Smaller footprint of the Mini-ITX
Pico-ITX	Half the size of the Nano-ITX
Mobile-ITX	Smallest ITX motherboard

Form Factors



Standard-ATX



Micro-ATX



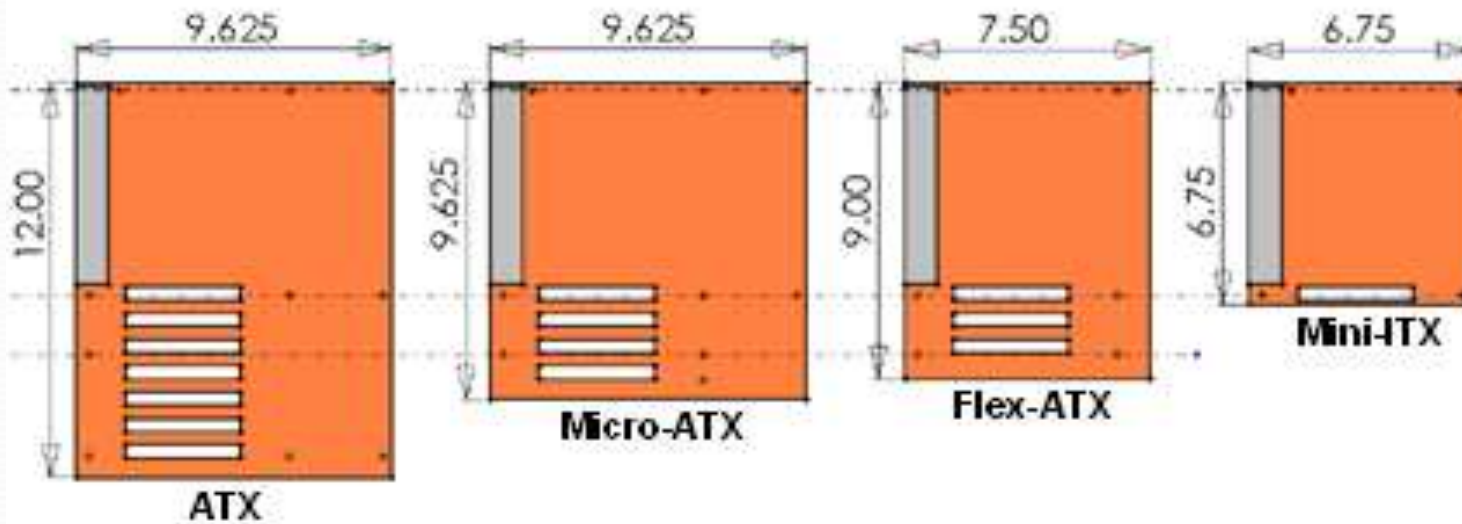
Mini-ITX



Nano-ITX

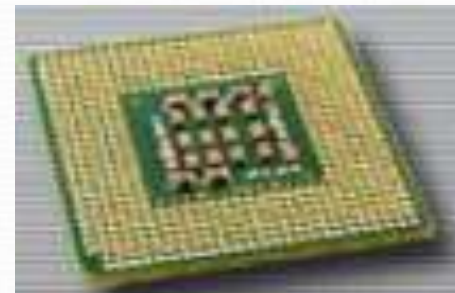


Pico-ITX



Central Processing Unit (CPU)

- The CPU is known as the brain of the computer. It is also referred to as the processor.
- The CPU executes a program, which is a sequence of stored instructions.
- The 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.

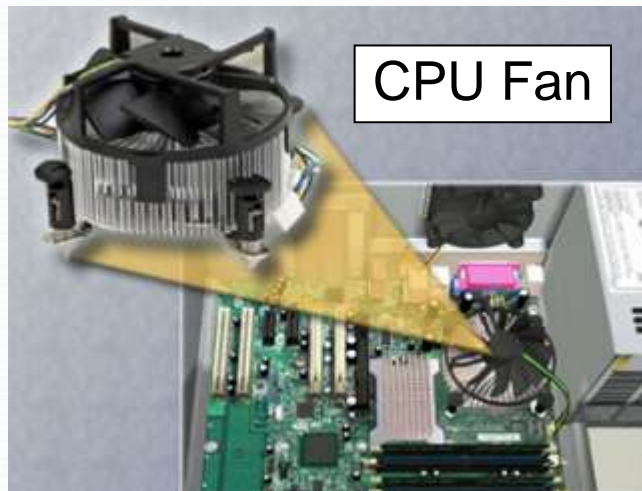


Central Processing Unit (Continued)

- 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



Cooling Systems

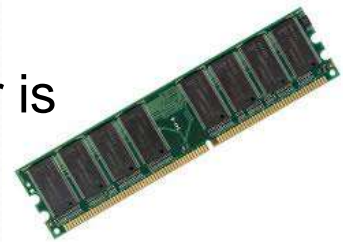


- Electronic components generate heat. Too much heat can damage components.
- A **case fan** makes the cooling process more efficient.
- A **heat sink** draws heat away from the core of the CPU. A fan on top of the heat sink moves the heat away from the CPU.
- Fans can be dedicated to cool the **Graphics-processing unit (GPU)**.

ROM and RAM



- 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.
- 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.
- More RAM means more capacity to hold and process large programs and files, as well as enhance system performance.



Memory Modules

- Memory modules are memory chips that have been soldered on to a special circuit board for easy installation and removal.
- Dual Inline Package (**DIP**) is an individual memory chip.
- Single Inline Memory Module (**SIMM**) is a small circuit board that holds several memory chips.
- Dual Inline Memory Module (**DIMM**) is a circuit board that holds SDRAM, DDR SDRAM, and DDR2 SDRAM 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.

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.

Adapter Cards

- Adapter cards increase the functionality of a computer by adding controllers for specific devices or by replacing malfunctioning ports.
- Examples of adapter cards:
 - Sound adapter and video adapter
 - USB, parallel, and serial ports
 - Network Interface Card (NIC), wireless NIC, and modem adapter
- Types of expansion slots:
 - Peripheral Component Interconnect (PCI)
 - Advanced Graphics Port (AGP)
 - PCI-Express
 - Mini PCI (laptops)



Storage Drives

- Storage drives read or write information to magnetic storage media.
- They may be fixed or removable.
- The **hard disk drive (HDD)** is a magnetic storage device. The storage capacity is measured in gigabytes (GB) or terabytes (TB)
- Magnetic hard drives have drive motors designed to spin magnetic platters and move the drive heads.
- **Solid state drives (SSDs)** do not have moving parts, which results in faster access to data, higher reliability, reduced power usage.



Hard Drive

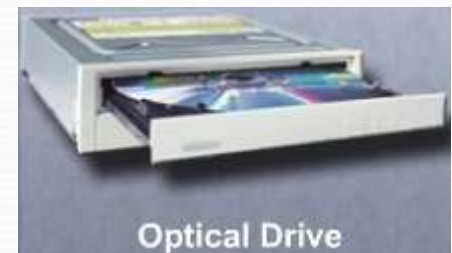


Floppy Drive

- 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.

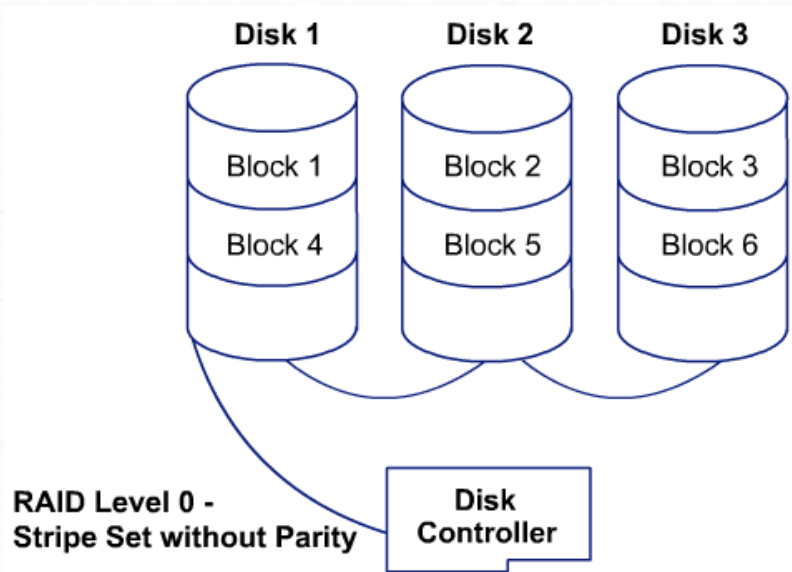
Optical Drives, Flash Drives and Drive Interfaces

- An **optical drive** is a storage device that uses lasers to read data on the optical media. The three types are CD, DVD, and BD (Blu-ray).
- A **flash drive** is a removable storage device that connects to a USB port. A flash drive uses a type of memory that requires no power to maintain the data.
- Common drive interfaces are:
 - Integrated Drive Electronics (IDE)
 - Enhanced Integrated Drive Electronics (EIDE)
 - Parallel ATA (PATA)
 - Serial ATA (SATA) and External SATA (eSATA)
 - Small Computer System Interface (SCSI)



Types of RAID

- Arrays, such as a Redundant Array of Independent Disks (RAID), improve fault tolerance when connecting multiple hard drives.
- Some types of RAID require two or more hard drives.
- Install RAID using hardware or software.
 - Hardware installations are usually more dependable, but more expensive.



RAID Levels

- RAID provides a way to store data across multiple hard disks for redundancy.

RAID Level	Min # of Drives	Description
0	2	Data striping without redundancy
1	2	Disk mirroring
2	2	Error-Correcting Coding
3	3	Byte-level data striping with dedicated parity
4	3	Block-level data striping with dedicated parity
5	3	Block-level data striping with distributed parity
6	4	Independent Data Disks with Double Parity
0/1	4	Combination of data striping and mirroring
10	4	Mirrored set in a striped set

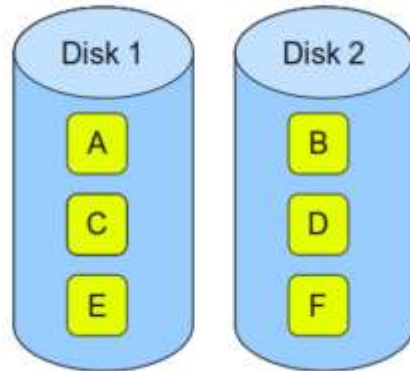
Parity – A method used to detect data errors.

Striping – A method used to write data across multiple drives.

Mirroring – A method of storing duplicate data to a second drive.

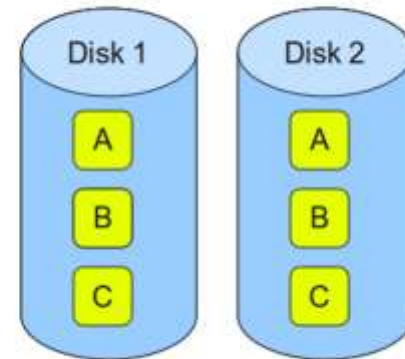
Types of RAID

RAID LEVEL 0



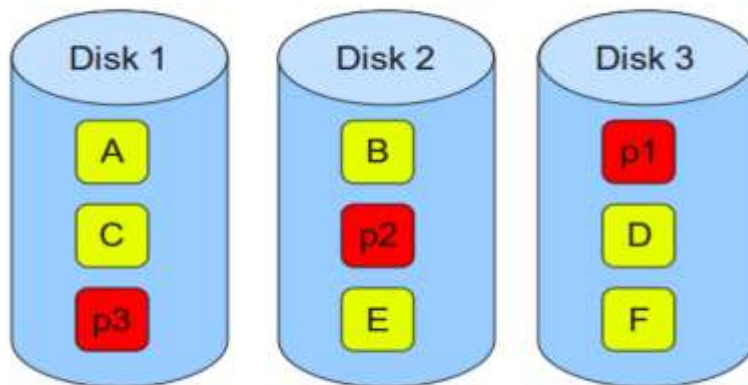
RAID 0 – Blocks Striped. No Mirror. No Parity.

RAID LEVEL 1



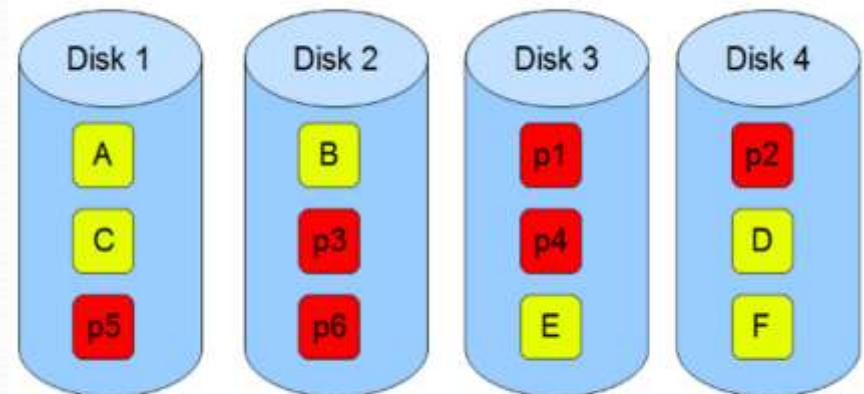
RAID 1 – Blocks Mirrored. No Stripe. No parity.

RAID LEVEL 5



RAID 5 – Blocks Striped. Distributed Parity.

RAID 6



RAID 6 – Blocks Striped. Two Distributed Parity.

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
 - SCSI data cable



Video Ports and Cables

- A video port connects a monitor cable to a computer. **Video ports and connector types:**
DVI, Displayport, RCA, DB-15, BNC, RJ-45, MiniHDMI, Din-6
- Display cables transfer video signals from the computer to display devices. **Display cable types:**
High-Definition Multimedia Interface (HDMI), DVI, Video Graphics Array (VGA), Component/RGB, Composite, S-Video, Coaxial, Ethernet,

Ports and Cables

- **Serial ports** transmit one bit of data at a time.
- A **telephone cable** (RJ11) is used to connect a modem to a telephone outlet.
- **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.
- 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.

Ports and Cables (Continued)

- 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 feet (100 m).
- 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.

Input Devices

- Input devices are used to enter data or instructions into a computer:
 - Mouse and Keyboard
 - KVM switch
 - Gamepad and joystick
 - Digital camera and digital video camera
 - Biometric authentication device
 - Touch screen
 - Scanner



Output Devices



CRT



LCD



Projector

- Monitors and Projectors:
 - **Cathode-ray tube (CRT)** has three electron beams. Each beam directs colored phosphor on the screen that glows either red, blue, or green.
 - **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.

Output Devices (continued)

- Monitors and Projectors:
 - **Plasma** - Plasma displays are another type of flat panel monitor
 - **Digital light processing (DLP)** is a technology used in projectors.
 - **Monitor Resolution** refers to the level of image detail that can be reproduced. Higher resolution settings produce better image quality.
 - Several factors are involved in **Monitor Resolution** –Pixel, Dot Pitch, Contrast Ratio, Refresh rate, Interlace/Non-Interlace, Horizontal vertical color, Aspect ratio, Native resolution

Output Devices (Continued)

- **Printers and Fax Machines** are output devices that create hard copies of computer files.
- **Scanners** create electronic file versions of paper documents.
- **Speakers and headphones** are output devices for reproducing audio signals.



Selecting Case and Power Supply

- Determine the user's needs before making any purchases or performing upgrades.
 - A power supply should support 25 percent more wattage than all the attached components require.
- The computer case holds the power supply, motherboard, memory, and other components.
- When purchasing a new computer case and power supply separately, ensure that all of the components will fit into the new case and that the power supply is powerful enough to operate all of the components.



Selecting a Motherboard

- When selecting a replacement motherboard, make sure it supports the CPU, RAM, video adapter, and other adapter cards.
- The socket and chip set on the motherboard must be compatible with the CPU.
- The motherboard must accommodate the existing heat sink/fan assembly.
- The existing power supply must have connections that fit the new motherboard.
- The number and type of expansion slots must match the existing adapter cards.
- The new motherboard must physically fit into the current computer case.

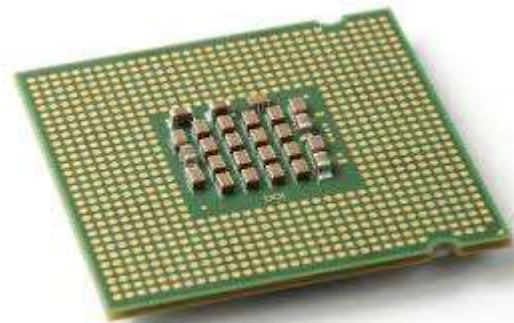
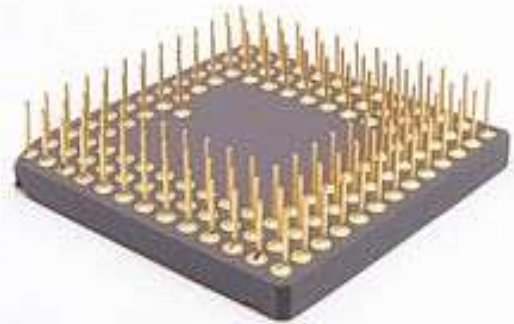


Selecting a CPU

- Replace the CPU when it fails or is no longer adequate for the current applications.
- Make sure the CPU is compatible with the existing motherboard:
 - The new CPU must use the same socket type or slot type and chip set.
 - The BIOS must support the new CPU.
 - The new CPU may require a different heat sink/fan assembly.
 - Make sure the correct voltage is maintained.
 - Use manufacturers' websites to investigate the compatibility between CPUs and other devices.

Selecting a CPU

- **CAUTION:** Always work on an antistatic mat and wear a wrist strap when installing and removing CPUs.
- Remove the existing CPU by releasing it from the socket using the zero insertion force lever.
- Insert the new CPU into place.
 - Pin Grid Array (PGA)
 - Single-Edge Connector (SEC)
 - Land Grid Array (LGA) socket
- Excessive force may damage the CPU or its socket.



Selecting a CPU

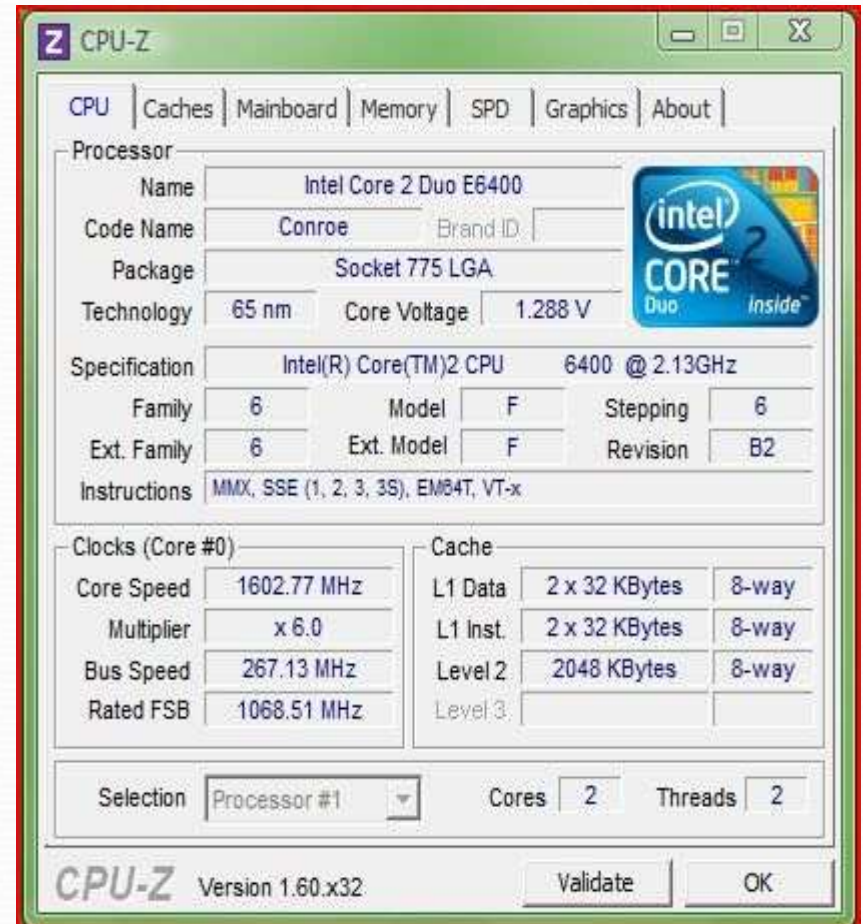
- Cache memory - L1, L2 and L3
 - Processors have areas of fast memory designed to increase the speed and performance of the processor.
 - **L1:** When this area of memory is located inside the processor, it is the primary, or Level 1 (L1), cache. Also the fastest cache.
 - **L2:** Cache memory external to the processor is Level 2 (L2) cache.
 - Starting with the Pentium Pro (1995) and later processors, the L2 cache was included in the processor architecture.
 - Larger than L1 cache but slower.
 - **L3:** After the L2 cache was added to the processor, the extra cache installed on the motherboard was named Level 3 (L3).
 - These CPU caches are much faster than the main memory.

Selecting a CPU

- Multi-core processors - RAM is shared between the processors
- Multi-core processors have two or more processors on the same integrated circuit. Multi-core processors execute instructions more quickly and have increased data throughput than single-core processors. A multi-core processor is recommended for applications such as video editing, gaming, and photo manipulation.
- High power consumption creates more heat in the computer case. Multi-core processors conserve power and produce less heat than multiple single-core processors, thus increasing performance and efficiency.

Test your CPU

- Freeware program that gathers information on some of the main devices of your system including your CPU.
- If you are unsure what type of CPU, it's cache, core etc then this will get that information.

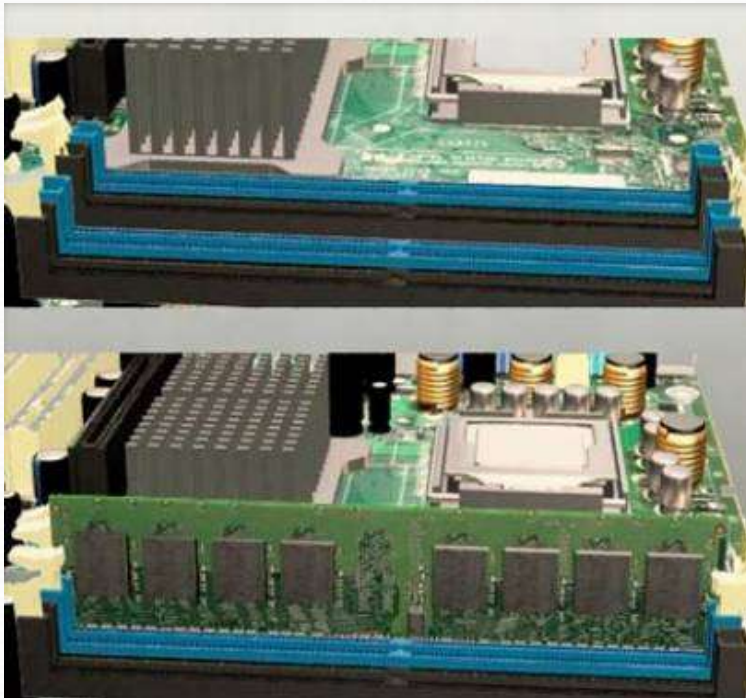


Selecting Heat Sink/Fan and Case Fan

- Heat sink/fan assembly considerations:
 - Socket type
 - Motherboard physical specifications
 - Case size
 - Physical environment
- Case fan considerations:
 - Case size
 - Fan speed
 - Number of components in the case
 - Physical environment
 - Number of mounting places available
 - Location of mounting places available
 - Electrical connections

Selecting RAM

- New RAM may be needed when an application locks up or the computer displays frequent error messages



- When selecting new RAM, check the compatibility with the current motherboard.
- The speed of the new RAM must be the same or faster than the existing RAM.

Selecting Adapter Cards

- Adapter (or expansion) cards add extra functionality to a computer. Before purchasing an adapter card, check:



- Is there an open expansion slot?
- Is the adapter card compatible with the open slot?
- What are the user's current and future needs?
- What are the possible configuration options?

If the motherboard does not have compatible expansion slots, external devices are an option:

- Are USB or FireWire versions of the external device available?
- Does the computer have an open USB or FireWire port?

Selecting Hard Drives and Floppy Drives

- The signs that a hard drive is failing and should be replaced as soon as possible:
 - Unusual noises
 - Error messages
 - Corrupt data or applications
- Replacement options:
 - Solid State Drives
 - Optical Drives
 - External Storage
 - Hard Drive
 - Floppy Disk Drive (limited use)

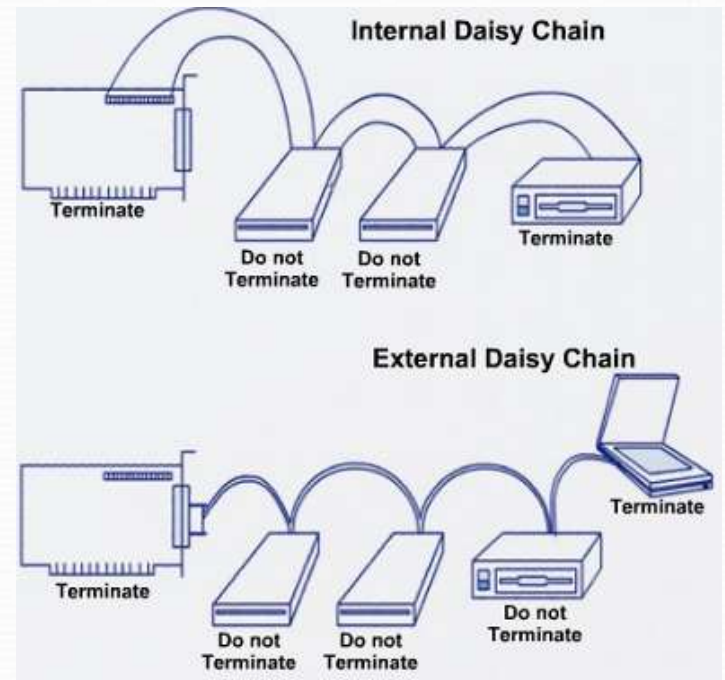
Hard Drive Connectors

- **PATA** (Parallel ATA) hard drives
 - Originally, called **ATA** (Advanced Technology Attachment).
 - With the introduction of SATA, ATA was renamed to PATA.
 - Can use a 40-pin / 80-conductor cable or a 40-pin / 40-conductor cable.
- **SATA** (Serial ATA) hard drives
 - Connect to the motherboard using a serial interface.
 - Have a higher data-transfer rate than PATA drives.
 - Smaller data cable allows for improved airflow.
 - **eSATA** external SATA
- **SCSI** (Small Computer Systems Interface) hard drives
 - use a 50-pin, 68-pin, or 80-pin connector.
 - Up to 15 SCSI drives can be connected to a SCSI drive controller.



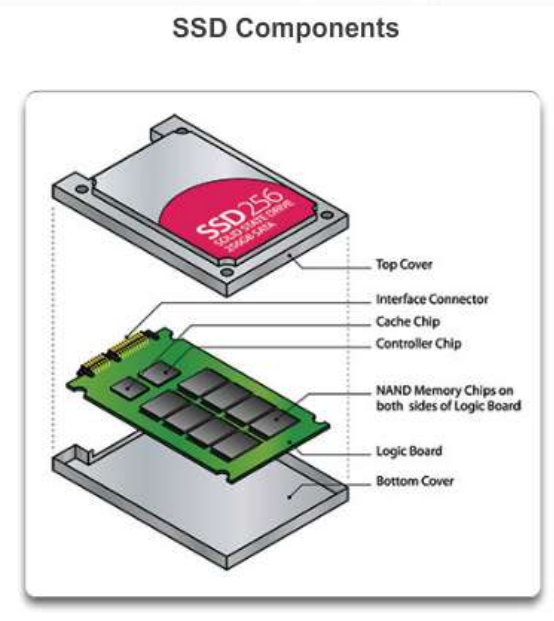
Small Computer Systems Interface (SCSI)

- Usually used for hard drives and for tape storage .
- Ideal for high-end computers, including network servers that require high transfer speeds and reliability.
- SCSI devices are connected in a series, forming a chain that is called a **daisy chain**.
- Each end of the daisy chain is terminated to prevent signal reflections and interference.
- Each device must have a unique SCSI ID.



Selecting Solid State Drives

- **Solid State Drives (SSD)** use static RAM instead of magnetic platters to store data.
- SSDs are highly reliable because they have no moving parts.
- Considerations when selecting:
 - Cost
 - Internal or external
 - Case location
 - System compatibility
 - Power requirements
 - Speed
 - Capacity



Selecting Media Readers

- **Media Reader** -device that reads and writes to different types of media cards, found in a digital camera, smart phone, or MP3 player.
- Considerations when selecting:
 - Internal or external
 - Type of connector used
 - Type of media cards supported

Common Media Cards



SD



microSD



CompactFlash



Memory Stick

Selecting Optical Drives

- **An optical drive** uses a laser to read and write data to and from optical media.
- **CD-ROM** drive can only read CDs.
- **CD-RW** can read and write to CDs.
- **DVD-ROM** drive can only read DVDs and CDs
- **DVD-RW** can read and write to DVDs and CDs. DVDs hold significantly more data than CDs
- A **Blu-ray reader (BD-R)** can only read Blu-ray Discs, DVDs, and CDs.
- A **Blu-ray writer (BD-RE)** can read and write to Blu-ray Discs and DVDs. Blu-ray Discs hold significantly more data than DVDs.

Selecting External Storage

- External storage connects to an external port such as a USB, IEEE 1394 (Firewire), SCSI, or eSATA.
- Considerations when selecting:
 - Port type
 - Storage capacity
 - Speed
 - Portability
 - Power requirements

Selecting Input and Output Devices

- **FireWire (IEEE 1394)** - Transfers data at 100, 200, or 400 Mbps and IEEE 1394b at 800 Mbps.
- **Parallel (IEEE 1284)** - Transfers data at a maximum speed of 3 MBps.
- **Serial (RS-232)** - Early versions were limited to 20 Kbps, but newer versions can reach transfer rates of 1.5 Mbps.
- **SCSI (Ultra-320 SCSI)** - Connects as many as 15 devices with a transfer rate of 320 MBps.
- **USB** interface is widespread and used with many different devices. USB (1.1) , USB 2.0 (480Mbps) and USB 3.0 (5Gbps).
- **SATA** interface is replacing IDE and EIDE as the standard interface for hard drives. The eSATA (external SATA) connection can be hot-swappable.

Specialised Computer Systems

- **CAD or CAM (CAx) workstation**
 - Powerful processor
 - High-end video card
 - Maximum RAM
- **Audio and video editing workstation**
 - Specialised audio card
 - Specialised video card
 - Large, fast hard drive
 - Dual monitors
- **Virtualization workstation**
 - Maximum RAM
 - Maximum CPU cores

Specialised Computer Systems

- **Gaming PC**

- Powerful processor
- High-end video card
- High-end sound card
- High-end cooling
- Large amounts of fast RAM
- Fast storage
- Gaming-specific hardware

- **Home Theater Personal Computer (HTPC)**

- Specialised cases and power supplies
- Surround sound audio
- HDMI output
- TV tuners and cable cards
- Specialised hard drive