Unit 1 (Motherboard and It's Components Objective)

CPU

1: CPU is short for Central Processing Unit. It is also known as a processor or microprocessor.
2: It's one of the most important pieces of hardware in any digital computing system – if not the most important.
3: Inside a CPU there are thousands of microscopic transistors, which are tiny switches that control the flow of electricity through the integrated circuits.
4: CPU is located on a computer's motherboard.
5: A computer's motherboard is the main circuit board inside a computer. Its job is to connect all hardware components together.
6: Often referred to as the brain and heart of all digital systems, a CPU is responsible for doing all the work. It performs every single action a computer does and executes programs.
The CPU can handle interrupts, which are signals that require immediate attention. This allows the CPU to stop its current task and execute a more urgent task.
The CPU can perform mathematical operations like addition, subtraction, multiplication, and division, as well as logical operations like AND, OR, NOT, and XOR.
Modern CPUs can handle multiple threads or tasks at the same time, improving the efficiency and performance of processing.

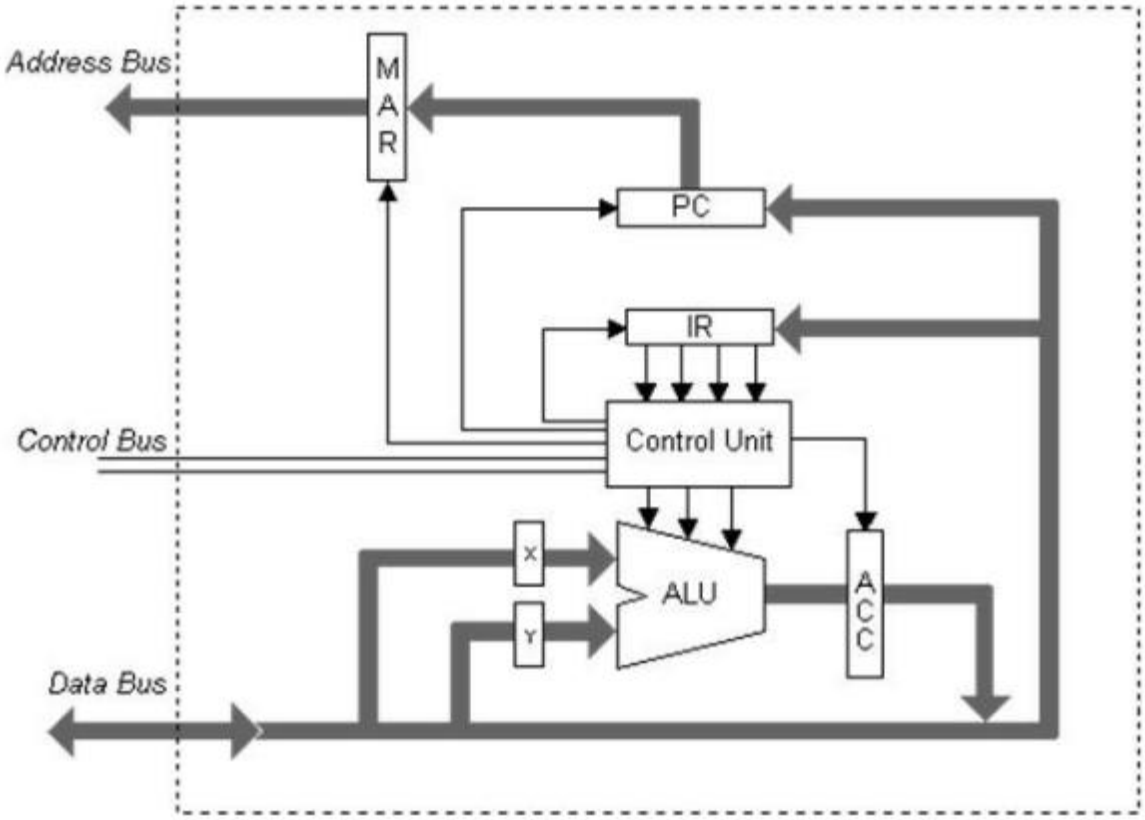


Fig: 1 - A simple CPU design

Components of CPU

1: Arithmetic Logic Unit (ALU): The ALU performs arithmetic and logical operations on the data that is being processed. It can perform tasks like addition, subtraction, AND, OR, and NOT operations.

2: Control Unit (CU): The

control unit manages the execution of instructions by directing the flow of data within the CPU and between the CPU and other hardware components. It fetches instructions from memory, decodes them, and coordinates the execution of operations.

3: Registers: Registers are small, high-speed storage locations within the CPU that hold data temporarily during processing. They are used to store instructions, addresses, and intermediate results. Common types of registers include the program counter (PC), instruction register (IR), and general-purpose registers (such as the accumulator).

These components work together to execute instructions, perform calculations, and manage data within the computer system.

Modes of operation of CPU

Real Mode: In real mode, the processor behaves as a 16-bit processor and can directly address only 1 MB of memory. It lacks memory protection, multitasking, and other modern features.

All processors have this real mode available, and in fact the computer normally starts up in realmode.

Virtual Mode; Virtual mode, also known as protected mode, is a mode that allows the CPU to access memory beyond 1 MB and provides features like memory protection, multitasking, and virtual memory. It's called "virtual" because memory addresses are translated from virtual addresses to physical addresses using a memory management unit (MMU).

Virtual-Real Mode: This is a hybrid mode that allows the CPU to switch between real mode and protected mode. It's used during system startup to transition from real mode (used during system initialization) to protected mode (used by the operating system). It's also known as "unreal mode" because it allows real mode software to access memory beyond 1 MB while still running in real mode. This mode is typically used during system bootstrapping.

Dual Independent Bus Architecture

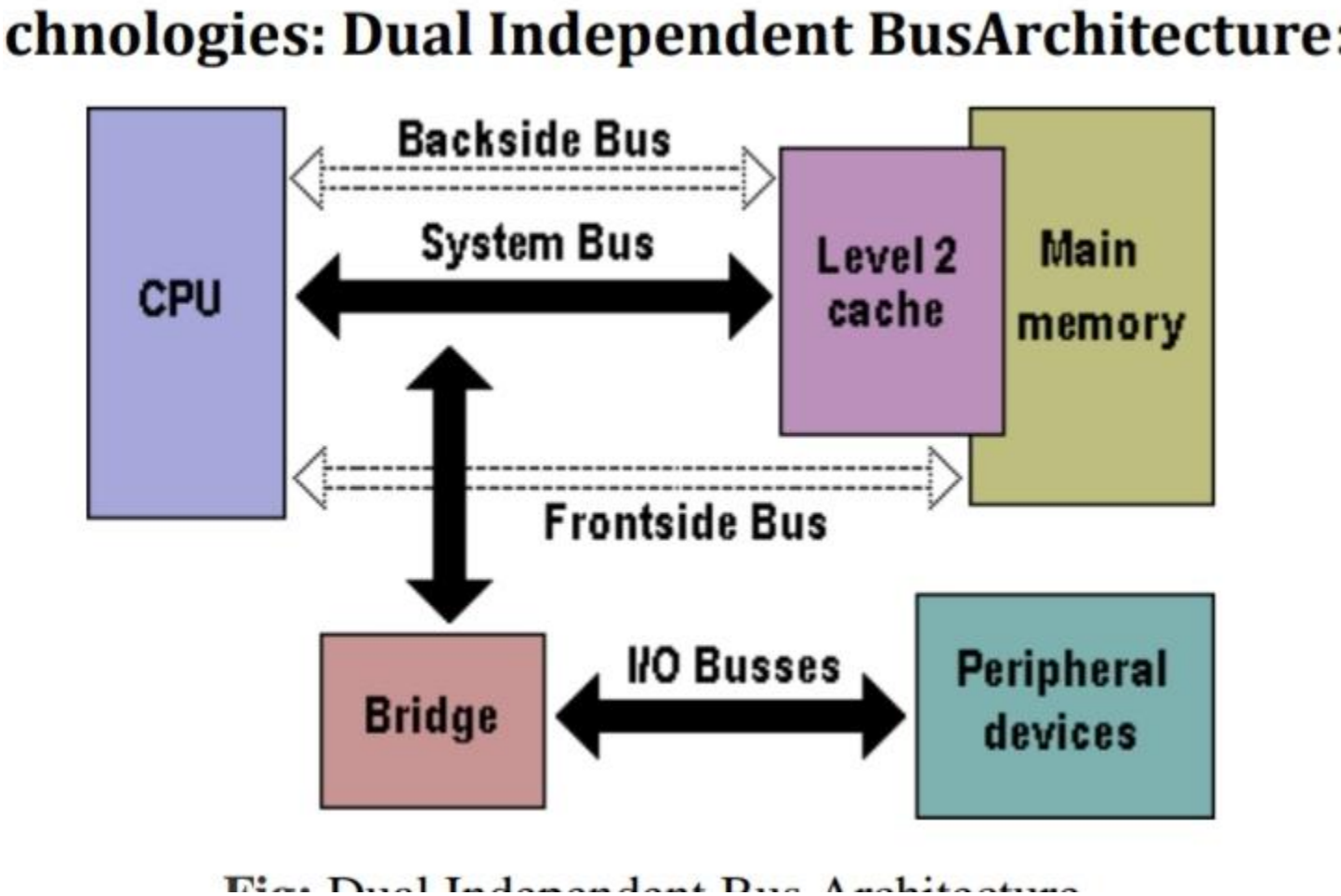


Fig: Dual Independent Bus Architecture

North bridge and South Bridge

1. North Bridge : North bridge is one of the two chips located in the direction towards North in the motherboard. The main function of North bridge is to manage the communications between the Central Processing Unit and parts of motherboard. North bridge is directly towards Front Side Bus (FSB). Other names for North bridge are host bridge and Memory Controller Hub (MCH).

2. South Bridge : South bridge is the another chip of the logical chipset architecture. It is located to the South of Peripheral Component Interconnect (PCI) bus in the motherboard. The main function of South bridge is to control the IO functioning. The North bridge is the medium that

connects South bridge and Central Processing Unit. IO Controller Hub is the other name given to South bridge for its functionality.

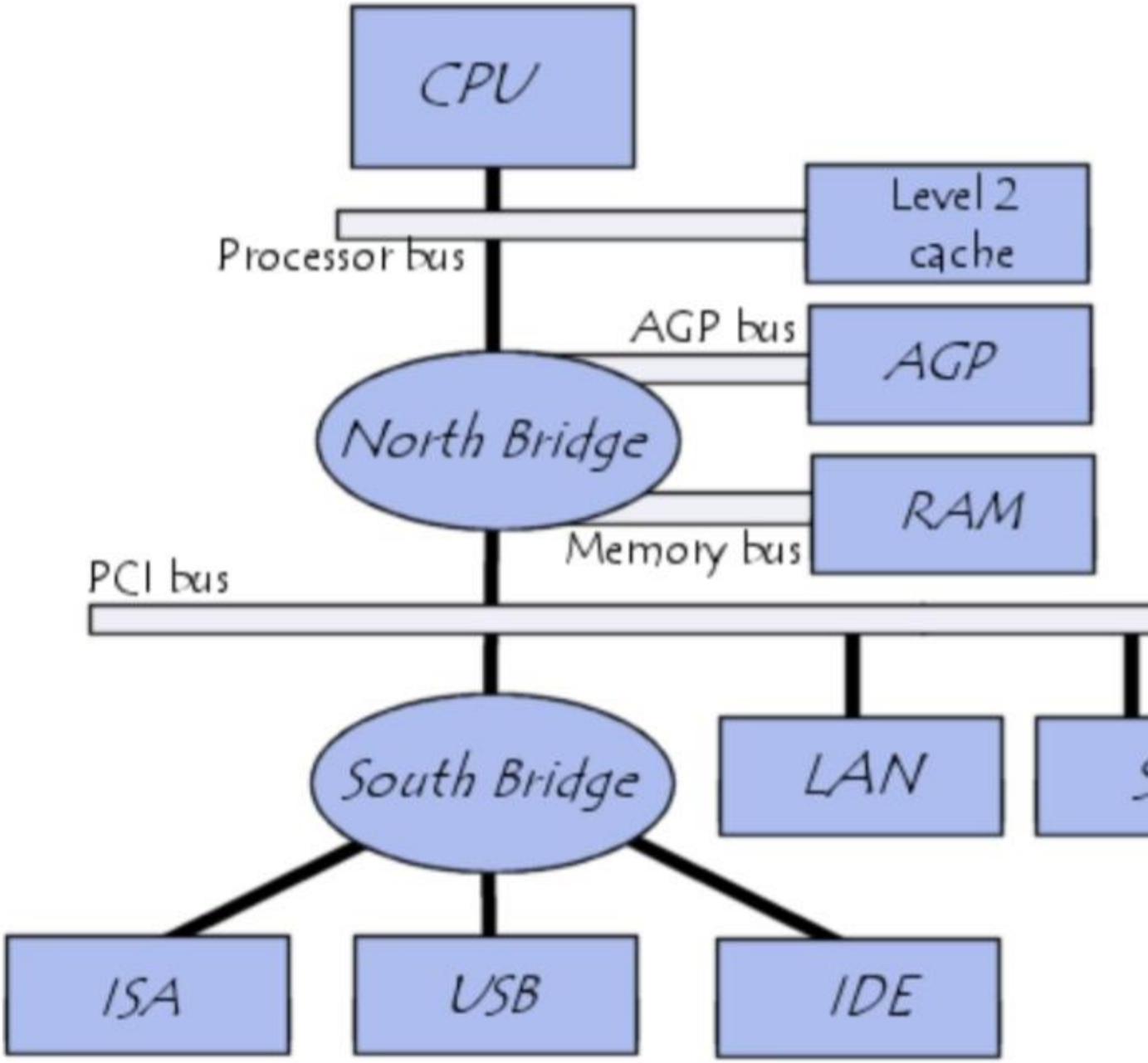


Fig: Northbridge & Southbridge Architecture

Features of PCI bus:

1. **Signaling Environment :** Support both 3.3 and 5 volt signaling environments.
2. **Reliability:** It offers the ability to replace modules without disturbing a system's operation called as hot plug and hot swap.
3. **Speed:** It can transfer up to 132 MB per second.
4. **Configurability :** The ability to configure a system automatically means automatically identify the interfacing systems and assigns new addresses.
5. **Synchronous bus architecture :** PCI is a synchronous bus where data transfer takes place according to a system clock.
6. **32 and 64 bit addressing :** The PCI bus also supports 64 bit addressing with the same 32 bit connector.
7. **Large bandwidth :** It can handle both 32 bit as well as 64 bit data hence the maximum bandwidth will be 132 MB per second.

Features of PCI-X bus

The PCI-X bus, an extension of the original PCI bus, offers several key features:

1. Increased Speed: PCI-X provides higher data transfer rates compared to traditional PCI.

2. 64-bit Data Bus: PCI-X supports a wider data bus compared to the 32-bit bus of PCI, allowing for larger amounts of data to be transferred simultaneously.

3. Extended Addressing: PCI-X supports extended addressing capabilities, allowing access to larger memory spaces and addressing up to 64 GB of memory.

4. Enhanced Error Handling: PCI-X includes features for improved error detection and handling, helping to ensure data integrity and system reliability.

5. Multiple Bus Widths: PCI-X supports different bus widths, including 32-bit and 64-bit configurations.

Features of PCI Express

1. Point-to-Point connection: PCI Express is a point-to-point connection, which means it does not share bandwidth but communicates directly with devices via a switch that directs data flow.

2. Hot Swapping & Plugging: This allows for "hot swapping" or "hot plugging," which means cards in PCIe slots can be changed without shutting down the computer.

3. Less Power Consumption: It consumes less power than previous PCItechnology.

4. Scalable: One of the most promising features of PCI-Express is that it is scalable, which means greater bandwidth can be achieved through adding more"lanes.

Advantages of PCI-E over PCI-X

1. Interface: PCI Express is a serial interface format, unlike PCI and PCI-X, which are parallel interface formats.

2. High Speed: The 32-bit PCI bus has a maximum speed of 33 MHz, which allows a maximum of 133 MB of data to pass through the bus per second.

3. Point to Point Communication: PCI Express is designed to support chip-to-chip connections, board-to-board connections, and hot pluggable devices.

4. Superior Performance and Scalability: Another advantage of PCI Express over PCI and PCI-X is the amount of bandwidth the former can support while using significantly fewer pins and traces.

5. Full Compatibility with the PCI Software Model: PCI Express uses the same load/store I/O architecture as PCI and PCI-X. This similarity makes PCI Express fully compatible with the PCI software mode.

Features of AGP bus

1. It has high quality and very fast performance.
2. It has a direct path to the PC's main memory.
3. It connects to the CPU and operates at the speed of the processor bus.
4. It sends video information more quickly to the card for processing.
5. It uses the main memory to hold 3D images.
6. It provides the graphics card with two methods of directly accessing texture maps in system memory: pipelining and sideband addressing.

Comparison between AGP & PCI

1. AGP is a port (it only connects two nodes) while PCI ia bus.
2. AGP can access the system memory via complex operations while PCI can only access the memory inside the actual card.
3. AGP also doesn't share bandwidth with other local devices while PCI does.
4. AGP does not replace the PCI bus, it is a dedicated connection that can be used only by the graphics subsystem.
5. AGP transaction are multiples of 8 bytes in length and are aligned on 8 byte boundaries,while PCI transactions must be multiples of 4 bytes and are aligned on 4 byte boundaries.

Extended Memory

1. All above the 1 Mb is called extended memory.
2. Extended memory refers to any amount of memory that is available for use over the main memory that is inherent in most DOS systems.
3. In most cases, this means that any memory over the 1 megabyte (MB) that is supported by DOS would be considered extended memory.
4. This is all above the high memory area until the end of system memory.
5. Memory of this type is supported by the use of certain types of microprocessors that allow loading and access to the extended memory.
6. It is best for windows & multitasking operating system.

Difference Between DDR1, DDR2, DDR3 And DDR4

DDR RAM:

1. It stands for DDR RAM (Double Data Rate).

2. It transfers data on rising and falling edge of clock.

3. Hence it has data transfer rate double compare to SDR SDRAM type.

4. It was released in 2000.

5. Its Internal Rate (MHz) Clock Speed is 133 to 200 MHz.

6. The prefetch is 2n.

DDR2 SDRAM:

1. It stands for Double Data Rate 2 Synchronous Dynamic Random Access Memory.

2. It operates external data bus two times faster compare to DDR1 SDRAM

type or DDR SDRAM.

3. It was released in 2003.

4. Its Internal Rate (MHz) Clock Speed is 133 to 200 MHz.

5. The prefetch is 4n.

DDR3 SDRAM:

1. It stands for double data rate 3 Synchronous Dynamic Random Access Memory.

2. Its power consumption is less compare to previous version i.e. DDR2 which is about 40% less. This is due to use of lower operating voltage of 1.5V.

3. It was released in 2007.

4. Its Internal Rate (MHz) Clock Speed is 133 to 200 MHz.

5. The prefetch is 8n.

DDR4 SDRAM:

1. It stands for double data rate fourth-generation synchronous dynamic random-access memory.

2. It provides further lower operating voltage and faster transfer rate compare to other DDR types.

3. It was released in 2014.

4. Its Internal Rate (MHz) Clock Speed is 133 to 200 MHz.

5. The prefetch is 8n.

Types of Cache Memory

1. Level 1 Cache (L1):

1. Located directly on the CPU core.
2. Very small in size, typically ranging from 16KB to 128KB.
3. Extremely fast access times, often measured in single-digit cycles.
4. Divided into separate instruction and data caches.
5. Expensive to manufacture due to its proximity to the CPU core.

2. Level 2 Cache (L2):

1. Located on the CPU die but farther away from the core compared to L1 cache.
2. Larger in size compared to L1 cache, ranging from 128KB to several megabytes.
3. Slightly slower access times compared to L1 cache but still significantly faster than accessing main memory.
4. Shared between different CPU cores in multi-core processors.
5. More cost-effective than L1 cache due to larger size but still more expensive than main memory.

Cache hit

1. A cache hit describes the situation where your site's content is successfully served from the cache.
2. The tags are searched in the memory rapidly, and when the data is found and read, it's considered as a cache hit.
3. A cache hit is when content is successfully served from the cache instead of the server.

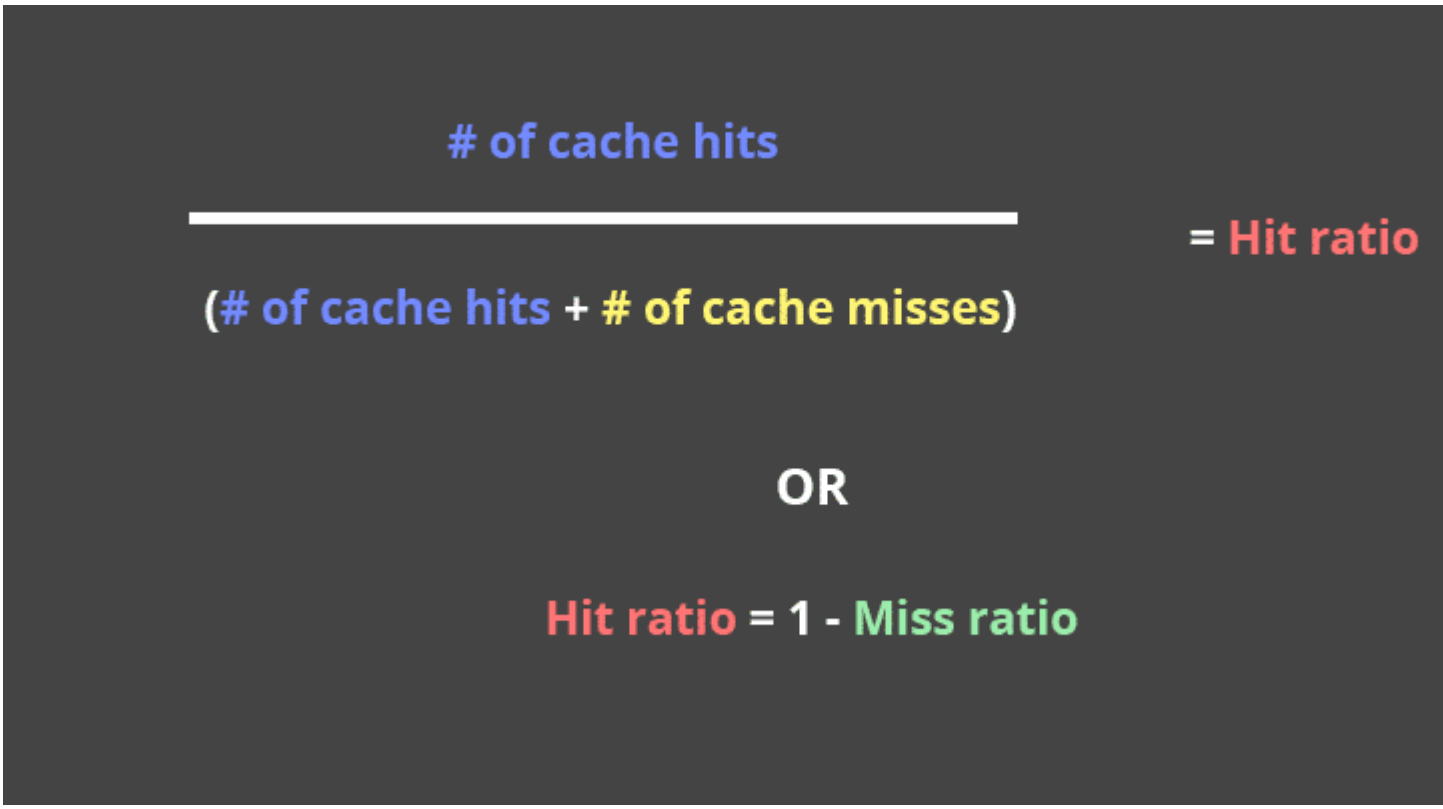
4. A hot cache is an instance where data was read from the memory at the fastest possible rate. This happens when the data is retrieved from L1.
5. A cold cache is the slowest possible rate for data to be read, The data is just found lower in the memory hierarchy such as in L3, or lower.
6. A warm cache is used to describe data that's found in L2 or L3. It's not as fast as a hot cache, but it's still faster than a cold cache.

Cache miss

1. A cache miss refers to the instance when the memory is searched, and the data isn't found. When this happens, the content is transferred and written into the cache.
2. Reducing the frequency of cache misses is crucial for optimizing CPU performance and improving system responsiveness.
3. Strategies such as cache optimization, data locality improvement, and code restructuring can help mitigate the impact of cache misses and enhance overall system efficiency.

Cache hit ratio

1. Cache hit ratio, also known as cache hit rate, is a metric that measures how well a cache is at fulfilling content requests.
2. It's calculated by dividing the number of cache hits by the total number of cache hits and misses.
3. Cache hit ratio is measured as a percentage.
4. A higher ratio means the cache is more effective at improving query performance.
5. A high cache hit ratio means that most requests have been fulfilled by the cache, which can lead to faster load times.



BIOS

The BIOS, or Basic Input/Output System, is a firmware embedded into the motherboard of a computer. It is the first software that runs when you turn on the computer, initializing and testing hardware components to ensure they are functioning properly.

Here's a breakdown of the BIOS's functions:

1. Power-On Self Test (POST): The BIOS conducts a series of tests known as the POST to check the functionality of essential hardware components such as the CPU, RAM, storage devices.

2. Hardware Initialization: Once the POST completes successfully, the BIOS initializes various hardware components, setting them up for use by the operating system.

3. System Configuration: The BIOS contains settings that allow users to configure certain aspects of their computer's hardware.

4. BIOS Updates: The BIOS firmware can be updated to provide bug fixes, performance improvements, and support for new hardware.

5. UEFI: In modern computers, the BIOS is gradually being replaced by UEFI (Unified Extensible Firmware Interface), which offers more advanced features compared to BIOS.

Motherboard selection criteria

1. CPU Socket Compatibility: Ensure that the motherboard's CPU socket matches the processor you intend to use. Different CPUs use different socket types.

2. Memory Support: Check the motherboard's memory specifications to ensure compatibility with your RAM.

3. Expansion Slots: Consider the number and type of expansion slots the motherboard offers. These slots accommodate components like graphics cards, sound cards, Wi-Fi adapters, and storage expansion cards.

4. Storage Options: Look for the types and number of storage connectors available on the motherboard. Common connectors include SATA ports for traditional hard drives and SSDs,

5. BIOS Features: A feature-rich BIOS with intuitive user interfaces and overclocking options can enhance your experience.

Unit 2 (Storage Devices and Interfacing Objectives)

FM Encoding Scheme

1. FM or Frequency Modulation was the original data-encoding scheme used for storing the data on the magnetic recording surface.
2. This method of data encoding is also known as the“Single density recording”.
3. In this method,a clock signal is put with every data signal on there cording surface.
4. This clock signal is used for synchronizing the read operation,as there will always be a clock signal, whether the data signal is there or not.
5. In this FM method of data recording a 1 bit is stored as two pulses (one clock pulse and one data pulse),and a 0 bitis stored as a one pulse and one gap or no pulse.

6. For example, a binary number 1011 will be stored as PP PN PPPP.

MFM Encoding Scheme

1. More data can be stored on the same surface or the data storage density can be increased, if the number of pulses required to store the data can be minimized.

2. It is able to store more data without any data and synchronization loss.

3. In MFM recording the 0s and 1s are encoded as given below:

● 1 is always stored as no pulse, and a pulse(NP)

● 0, when preceded by another 0, is stored as a pulse, and no pulse(PN)

● 0, when preceded by a1,is stored as two no pulses(NN)

● If you store 1001 on the disk surface using the MFM storage method, it would be

stored as NP NNPN NP.

RLL Encoding Scheme

1. The RLL is encoding or the run length limited encoding is the most common encoding scheme used in the hard disk storage.

2. This encoding scheme can be more accurately called as 2,7 RLL encoding because in this scheme, in a series or in a running length the minimum number of 0s next to each other is two, and the maximum number of 0s together cannot be more than seven.

3. The RLL encoding scheme can store 50 percent more information than MFM encoding scheme on a given surface and it can store three times as much information as theFM encoding scheme.

4. For example, if you want to encode a byte 100011 to proper RLL pulse signal then theBit10 can be encoded as NPNN.

Hard DiskPlatters (Disks)

1. The platters stores information.

2.It comes in varying sizes like 5.12”, 3.14”, 0.85”etc
3. The physical size of a drive is expressed as the sizeof the platters
4. Most hard disk have two or more platters
5. Platters were originally made from an aluminum/magnesium alloy which provides both strength and lightweight
6. All modern drives use glass or glass ceramic plates.

Master Boot Record (MBR)

1. The Master Boot Record (MBR) is a crucial part of the storage architecture in most computers.

2. It's the first sector of a storage device like a hard disk or solid-state drive, containing the information necessary for the computer to boot up the operating system.

3. The initial 446 bytes of the MBR contain the bootstrap code.

4. Following the bootstrap code is the partition table, which occupies the next 64 bytes of the MBR.

5. The partition table describes the layout of the disk and provides information about each partition.

6. The next four bytes store a unique disk signature, which is used by the operating system to identify the disk.

7. Finally, the last two bytes of the MBR contain a signature, which serves as a validation check.

Low Level Formatting

1. It is done at the factory level.

2. In low level formatting all the data stored on the disk is lost as the disk is physically formatted.

3. It magnetically divides the disk into tracks and sector.

4. Basic addressing information is written to each sector of each cylinder.

5. It checks for bad sectors and maps them out.

High Level Formatting

1. It is done with the help of OS.

2. High level Format program scans the disk for tracks and sectors marked bad during low level formatting.

3. The scanning program performs five retries to read the tracks or sectors. If the tracks are still unreadable, the area is noted as bad

cluster in FAT.

4. After scanning the entire disk, the drive heads return to the first sector of the partition and write MBR.

5. Immediately in the next sector 1st copy of FAT is written and after that 2nd copy of FAT is written.

6. Initially FATS are blank except for the bad cluster marks found in the initial scan.

7. After the 2nd copy of FAT blank root directory is created.

FAT

1. FAT stands for File Allocation Table. It's a file system used for organizing and managing files on storage devices like hard drives, USB flash drives, and SD cards.

2. FAT is known for its relatively simple structure, which makes it easy to implement and compatible with a wide range of devices and operating systems.

3. The core of the FAT file system is its file allocation table(s). These tables keep track of the clusters (allocation units) on the storage device and their allocation status.

4. FAT allocates storage space in clusters rather than individual sectors.

5. FAT is widely supported by various operating systems, including Windows, macOS, Linux, and many others.

Compare FAT 16, FAT 32, NTFS

Features	NTFS	FAT32	FAT16	FAT12
Max Partition Size	2TB	32GB	4GB	16MB
Max File Size	16TB	4GB	2GB	Less than 16MB
Cluster Size	4KB	4KB to 32KB	2KB to 64KB	0.5KB to 4KB
Fault Tolerance	Auto Repair	No	No	No
Compression	Yes	No	No	No
Security	Local and Network	Only Network	Only Network	Only Network
Compatibility	Windows 10/8/7/XP/Vista/2000	Windows ME/2000/XP/7/8.1	Windows ME/2000/XP/7/8.1	Windows ME/2000/XP/7/8.1

PATA Parallel Advanced Technology Attachment(IDE)

1. Proven and reliable technology integration.

2. Upto 133 MB/s interface transfer rate.

3. PATA allows cable lengths upto 18 inches(46 cms).

4. Designed for desktop PCs and Notebook PCs with usage in entry serversand consumer electronics as well.

5. PATA is based on the original IBM PC ISA bus.

SCSI Small Computer System Interface

1. Fast and wide Data Path.

2. Supports upto 7 peripheral Devices such as CD-Rom, scanner that can attach to a single SCSI port.

3. Faster than the average parallel interface.

4. It will allow data transfer upto 100 MB/s to 160 MB/s.

5. SCSI is now plug and play in nature such as automatic SCSI ID assigning andtermination.

SATA (Serial Advanced Technology Attachment)

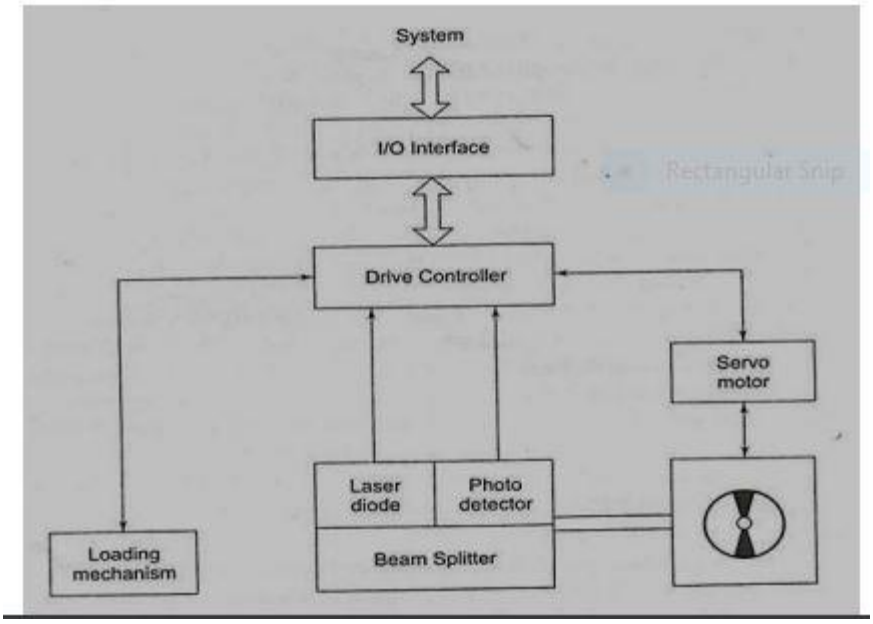
1. SATA is better more efficient interface than the dated PATA standard.

2. It supports hot swapping.

3. Serial ATA uses only 7 conductors while PATA uses 40.

4. Data Transfers at the rate of 1.5 Gbit/s, 3 Gbit/s and 6 Gbit/s.

Working of CD-ROM drive



1. The laser diode emits a low –energy infra-red beam towards the reflecting mirror.

2. The servo motor positions the beam onto the correct track on the CD ROM by moving the reflecting mirror.

3. When the beam hits the disc, its reflected light is gathered and focused through the first lens beneath the platter, bounce off the mirror and sent towards the beam splitter.

4. The beam splitter directs the returning laser light towards another focusing lens.

5. The last lens direct the light beam to a photo detector and convert the light into electric impulses.

6.These incoming impulses are decoded by the microprocessor and sent along to the host computer as data.

Unit 3 (Display Devices and Interfacing)

Electron Gun

1.The role of this gun is to produce electrons at a high, fixed, velocity.
2. This is done through a process known as thermionic emission.
3. A filament in the cathode is heated to the point where its electrons become loose.
4. An anode with a high voltage applied to it accelerates the electrons towards the screen due to electrostatic attraction.
5. On the way, the electrons pass through a series of control grids which control the brightness of the image produced.
6. The more negative the grid, the darker the image and vice versa.

Deflection system

1.The role of the deflection system is to control the image produced by controlling the position that the electrons hit the screen.

2. It consists of Two PERPENDICULAR sets of Electric/Magnetic fields.

3. This allows control over both horizontal and vertical axes.

4. By controlling the Voltage applied to the fields, it is possible to vary the deflection

through Electrostatic force/Motor effect.

Fluorescent screen

1. The role of this part is to display where the electrons are hitting the CRT.

2. It is a screen coated with a material that emits light when struck by electrons.

3. Zinc sulfide or Phosphorus are two commonly used materials.

Working of CRT Monitor

1. An electron gun consists of a series of electrodes producing a narrow beam of high velocity electrons.

2. When voltage is applied to the heater coil the cathode energizes the electrons and starts the emission of electrons

3. The intensity of the beam is controlled by variation of the negative potential of the cylindrical control grid surrounding the cathode.

4. The control grid has a hole in the front to allow passage of the electron beam.

5. The focus grid adjust its potential to achieve the desired focus. The electrons are accelerated and focused on the fluorescent screen In order to eliminate flicker, most monitors refresh the screen at a 60 Hz rate.

Characteristics of CRT Monitor

1. Pixel or picture element: It is the smallest are of the monitor screen that can be turned on or off to

help create an image.

2. Dot Pitch: Measurement of how close the holes (in the mask) are to each other. The closer the

holes, smaller is the dot pitch and sharper is the image.

3. Resolution: Amount of detail a monitor can show. It is expressed in terms of number of horizontal

and vertical pixels contained in the screen.

4. Video Bandwidth: It is the maximum input frequency that a monitor can handle. It helps in

determining the resolution capability of the monitor.

Interlaced scanning

Interlace scanning is a technique used in traditional TV broadcasting and video to display images.

Here's a simple breakdown:

1. A video frame, or picture, is made up of horizontal lines stacked on top of each other.
2. Instead of showing all the lines at once, interlace scanning splits the picture into two sets of lines:
3. The first set includes odd lines such as the 1st, 3rd, 5th lines, and so on.
4. The second set includes even lines such as the 2nd, 4th, 6th lines, and so on.
5. The TV or monitor displays these sets of lines alternately.
6. This alternation happens so quickly (typically 50 or 60 times per second) that your eyes blend the two sets of lines together, making it look like a complete, smooth picture.
7. It reduces the amount of data needed to be transmitted and displayed at one time

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Non Interlaced scanning

1. In non-interlace scanning, the entire picture (or frame) is displayed on the screen at once, from top to bottom. Each line is drawn in sequence, one after the other.
2. Unlike interlace scanning, there is no splitting of lines into odd and even sets.
3. Every frame contains all the lines of the image.
4. The screen refreshes continuously, displaying one full frame after another. This typically happens many times per second (like 24, 30, 60, or even 120 times per second).
5. Progressive scanning tends to produce sharper and clearer images, especially for scenes with a lot of detail or fast motion.

6. Because each frame is displayed in its entirety without the rapid alternation of interlaced fields, there is less flicker.

Difference between Interlaced Scanning and Non Interlaced Scanning

Sr. No	Interlaced Scanning	Non Interlaced Scanning
1	Scan every other line of image in one pass & remaining line in other Pass	Scan all lines in one Pass
2	Difficult on eyes	Easy on eyes
3	Flicker is more	Flicker is less
4	Effective image refresh rate is half of vertical scanning rate	Entire image is refresh at vertical scanning rate.

Advantages of CRT display over LCD display

1. CRT monitors cost less than LCDs.

2. CRT monitors represent colors and different generations of colors better than LCD monitors.

3. CRT monitors have fewer problems with ghosting and blurring because they redraw screen image faster than LCD monitors.

4. CRT monitors can handle multiple resolutions, LCD monitors do not.

5. CRT monitors are more rugged than LCD monitors.

LCD(Liquid Crystal Display)

1. A liquid crystal display or LCD draws its definition from its name itself.

2. It is combination of two states of matter, the solid and the liquid.

3. LCD uses a liquid crystal to produce a visible image.

4. Liquid crystal displays are super-thin technology display screen that are generally used in laptop computer screen, TVs, cell phones and portable video games.

5. LCD's technologies allow displays to be much thinner when compared to cathode ray tube (CRT) technology.

6. Liquid crystal display is composed of several layers which include two polarized panel filters and electrodes.

7. This combination of colored light

with the grayscale image of the crystal

forms the colored image. This image is then displayed on the screen.

Working of LCD

Layers: An LCD consists of several layers:

- Backlight: Provides the light source.
- Polarizing Filters: Two filters that only let light waves oriented in a specific direction pass through.
- Liquid Crystal Layer: Contains liquid crystal molecules that can change orientation when an electric current is applied.
- Color Filters: Tiny red, green, and blue (RGB) filters that create the color in each pixel.
- Glass Substrates: Protect the liquid crystals and hold the components together.

How LCD Works

1. The backlight shines a constant, white light through the first polarizing filter.
2. Polarization filter only allows light waves oriented in one direction to pass through.
3. In their natural state, the liquid crystal molecules twist the light passing through them, so it can pass through the second polarizing filter, which is oriented 90 degrees to the first.

4. When an electric current is applied to the liquid crystals, they align themselves in such a way that they do not twist the light, blocking it from passing through the second polarizing filter.
5. A pixel is composed of three sub-pixels with red, green, and blue color filters.
6. By adjusting the voltage applied to the liquid crystals in each sub-pixel, the amount of light that passes through can be controlled. This allows each sub-pixel to display different levels of brightness.
7. The entire screen is made up of millions of these tiny pixels. By controlling the light and color of each pixel, the LCD can display images, text, and videos.

Passive matrix LCD

1. They use a simple grid to supply the charge to a particular pixel on the display.

2. The liquid crystal material is sandwiched between the two glass subtrates and a polarizing film is added to the outer side of each substrate.

3. To turn on a pixel, the integrated circuit sends a charge down the correct column of one substrate and a ground activated on the correct row of the other.

4. The row and column intersect at the designated pixel, and that delivers the voltage to untwist the liquid crystals at that pixel.

5. When sufficient voltage is placed across the pixel, the liquid crystal

molecules align parallel to the electric field.

Active matrix LCD

1. In active matrix LCDs, a switching device and a storage capacitor are

integrated at each cross point of the electrodes.

2. The active addressing removes the multiplexing limitations by incorporating an active switching element.

3. In contrast to passive matrix LCDs, active matrix LCDs have no inherent limitation in the number of scan lines, and they present fewer cross talk issues.

Advantages of an LCD

1. LCD’s consumes less amount of power compared to CRT and LED.

2. LCD’s are consist of some microwatts for display in comparison to some mill watts for LED’s.

3. LCDs are of low cost

4. Provides excellent contrast.

5. LCD’s are thinner and lighter when compared to cathode ray tube and LED.

Disadvantages of an LCD

1. Require additional light sources.

2. Range of temperature is limited for operation.

3. Low reliability.

4. Speed is very low.

5. LCD’s need an AC drive.

Touch screen display

1. A touch screen display works using a technology that detects the location of your touch.

2. There are different types of touch screen technologies, but one common one is called capacitive touch.

3. In a capacitive touch screen, there's a layer of material that holds an electrical charge covering the screen.

4. When you touch the screen with your finger, it disrupts the electrical field, and the device can detect where that disruption happened.

5. It then translates that information into commands, like opening an app or typing a letter, based on where you touched.

6. This happens really quickly, so it feels like the device responds instantly to your touch.

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plasma display panel

1. A plasma display panel (PDP) is a type of flat-panel display technology used in televisions and monitors.

2. It's made up of thousands of tiny cells filled with gas (usually a mix of neon and xenon).

3. When an electrical charge is applied to these cells, the gas becomes ionized, creating ultraviolet light.

4. This light then excites phosphors on the screen, causing them to emit colored light, which forms the images you see.

5. Plasma displays were popular for their vibrant colors and wide viewing angles, but they've become less common with the rise of LCD and OLED displays, which are more energy-efficient and thinner.

Video Accelerator card

1. The core of the accelerator is the graphics chip (or Video chipset).

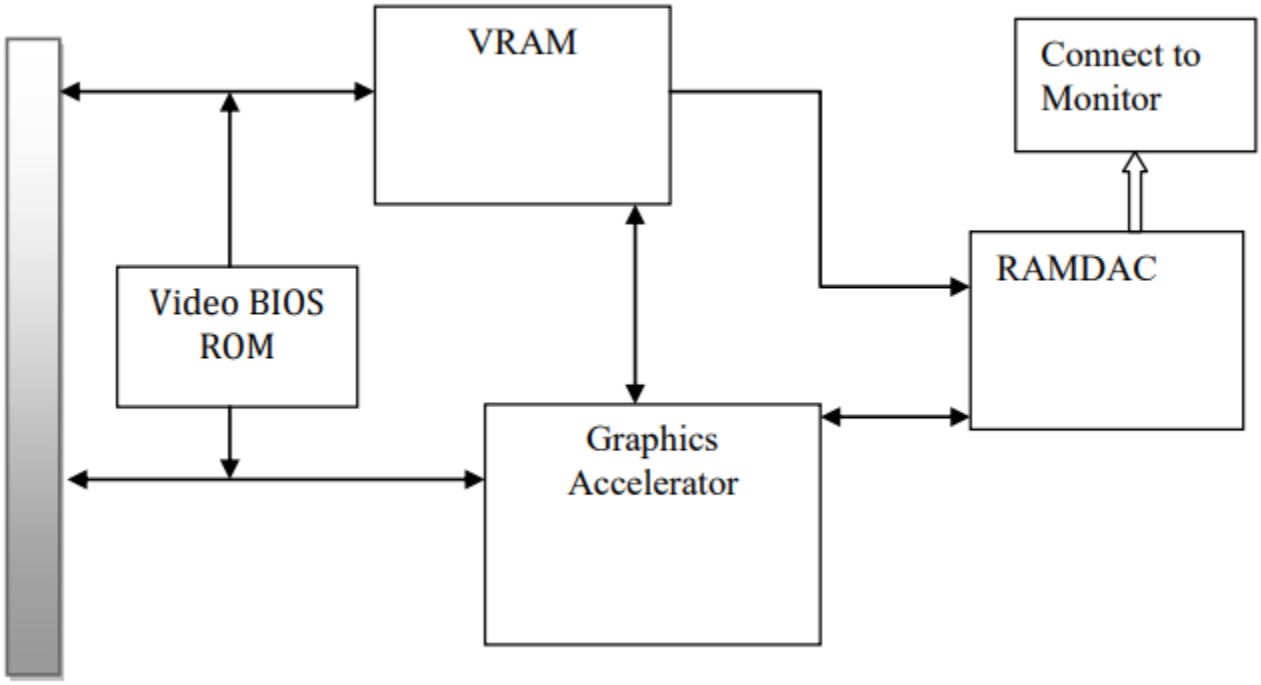
2. The graphics chip connects directly with the PC expansion bus.

3. Graphics command and data are transmitted into pixel data and stored in Video memory offers a second data bus that is routed directly to the Video board’s RAM DAC (Random Access Memory Video to Analog Converter).

3. The graphics chip directs RAM DAC operation and ensures that VRAM data is available.

4. The RAM DAC then translates Video data into red, green and horizontal and vertical synchronization signals output signals generated by the monitor.

5. This architecture may appear simple, but this is due to high level of integration provided by the chipsets being used.


VRAM
Connect to Monitor
Video BIOS ROM
RAMDAC
Graphics Accelerator

Unit 4 (Input and Output Devices)

Keys & Description

S.No	Keys & Description
1	Typing Keys **These keys include the letter keys (A-Z) and digit keys (09) which generally give the same layout as that of typewriters.**
2	Numeric Keypad **It is used to enter the numeric data or cursor movement. Generally, it consists of a set of 17 keys that are laid out in the same configuration**

	used by most adding machines and calculators.
3	Function Keys **The twelve function keys are present on the keyboards which are arranged in a row at the top of the keyboard. Each function key has a unique meaning and is used for some specific purpose.**
4	Control keys **These keys provide cursor and screen control. It includes four directional arrow keys. Control keys also include Home, End, Insert, Delete, Page Up, Page Down, Control(Ctrl), Alternate(Alt), Escape(Esc).**
5	Special Purpose Keys **Keyboard also contains some special purpose keys such as Enter, Shift, Caps Lock, Num Lock, Space bar, Tab, and Print Screen.**

Unit 5 (Power Supplies)

SMPS

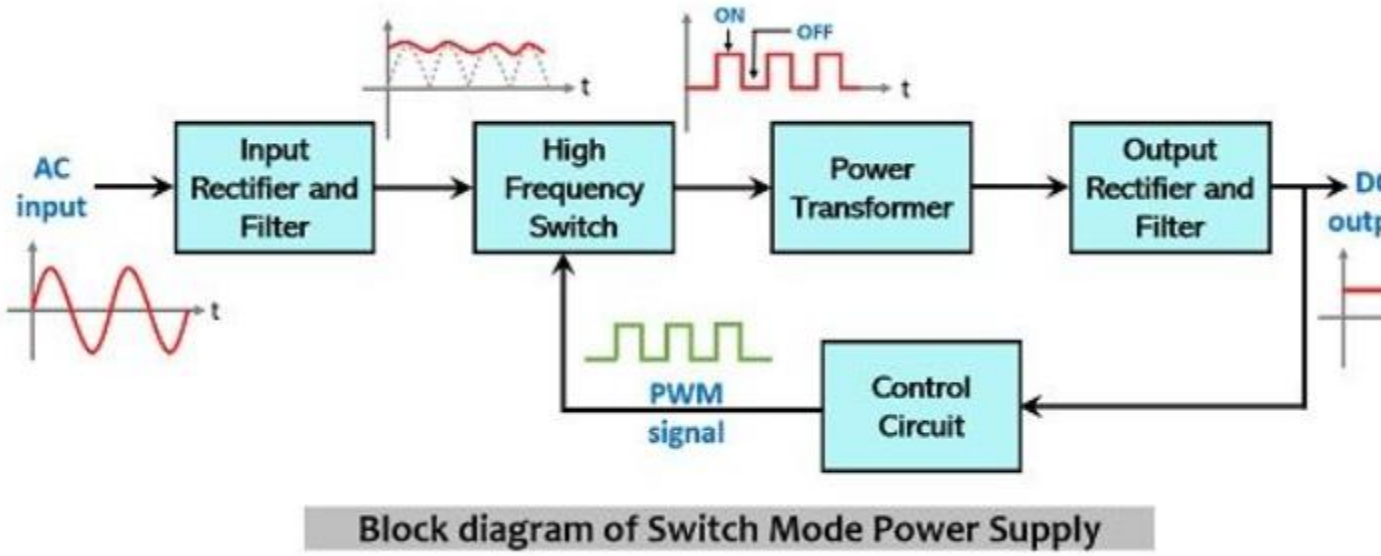
1. Switch mode power supplies (SMPSs) are used in a range of applications as an efficient and effective source of power.
2. This is in major part of their efficiency.
3. For anybody still working on a desktop, look for the fan output in the central processing units (CPU).
4. That's where the SMPS is.
5. SMPS offers advantages in terms of size, weight, cost, efficiency and overall performance.
6. These have become an accepted part of electronics gadgets.
7. Basically, it is a device in which energy conversion and regulation is provided by power semiconductors that are continuously switching "on" and "off" with high frequency.

Block Diagram and Working of SMPS

The major components that constitute SMPS are as follows:

1. Input rectifier and Filter (Diode rectifier and capacitor filter)
2. High-frequency switch (Power transistor or MOSFET)
3. Power transformer
4. Output rectifier and Filter (Diode rectifier and capacitor filter)
5. Control circuit (comparator and pulse width modulator)

The figure given below represents the functional block diagram of SMPS:



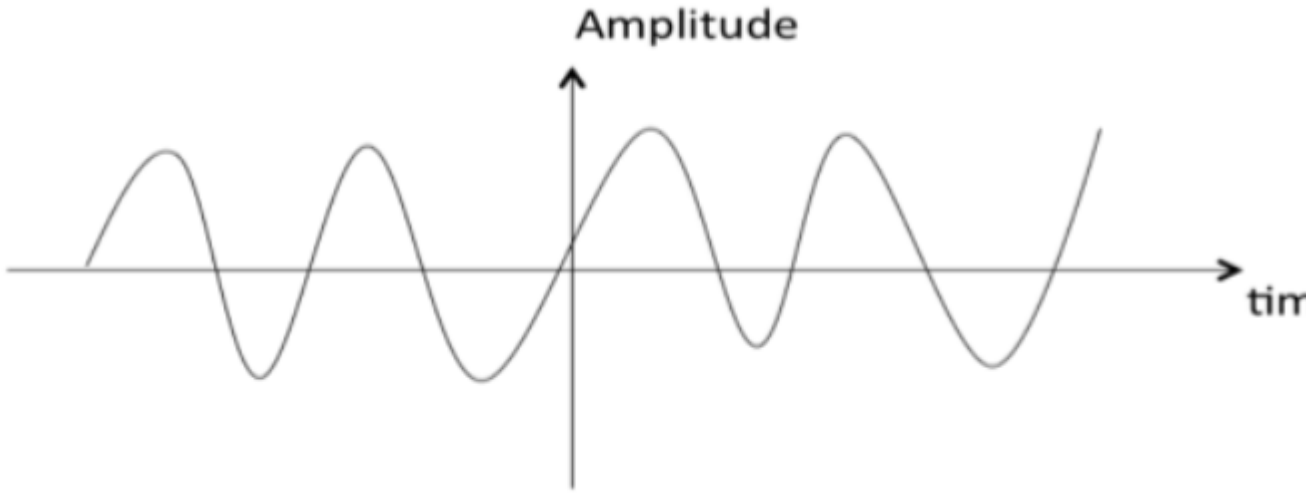
Block diagram of Switch Mode Power Supply

1. The input signal from the source undergoes rectification and smoothing to generate a DC signal, then enters a chopper circuit where it is switched on and off.
2. When the power transistor is on, the output yields DC voltage; when off, there's no voltage.
3. This switching action determines the output voltage, regulated by the chopping frequency.
4. The DC signal from the chopper circuit enters a transformer for voltage reduction before passing through a rectifier and filter for further smoothing.
5. A control circuit, featuring a comparator and pulse width modulator, adjusts the chopping frequency based on the comparison between the output voltage and a reference value.
6. If the output exceeds the reference, the frequency decreases, and vice versa, ensuring a regulated DC output.

Classification Of Signals

1. Continuous Time and Discrete Time Signals:

A signal is said to be continuous when it is defined for all instants of time.

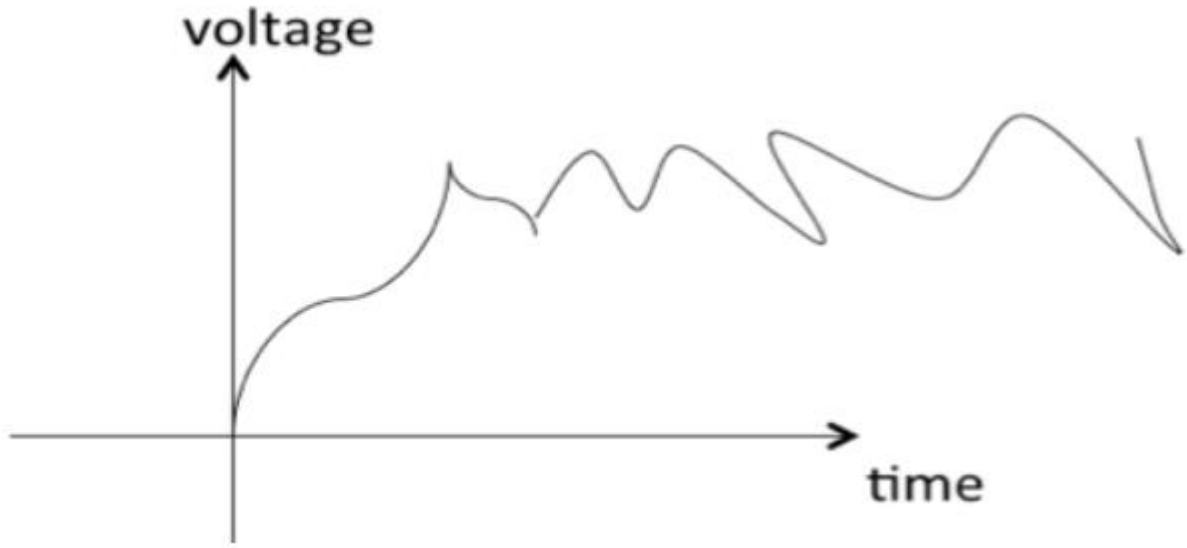


A signal is said to be discreete when it is defined at only discrete instants of time.

2. Deterministic and Non-deterministic Signals:

A signal is said to be deterministic if there is no uncertainty with respect to its value at any instant of time. Or, signals which can be defined exactly by a mathematical formula are known as deterministic signals.

A signal is said to be non-deterministic if there is uncertainty with respect to its value at some instant of time. Non-deterministic signals are random in nature hence they are called random signals. Random signals cannot be described by a mathematical equation. They are modeledd in probabilistic terms.



3. Periodic and Aperiodic Signals:

A signal is said to be periodic if it satisfies the condition $x(t) = x(t + T)$ or $x(n) = x(n + N)$.

Where-

T = fundamental time period,

$1/T = f$ = fundamental frequency.

4. Real & Complex Signal:

The main difference between real and complex signals is that real signals only contain real values, while complex signals contain both real and imaginary components.

Power supply characteristics

1. Efficiency: The ratio of output power to input power, indicating how effectively the power supply converts input power into usable output power.

2. Output Voltage: The voltage level provided by the power supply to the load.

3. Output Current: The maximum current that the power supply can deliver to the load.

4. Regulation: The ability of the power supply to maintain a stable output voltage despite variations in input voltage or load.

5, Ripple and Noise: The amount of unwanted AC components in the DC output, typically measured in millivolts.

6. Transient Response: How quickly the power supply can respond to sudden changes in load or input voltage without significant deviation in the output voltage.

Power Problems

1. Power Outages: Complete loss of power supply due to factors such as grid failure, severe weather conditions, or equipment failure.

2. Voltage Sags/Dips: Temporary decreases in voltage levels, typically lasting from a few milliseconds to several seconds. Voltage sags can cause equipment malfunction, data loss, and system crashes.

3. Voltage Surges/Spikes: Brief increases in voltage levels, often caused by lightning strikes, switching operations, or faulty equipment.

4. Brownouts: Prolonged periods of reduced voltage levels, typically caused by utility grid issues or high-demand periods. Brownouts can lead to equipment malfunction, data corruption, and premature failure of electrical components.

5. Electrical Noise: Interference or disturbances superimposed on the power supply waveform, caused by nearby electronic devices, radio signals, or power line transients.

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circuit breaker

1. A circuit breaker is a device that automatically stops the flow of electricity in an electrical circuit when it detects a fault, such as an overload or a short circuit.

2. It helps prevent damage to electrical equipment and reduces the risk of electrical fires.

3. When a fault occurs, the circuit breaker trips, cutting off the electricity flow, and can be reset manually after the issue is fixed.

4. Circuit breakers are made in varying sizes, from small devices that protect an individual household appliance up to large switch gear designed to protect high voltage circuits feeding an entire city.

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surge suppressor

1. A surge suppressor, is a device designed to protect electronic devices and appliances from voltage spikes or surges in electrical power.

2. These spikes can occur due to lightning strikes, power grid fluctuations, or sudden changes in electrical load.

3. The surge suppressor works by diverting excess voltage away from connected devices, ensuring that they receive only the amount of electricity they need to operate safely.

4. Surge suppressors are commonly used with sensitive electronic equipment such as computers, TVs, and home entertainment systems to prevent damage to their internal components caused by voltage surges.

5. They usually plug into wall outlets and provide multiple outlets for connecting various devices, offering an additional layer of protection against unexpected power fluctuations.

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uninterruptible power supply

1. An uninterruptible power supply (UPS) is a device that allows a computer to keep running for at least a short time when the primary power source is lost.

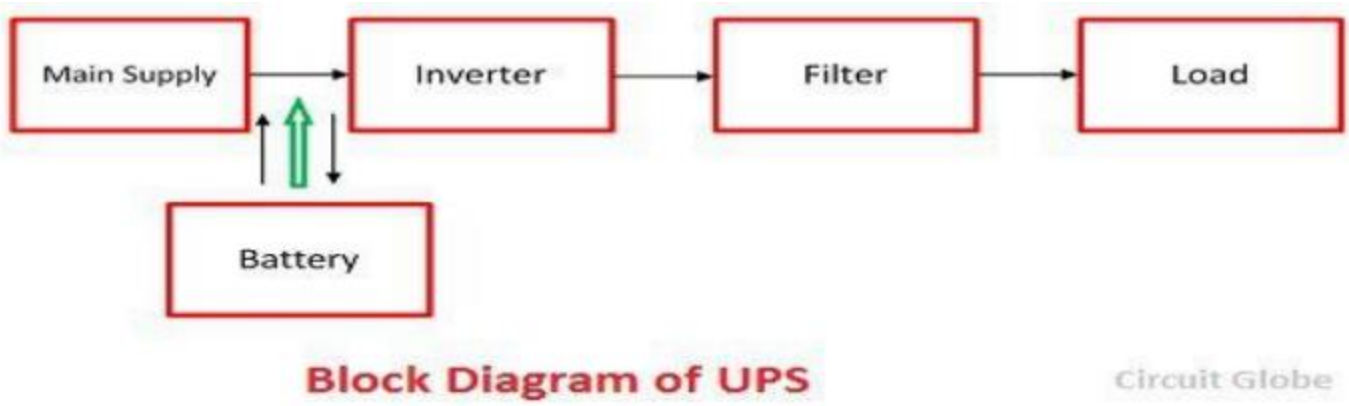
2. UPS devices also provide protection from power surges.

3. A UPS contains a battery that "kicks in" when the device senses a loss of power from the primary source.

4. If an end user is working on the computer when the UPS notifies of the power loss, they have time to save any data they are working on and exit before the secondary power source (the battery) runs out.

5. When all power runs out, any data in your computer's random access memory (RAM) is erased.

6. When power surges occur, a UPS intercepts the surge so that it does not damage the computer.



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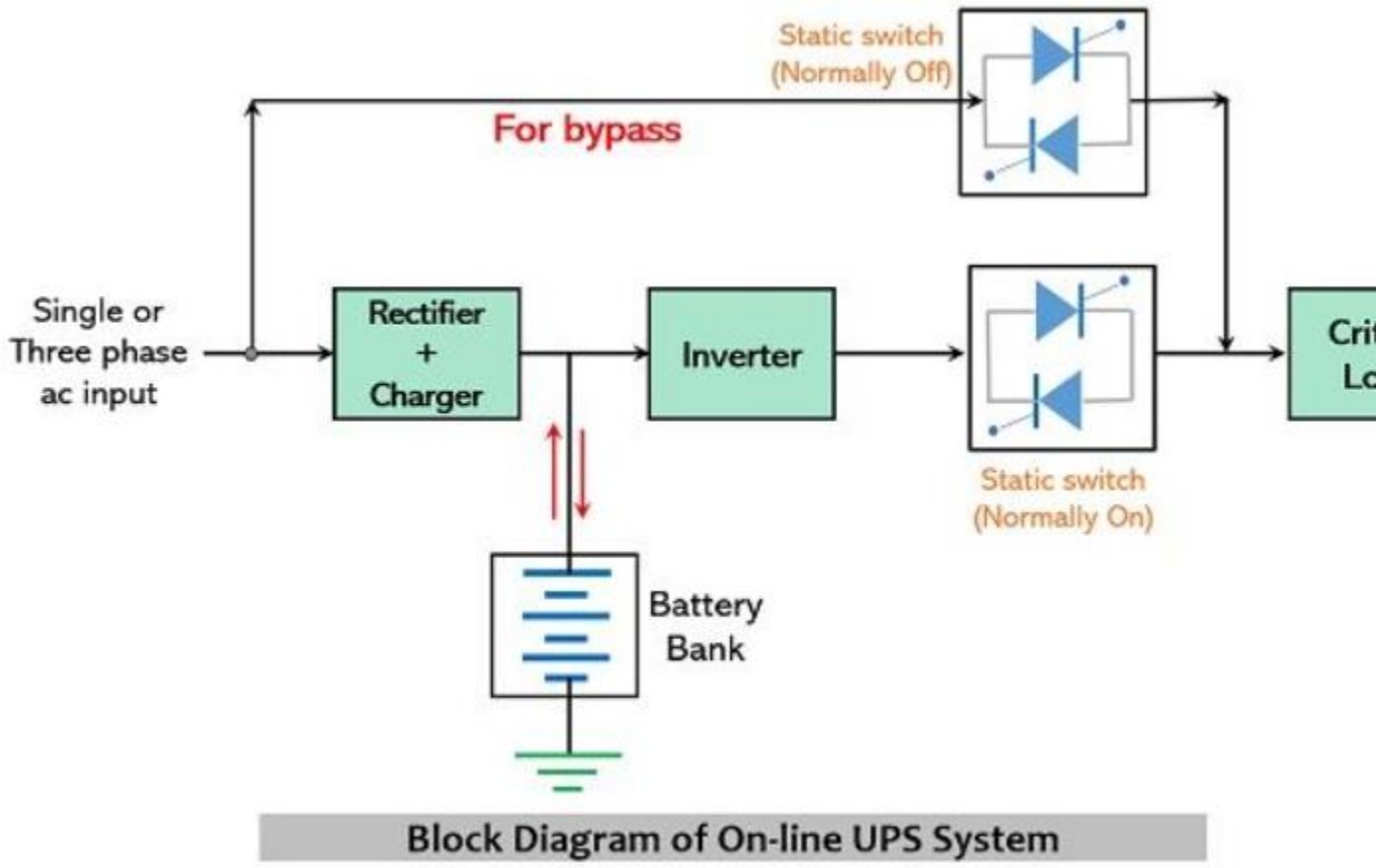
online UPS

1. An online UPS is the one that provides power supply to the load.

2. The supply provided to the load is of uninterruptible nature because initially, load draws current from the main supply source however, in case of power failure the load draws current from battery backup, and that too with zero transfer time.

The figure below represents the block diagram of On-line UPS system:



Here in the above arrangement, it is clearly shown that power to the critical load can be provided in three ways. These are as follows:

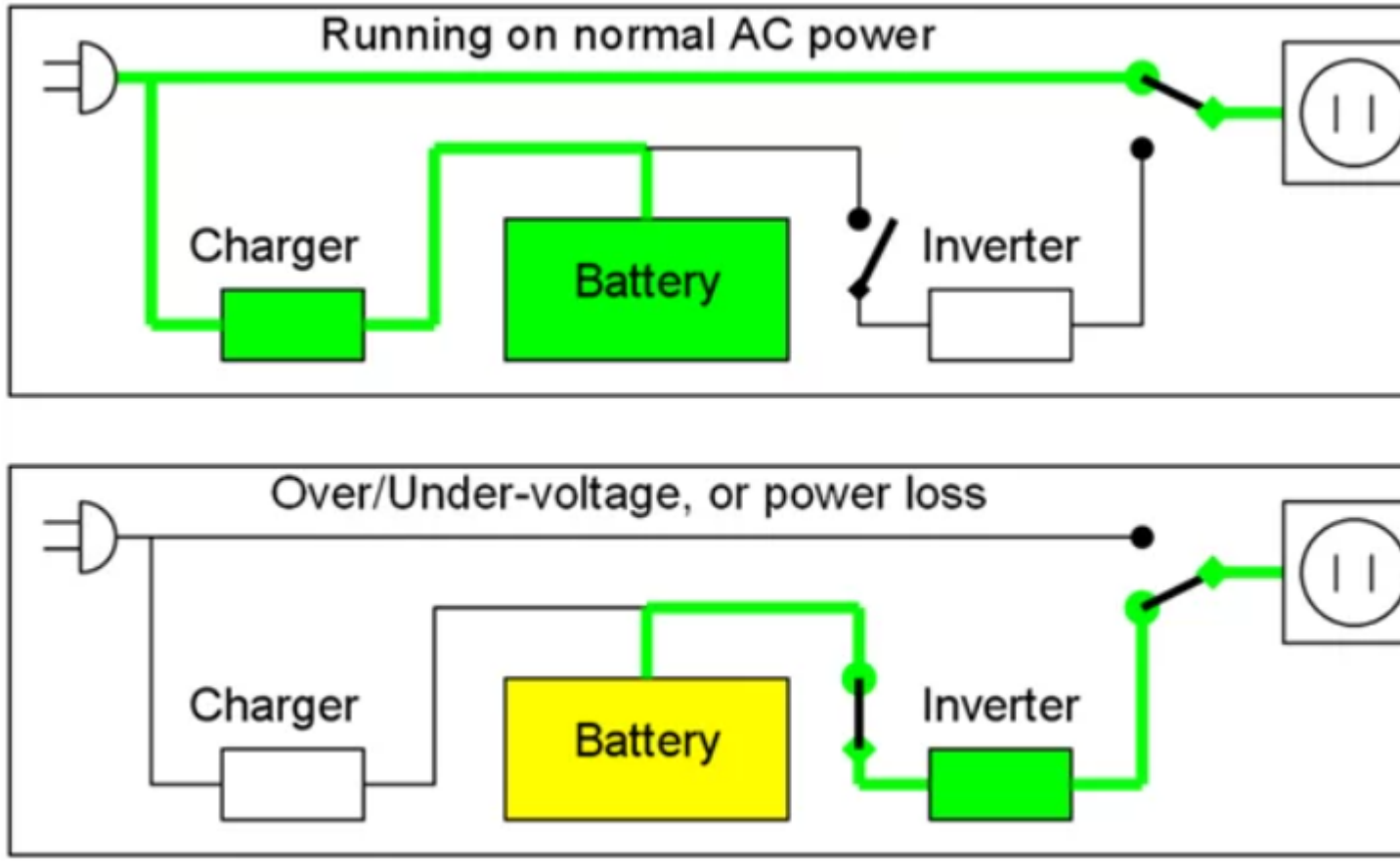
- First, directly from ac mains to the critical load (including rectifier, inverter circuit, and primary static switch).
- Second, from battery backup to critical load (including inverter circuit only).
- Last, from ac mains to critical load (without including rectifier and inverter circuit) via following the path (i.e., bypass) through the secondary static switch.

Offline UPS

1. Offline UPS – also referred to as VFD (Voltage and Frequency Dependent) or Standby UPS – offer the most basic level of power protection.

2. When the mains supply fails or fluctuates outside of the UPS's operating window, a relay connects the load to the inverter output (resulting in a 4-8ms transfer time).

3. In normal operation, with mains supply present, both output voltage and frequency will track the input voltage and frequency respectively.



Advantages and disadvantages of UPS

Advantages:

- No delay between switching from the primary power source to the UPS.
- Can better support critical instruments compared to generators.
- Consumers can choose the type and size of UPS, depending on the amount of power they need to supply to a device.
- UPSs are silent.
- Maintenance of UPS systems is cheaper compared to generators.

Disadvantages:

- The inability to run heavy appliances- because UPSs are run off of batteries.
- If substandard batteries are used, users may end up replacing the batteries often.
- UPSs may need professional installations.

Unit 6 (Interfaces)

SCSI

1. SCSI (Small Computer System Interface) is used to connect and communicate between computers and peripheral devices, such as hard disk drives, tape drives, CD/DVD drives, and scanners.
2. SCSI was originally developed as both a protocol and a parallel physical interface.
3. Today, SCSI has retained and expanded the protocol, but replaced the parallel physical interface with multiple different types of serial interfaces.
4. The SCSI protocol is now transported over a Serial Attached SCSI bus (using SAS and SPL), in Fibre Channel environments (using FCP), and over IP based networks (LAN/WAN).
5. The SCSI protocol continues to be used in enterprise and professional environments where high-performance storage connectivity is crucial.

External SCSI connectors

1. D-Shell Connector:
    - The D-shell connector for SCSI is similar to the connectors used in VGA or serial ports on older computers. It's named after its shape, which resembles the letter "D".
    - It's a relatively large connector with pins arranged in two rows inside the D-shaped housing.
    - This connector type is not very common in modern SCSI setups, as it has been largely replaced by smaller, more efficient connectors.
2. Centronics Connector:
    - The Centronics connector is named after the company that originally developed it for use in printers. It's also known as the Amphenol connector.
    - It's a larger connector with a rectangular shape and a series of metal pins inside.
    - They are less common today due to their size and limitations compared to newer connector types.
3. High Density (HD) Connector:
    - The High Density (HD) connector is a smaller and more compact connector compared to the D-shell and Centronics connectors.
    - It has a smaller rectangular shape with more pins packed into a smaller space.
    - HD connectors are more commonly used in modern SCSI setups, especially in configurations where space is limited or where multiple devices need to be connected in a compact environment.
4. Very High-Density Cable Interconnect (VHDCI):
    - VHDCI stands for Very High-Density Cable Interconnect. It's a small, high-density connector that provides a significant number of pins in a compact form factor.
    - VHDCI connectors are commonly used in modern SCSI setups, particularly in high-performance environments where fast data transfer rates are required.

Universal Serial Bus (USB)

1. USB stands for Universal Serial Bus.

2. It's a common type of connection that lets you plug devices into your computer, like keyboards, mice, printers, and smartphones. 3. It's called "universal" because it's widely used and works with many different devices.

4. USB transmits data between two devices in smaller, bite-sized quantities known as “packets.

5. Each packet transmits a predetermined amount of bytes (a digital information unit).

6. This might include details such as the source and destination of the material, and any anomalies that may have been discovered.

Features of USB

1. Ease of Use: USB is known for its simplicity and ease of use. You can plug USB devices into compatible ports without needing to restart your computer or install special software in most cases.

2. Speed and Performance: USB technology has evolved over the years, with newer versions offering faster data transfer speeds.

3. Power Delivery: USB ports can also provide power to connected devices, allowing them to operate without needing a separate power adapter. This feature is especially useful for charging smartphones, tablets, and other portable devices.

4. Versatility: USB is a versatile technology that supports various types of devices, including storage devices, input devices (like keyboards and mice), audio devices, and more.

5. Hot Swapping: USB supports hot swapping, which means you can connect and disconnect devices while your computer is running without causing any damage or requiring a restart.

Centronics

1. Centronics refers to a type of parallel connector originally developed by the Centronics Corporation for connecting printers to computers.

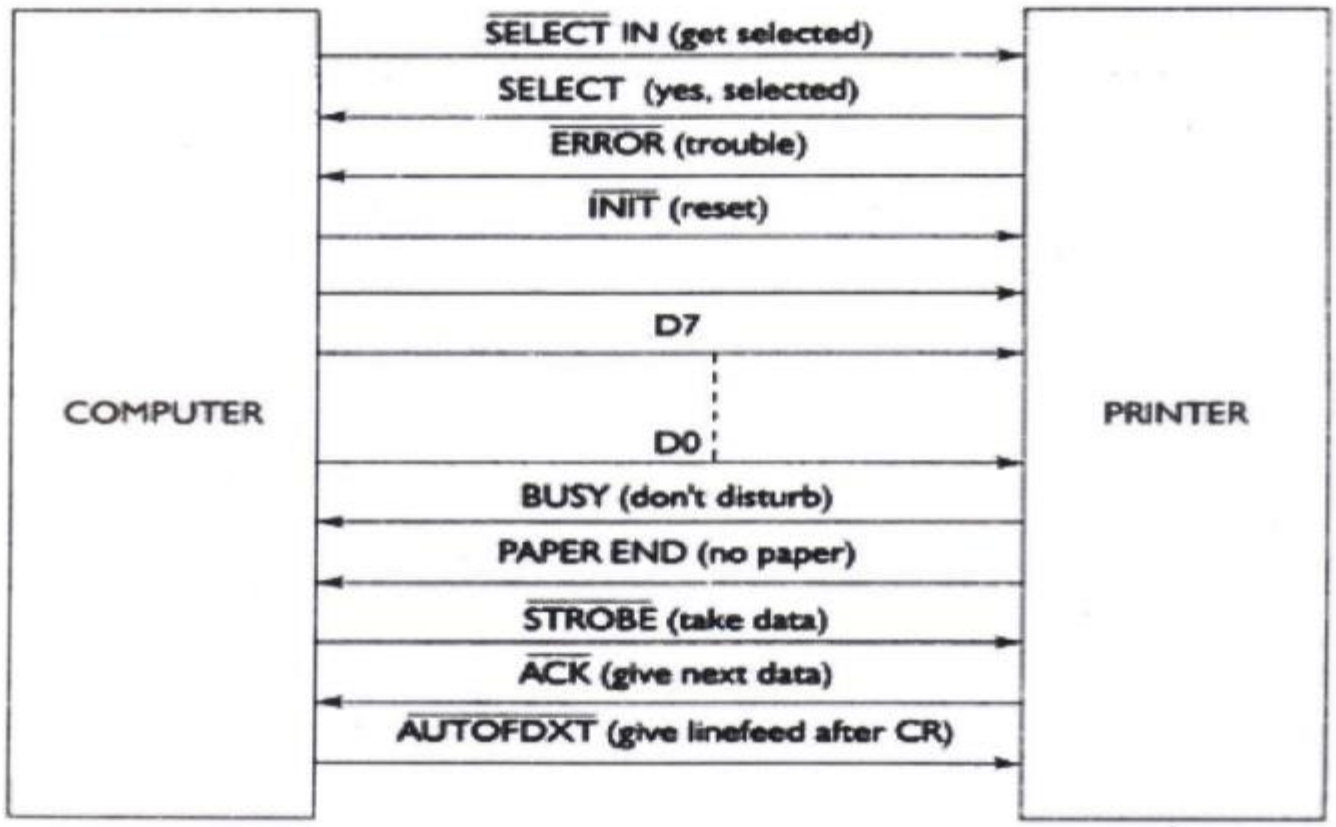
2. It is also known as the Centronics interface or Centronics connector.

3. The Centronics connector is a rectangular-shaped connector with numerous pins arranged in two rows.

4. The Centronics interface was widely used in early computing systems for its simplicity and reliability in transferring data between devices.

5. However, with advancements in technology and the introduction of more versatile and faster interfaces like USB, the Centronics interface gradually became less common.

Centronics Interface and signals



1. STROBE: this becomes low. Whenever the PC sends a byte of data to

printer. This low voltage tells the printer that data is being sent.

2. INIT: when itis low, the printer resets its electronics logic and clears the printer buffer.

3. SELECT IN: it is an interface enable signal. When this signal is low, the printer responds to signals from the controller.

4. AUTOFEEDXT: After printing every line, the printer will provide one line feed automatically if signal is low.

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signals from printer to PC

1. ACK: when this low indicate that the character has been accepted and the printer is ready for the next character.

2. BUSY: when this signal is high for some reason such as being out of paper, the printer is not ready.

3. PE (PaperEnd): if this signal is high means no paper in the printer.

4. SELECT: this signal is indicates that the printer is selected and logically connected to the computer.

5. ERROR: this signal goes low for various error condition of the printer.

Firewire

1. Firewire, also known as IEEE 1394, is a type of connection used to transfer data between devices like computers, cameras, and external hard drives.

2. It's similar to USB but faster and can handle large amounts of data more efficiently.

3. While Firewire was popular in the early 2000s, it's less common now compared to USB and other newer technologies.

4. it a versatile option for certain applications.

5. However, it's still used in certain industries, particularly in professional audio and video production.

USB 2.0 vs. FireWire

Sr. No.	USB2.0	FireWire(IEEE1394)
1.	1.5 Mbps, 12Mbps, 480 Mbps supported.	100 Mbps, 200Mbps, 400 Mbps supported.
2.	USB controller is required to control the bus and data transfer.	Works without control, devices communicate peer-to-peer.
3.	Cable up to 5m.	Cable up to 4.5m.
4.	Up to 127 devices supported.	Up to 63 devices supported.
5.	Power supplyto externaldevices is 500 mA/5V (max).	Power supplyto externaldevices is 1.25A/12V (max).
6.	Fullcompatibilitywith USB1.1 devices.	Theonlycomputer bus used in digital videocameras.
7.	**Application**: USBis a small and medium bandwidth connection for telephonyproducts, digital cameras, monitors, keyboards, mice, and othersimilarI/O devices.	**Application:** IEEE 1394 is a high-speed bus designed fordigital videocameras,DVD players, mass storagedevices, and other peripherals that requiregreater bandwidth.

Bluetooth

1. Bluetooth is used for short-range wireless voice and data communication.

2. It is a Wireless Personal Area Network (WPAN) technology and is used for data communications over smaller distances.

3. Bluetooth simply follows the principle of transmitting and receiving data using radio waves.

4. It can be paired with the other device which has also Bluetooth but it should be within the estimated communication range to connect.

5. When two devices start to share data, they form a network called piconet which can further accommodate more than five devices.

6. A Bluetooth network is called a piconet and a group of interconnected piconets is called a scatternet.

How Bluetooth works

1. When you want to connect two Bluetooth-enabled devices, like a smartphone and a speaker, you put them into "pairing mode."

2. This allows them to search for and recognize each other.

3. Once the devices are paired, they establish a connection.

4. This connection creates a secure link between the devices, allowing them to communicate with each other.

5. Bluetooth operates on the 2.4 GHz frequency band, which is divided into multiple channels.

6. To avoid interference from other devices using the same frequency, Bluetooth uses a technique called frequency hopping.

7. It rapidly switches between different channels, making it more resilient to interference.

8. After the connection is established, the devices can send data back and forth.

9. This data can include things like audio for music streaming, files for sharing, or commands for controlling other devices.

Unit 7 (PC Troubleshooting, Maintenance and Tools)

Need of Computer Diagnostic Tools

1. They help pinpoint hardware or software problems within a computer system.
2. By running diagnostic tests, users can determine the root cause of issues such as slow performance, system crashes, or hardware failures.
3. Diagnostic tools provide valuable information for troubleshooting purposes.
4. They can help users diagnose problems themselves or provide technicians with detailed reports to expedite the repair process.
5. Regularly running diagnostic tests can help prevent potential problems before they occur.
6. Some diagnostic tools offer optimization features that help improve system performance.
7. Diagnostic tools can perform comprehensive tests on hardware components such as the CPU, RAM, hard drive, and graphics card.
8. This helps ensure that all components are functioning correctly and identify any faulty hardware that needs replacement.

POST Sequence

POST (Power-On Self-Test) is a series of tests that a computer runs when it is first powered on to check if the hardware components are functioning correctly.

POST Sequence: When you turn on a computer, the POST sequence typically involves the following steps:

- The CPU is tested to ensure it is functioning properly.
- The system BIOS (Basic Input/Output System) is checked to ensure it can communicate with essential hardware components.
- Memory (RAM) is tested to verify that it is properly installed and functional.
- The video card is tested to ensure that the display subsystem is functioning correctly.
- Other essential hardware components, such as the hard drive and keyboard, may also be tested.

Beep codes

1. One short beep: Everything is normal and the computer is booting properly.

2. One long beep followed by two or more short beeps: Indicates a problem with the video card or display circuitry.

3. Continuous short beeps: Indicates a power issue, such as a loose cable or a failing power supply.

4. Continuous long beeps: Indicates a memory (RAM) error. This could mean the RAM is not properly seated or is defective.

5. One long beep followed by three short beeps: Indicates a problem with the system's RAM or a possible motherboard failure.

POST visual Errors

- **100-199**: Motherboard
- **200-299**: RAM or Memory
- **300-399**: Keyboard
- **400-499**: Video (Mono)
- **500-599**: Video (Color)
- **600-699**: Floppy Drive
- **700-799**: Math Co-Processor
- **900-999**: LPT1 (Parallel Port 1)
- **1000-1099**: LPT2 (Parallel Port 2)
- **1100-1199**: COM1 (Serial Port 1)
- **1200-1299**: COM2 (Serial Port 2)
- **1700-1799**: Hard Disk Controller
- **3000-3999**: Network Interface Card (NIC)
- **8600-8699**: Mouse

Active Preventive Maintenance

1. Conducting regular inspections of equipment or systems to identify potential issues before they escalate into major problems.

2. Regularly cleaning components and applying lubricants to moving parts to prevent wear and tear and ensure smooth operation.

3. Checking and tightening loose components and making necessary adjustments to maintain proper alignment and functionality.

4. Monitoring temperature and vibration levels to detect abnormalities that may indicate potential failures.

5. Implementing advanced technologies such as sensors and predictive analytics to monitor equipment condition and predict failures before they occur.

Passive Preventive Maintenance

1. Maintaining suitable environmental conditions such as temperature, humidity, and cleanliness to prevent corrosion, contamination, or other damage.

2. Installing backup systems or redundancy to ensure continuous operation in case of primary system failure.

Using protective measures such as covers, guards, or enclosures to shield equipment from environmental hazards or physical damage.

3. Implementing security measures to protect equipment from theft, vandalism, or unauthorized access.

4. Avoid disturbances such as shock and vibration from external environment.

Periodic Preventive Maintenance

1. Establishing a schedule for routine maintenance tasks such as inspections, cleaning, calibration, and component replacements.

2. Developing comprehensive checklists and procedures for conducting preventive maintenance activities systematically and consistently.

3. Documenting maintenance activities, including observations, measurements, and actions taken, and maintaining records for future reference and analysis.

4. Providing training to maintenance personnel on proper preventive maintenance techniques, equipment operation, and safety procedures.

5. Over time, certain components may wear out or degrade due to normal usage.

6. Periodic maintenance procedures include the inspection and replacement of wear parts such as belts, filters, seals, and bearings to prevent unexpected failures and maintain equipment efficiency.

LogicProbe

1. A LogicProbe is a diagnostic tool used in electronics to troubleshoot digital circuits.

2. A LogicProbe is designed to detect and display digital logic states within a circuit.

3. It typically indicates whether a signal is high (logic 1) or low (logic 0) by illuminating LEDs or displaying the corresponding state on a digital display.

4. LogicProbes are voltage-sensitive devices, meaning they can detect and respond to changes in voltage levels within a circuit.

5. One advantage of LogicProbes is that they are non-intrusive, meaning they can be used to test circuits without disrupting their operation or requiring disconnection of components.

6. LogicProbes are particularly useful for basic troubleshooting tasks, such as verifying signal presence, identifying signal transitions, and locating faults in digital circuits.

LogicPulser

1. A LogicPulser, is a diagnostic tool commonly used in electronics and digital circuit troubleshooting.

2. The primary function of a LogicPulser is to inject digital signals into a circuit under test.

3. It generates pulse signals of specific voltages and durations, allowing technicians to stimulate various nodes within a digital circuit and observe the response.

4. LogicPulsers typically offer adjustable parameters for controlling the characteristics of the generated pulses, such as voltage levels, pulse widths, and repetition rates.

5. This flexibility enables users to simulate different signal conditions and evaluate the behavior of the circuit.

6. By injecting pulse signals into different parts of the circuit, a LogicPulser helps assess signal integrity, identify signal propagation delays, and detect faults such as open circuits, short circuits, or signal distortions.

Working of Logic Analyzer

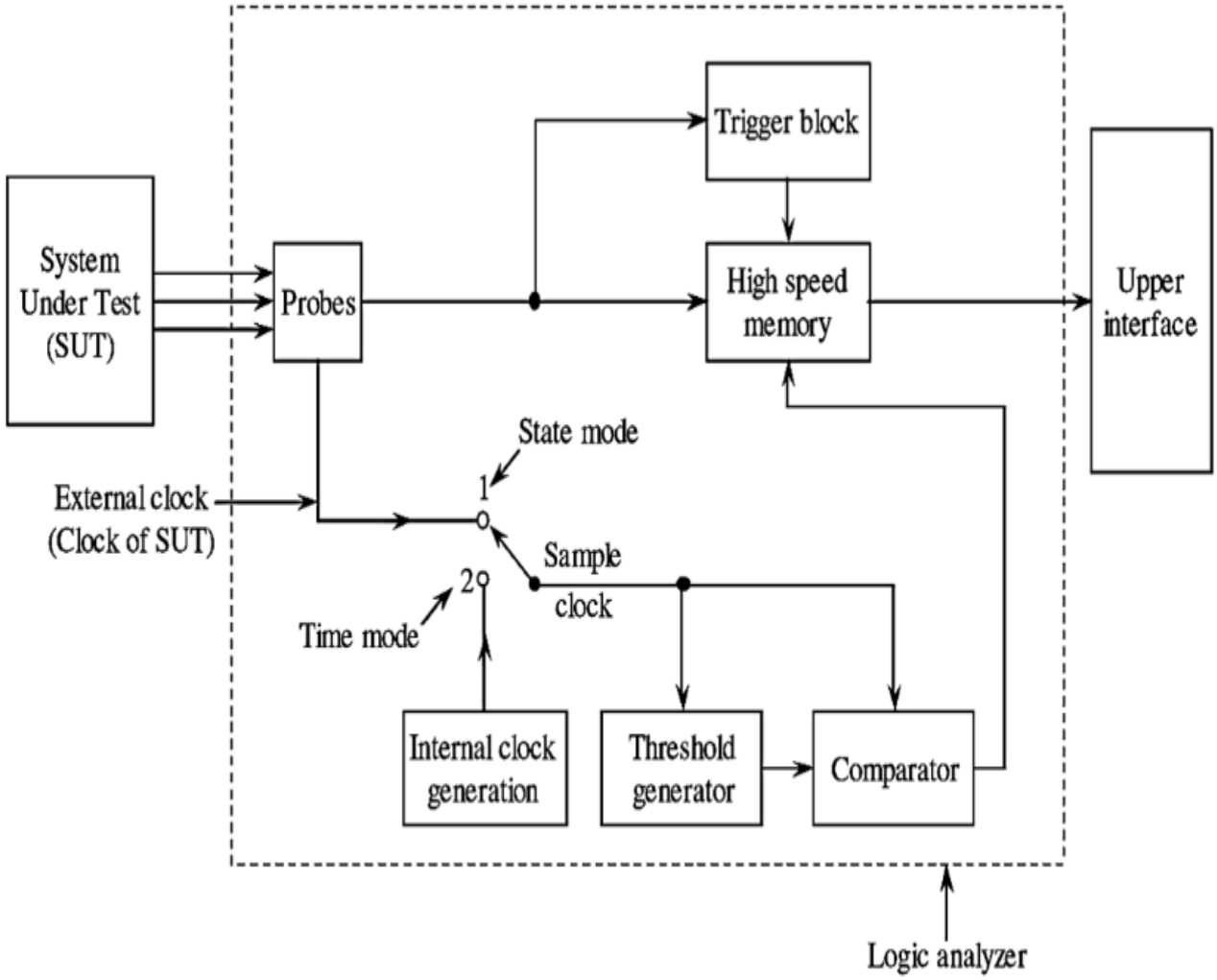


Figure 1: Block Diagram of Logic Analyzer

1. After receiving the signal from the system tinder test SUT, it samples the input signal at certain clock frequency.

2. In the sampling process, it compares the input signal with a certain threshold voltage at each sample point (i.e., at each clock pulse) and depending upon the result of comparison it converts the input signal at that sampling instant into a logic 1 (High) or logic 0 (low) state.

3. If the level of input signal is higher than the threshold voltage it is recognized as logic-I and if its level is less then the threshold level it is recognized or logic 0.

4. Thus, by sampling process the input signal gets converted into a pattern of O's and I's (i.e., the sample data is a series of 0's and 1 's).

5. The sampled data is then stored in the memory of logic analyzer with each sample point occupying a single memory location.

Ball Grid Array(BGA)

1. Ball Grid Array (BGA) is a type of surface-mount packaging used for integrated circuits (ICs) and other electronic components.

2. In a BGA package, the integrated circuit is mounted on a substrate, and the electrical connections are made through an array of solder balls arranged in a grid pattern on the bottom of the package.

3. The solder balls serve as the connection points between the BGA package and the circuit board.

4. BGA packages provide shorter electrical paths between the integrated circuit and the circuit board, resulting in improved electrical performance.

5. The solder balls on the bottom of the BGA package provide mechanical stability and shock resistance, making BGA assemblies more robust.

Unit 8 (Overview of Parallel Processing and Pipeline Processing)

UNIPROCESSORS

1. Uniprocessor is a computer system type that has only one central processing unit which means that only one instruction will be executed at a time.
2. All tasks and operations are handled by a single processor.
3. This type of processor is found only on personal computers mobile devices and small embedded systems.
4. These systems have limited computing power as they can execute only one instruction at a time.
5. These types of processors are suitable for various common computing tasks such as web browsing, word processing, and basic gaming.
6. But multiprocessor systems it has multiple processors that execute instructions simultaneously by providing greater computing power and faster processing speeds.

Parallelism in Uniprocessor

1. Uniprocessor has only one processor but still, it is possible to achieve parallelism by using certain techniques such as pipelining and multitasking.

2. Multitasking is a technique where it enables a uniprocessor to execute multiple tasks simultaneously.

3. This is achieved by dividing the processor's time into short time slots and switching tasks rapidly.

4. Each task is given a specific time slot in which the needs to be executed.

5. This gives an appearance of parallel execution even if the processor is only executing one task at a time.

6. Pipelining is a technique that allows a processor to execute a set of instructions simultaneously by dividing the instructions execution process into several stages.

Explicitly Parallel Instruction Computing

1. Explicitly Parallel Instruction Computing (EPIC) is a type of computer processor design that focuses on achieving higher performance by executing multiple instructions simultaneously.

2. EPIC allows the processor to execute several instructions at the same time, rather than one after the other.

3. This can speed up processing by handling multiple tasks simultaneously.

4. The term "explicit" means that the instructions themselves tell the processor which ones can be executed in parallel.

5. This is different from other designs where the processor has to figure this out on its own.

Evolution of parallel processors

1. Single-core Processors: Early computers featured single-core processors, where all computing tasks were executed sequentially by a single processing unit.

2. Multi-core Processors: As the demand for more computing power grew, manufacturers began integrating multiple processing cores onto a single chip.

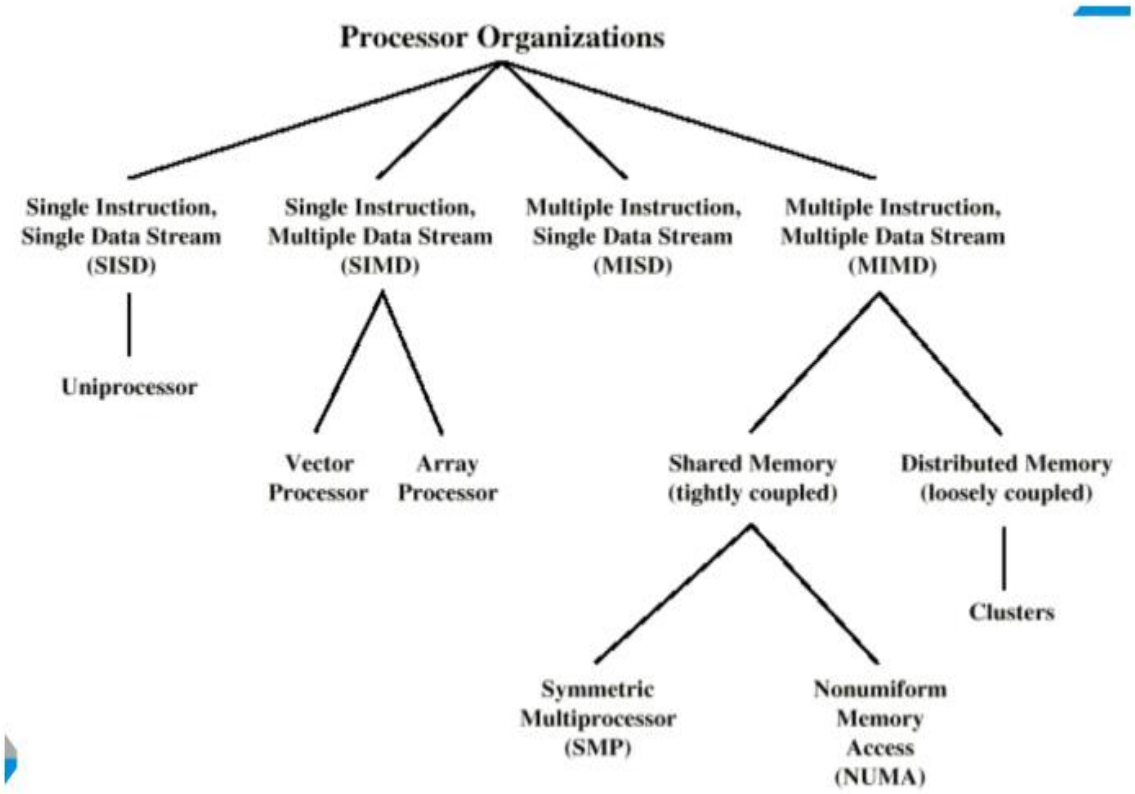
3. Symmetric Multi-processing (SMP): SMP systems enable multiple cores to access shared memory, allowing them to work on different tasks simultaneously. This architecture is common in modern desktops and laptops.

4. Many-core Processors: Beyond a few cores, processors with tens or hundreds of cores emerged. These many-core processors are designed for highly parallel workloads such as scientific simulations, data analytics, and multimedia processing.

5. Distributed Processing: In distributed processing systems, multiple processors work together over a network to solve a single problem.

6. Heterogeneous Computing: Heterogeneous computing combines different types of processing units, such as CPUs, GPUs, and specialized accelerators, to maximize performance and energy efficiency for specific workloads.

Processor Organization



SIMD Architecture

1. SIMD (Single Instruction, Multiple Data) architecture is a type of parallel computing architecture that performs the same operation on multiple data points simultaneously.

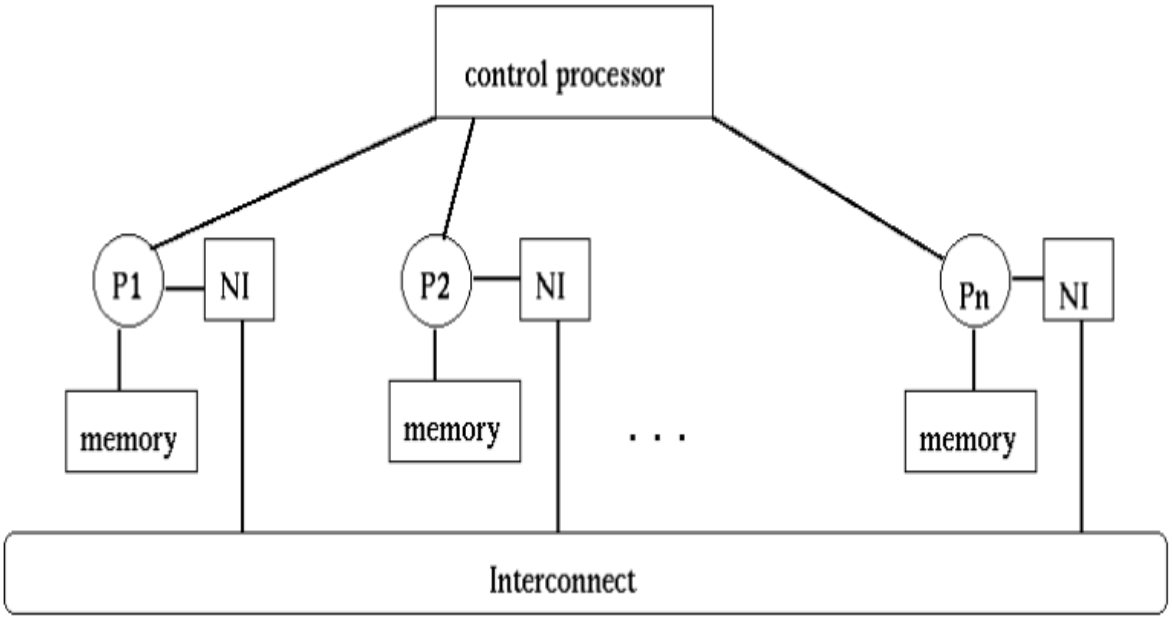
2. In SIMD architecture, a single instruction is executed across multiple processing elements, each operating on different data elements. This approach enables efficient parallelization of computations, especially for tasks that involve repetitive operations on large datasets.

3. SIMD architecture exploits data-level parallelism by performing identical computations on multiple data elements concurrently.

4. This parallelism can lead to significant performance improvements for tasks such as multimedia processing, scientific simulations, and signal processing.

5. To fully utilize SIMD capabilities, algorithms and applications need to be vectorized, meaning they are optimized to take advantage of parallel vector operations.

A schematic view of the architecture is shown below.



MIMD Architecture

1. MIMD (Multiple Instruction, Multiple Data) architecture is another type of parallel computing architecture where multiple processing units execute different instructions on different sets of data simultaneously.

2. In contrast to SIMD, MIMD allows each processing unit to operate independently, executing its own program and accessing its own data.

3. MIMD systems consist of multiple processing units, each with its own instruction stream and data stream.

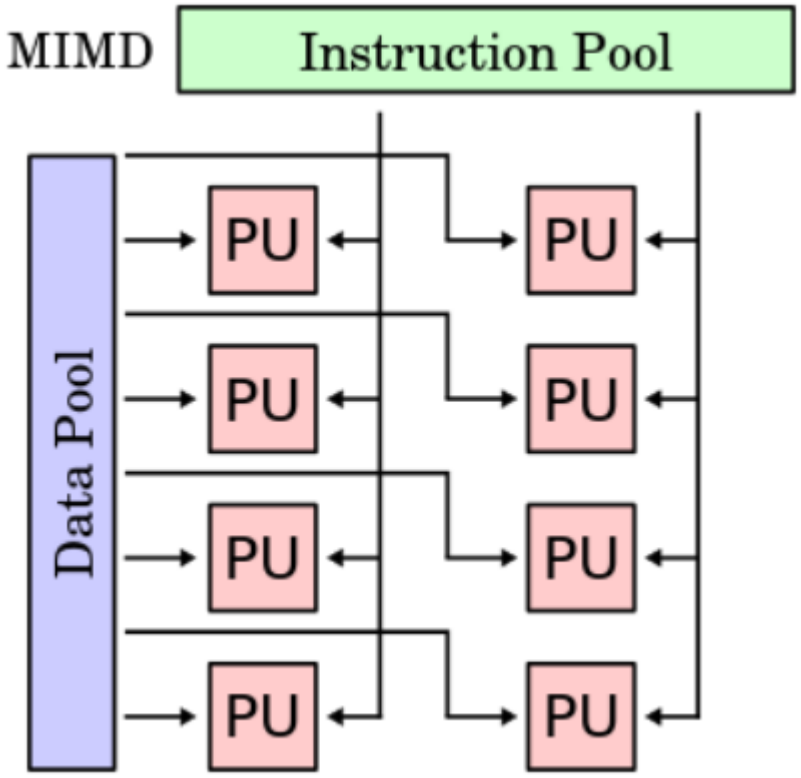
4. MIMD systems can be classified based on their memory architecture.

5. MIMD architecture enables task-level parallelism, where different processing units execute independent tasks concurrently.

6. MIMD systems can scale effectively to accommodate increasing computational demands by adding more processing units.

7. In MIMD systems, coordination and synchronization mechanisms are essential for managing concurrent execution and ensuring data consistency.

A schematic view of the architecture is shown below.



Pipelining Processing

1. Pipelining is the process of accumulating instruction from the processor through a pipeline.

2. It allows storing and executing instructions in an orderly process. It is also known as pipeline processing.

3. Pipelining is a technique where multiple instructions are overlapped during execution.

4. Pipeline is divided into stages and these stages are connected with one another to form a pipe like structure.

5. Instructions enter from one end and exit from another end.

6. Pipelining increases the overall instruction throughput.

How Pipelining Works

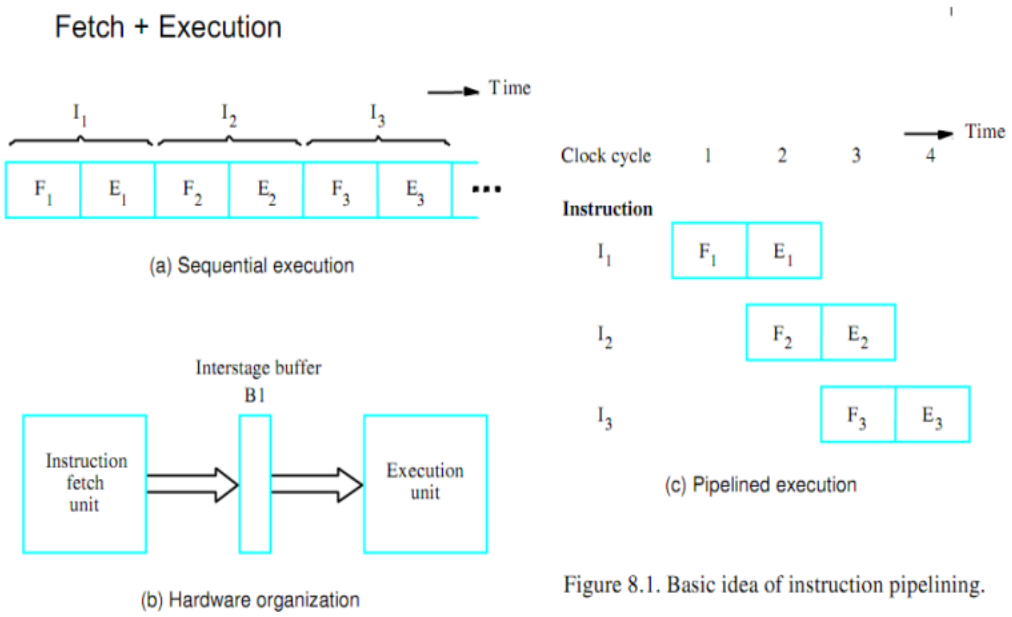


Figure 8.1. Basic idea of instruction pipelining.

- Computer that has two separate hardware units, one for fetching and another for executing them.
- the instruction fetched by the fetch unit is deposited in an intermediate buffer B1.
- This buffer needed to enable the execution unit while fetch unit fetching the next instruction.
- The computer is controlled by a clock.
- Any instruction fetch and execute steps completed in one clock cycle.

HIGH PERFORMANCE COMPUTING

1. High-performance computing (HPC) evolved due to meet increasing demands for processing speed.

2. HPC brings together several technologies such as computer architecture, algorithms, programs and electronics, and system software under a single canopy to solve advanced problems effectively and quickly.

3. HPC can take the form of custom-built supercomputers or groups of individual computers called clusters.

4. A supercomputer is one of the best-known examples of HPC, where one large computer is made up of many computers and processors that work together to achieve parallel processing and high performance.

5. A highly efficient HPC system requires a high-bandwidth, low-latency network to connect multiple nodes and clusters.

6. HPC technology is implemented in multidisciplinary areas including Geographical data, Oil and gas industry modelling, Electronic design automation and Climate modelling.

INTEL ITANIUM ARCHITECTURE

1. Itanium processors utilized the EPIC architecture, which aimed to exploit parallelism at the instruction level.

2. Itanium processors introduced a 64-bit instruction set architecture, allowing for larger memory addressing, increased memory capacity, and support for 64-bit applications.

3. Itanium processors had large register files to store intermediate values and facilitate parallel execution of instructions.

4. Itanium processors featured predication, a technique that allowed instructions to be conditionally executed based on the evaluation of a predicate register.

5. Instructions in the Itanium architecture were bundled together into groups called bundles, which contained multiple instructions along with associated metadata.

6. Despite its innovative features and initial industry hype, the Itanium architecture faced several challenges and ultimately failed to gain widespread adoption.
