Unit – 01 : PC Components and System Board.

- Hardware used for I/P, O/P & inside computer case,
- System board components used for communication among devices,
- Software - 3 types of Software, OS, application software,
- ROM BIOS,
- Functions of BIOS, The boot process,
- POST and important beep codes,
- Know about different connectors,
- The CPU & the chipset – CPU form factor, CPU slots and sockets,
- Different types of RAM,
- Buses – ISA, MCA, EISA, USB,
- Firewire, AGP, PCI, Setting the CPU & Bus speeds, CMOS setup and data protection.

Questions to be discussed :

1. What is hardware ? Explain in brief different hardware components.
2. What is software ? Explain different types of software.
3. Discuss BIOS in brief. Write the function of BIOS.
4. Discuss about motherboard. Also explain its type in brief.
5. What is Expansion Bus ? Explain different types of bus in computer system.
6. Explain different types of RAM in details.
7. Write short notes on :
   a. POST
   b. Beep Code
   c. USB
   d. CMOS

What is Hardware ?

- The physical device that make up the computer are called Hardware.
- The hardware units are responsible for input, storing and processing the given data and the displaying the output to the users.
- The basic hardware units of a computer are keyboard, mouse, CPU, memory, monitor & printer.
- Among these hardware units keyboard & mouse are used to input data into the computer.
- Memory is used to store data, CPU is used to process the input data and monito & printer are used to display the processed data to the user.




Hardware used for I/P and O/P :

- Hardware is the physical parts of a computer.
- A computer system usually contains, the following hardware components:

1. The System Unit
   - ✓ Motherboard (aka System Board)
   - ✓ CPU (Central Processing Unit)
   - ✓ Memory, such as RAM, ROM
   - ✓ Ports
   - ✓ Expansion Slots
2. Secondary Storage, such as hard disk drives, CD-ROMs, etc.
3. Input/output Devices
4. Communications Devices

Motherboard:

- The Motherboard is the main circuit board for the computer, containing both soldered, and non-removable components along with slots for components that can be removed.
- The motherboard holds the CPU, RAM and ROM chips, etc.

Central Processing Unit(CPU):

- The CPU is the "brain" of the computer.
- It executes instructions and tells other components what to do.
- There are 2 parts of the CPU: The ALU and Control Unit.
  - The ALU performs arithmetic operations (such as addition and subtraction) and logical operations (such as comparing two values).
  - The Control Unit deciphers and carries out instructions.

RAM

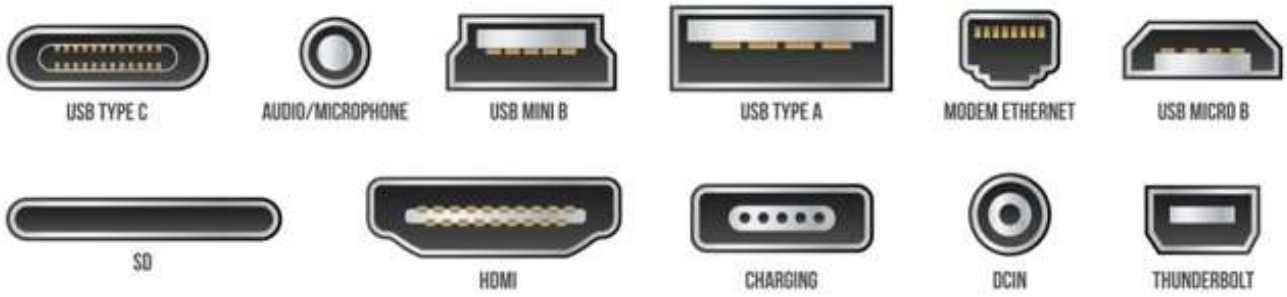
- RAM is used to hold instructions and data while they are being used.
- RAM is volatile, meaning its contents are lost when the power goes off.

ROM :

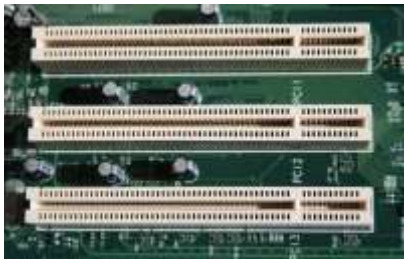
- ROM chips are non-volatile memory that generally contains instructions for "booting" the computer (i.e. loading the operating system when the computer starts up).

Ports :

- Ports are sockets that are on the outside of the system unit, meaning you can easily plug a cable into a port without opening the system unit.
  - **Serial** ports transmit one bit of data at a time.
  - **Parallel** ports transmit 8 bits of data at a time.
  - USB ports are much faster than serial or parallel ports and allow multiple devices to be connected to the same port.



Expansion Slots



- Expansion Slots are sockets on the motherboard that you can plug expansion cards into.
- To plug a card into a slot, you must open the system unit.
- Common types of cards are graphics, sound, and network cards.

Secondary Storage

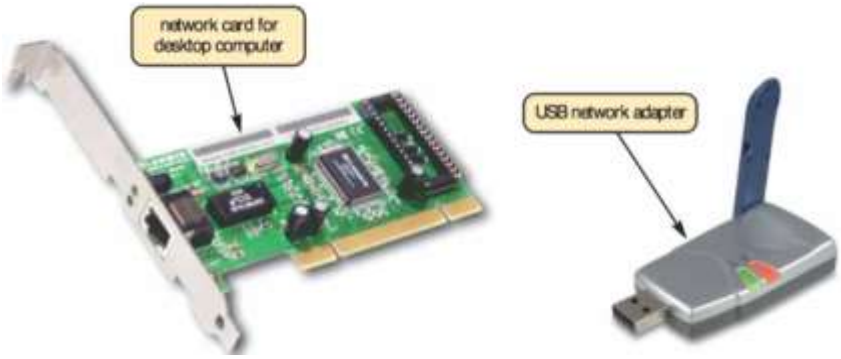
- Devices that "permanently" hold data and information (i.e. programs).
- It is non-volatile memory, when the power goes off, contents are still saved.
- Used to store instructions and data while they are **not** being used.

Input/Output Devices

- Input devices translate data into a form the computer can understand.
- The keyboard is the most common input device, but this type of data entry is very slow.
- Pointing devices such as the mouse, trackball, and touchpad allow you to manipulate a cursor on the screen.

Communications Devices :

- These allow your computer to send/receive data to/from other computers.
- A modem sends information over a phone line.
- Modems are slow and susceptible to problems such as phone line static.
- A network card sends information over a network cable.

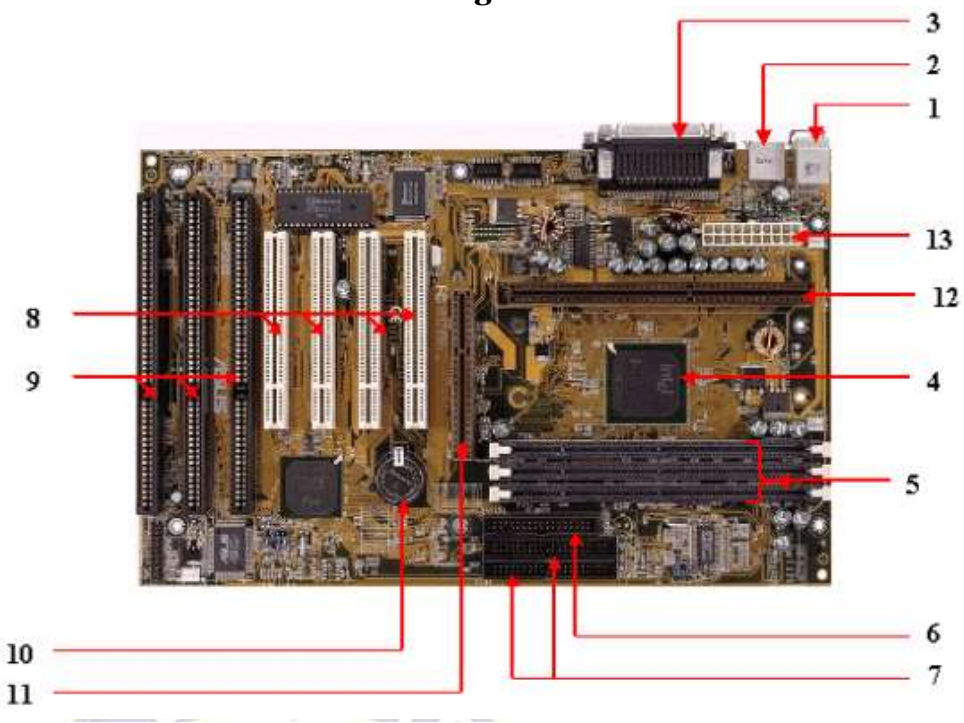


Motherboard :

- It is the piece of computer hardware that can be thought of as the "backbone" of the PC.
- The motherboard serves to connect all of the parts of a computer together.
- The CPU, memory, hard drives, and other ports and expansion cards all connect to the motherboard directly or via cables.
- A computer's motherboard is also known as the mainboard or system board.
- The IBM PC that was released in 1981, is considered to be the first computer motherboard.

Motherboard components used for communication among devices :

1. Mouse & keyboard
2. USB
3. Parallel port
4. CPU Chip
5. RAM slots
6. Floppy controller
7. IDE controller
8. PCI slot
9. ISA slot
10. CMOS Battery
11. AGP slot
12. CPU slot
13. Power supply plug in



Keyboard and mouse :

- There are mainly 2 types of mouse and keyboard connectors.
- The first connector is known as PS/2 & the second connector is known as USB.

Universal Serial Bus (USB) :

- The USB port is used for connecting the computer system.
- The main use of a USB port is to connect the peripheral devices and computer motherboards.
- The peripheral device connected to the computer system can be inserted or remove without system restarts that can be the main advantage of a USB port.

Parallel port

- The old printers that are used the parallel port to connect with the computer system.
- In the parallel port, multiple wires are used to send or receive multiple bits of the data in a single instance.
- On the other hand, serial ports use only one wire at a time.
- In the parallel port, 25 pins female DB type connector is used.

CPU chip

- The CPU is the processor that controls all the functions of the computer system.
- The overall flow of task and functions are controlled by the central processing unit.
- For the computer system, the CPU is called the brain of the computer system.

RAM slots

- The RAM slots are used for connecting the RAM (memory) in the computer system.
- In the general computer system, there are mainly two RAM slots but sometimes there can be four-plus slots in the motherboard to increase the memory of the computer system.

Floppy Controller

- The older motherboard chip contains a 34-pin type ribbon cable for connecting the computer system with a floppy drive.
- In this ribbon cable, one end is directly connected with the computer system and one end is connected with the motherboard.

IDE controller

- The integrated drive electronics are also known as ATA or Parallel ATA.
- The IDE is the type of component that issued for hard drive control.
- In today's computer system, the IDE controller supports is not supported.

PCI slot

- The full form of PCI is a peripheral component interface.
- The PCI slot is mainly used to insert the expansion cards on the computer.
- The other PCI devices can also be connected like a sound card, network card, video, card, modems, and other devices.
- In today's computer system support for PCI expansion slots are not there.

ISA slot

- Industry-standard architecture (ISA) is defined as standard architecture for expansion bus.
- The ISA slot issued for connecting input devices and modems.

CMOS Battery

- The CMOS battery is used for storing the BIOS settings on the motherboard.
- The CMOS battery is also capable of storing the time and data in it.

AGP slot

- AGP stands for Accelerated Graphics slot.
- AGP is a type of computer slot that is used for attaching the video card to the system.
- This slot is a high-speed slot so that data transfer can be done at high speed.

CPU slot

- The CPU slot is a type of port that is used to connect the central processing unit to the motherboard of the computer system.

Power supply slot

- The power supply slot is used for providing the electric supply to the computer system so that it can start and perform its functions.

Factors of Motherboard :

- The main form factor for the motherboard is size and shape.
- The other factors are physical layout, mounting holes, and board organization.
- In the below section, some of the form factors are mentioned below:

1. ATX

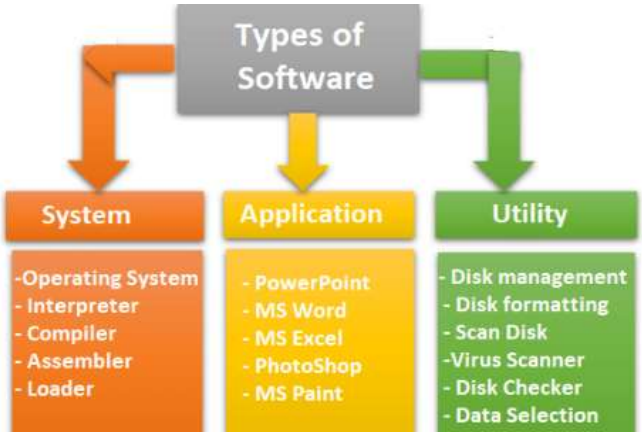
- In this type, the standard locations were defined for mouse, keyboard, input/output devices, video connectors, and other devices.
- In the year 1990, the ATX form factor was developed.

2. Micro-ATX

- The benefit obtained from the Micro-ATX is the same as from the ATX form factor.
- The main difference is an improvement in system design so that the overall cost of the component can be reduced as the size of the motherboard is reduced in this form factor.

What is software?

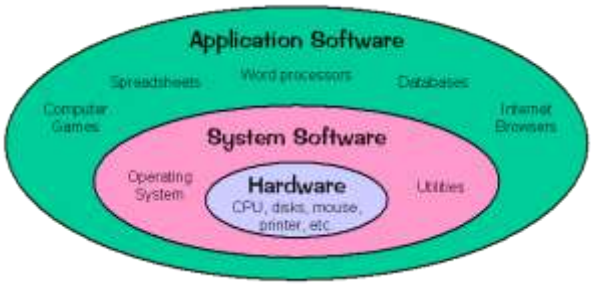
- A Software is a collection program that enables a computer to perform a specific task according to given instruction.
- A program is a set of instructions and data.
- An instruction is a set of rules.



System Software :

- The system software is a software that manages and controls the hardware.
- It is an essential part of the computer system.
- They create an interface between the user and the hardware and provide a platform to execute the application software.
- It is a type of software that requires to operate the system.
- Without system software we can't operate any hardware or even computer system also.

  Example :
  - Operating System(OS)
  - Language Processor
    like Compiler, Interpreter, Assembler.
  - Device Driver



Application Software(apps)

- Application Software is a group of software programs.
- That helps a user to perform single or multiple tasks.
- They can be constructed in any language depending on the work.
- It is also called end-user software.
- It is a type of software that is used for special purpose.
  - Word processors, spreadsheets, Powerpoint.
  - Web Browser(Google Chrome, IE, Opera Mini etc), Media Player, Photoshop etc.

Utility Software :

- Utility software is also known as a Service program.
- It is a computer system software that is designed to help organize computer hardware, operating system, or application software.
- It also helps to configure, and monitor, or maintain a computer.
- It controls the health issue of system software.

  Example :
  - Disk management
  - Virus Scanner, Disk Checker, Anti-Virus, Firewall etc.

What is BIOS ?

- BIOS stands for Basic Input Output System.
- BIOS is a small program which is pre-installed on windows based OS.
- It is used to start up the computers.
- It is the first program which is installed in computer even before the OS.

Boot process :

- BIOS check the CMOS settings after starting the computer.
- They read the settings of the CMOS, to check whether everything is functioning correctly.
- After checking BIOS setting BIOS load computer driver which works as interface between the operating system and connected device.
- After loading the computer driver, it starts all CPU registers are ready to work correctly.
- After all this process, BIOS finds a bootable medium after reading the bootable medium, and they load the correct file to the RAM just after the computer is on.

Function of BIOS :

- The main function of BIOS is to boot the operating system of the computer.
- When the computer is on, then BIOS does this tasks given below.
  - For the custom setting, you can check the CMOS setup.
  - To load the Interrupt handlers and device driver.
  - To conduct Power-on-self-test (POST).
  - For display system settings.
  - To decide from which device system is the boot.

Difference between BIOS and CMOS :

BIOS	CMOS
BIOS Stands for Basic Input Output System	CMOS Stands for Complementary Metal Oxide Semiconductor.
BIOS configure the i/p & o/p of the computer, store all settings, and start the computer.	CMOS work is in the form of battery and to secure all settings of BIOS.
BOIS is known as Computer Boot Process Start-up.	CMOS is known, Real Time Clock (RTC), Non-volatile RAM (NVRAM).
BIOS Software are installed in motherboard's EEPROM is stored on the ROM chip.	The CMOS battery is small coin shaped cell on the motherboard,
Their work is incomplete without each other if CMOS is damaged, then BIOS still works,	If BIOS is damaged, then CMOS stops responding.
BIOS gets power from CMOS.	CR2032 cell battery gives power to CMOS which is also called CMOS battery

What is beep code ?

- A beep code is the audio signal given out by a computer to announce the result of testing sequence the computer performs when first powering up (called POST).

1 short beep	Normal post –system is ok
2 short beeps	Post error –error code shown on screen
3 no beep	Power supply or system board problem
Continous beep	Power supply, system board or keyboard problem
Repeating short beeps	Power supply or system board problem
1 long, 1 short beep	System board problem
1 long. 2 short beeps	Display adapter problem (MDA, CGA)

POST :

- POST stands for Power On Self-Test.
- The POST is a collection of test programs.
- The function of these programs is testing the various functional units in the PC and verifying whether they are working or not.
- The POST programs are automatically executed whenever the PC is turned on or reset.
- If the computer passes the POST the computer will have a single beep as the computer starts and the computer will continue to start normally.
- However, if the computer fails the POST, the computer will either not beep at all or will generate a beep code, which tells the user the source of the problem.

CPU Form Factors :

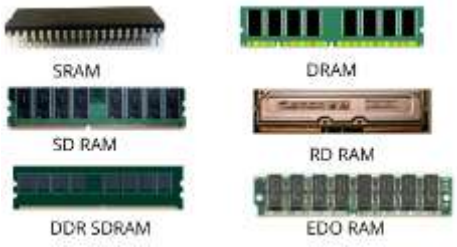
- The form factor of the CPU describes its general shape, what sorts of Sockets and slots used and how heat sink is arranged, and its physical organization.

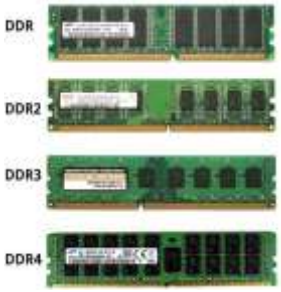
CPU Slots and Sockets

- Slot or socket is the physical connection used to connect a device (CPU) to the system board.
- The type of slot or socket supplied by the system board for the processor must match that required by the processor

History of RAM :

Type of RAM	Year Invented
FPM-(Fast page mode RAM)-	1990
EDO RAM (Extended data out random access memory)	1994
SDRAM (Single dynamic RAM)	1996
RDRAM (Rambus RAM)	1998
DDR (Double Data Rate)	2000
DDR2	2003
DDR3	2007
DDR4	2012





What is RAM ?

- RAM stands for Random Access Memory.
- It is a read-write memory, where data is stored that the processor is currently using.
- Your computer can access RAM memory much faster than data on a hard disk, SSD.
- RAM capacity is critical for system performance.
- It is volatile in nature and also known as working memory of computer.
- There are two types of RAM : Static RAM and Dynamic RAM

Difference between SRAM and DRAM :

SRAM	DRAM
SRAM has lower access time, so it is faster compared to DRAM.	DRAM has higher access time, so it is slower than SRAM.
SRAM is costlier than DRAM.	DRAM costs less compared to SRAM.
SRAM consumes more power.	DRAM consumes less power.
It is a complex internal circuitry, and it offers less storage capacity.	It is the small internal circuitry and it offers large storage capacity is available.

What is Computer Bus ?

- The computer system consist of number of internal and external components.
- These components are physically interconnected & communicate with each other through a network of wires, these wires are called computer bus.
- It is used to send data, addresses, control signals and power to the various components.
- In simple computer buses are electrical wires that connect hardware components of computer system.
- There are three types of computer bus :
  1. System Bus
  2. Expansion Bus
  3. Input/Output Bus

What is Expansion Bus ?

- The expansion bus connects most important internal system component CPU and PCI.
- The PCI slots are used to add card such as graphics card and sound card.
- These cards are installed to enhance the system performance.
- Buses are classified by their shape, number of connector pins, and the type of signals.

What is an ISA Bus?

- ISA stands for Industry Standard Architecture.
- An ISA bus is a computer bus that allows additional expansion cards to be connected to a computer's motherboard.
- An ISA bus that appeared in 1981 is a 8-bit bus with a clock speed of 4.77 MHz.
- In 1984, the bit was expanded into a 16-bit bus and the clock speed went from 6 to 8 MHz.

8-bit ISA Connector:

16-bit ISA Connector:

What is MCA Bus?

- MCA stands for Micro Channel Architecture.
- It is an improved bus designed by IBM in 1987.
- The MCA bus was designed to upgrade ISA features, including:
  Slow speed Complex configuration, Limited hardware options etc.

What is an EISA Bus?

- EISA stands for Extended Industry Standard Architecture.
- It was developed in 1988 by a consortium of companies to compete with the MCA bus that was launched by IBM the previous year.
- The EISA bus used connectors that were the same size as the ISA connector but with 4 rows of contacts instead of 2, for 32-bit addressing.

Universal Serial Bus (USB) :

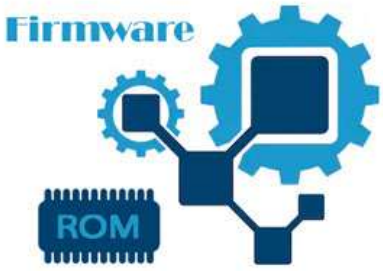
- USB stands for Universal Serial Bus.
- USB is the bus standard for connecting cables between computers, and devices.
- USB is used for data transfer and power supply.
- It connects peripheral devices such as digital cameras, mice, keyboards, printers, scanners, media devices, external hard drives and flash drives.

What is Firmware ?

- Firmware is a software that provides basic machine instructions that allow the hardware to function and communicate with other software running on a device.
- Firmware provides low-level control for a device's hardware.
- It is a piece of programming code embedded in a particular hardware.

  Examples :

  Firmware resides in keyboards, video cards, routers, webcams, motherboards, mice, microwave ovens, refrigerators, washing machines, etc.



Unit – 02: Managing Storage devices

- Know about Semiconductor Memories – RAM, ROM, Main Memory.
- SIMMs, DIMMs, Other RAM Technologies,
- Hard drives – hard drive technology –IDE, EIDE, SCSI, SATA,
- Trouble-shooting hard drives & data recovery, Optimizing Hard drive.
- Disk clean-up, disk fragmentation & Disk backup.

Questions to be discussed:

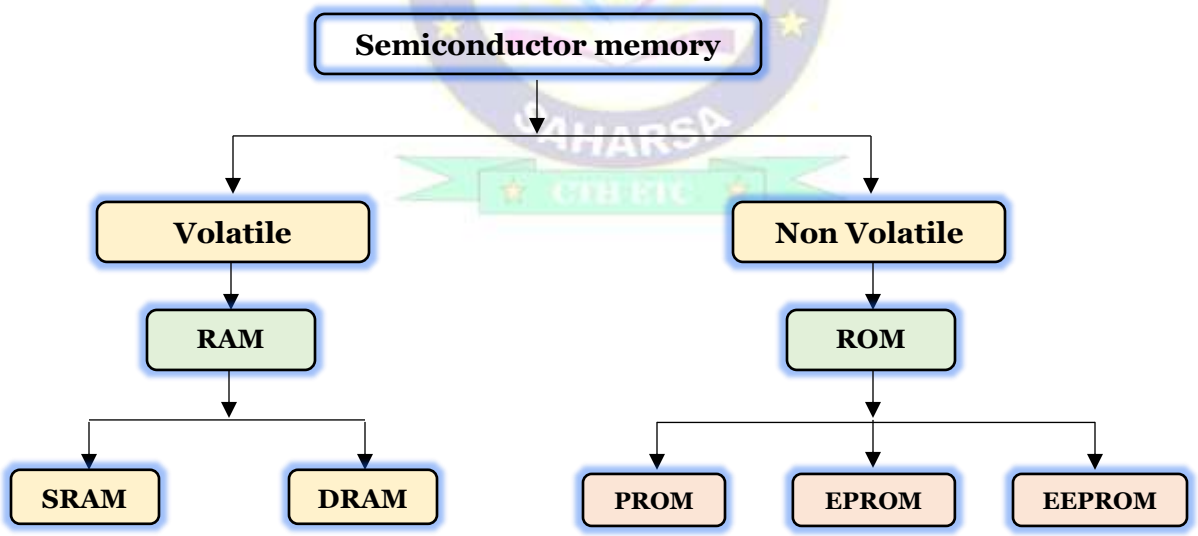
1. What is semiconductor memory? Also explain its type.
2. Differentiate between RAM and ROM.
3. Write the difference between SRAM and DRAM.
4. Explain different types of Read Only Memory.
5. Discuss about different types hard drive technology.
6. What is troubleshooting? How to troubleshoot hard drive?
7. Write short notes on:
   a. SIMM and DIMM
   b. Disk fragmentation
   c. EEPROM

What is Semiconductor?

- Semiconductors are those materials which have conductivity between conductors(silver, copper, etc) and insulators(glass, diamond, etc).
- Semiconductors can be pure elements, such as silicon or germanium, or compounds such as gallium arsenide or cadmium selenide.

Semiconductor Memory:

- A device which is used to stores digital information is known as semiconductor memory.
- It is also known as memory chip, semiconductor storage or transistor memory.
- The semiconductor memory is directly accessible by the microprocessor.
- It offers high operating speed and has the ability to consume low power.
- It fabricated as IC's thus it requires less space inside the system.
- The access time of these memory must be compatible with the microprocessor.
- Thus semiconductor devices are preferred as primary memory.
- The fabrication of semiconductor memories is done through CMOS technology.
- There are two types of semiconductor memory :
  1. Volatile
  2. Non-volatile



Volatile memory:

- Volatile memories are those memories that store the data temporarily.
- We can say that data is stored in volatile memory only till the duration power supply is ON.
- Once the supply gets OFF then the stored data gets lost.
- RAM is a volatile memory.

Random Access Memory (RAM) :

- It is also knows as working memory of computer.
- The Read and write (R/W) memory of a computer is called RAM.
- The User can write information to it and read information from it.
- RAM is a volatile memory, it means information written to it can be accessed as long as power is on.
- RAM holds data and processing instructions temporarily.
- There are two types of RAM**:**
  1. SRAM
  2. DRAM

Difference between SRAM and DRAM :

SRAM	DRAM
SRAM stands for Static RAM.	DRAM stands for Dynamic RAM.
It stores data as long as the power is supplied.	It stores data as long as the power is supplied or a few milliseconds when power is switched off.
Transistors are used to store data in SRAM.	Capacitors are used to store data in DRAM.
Capacitors are not used hence no refreshing is required.	To store information for a longer time, contents of the capacitor need to be refreshed periodically.
SRAM is faster compared to DRAM.	DRAM slower compared to SRAM.
The storage capacity of SRAM is low.	The storage capacity of DRAM is higher than SRAM.
These are expensive.	These are cheaper.
These are used in cache memories.	These are used in main memories.
Consumes less power and generates less heat.	Uses more power and generates more heat.

What are the common types of DRAM?

1. SDRAM - Synchronous DRAM
2. RDRAM - Rambus DRAM
3. DDR SDRAM - Double Data Rate SDRAM

Note : DDR1 SDRAM has been succeeded by DDR2, DDR3, and most recently, DDR4 SDRAM.

Non-volatile memory:

- Non-volatile memories are those memories that store the data permanently.
- The data retained in the memory even if the power supply is OFF.
- ROM is a non-volatile memory.

ROM:

- It stands for Read-Only Memory.
- ROM is an example of nonvolatile memory.
- It is a memory array that is permanently programmed by the programmer only once.
- User can not be changed or modify ROM data only read.
- Hence its data cannot be changed by the processor once it is programmed.
- There are various types of ROM:
  1. PROM
  2. EPROM
  3. EEPROM

PROM :

- It stands for Programmable Read Only Memory.
- It is a semiconductor memory which can only have data written to it once**.**
- Once the PROM is programmed, the information written is permanent and cannot be erased or deleted.
- PROM was first developed by Wen Tsing Chow in 1956.
- An example of a PROM is a computer BIOS in early computers.
- Today, PROM in computers has been replaced by EEPROM.

Note : PROM is also called a **FPROM** (field PROM) or **OTP** (one-time programmable) chip.

EPROM:

- It stands Erasable Programmable Read-Only Memory.
- EPROM was the replacement for ROM and PROM.
- It was developed to overcome the disadvantages of ROM and PROM.
- EPROM is a non-volatile memory.
- EPROM is developed by Dov Frohman in 1971 at Intel.
- EPROM is a type of ROM chip that can retain the data even if there is no power supply.
- The data can be erased and reprogrammed by using ultraviolet (UV) light.
- The process of programming an EPROM is often called BURNING.
- Nowadays EPROM chips are not used in the computer, and these EPROM chips replaced by EEPROM.
- A programmed EPROM can retain its data for a minimum of 10 to 20 years.

EEPROM:

- It stands for electrically erasable programmable read-only memory.
- It is a non-volatile ROM chip which is used for storing a small amount of data in computers.
- In EEPROM, the data is erased using an electrical signal.
- EEPROM was developed by George Perlegos in 1978 at Intel.
- EEPROM used as a replacement for PROM and EPROM.
- Here, erase and write operations are performed by byte per byte.
- We can reprogram EEPROM infinite number of times.
- We can program and erase the contents of EEPROM without removing the chip from the computer.

Difference between EPROM and EEPROM :

EPROM	EEPROM
EPROM stands for Erasable Programmable ROM.	EEPROM stands for Electrically Erasable Programmable ROM.
In EPROM, ultraviolet (UV) light is used to erase the content.	In EEPROM, the data is erased using an electrical signal.
We have to remove the EPROM chip from the computer for erasing and reprogramming of the data.	There is no requirement of removing the chip from the computer for erasing and reprogramming of the data.
It is less expensive as compared to the EEPROM.	It is expensive as compared to the PROM & EPROM.
EPROM is an older technology.	An EEPROM is modern technology.

What is Flash Memory?

- Flash memory combines the advantages of ROM and RAM.
- It can be written or programmed in units called “Sector” or a “Block.”
- Flash Memory is EEPROM means that it can retain its contents when the power supply removed.
- It commonly found in mobile phones, USB flash drives, tablet computers, and embedded controllers.
- Flash memory is often used to hold control code such as the BIOS in a personal computer.
- This memory is used in USB, SD card, memory chip etc.

Difference between RAM and ROM :

RAM	ROM
RAM stands Random Access Memory.	ROM stands Read-only Memory.
It stores data on temporary basis.	It stores data on permanent basis.
It is also known as working or R/W memory.	It is also known as firmware.
RAM is expensive when compared to ROM.	ROM is cheaper when compared to RAM.
It is a high-speed memory.	It is much slower than the RAM.
RAM data can be modified, erased, or read.	ROM data cannot be modified or erased only read.
It is used in CPU Cache, Primary memory etc.	It is used in Firmware, Micro-controllers etc.

RAM technology ?

SIMM :

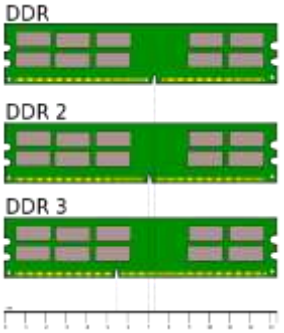
- SIMM stands for Single In-Line Memory Module.
- SIMM modules were widely used from the late 1980s to 1990s, and are now obsolete.
- They typically had 32-bit data bus and were available in two physical types—30- and 72-pin.

DIMM :

- DIMM stands for Dual In-Line Memory Module.
- Current memory modules come in DIMMs.
- "Dual in-line" refers to pins on both sides of the modules.
- A DIMM had a 168-pin connector supporting 64-bit data bus, which is twice the data width of SIMMs.
- The wider bus means, more data can pass through a DIMM, translating to faster overall performance.
- Latest DIMMs based on fourth-generation double data rate (DDR4) SDRAM have 288-pin connectors for increased data throughput.

SIMM

DIMM



What is HDD ?

- HDD stands for hard disk drive.
- It is a non-volatile hardware component on a computer.
- A hard drive acts as the storage for all digital content.
- It holds program files, documents, pictures, videos, music, and more.
- The non-volatile nature of hard drives means they don't lose data, even if power is lost.
- Due to this, they help computers store files and other data for a long time – as long as they don't get damaged or corrupted.
- The HDD was introduced in the year 1956 by IBM.

Hard Drive Technology :

1. IDE
2. EIDE
3. SCSI
4. SATA

IDE :

- IDE stands for Integrated Drive Electronics.
- IDE is also known as ATA or PATA (parallel ATA).
- It is a standard interface for IBM computers that was first developed by Western Digital and Compaq in 1986 for hard drives and CD or DVD drives.
- IDE and its updated successor, EIDE, are common drive interfaces found in IBM computers.

EIDE:

- EIDE stands for Enhanced integrated drive electronics.
- EIDE is the hard drive interface that succeeded IDE, also known as ATA-1.
- The interface acts as an intermediary between the computer and a mass storage device.
- EIDE provides much faster transfer rates than IDE.
- The term was coined by Western Digital in 1994.

SCSI:

- SCSI stands for Small Computer System Interface.
- SCSI hard drives are upgrades over SATA and PATA drives for many reasons such as round-the-clock operations, speed, storage, and several others.
- For connection, SCSI hard drives use a small computer system interface – which is a standard for connecting peripheral devices such as printers, scanners, and others.
- Connections through SCSI on personal computers have now been replaced by the USB.
- This means that SCSI is no longer used as consumer hardware.

SATA:

- SATA stands for Serial Advanced Technology Attachment.
- In recent times, a lot of desktop and laptop computers have gotten SATA hard drives because they have superseded PATA hard drives in size, power consumption, and even better pricing.
- The mode of connection to a computer remains the same as PATA, but instead of parallel signaling technology for data transmission, they use serial signaling technology.
- This means that they transfer data one bit at a time.

What is Troubleshooting?

- It is the process of identifying a common error or fault within a software or computer system.
- It enables the repair and restoration of a computer software when it becomes faulty, unresponsive or acts in an abnormal way.

How to Troubleshoot Hard Disk:

1. Open File Explorer and find the disk which has problems.
2. Right click on the hard disk with errors.
3. Choose Properties.
4. Navigate to Tools bar in the Properties window.
5. Click on the Check button.
6. Select Scan and repair drive to start detecting & fixing disk errors.

Recover Data from a Corrupted or Crashed Hard Drive

1. Type cmd into the search box on taskbar.
2. Right click on Command Prompt from the search result.
3. Select Run as administrator.
4. Type CHKDSK *: /f and press Enter.
5. Wait for the completion.

Recover Data from a Corrupted or Crashed Hard Drive with Software:

- Disk Drill is a data recovery tool that facilitates easy recovery of your essential documents, photos, videos, and other related data lost from a variety of storage devices.
- It is an effective and economical solution with a straight forward interface for beginners.

Steps :

1. Download and Install Disk Drill for Windows or Mac OS.
2. Launch Disk Drill recovery software, select the crashed hard disk and click:
3. Preview the files you found with Quick or Deep Scan. Disk Drill provides you with a complete disk scan report at the end of the recovery operation.
4. Click Recover to recover your lost data.

What does it mean to optimize a drive? How to optimize?

- Optimizing the disk means that it compresses and organizes the files on your hard disk.
- Optimizing your drives can help your PC run smoother and boot up faster.
- To optimize them:
  1. Select the search bar on the taskbar and enter defrag.
  2. Select Defragment and Optimize Drives.
  3. Select the disk drive you want to optimize.
  4. Select the Optimize button.

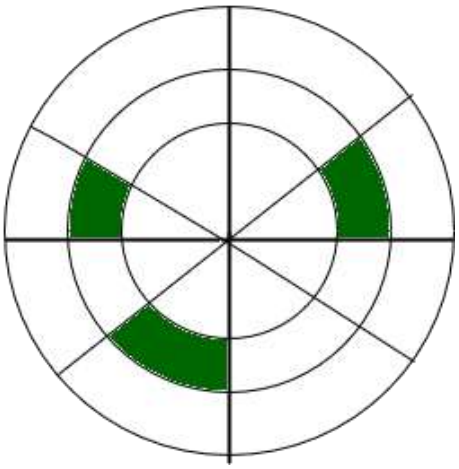
Disk Cleanup:

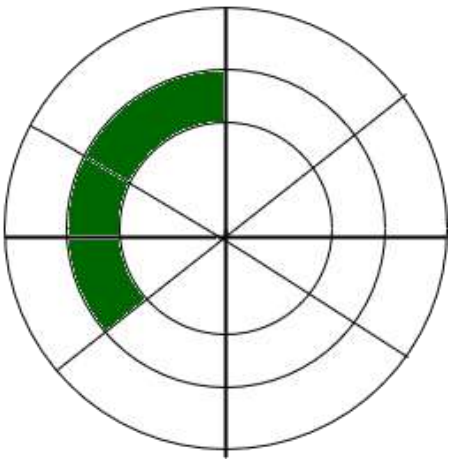
- It is a Microsoft software utility program.
- First introduced with Windows 98 and included in all subsequent releases of Windows.
- It allows users to remove files that are no longer needed or that can be safely deleted.
- Removing unnecessary files, including temporary files, helps speed up and improve the performance of the hard drive and computer.
- Running Disk Cleanup at least once a month is an excellent maintenance task and frequency.

Disk Fragmentation:

- Fragmentation of disk means allocating data in non-sequence form.
- Usually, data is stored in hard drive in sequence form.
- Operating System split entire data into small packets and store data in different locations of storage area.

- The process of defragmentation moves the data blocks on the hard drive around to bring all the parts of a file together.
- Defragmentation is the opposite of fragmentation, which is an inefficient use of computer storage.





Disk backup:

- Hard disk backup is a process to create a complete copy of everything in a hard drive to another HDD/SSD or an external hard drive.
- With a hard disk backup, you can fully protect your computer data from the following disasters:
  - Virus attack
  - Accidental deletion
  - Careless formatting
  - Hard drive corrupted
  - OS crash or boot issue

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Unit – 03 : Troubleshooting Fundamentals

- Troubleshooting tools –
  - Bootable rescue disk,
  - diagnostic software,
  - virus detection software,
  - Anti-Static tools,
- Trouble-shooting guidelines –
  - Power system,
  - system board
  - hard drive, Optical drives,
  - keyboard, Monitor and printer problems,
- Surge protection & battery backup,
- Stand by UPS, Inline UPS, Line-interactive UPS, and intelligent UPS.

Questions to be discussed:

1. What is troubleshooting?
2. Explain in brief different troubleshooting tools.
3. Discuss about troubleshooting guidelines.
4. How to troubleshoot hard drive?
5. What is UPS? Discuss about different types of UPS.
6. Differentiate between online UPS and offline UPS.
7. Write short notes on :
   a. Online UPS
   b. Surge protection
   c. Bootable rescue disc
   d. diagnostic software

What is Troubleshooting?

- It is the process of identifying and resolving a technical problem within a software or computer system.
- Troubleshooting is needed to identify the trouble and make the product operational again.
- It enables the repair and restoration of a computer or software when it becomes faulty.
- The goal of troubleshooting is to determine why something does not work as expected and explain how to resolve the problem.
- Most troubleshooting begins with hardware.

Troubleshooting tools :

- The tools which is used in troubleshooting is called troubleshooting tools.
- There are various troubleshooting tools, some of them are given below:
  - Bootable rescue disk
  - Diagnostic software
  - Virus detection software
  - Anti-Static tools

Bootable rescue disc:

- It is a type of disc that finds threats and removes without disturbing the operating system.
- Rescue Disk can scan hidden files, system drivers, Master Boot Record (MBR) and hard drive.
- It is also known as Recovery disc, Rescue Disk and Emergency Disk.
- The ability to be a boot system independent of an internal hard drive is called bootable rescue disc.
- The rescue disk contains malware and rootkit detection, antivirus scanning, temporary file cleaners, data and driver backups, partition scanning, and even password crackers.

What is diagnostic software?

- It is a software used to test a computer's hardware & software to ensure their performance an proper working.
- It can be used by a trained technician to identify and resolve hardware issues.
- The testing through this tool is done before realising computers in public.
- Different tools are presents for hardware, for better performance & repair.
  - Hardware diagnostic tools
  - PC optimization tools
  - Repair tools

Virus detection software:

- Virus stands for Vital Information Resources under Siege.
- It is a type of malicious software that can damage to your data, files, and software through replication.
- Malicious software is also known as malware - is a code that can harm your computers and laptops.
- Antivirus is known as virus detection software.
- Antivirus is a kind of software used to prevent, scan, detect and delete viruses from computer.
- Once installed, most antivirus software runs automatically in the background to provide real-time protection against virus attacks.

Antistatic tools:

- Antistatic tools are tools that improves the safety and workplace protection.
- It is used to prevent the undesirable effects of static electricity caused by mechanical friction.
- Some antistatic tools are:
  - Antistatic work benches.
  - Antistatic gloves.
  - ESD rubber matting.
  - Antistatic clothing etc.




Trouble shooting guide lines:

- Systematic trouble shooting means logical approach.
- It is a scientific and analytical process.
- The systematic trouble shooting approach can be divided into following steps
  1. Symptom observation
  2. Symptom analysis
  3. Fault diagnosis
  4. Fault rectification.

Power system troubleshooting:

- Check the power strip or surge protector to make sure it is plugged in and turned on.
- Check for loose cables in the back of the computer (especially the main power cable).
- Check the outlet for power problems or try moving the power cable to a different outlet.
- Try a different power cable.

Troubleshooting the System Board:

- The microprocessor, RAM modules, ROM BIOS, and CMOS battery are typically replaceable units on the system board.
- Both the microprocessor and the ROM BIOS can be sources of such problems.
- You should check both by substitution when dead system symptoms are encountered but the power supply is good.

How to troubleshoot a hard drive?

- Open File Explorer and find the disk which has problems.
- Right click on the hard disk with errors.
- Choose Properties.
- Navigate to Tools bar in the Properties window.
- Click on the Check button.
- Select Scan and repair drive to start detecting & fixing disk errors.

How to troubleshoot optical drive?

- Boot to the Windows 10 desktop, then launch Device Manager by pressing Windows key + X and clicking Device Manager.
- Expand DVD/CD-ROM drives, right-click the optical drive listed, then click Uninstall.
- Exit Device Manager then restart your computer.
- Windows 10 will detect the drive then reinstall it.

Troubleshooting Keyboard:

- An outdated or corrupt driver could be the reason your keyboard isn't working.
- Step 1: Right-click on Start and select Device Manager.
- Step 2: Expand Keyboards.
- Step 3: Right-click on the affected keyboard and select Update driver.

How to troubleshoot a monitor:

- Unplug the cable running from your monitor to your PC and plug it back.
- Replace your monitor with another monitor if possible.
- Check for physical damages.
- Update the video card (GPU) driver, monitor driver, chipset driver & BIOS.

Troubleshooting printer:

- Check to make sure the printer is turned on and connected to the same Wi-Fi network as your device.
- Unplug and restart your printer.
- Set your printer as the default printer.
- Clear the print queue.
- Reset the service that manages the printing queue.

Surge Protection:

- A surge protector is an electrical device.
- It is used to protect equipment against power surges and voltage spikes while blocking voltage over a safe threshold (approximately 120 V).
- Without a surge protector, anything higher than 120V can create component issues, such as permanent damage, reduced lifespan of internal devices, burned wires and data loss.
- The other function of the surge protector is to protect the devices from electric surges.

Battery Backup:

- A device which provides power to equipment during the absence of commercial AC with the help of a battery is known battery backup's device.
- UPS is the poplar battery backup device.

What is an UPS?

- UPS stands for Uninterruptible Power Supply.
- It is a device that allows computer to keep running for short time when incoming power is interrupted.
- Small UPS provide power for a few minutes, while larger UPS have enough battery for several hours.
- The main parts of a UPS are: rectifier, battery, inverter and controller.
- There are four types of UPS:
    1. Stand by UPS,
    2. Online UPS,
    3. Line-interactive UPS, and
    4. Intelligent UPS.

Standby UPS:

- A Standby UPS can detect an electrical failure and switch to battery power automatically.
- The standby is also called off-line UPS.
- They provide surge protection and battery backup.
- The protected equipment is normally connected directly to incoming utility power.

Online UPS:

- Online UPS supplies power to the AC load through the Rectifier and inverter in normal operation.
- It uses an inverter to supply AC power during a power failure.
- Therefore, the output power supply always stays ON and there is no need for switching**.**
- Hence, there is no time delay in switching between its sources.
- There is no interruption in the case of power failure even for a nanosecond.

Line interactive UPS:

- A line-interactive UPS maintains the inverter in line and redirects the battery's DC current path from the normal charging mode to supplying current when power is lost.
- It provides power with a 4-6 millisecond break in power when transferring to battery back-up.
- Here the UPS also monitors the voltage level and balances under and over voltages.
- Line Interactive UPS are typically used in smaller, less critical applications, such as PCs, telephone systems, non-critical networking equipment and small motor loads.

Intelligent UPS:

- Intelligent UPS systems are designed with line interactive or standby topology.
- It offer guaranteed power protection for computers, routers, modems, and home theater equipment.
- Intelligent UPS is also known as smart UPS.
- It include an LCD status panel, Automatic Voltage Regulation (AVR), energy-saving Green Power UPS Design, data line protection, and management software to easily control and monitor your UPS.
- A smart UPS that integrates with your network can provide real-time status updates, giving you better visibility into device health and performance.

What is the difference between Online UPS and Offline UPS?

Online UPS	Offline UPS
An Online UPS uses a rectifier and inverter circuit to carry power from the AC mains to the load.	An offline UPS directly carries power from the AC mains to the load.
The inverter is used around the clock, during power availability as well as power outages.	An offline UPS inverter is only used when there is a power outage.
The transfer switch of an online UPS is always on.	The switch of an offline UPS needs to be turned on in case of power outages.
An online system requires a large heat sink.	An offline system requires a small heat sink.
More expensive than offline UPS.	Less costly when compared to online UPS.

What is the difference between UPS and inverter?

UPS	Inverter
A UPS is a device which provides power to the load in case of main power failure.	Inverter is a power electronic circuit which converts the direct current into alternating current.
The main parts of a UPS are: rectifier, battery, inverter and controller.	The main parts of an inverter are: inverter circuit and battery.
UPS converts DC into AC and AC into DC at the same time.	Inverter only converts DC into AC.
A UPS can charge the battery from AC mains.	Inverter cannot charge a battery itself.
UPS provides necessary protection against abnormal conditions like short circuit, overload, etc.	Inverter does not provide protection against abnormal conditions.
UPS includes smart devices to provide necessary protections which makes it more expensive.	Inverters are less expensive than a UPS.

Unit – 04: Introduction to Networks and LAN components

- Understand the Overview of Networking,
- State the Need for Networking,
- Overview of Network Topologies.
- Classification of Networks –LAN, MAN,WAN,
- Explain LAN Devices, Repeaters, Hubs, Switches, Network Interface Cards (NICs), Routers, Modem,
- List the Hardware and Software Components,
- Various Network Communication Standards,
- OSI Reference Model,
- TCP/IP Reference Model,
- Know about LAN Cables and Connectors, wireless network adapter,
- Know about :
  - Coaxial Cables,
  - Twisted-Pair Cables,
  - Optical Fiber Cables, and Connectors.

Questions to be discussed:

1. What is network? Explain different types of computer networks.
2. What are the three necessary criteria for an effective and efficient network?
3. Discuss in brief different types of network topology in computer networks.
4. Explain about different networking devices in details.
5. Explain different layers of OSI model in details.
6. Explain in details about TCP/IP reference model.
7. Differentiate between OSI and TCP/IP model.
8. Write short notes on:
   a) Modem
   b) Router
   c) Coaxial cable
   d) Optical fiber

What is Network?

- Two or more computers are connected together to sharing data or information is called network.
- In network computers are connected either by wired (cables) or wireless (Wi-Fi).
- These networked devices use a system of rules, called communications protocols, to transmit information over physical or wireless technologies.
- A server is a main computer that manages resources connected to a network.
- Any user on the network can access the resources stored on the server.

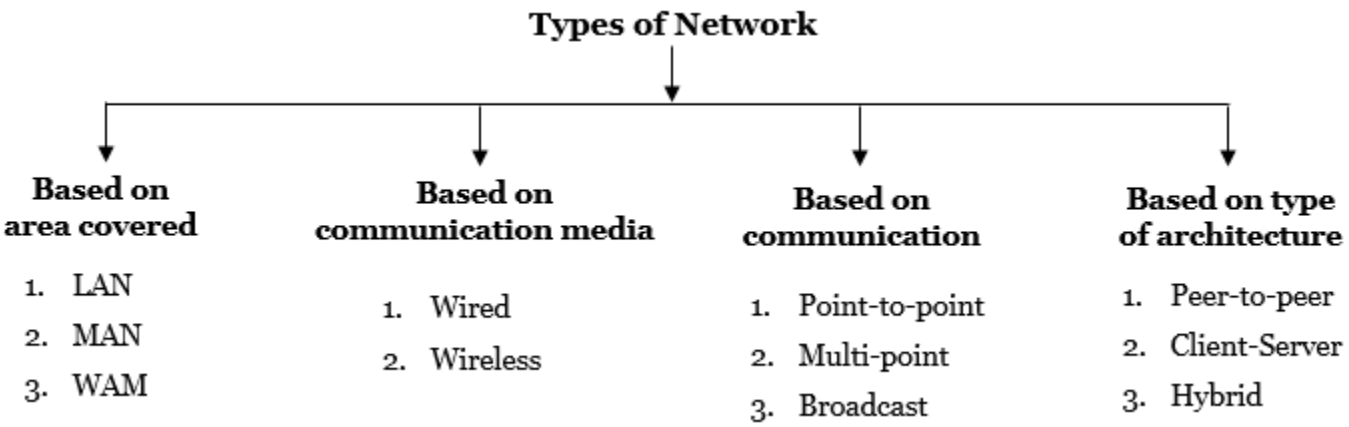
What is networking?

- The process of making connections and building relationships among computers are called networking.
- The main purpose of networking is transmitting or sharing data and resources.

Need of Networking:

- The need for networking is mainly to break the barriers of distance, time and cost.
- For sharing resources, exchange files or allow electronic communications.
- Networking can even help you find unadvertised jobs/internships.
- We can easily access the files stored on various computers on a network.
- Networking also allows many people to work simultaneously on the data stored in a database.
- Computer networks allow people to communicate through emails and instant messaging facilities.

Types of network:



Based on area covered, there are three types of network:

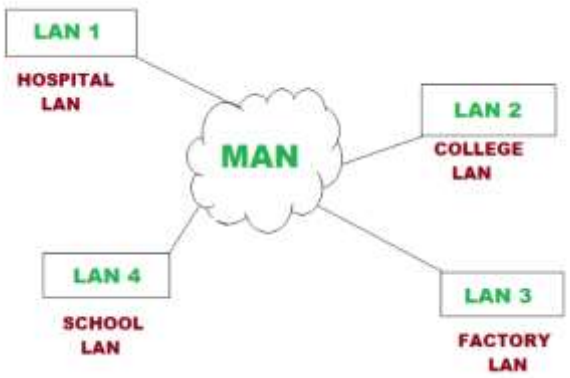
1. LAN
2. MAN
3. WAN

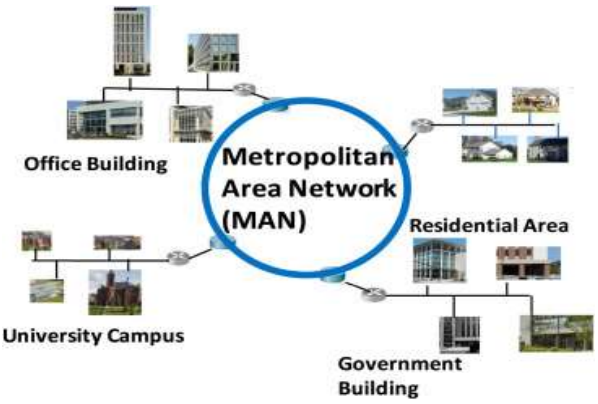
Local Area Network (LAN):

- LAN stands for Local Area Network.
- It is a computer networks that spans only a small geographical area such as office, home or building.
- In LAN one computer is designed as the file server which stores all the software that controls the network.
- A LAN is the simplest form of network that covers an area of around 10 kilometers.
- For example, a college network or an office network.

Metropolitan Area Network (MAN):

- MAN stands for Metropolitan Area Networks.
- It is a type of network that spread over a “metropolitan” area such as a city.
- A MAN may be operated by one organization or be shared resources used by several organization in the same city.
- MAN connect multiple LANs to one another at high speeds.
- MAN refers to a network that covers an entire city.
- For example: consider the cable television network.





Wide Area Network (WAN):

- WAN stands for Wide Area Network.
- It is a type of network over a large geographical area such as states, countries or even the whole world.
- The large WAN is existence in the Internet.
- These kinds of networks use telephone lines, satellite links and other long range communications technology to connect.
- A WAN connects multiple LANs to one another over great geographic distances.
- WAN interconnects connecting devices such as switches, routers, or modems.

Wide area network (WAN)

What are the three necessary criteria for an effective and efficient network?

- The three necessary criteria for an effective and efficient network are:
  1. Performance
  2. Reliability
  3. Security.

Performance:

- It can be measured in many ways, including transmit time and response time.
- Transit time is the amount of time required for a message to travel from one device to another.
- Response time is the elapsed time between an inquiry and a response.
- The characteristics that measure the performance of a network are Bandwidth, Throughput, Latency(delay) etc.

Reliability:

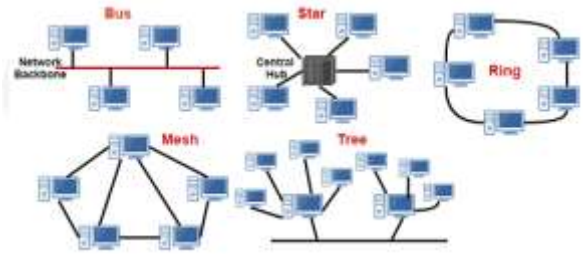
- Capacity of the network to offer the same services even during a failure.
- The accuracy is measured by frequency of failure, the time it takes a link to recover from failure.

Security:

- Network security issues include protecting data from unauthorized access, damage or loss data.

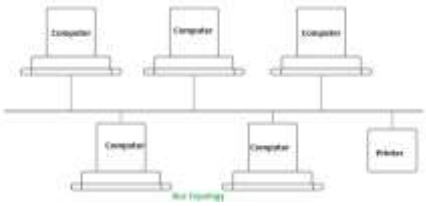
What is network topology?

- The arrangement or structure of nodes and links is called network topology.
- They can be configured in different ways to get different outcomes.
- There are five types of network topologies:
  1. Bus
  2. Ring
  3. Star
  4. Tree
  5. Mesh



Bus Topology:

- In Bus topology each computer is connected to the single bus cable.
- Linear Bus topology is defined as having exactly two terminals.
- A signal from the source travels in both directions to all machines connected on the bus cable.
- If the machine address does not match the intended address for the data, the machine ignores the data.
- In local area networks bus topology is used.



Advantages

- ➢ Installation is simple.
- ➢ Compared to other topologies, the bus utilizes less cabling.

Disadvantages

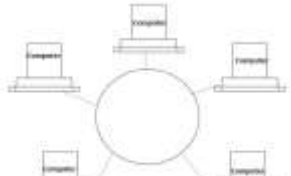
- ➢ Difficulty in reconfiguring and isolating faults.
- ➢ A bus cable malfunction or break interrupts all communication.

Ring Topology:

- In ring topology each computer is connected to another and the last one is connected to the first.
- A network topology that is set up in a circular fashion in which data travels around the ring.
- Exactly two neighbors for each device.
- Each device receive the incoming signal and transmit the data to the next device in the ring.
- Here, each device on the network acts as a repeater.

Advantages

- ➢ Data transmission is relatively straightforward because packets only move in one direction.
- ➢ There is no requirement for a central controller to manage communication between nodes.
- ➢ Easy installation & Reconfiguration
- ➢ Simplified Faulty connections

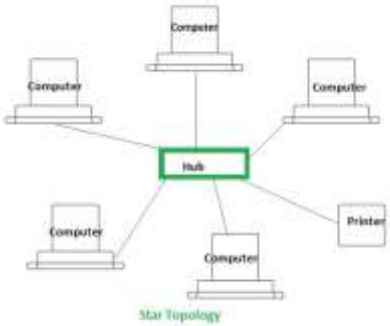


Disadvantages

- In a Unidirectional Ring, a data packet must traverse through all nodes.
- All computers must be turned on in order for them to connect with one another.

Star Topology:

- In Star topology every node is connected to central controller called hub or switch.
- The hub acts as a signal repeater.
- The star topology is considered the easiest topology to design and implement.
- There is no direct connection between the devices.
- Used in high-speed LANs



Star Topology

Advantages

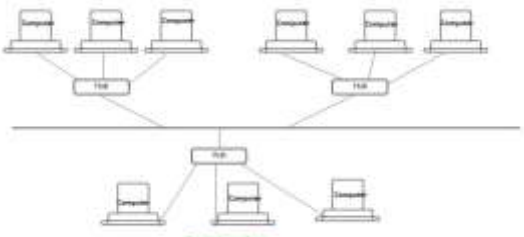
- It's simple to set up and configure.
- Identifying and isolating faults is simple.
- Easy to install & configure

Disadvantages

- Nodes attached to the hub, switch, or concentrator is failed if they fail.
- Because of the expense of the hubs, it is more expensive than linear bus topologies.
- More cable required compared to bus or ring
- Too much dependency on Hub

Tree Topology:

- It is a combination of a star and bus topology.
- It is also known as hierarchical topology.



Advantages

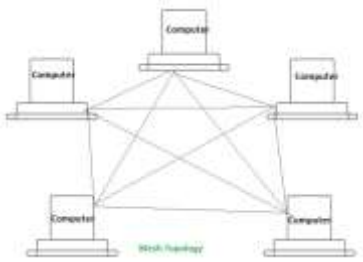
- Network expansion is both possible and simple.
- We partition the entire network into pieces (star networks) that are easier to manage and maintain.
- Other segments are unaffected if one segment is damaged.

Disadvantages

- All device are connected to bus cable, and if it fails, the entire network is handicapped.
- Maintenance becomes more challenging when more nodes and segments are added.

Mesh Topology:

- It is a network topology in which all the nodes are individually connected to the other nodes.
- Every device in a mesh topology has dedicated point-to-point connectivity to every other device.
- To connect n devices, a fully connected mesh network contains n *(n-1)/2 physical channels.



Advantages

- Data can be sent from multiple devices at the same time.
- Even if one of the connections fails, a backup is always available.
- Point to Point links make fault transmission & fault isolation easy.

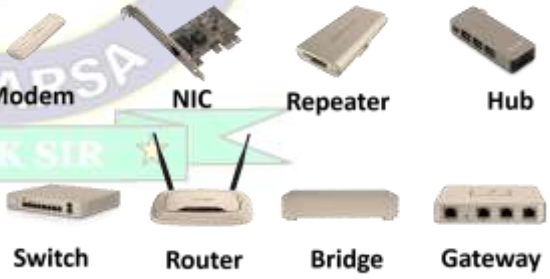
Disadvantages

- The amount of cabling is increased so it is very expansive.
- It is difficult to install and reconfigure.

Example: connection of telephone regional office in which each regional office needs to be connected to every other regional office.

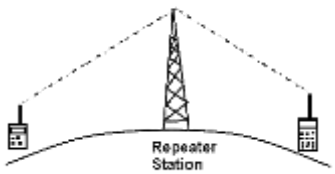
Network devices:

- A network device allows computers to connect through a network and transmit data.
  1. Repeater
  2. Hub
  3. Switch
  4. Bridge
  5. Router
  6. Gateway
  7. Modem
  8. NIC



Repeater:

- A repeater is a network device that increases a signal's strength, so it can travel greater distances without a loss in quality.
- It receives a signal, cleans it of unwanted noise, regenerates it & retransmits it at a higher power level.
- It allowing the signal to travel greater distances without degradation.
- A repeater is also known as range extender.



Hubs

- A hub is a small device that allows wired devices to connect to a network.
- It is also known as multiport repeater.
- A network hub is a relatively simple broadcast device.
- Hubs have no knowledge of the devices connected.
- That means that all packets of data that arrive at the hub are transmitted to all connected computers.
- This affects network performance, as many unnecessary signals are transmitted across its connections.

Switch:

- Switches are similar to hubs, with one important difference - a switch records which computers are connected to which ports.
- When a message is received, the switch forwards each packet of data to its intended recipient only.
- This improves network performance by cutting down on unnecessary transmissions.

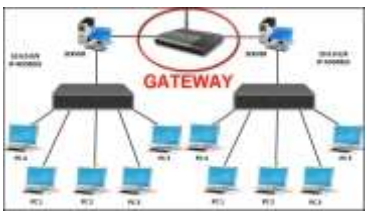
Bridge:

- A bridge is a network device used to connect multiple LANs together.
- The mechanism of network aggregation is known as bridging.
- The bridge is a hardware device that operates at data link layer.
- It is also known as a layer of two switches.

Router:

- A router is a network layer hardware device that transmits data from one LAN to another if both networks support the same set of protocols.
- It is used to connect two or more similar networks.
- It is a networking devices that that operates in network layer of OSI model.
- It uses routing tables to find the optimal way to forward data packets between networks.

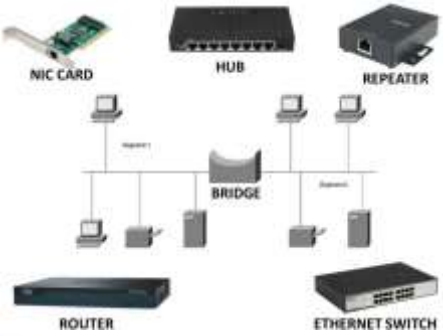
Gateway:



- A gateway joins together two networks that use different protocols, for example joining a LAN to a WAN.
- It is used to connect two or more dis-similar network.
- It converts information or data from one protocol or format to another.
- Gateway is also known as protocol converter.
- It is a hardware device that acts as a gate among various available networks.
- The gateway operates at the network layer (Layer 3) of the OSI Model.

Modem:

- Modem stands for modulator and demodulator.
- A modem is a box that connects your home network to your internet service provider, or ISP.
- It is a hardware device that allows a computer to send and receive information over telephone lines.
- When sending a signal, the device converts ("modulates") digital data into analog audio signal, and transmits it over a telephone line.
- Similarly, when an analog signal is received, then it converts back ("demodulates") to a digital signal.
- Modems operate on just the data link layer.



NIC (Network Interface Card):

- NIC stands for Network Interface Card.
- It is a hardware component without which a computer cannot be connected over a network.
- It is also called network interface controller, network adapter or LAN adapter.
- NIC allows both wired and wireless communications.
- NIC is both a physical layer and a data link layer device.

ISO/OSI Model in Communication Networks

- OSI stands for Open System Interconnection.
- It is a standard reference model for communication between two end users in a network.
- In 1983, ISO publish a document called “The basic reference model for OSI” which visualize network protocols as a seven-layered.
- It defines seven layers in a complete communication system.

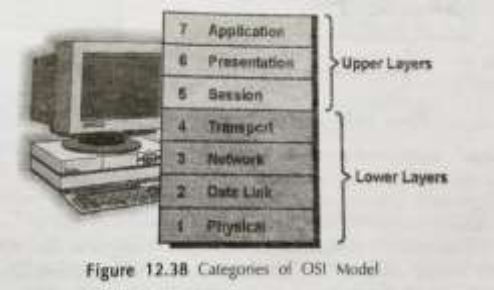
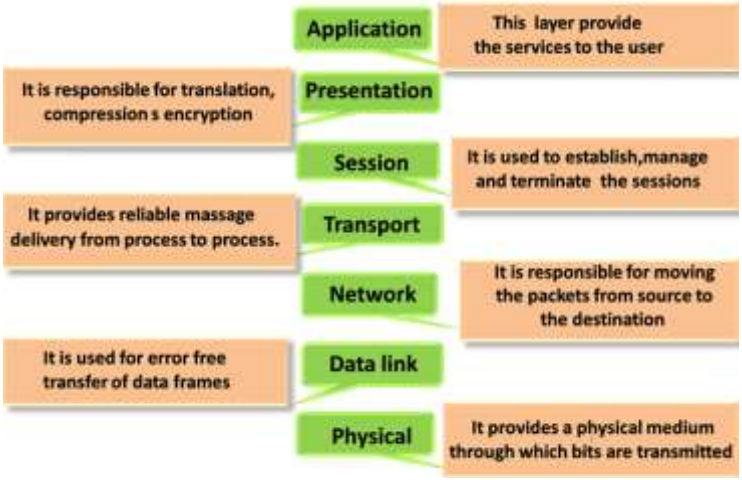


Figure 12.38 Categories of OSI Model



Functions of different layers:

Application Layer:

- It is the topmost layer.
- Transferring of files disturbing the results to the user is also done in this layer.
- Mail services, directory services, network resource etc. are services provided by application layer.

The Presentation Layer:

- Presentation layer takes care that the data is sent in such a way that the receiver will understand.
- If the language can be different of the two communicating systems then it plays a role of translator.
- It performs Data compression, Data encryption, Data conversion etc.

The Session Layer:

- Session layer manages synchronize.
- Transfer of data from source to destination session layer streams of data are resynchronized properly.

Transport Layer:

- It decides if data transmission should be on parallel path or single path.
- Functions such as multiplexing, segmenting or splitting on the data are done by this layer
- It receives messages, convert it into smaller units and passes it on to the Network layer.

The Network Layer:

- It acts as a network controller & manages the traffic.
- It decides by which route data should take.
- It select the shortest path to transmit the packet, from the number of routes available.
- The Network layer contains information in the form of **packets.**

Data Link Layer:

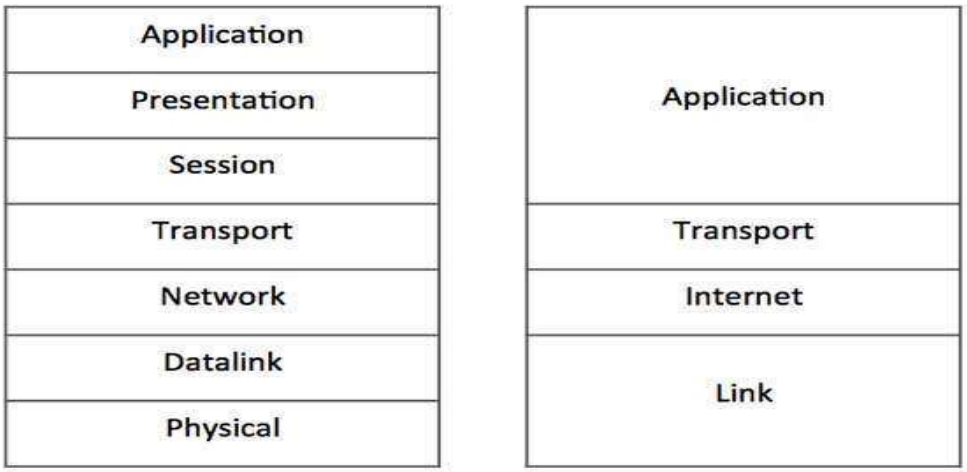
- The main function of this layer is to make sure data transfer is error free from one node to another.
- The data link layer contains information in the form of **frames.**
- Data Link Layer is divided into two sublayers:
  1. Logical Link Control (LLC)
  2. Media Access Control (MAC)

The Physical Layer:

- The lowest layer of the OSI reference model is the physical layer.
- It is responsible for the actual physical connection between the devices.
- The physical layer contains information in the form of **bits.**
- It is responsible for transmitting individual bits from one node to the next.

What is TCP/IP model?

- The TCP stands for Transmission Control Protocol, whereas IP stands for Internet Protocol.
- The TCP/IP model is a concise version of the OSI model.
- This model consists of 4 layers.
- It was developed by ARPANET (Advanced Research Project Agency Network).
- It consists of standard protocols that lead to the development of an internet.



OSI Reference Model TCP/IP Reference Model

Differentiate between OSI and TCP/IP model:

OSI	TCP/IP
OSI stands for open system interconnection.	TCP/IP stands for transmission control protocol/ Internet protocol
OSI model has been developed by ISO.	It was developed by ARPANET.
OSI model has 7 layers.	TCP/IP has 4 layers.
The smallest size of the OSI header is 5 bytes.	The smallest size of the TCP/IP header is 20 bytes.
Follows horizontal approach	Follows vertical approach.
Session & presentation layers are a part of the OSI model.	There is no session & presentation layer in the TCP model.
Network layer of OSI model provide both connection oriented and connectionless service.	The Network layer in TCP/IP model provides connectionless service.

What is Media?

- Media is used to transmit data or information from one location to another.
- It describes the various ways through which device communicate on the network.
- There are two types of media:
  1. Guided media
  2. Un guided media

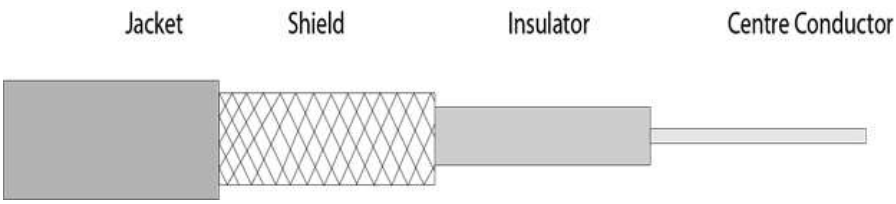
GUIDED MEDIA	UNGUIDED MEDIA
The signal requires a physical path for transmission.	The signal is broadcasted through air or sometimes water.
It is called wired communication or bounded transmission media.	It is called wireless communication or unbounded transmission media.
It provides direction to signal for travelling.	It does not provide any direction.
Twisted pair cable, coaxial cable and fiber optic cable.	Radio wave, microwave and infrared.

Twisted pair:

- Twisted pair is a physical media made up of a pair of cables twisted with each other.
- A twisted pair consists of two insulated copper wires arranged in a regular spiral pattern.
- Increasing the number of turns per foot decreases noise interference.
- A twisted pair cable is cheap as compared to other transmission media.
- Installation of the twisted pair cable is easy, and it is a lightweight cable.
- Twisted Pair cables are used in telephone lines to provide data and voice channels.
- RJ-45 is a very common application of twisted pair cables.
- There are two types of twisted pair cable:
  1. Shielded Twisted Pair Cables (STP) :
  2. Unshielded Twisted Pair Cables (UTP) :

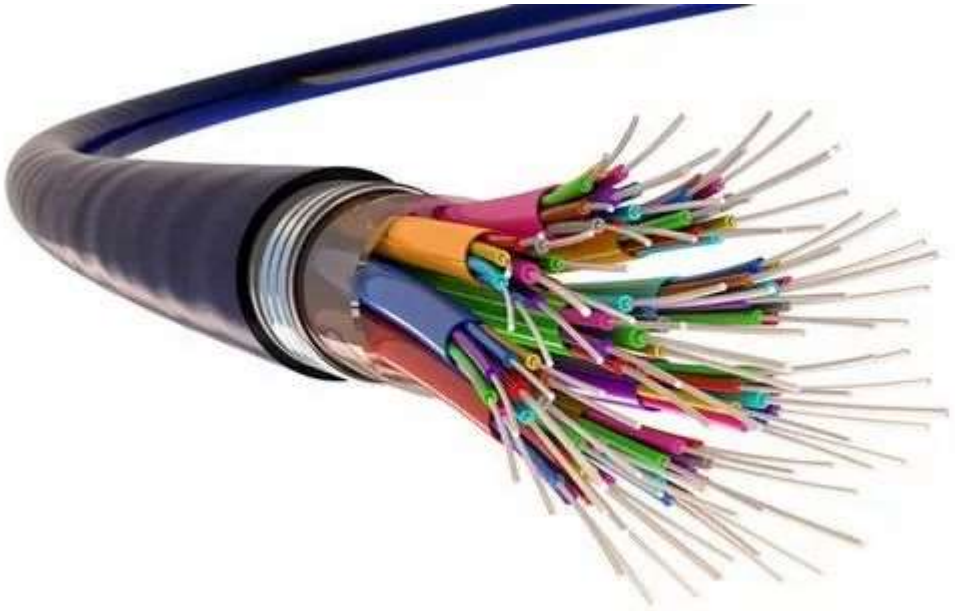
Coaxial Cable:

- Coaxial cable is very commonly used transmission media, for example, TV wire is usually a coaxial cable.
- Coaxial cable is also known as **coax.**
- It has a higher frequency as compared to twisted pair cable.
- The coaxial cables are used in Ethernet LANs and also used in MANs
- It is used in Television, Internet, CCTV, Video etc.



Fiber Optic:

- Fiber optic cable is a cable that uses electrical signals for communication.
- It is made up of high quality glass or plastic used to transfer digital data signal in the form of light.
- The plastic coating protects the optical fibers from heat, cold, electromagnetic interference etc.
- Fiber optics provide faster data transmission than other media.
- It is used in long distance high speed data transmission, video transmission, broadband services etc.



Unit – 05: Network Addressing and Management

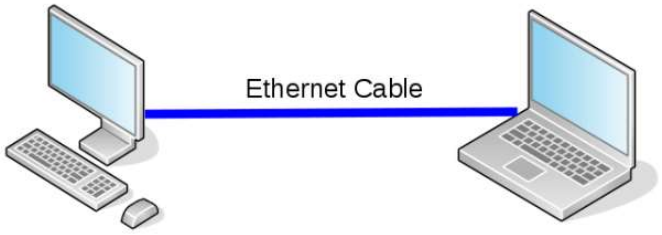
- Introduction to Network Addressing,
- Components of IP Address,
- IP Address Classes,
- IP Sub-netting,
- Classify the two types of Internet Protocol addressing IPv4 and IPv6 and state the need for IPv6, explain classful addressing and classless addressing in IPv4,
- State the need for protocols in computer networks,
  - Hyper Text Transfer Protocol (HTTP),
  - File Transfer Protocol (FTP),
  - Simple Mail Transfer Protocol (SMTP),
  - Telnet.

Questions to be discussed:

1. What is IP address? What are the components of IP Address?
2. What are the different classes of IP addresses and give the range of each class?
3. Explain the difference between Static and Dynamic IP?
4. Differentiate between classful and classless addressing.
5. What is subnet mask? Also explain sub-netting.
6. What is the LOOPBACK address?
7. State the need for protocol. Also differentiate between IPv4 and IPv6.
8. What are the important differences between MAC address and IP address?
9. Write short notes on:
   a) HTTP
   b) FTP
   c) SMTP
   d) TELNET

Computer Network:

- A computer network is a group of interconnected computers that are sharing a resources provided by network nodes.
- These sharing is governed by some set of rules called network protocols.
- These computers are identified by network addresses, and may have hostnames.



Network Address:

- It is a type of address that uniquely identifies a computer (host) in a network.
- Network Address may be logical or physical.
- IP address, MAC address and telephone numbers are some basic examples of network addresses.
- It can be of numeric type or symbolic or both in some cases.

Network Addressing:

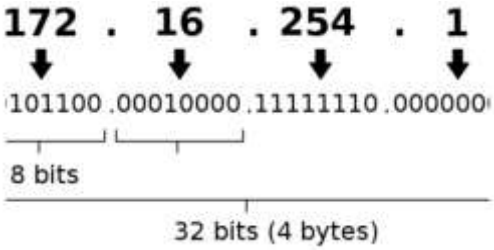
- The process of assigning a address of computer in a network is called network addressing.
- It is the responsibility of the network layer to assign unique addresses to the nodes in a network.
- The most widely used network address is an IP address.
- There are two types of network addressing:
  1. Classful addressing
  2. Classless addressing

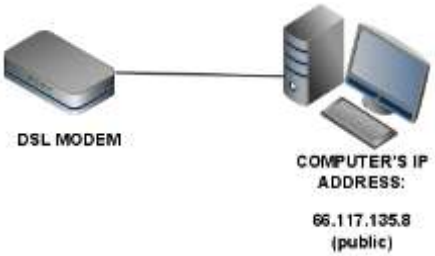
Difference between classful and classless addressing:

Classful Addressing	Classless Addressing
Classful addressing categorizes the IP addresses into five major classes: class A, B, C, D, and E.	Classless addressing is also called Classless Inter-Domain Routing (CIDR**).**
It follow the IP Address classes and subnet mask.	Doesn't follow IP Address classes & subnet mask.
NID and HID changes depending on class.	There is no boundary of NID and HID.
Not support VLSM(Variable Length Subnet Mask)	Support VLSM.
In classful routing, fault can be detected easily.	Here, fault detection is little tough.

What is an IP address?

- An IP address is a unique address that identifies a device on the internet or network.
- IP stands for "Internet Protocol," which is the set of rules governing the format of data sent via internet.
- An IP Address is an address of node (computer) within the network.
- It is used to uniquely identify a node in a network.
- An IP address consist of 32-bits address that is split into four sections separated by dots.
- The IP address is made up of four parts, each of which is 8 bits long (1 byte).
- Example:





Components of IP Address:

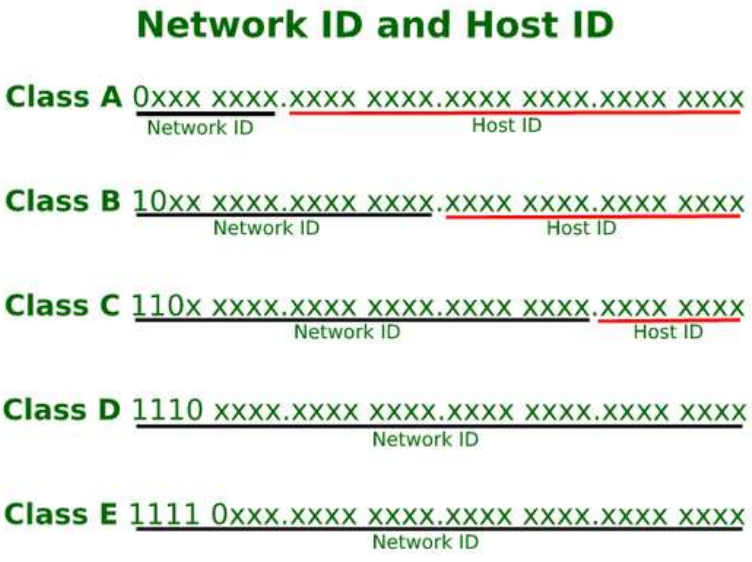
- ❖ Network ID(NID)
- ❖ Host ID(HID)

Network ID:

- The NID is the fragment of IP address identifies the network segment to which the host belongs.

Host ID:

- The HID is the fragment of an IP address that identifies an individual host on specific network segment.



IP address classes:

- **Class A:** An IP address is assigned to those networks that include large number of hosts.
- **Class B:** An IP address is assigned to networks range from small sized to large sized.
- **Class C:** An IP address is assigned to networks that are small sized.
- **Class D:** IP address are reserved for multicast address and does not possess sub-netting.
- **Class E:** An IP address is used for the future use and for the research and development purposes.

Class	Public IP Range	Subnet Mask	# of Networks	# of Hosts per Network
Class A	1 – 127	255.0.0.0	126	16,777,214
Class B	128 – 191	255.255.0.0	16,382	65,534
Class C	192 – 223	255.255.255.0	2,097,150	254
Class D	224 – 239	x	x	x
Class E	240 – 255	x	x	x

CLASS	LEADING BITS	NET ID BITS	HOST ID BITS	NO. OF NETWORKS	ADDRESSES PER NETWORK	START ADDRESS	END ADDRESS
CLASS A	0	8	24	2^7 (128)	2^{24} (16,777,216)	0.0.0.0	127.255.255.255
CLASS B	10	16	16	2^{14} (16,384)	2^{16} (65,536)	128.0.0.0	191.255.255.255
CLASS C	110	24	8	2^{21} (2,097,152)	2^8 (256)	192.0.0.0	223.255.255.255
CLASS D	1110	NOT DEFINED	NOT DEFINED	NOT DEFINED	NOT DEFINED	224.0.0.0	239.255.255.255
CLASS E	1111	NOT DEFINED	NOT DEFINED	NOT DEFINED	NOT DEFINED	240.0.0.0	255.255.255.255

- **By reading the first octet, we can determine the class of an address to which it belongs.**
  - 1 – 126 – Class A address
  - 128 – 191 – Class B address
  - 192 – 223 – Class C address
  - 224 – 239 – Class D address
  - 240 – 254 – Class E address

Note: the IP address 0.0.0.0 is used for broadcasting while 127.0.0.1 is used as a loopback address.

What is the LOOPBACK address?

- The IP address **127.0. 0.1** is called a loopback address.
- This can be used for diagnostic purposes to verify that the internal path through the TCP/IP protocols is working.
- Loopback Address is used to send a message to itself to make sure that the TCP/IP stack is installed correctly on the machine.

Difference between static and dynamic IP Address:

Static IP Address	Dynamic IP address
It is provided by ISP. (ISP - Internet Service Provider).	While it is provided by DHCP. (DHCP - Dynamic Host Configuration Protocol).
It does not change at IP any time.	It change at IP any time.
A static IP address is less secure.	A dynamic IP address is more secure.
The device designed by static IP address can be trace.	The device designed by dynamic IP address can't be traced.
It is more stable than a dynamic IP address.	It is less stable than static IP address.
Maintaining cost of static IP address is higher.	Maintaining cost of dynamic IP address is less.

Difference between MAC Address and IP Address:

MAC Address	IP Address
MAC stands for Media Access Control.	IP stands for Internet Protocol.
MAC Address is a 6 byte hexadecimal address.	IP Address is either 4 byte or 16 byte address.
NIC Card's Manufacturer provides MAC Address.	Internet Service Provider provides IP Address.
MAC Address is the physical address of computer.	IP Address is the logical address of the computer.
MAC Address operates in the data link layer.	IP Address operates in the network layer.
MAC Address of computer cannot be changed.	IP Address can be changed network to network.
MAC Address can't be found easily by third party.	IP Address can be found by third party.

What is subnet mask?

- A subnet mask is like an IP address, but for only internal usage within a network.
- Routers use subnet masks to route data packets to the right place.
- A subnet mask is a 32-bit number created by setting host bits to all 0s and setting network bits to all 1s.
- The "255" address is always assigned to a broadcast address, and the "0" address is always assigned to a network address.
- By default subnet mask:
  - Class A - 255.0.0.0
  - Class B - 255.255.0.0
  - Class C - 255.255.0.0

What is sub-netting?

- When a bigger network is divided into smaller networks, to maintain security, then it is known as Sub-netting.
- In other words, the process of dividing a network into two or more networks is called sub-netting.
- So, maintenance is easier for smaller networks.
- For example, if we consider a class A address, the possible number of hosts is 2^{24} for each network.
- It is obvious that it is difficult to maintain such a huge number of hosts, but it would be quite easier to maintain if we divide the network into small parts.

Difference between IPv4 and IPv6:

IPv4	IPv6
IPv4 stands for internet protocol version 4.	IPv6 stands for internet protocol version 6.
IPv4 has a 32-bit address length	IPv6 has a 128-bit address length
IPv4 has a header of 20-60 bytes.	IPv6 has header of 40 bytes fixed
IPv4 can be converted to IPv6	Not all IPv6 can be converted to IPv4
IPv4 consist of 4 fields which are separated by dot (.)	IPv6 consist of 8 fields, which are separated by colon (:)
In IPv4, IP addresses are divided into 5 classes. Class A , Class B, Class C , Class D & Class E.	IPv6 does not have any classes of IP address.
Example of IPv4: 66.94.29.13	Example of IPv6: 2001:0000:3238:DFE1:0063:0000:0000:FEFB

Network protocol:

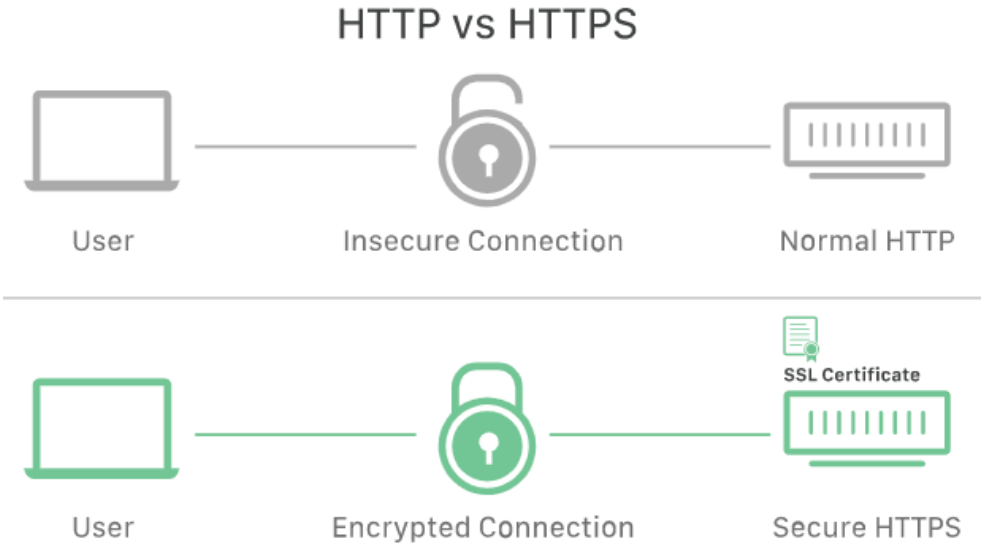
- Network protocol is a set of rules that is required for communication.
- It determine how data is transmitted between different devices in the same network.
- Network protocols are like a common language for computers.
- It also allows connected devices to communicate with each other.
- Network protocols are the reason you can easily communicate with people all over the world.
- Some popular network protocols are HTTP, FTP, SMTP, TCP, UDP, Telnet etc.

State the need of network protocol:

- As we know that, the set of rules and regulations is called a Protocol.
- A set of rules is needed for any means of communication.
- Human intercommunication requires rules of conversation to function effectively.
- Computers are no different.
- If the two people talk at the same time then we get what is known as data collision.
- Therefore, we need regulations and rules to how we communicate over a computer network.

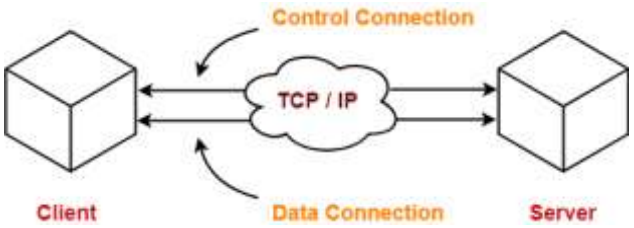
HTTP:

- HTTP stands for Hypertext Transfer Protocol.
- It is a protocol used to access the data on the WWW.
- It is used for transferring data between devices.
- It can be used to transfer the data in the form of plain text, hypertext, audio, video, and so on.
- HTTP belongs to the application layer (layer 7).
- It is invented by Tim Berner.
- HTTP is a connectionless protocol.
- By default, the standard port number of 80 for HTTP and 443 for HTTPS.



FTP

- FTP stands for File transfer protocol.
- It is a internet protocol provided by TCP/IP used for transmitting the files from one host to another.
- It is also used for downloading the files to computer from other servers.
- FTP is an application layer protocol.
- There are two types of connections in FTP:
  1. Control connection
  2. Data connection
- Port 21 for the control port and port 20 for the data port.



SMTP:

- SMTP stands for Simple Mail Transfer Protocol.
- It is a set of communication guidelines that allow software to transmit an electronic mail over the internet.
- It is a program used for sending messages to other computer users based on e-mail addresses.
- SMTP is an application layer protocol.
- SMTP is used to send the mail whereas POP/IMAP are used to retrieve those emails at receiver's side.
- Port 25 is the original standard email SMTP port.

  - ✓ POP - Post Office Protocol
  - ✓ IMAP - Internet Message Access Protocol

TELNET

- Telnet stands for **Tel**etype **Net**work.
- It is a client/server application protocol.
- It provides access to virtual terminals of remote systems on the Internet.
- The first version of Telnet was created for the ARPANET.
- Telnet uses the port 23 to establish a connection with remote computers.
- Telnet consists of two components:
  - ➢ The protocol itself which specifies how two parties communicate and
  - ➢ The software application that provides the service