UNIT I

Overview of Data Communications and Networking

DATA COMMUNICATION

- Data Communication is a process of exchanging data or information In case of computer networks this exchange is done between two devices over a transmission medium.

- This process involves a communication system which is made up of hardware and software.

- The hardware part involves the sender and receiver devices and the intermediate devices through which the data passes.

- The software part involves certain rules which specify what is to be communicated, how it is to be communicated and when. It is also called as a Protocol.

Characteristics of Data Communication

The effectiveness of any data communications system depends upon the following four fundamental characteristics:

1. **Delivery**: The data should be delivered to the correct destination and correct user.

2. **Accuracy**: The communication system should deliver the data accurately, without introducing any errors. The data may get corrupted during transmission affecting the accuracy of the delivered data.

3. **Timeliness**: Audio and Video data has to be delivered in a timely manner without any delay; such a data delivery is called real time transmission of data.

4. **Jitter**: It is the variation in the packet arrival time. Uneven Jitter may affect the timeliness of data being transmitted.

Components of Data Communication

A Data Communication system has five components:

1. **Message:** Message is the information to be communicated by the sender to the receiver.

2. **Sender:** The sender is any device that is capable of sending the data (message).

3. **Receiver:** The receiver is a device that the sender wants to communicate the data (message).

4. **Transmission Medium:** It is the path by which the message travels from sender to receiver. It can be wired or wireless and many subtypes in both.

5. **Protocol:** It is an agreed upon set or rules used by the sender and receiver to communicate data. A protocol is a set of rules that governs data communication. A Protocol is a necessity in data communications without which the communicating entities are like two persons trying to talk to each other in a different language without know the other language

➢ **Types of Networks**
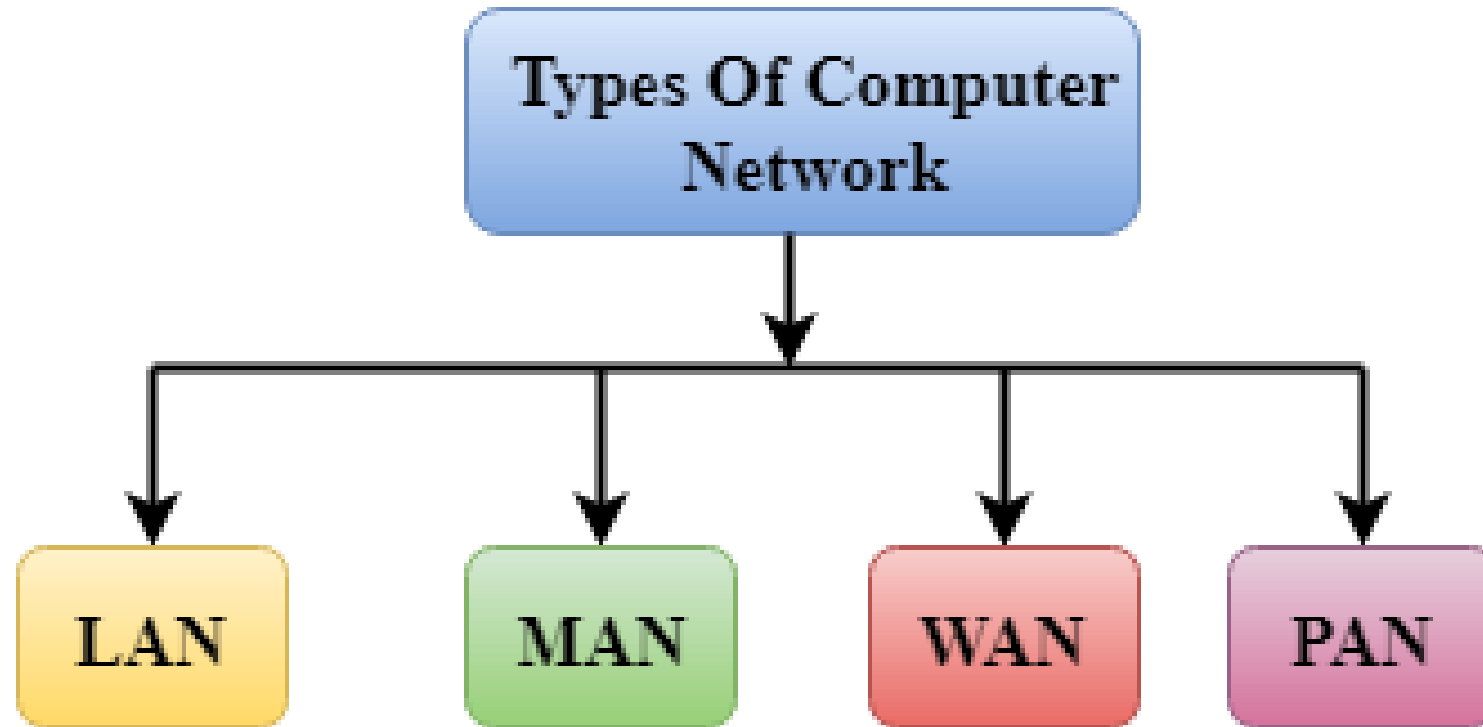
LAN(Local Area Network)

- Local Area Network is a group of computers connected to each other in a small area such as building, office.

- LAN is used for connecting two or more personal computers through a communication medium such as twisted pair, coaxial cable, etc.

- It is less costly as it is built with inexpensive hardware such as hubs, network adapters, and ethernet cables.

- The data is transferred at an extremely faster rate in Local Area Network.

- Local Area Network provides higher security.

WAN(Wide Area Network)

- A Wide Area Network is a network that extends over a large geographical area such as states or countries.

- A Wide Area Network is quite bigger network than the LAN.

- A Wide Area Network is not limited to a single location, but it spans over a large geographical area through a telephone line, fibre optic cable or satellite links.

- The internet is one of the biggest WAN in the world.

- A Wide Area Network is widely used in the field of Business, government, and education.
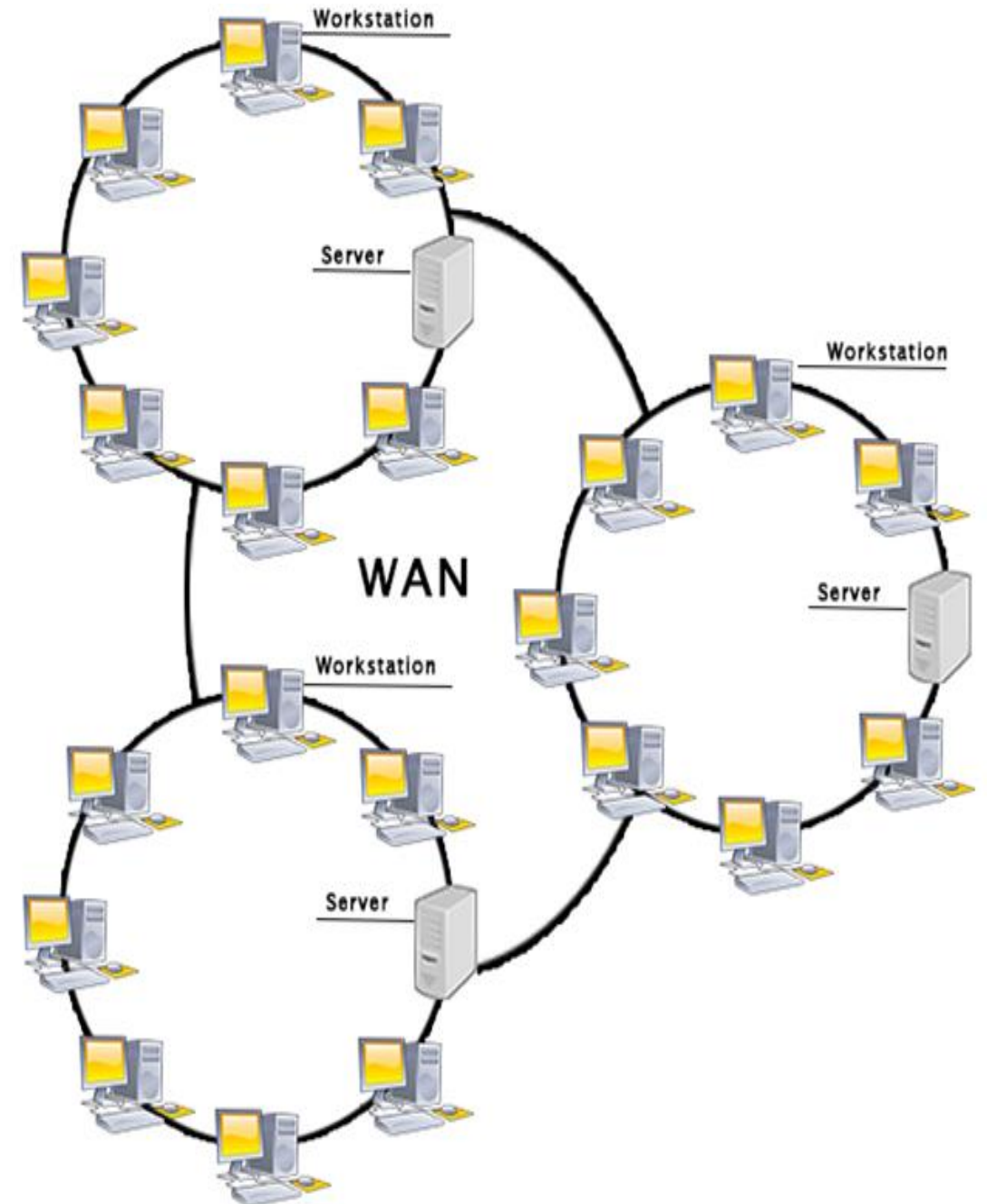
MAN(Metropolitan Area Network)

- A metropolitan area network is a network that covers a larger geographic area by interconnecting a different LAN to form a larger network.

- Government agencies use MAN to connect to the citizens and private industries.

- In MAN, various LANs are connected to each other through a telephone exchange line.

- It has a higher range than Local Area Network(LAN).
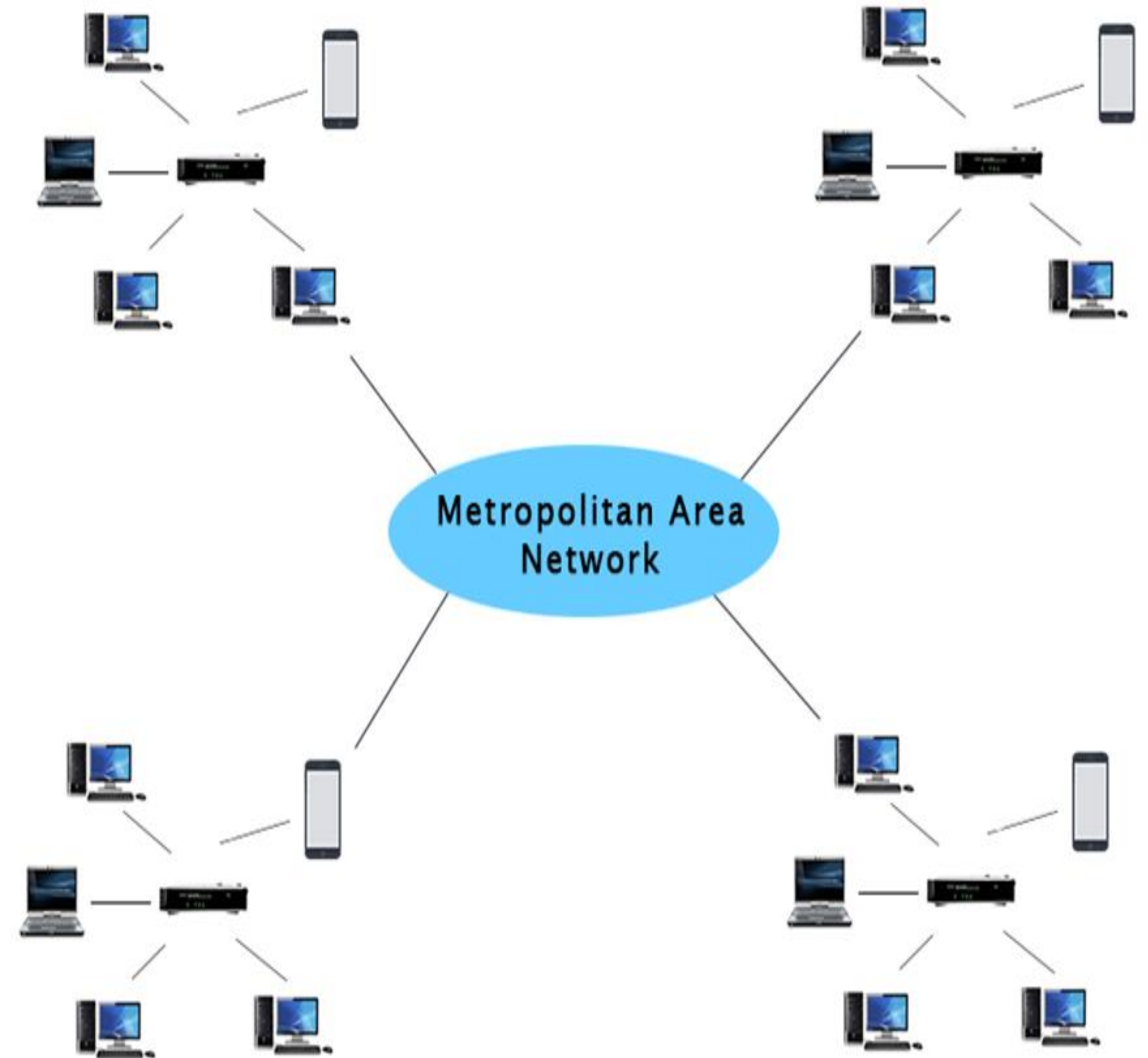
PAN(Personal Area Network)

- Personal Area Network is a network arranged within an individual person, typically within a range of 10 meters.

- Personal Area Network is used for connecting the computer devices of personal use is known as Personal Area Network.

- Personal Area Network covers an area of **30 feet**.

- Personal computer devices that are used to develop the personal area network are the laptop, mobile phones, media player and play stations.

➢ **Protocols**

- A Protocol is one of the components of a data communications system. Without protocol communication cannot occur. The sending device cannot just send the data and expect the receiving device to receive and further interpret it correctly.

- When the sender sends a message it may consist of text, number, images, etc. which are converted into bits and grouped into blocks to be transmitted and often certain additional information called control information is also added to help the receiver interpret the data.

- For successful communication to occur, the sender and receiver must agree upon certain rules called protocol.

- A Protocol is defined as a set of rules that governs data communications. A protocol defines what is to be communicated, how it is to be communicated and when it is to be communicated.

Elements of a Protocol

There are three key elements of a protocol:

I. **Syntax:** It means the structure or format of the data. It is the arrangement of data in a particular order.

II. **Semantics:** It tells the meaning of each section of bits and indicates the interpretation of each section. It also tells what action/decision is to be taken based on the interpretation.

III. **Timing:** It tells the sender about the readiness of the receiver to receive the data It tells the sender at what rate the data should be sent to the receiver to avoid overwhelming the receiver.

➢ <u>STANDARDS IN NETWORKING</u>

- Standards are necessary in networking to ensure interconnectivity and interoperability between various networking hardware and software components.

- Without standards we would have proprietary products creating isolated islands of users which cannot interconnect.

- Concept of Standard Standards provide guidelines to product manufacturers and vendors to ensure national and international interconnectivity.

- Data communications standards are classified into two categories:

1. **De facto Standard** : These are the standards that have been traditionally used and mean by fact or by convention. These standards are not approved by any organized body but are adopted by widespread use.

2. **De jure standard:** It means by law or by regulation. These standards are legislated and approved by an body that is officially recognized.

Standard Organizations in field of Networking

- Standards are created by standards creation committees, forums, and government regulatory agencies.

- **Examples of Standard Creation Committees** :

1. International Organization for Standardization(ISO)

2. International Telecommunications Union – Telecommunications Standard (ITU-T)

3. American National Standards Institute (ANSI)

4. Institute of Electrical & Electronics Engineers (IEEE)

5. Electronic Industries Associates (EIA)

- **Examples of Forums**

1. ATM Forum   2. MPLS Forum   3. Frame Relay Forum

- **Examples of Regulatory Agencies:**

1. Federal Communications Committee (FCC)

➢ **Introduction to OSI Model & its layers**

- The Open Systems Interconnection (OSI) Model was developed by International Organization for Standardization (ISO).

- ISO is the organization, OSI is the model.

- It was developed to allow systems with different platforms to communicate with each other. Platform could mean hardware, software or operating system.

- It is a network model that defines the protocols for network communications.

- It is a hierarchical model that groups its processes into layers. It has 7 layers as follows: (Top to Bottom)
  1. Application Layer
  2. Presentation Layer
  3. Session Layer
  4. Transport Layer
  5. Network Layer
  6. Data Link Layer
  7. Physical Layer
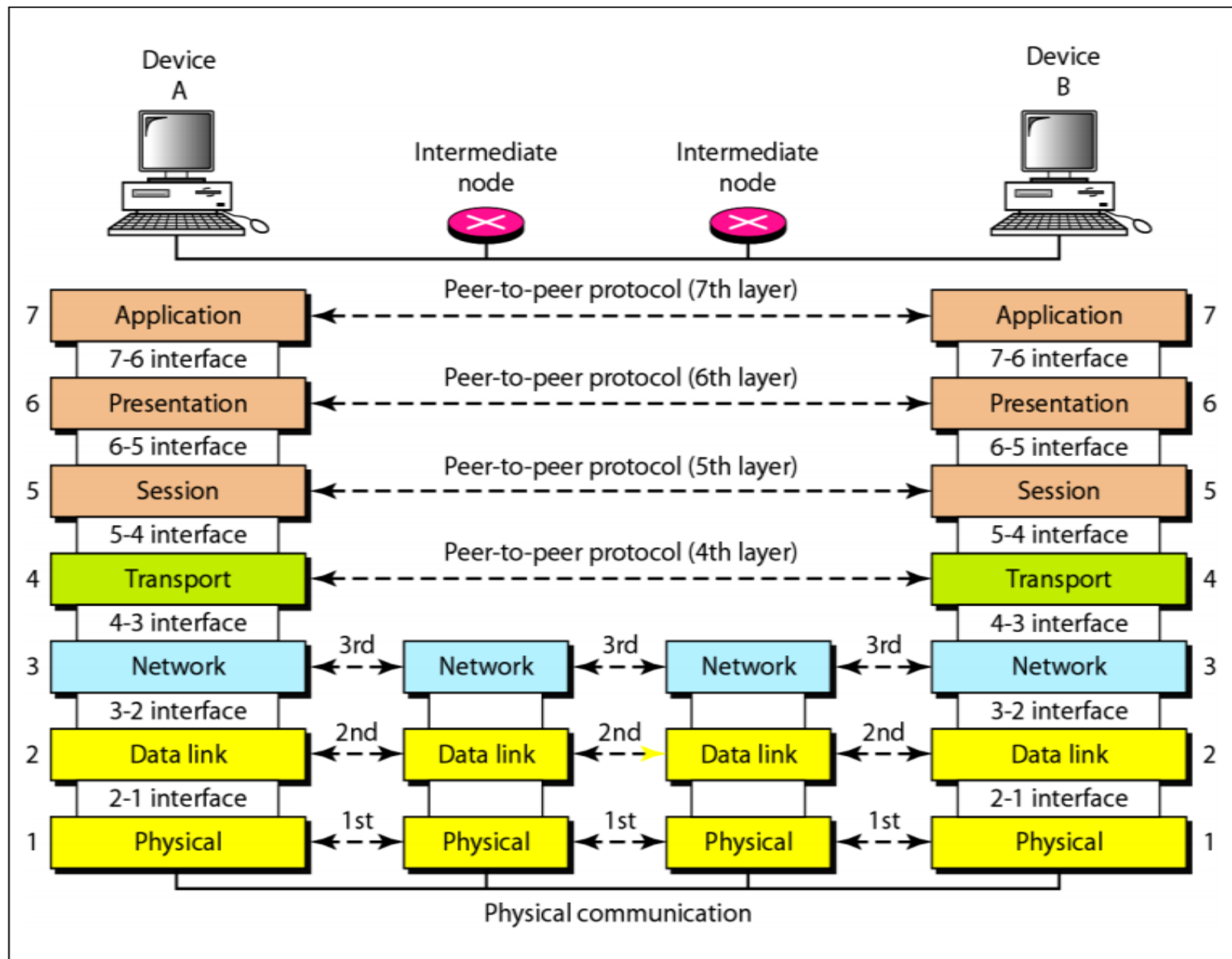
Fig: Communication & Interfaces in the OSI model

- The responsibilities of the 7 layers of OSI model can be summarized as follows:

1. **Application Layer** : To provide the users access to network resources

2. **Presentation Layer**: To provide the functions of translation, encryption and compression.

3. **Session Layer**: To establish, manage and terminate sessions

4. **Transport Layer**: To provide process to process delivery of message

5. **Network Layer**: To provide source to destination delivery of packets.

6. **Datalink Layer**: To provide hop to hop delivery of frames

7. **Physical Layer**: To transmit data over a bit stream from one hop to the next and provide electrical and mechanical specification.

➢ <u>**Connecting Devices**</u>

- Hub

- Switch

- Router

- Bridge

- Gateway

- Repeater

HUB

- **Hub** is basically a multiport repeater.

- A hub connects multiple wires coming from different branches, for example, the connector in star topology which connects different stations.

- Hubs cannot filter data, so data packets are sent to all connected devices.

- In other words, collision domain of all hosts connected through Hub remains one.

- Also, they do not have the intelligence to find out best path for data packets which leads to inefficiencies and wastage.

Types of Hub

- **Active Hub:-** These are the hubs which have their own power supply and can clean, boost, and relay the signal along with the network. It serves both as a repeater as well as wiring centre. These are used to extend the maximum distance between nodes.

- **Passive Hub :-** These are the hubs which collect wiring from nodes and power supply from active hub. These hubs relay signals onto the network without cleaning and boosting them and can't be used to extend the distance between nodes.

- **Intelligent Hub :-** It work like active hubs and include remote management capabilities. They also provide flexible data rates to network devices. It also enables an administrator to monitor the traffic passing through the hub and to configure each port in the hub.

Bridge

- A bridge operates at data link layer.

- A bridge is a repeater, with add on the functionality of filtering content by reading the MAC addresses of source and destination.

- It is also used for interconnecting two LANs working on the same protocol.

- It has a single input and single output port, thus making it a 2 port device.
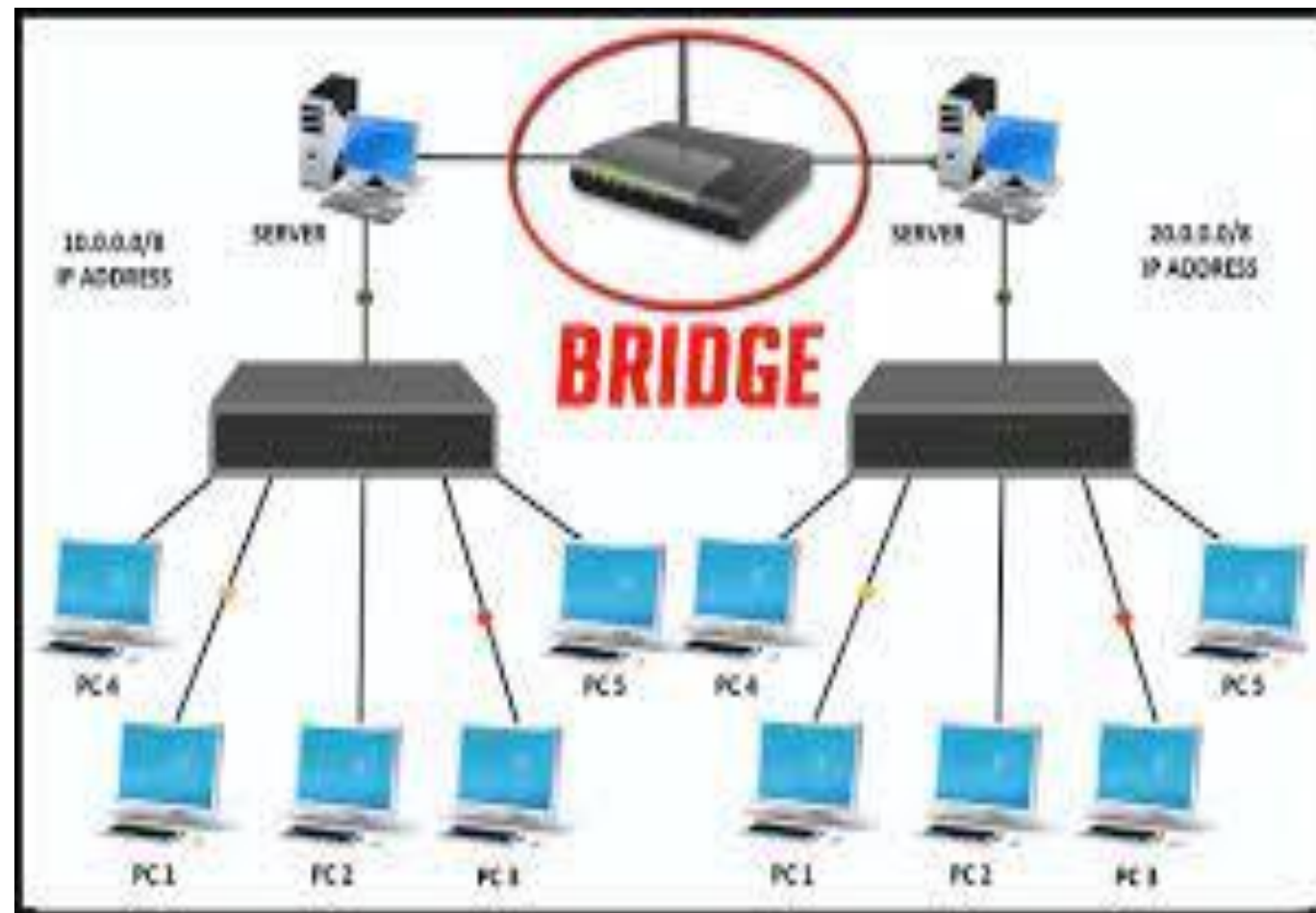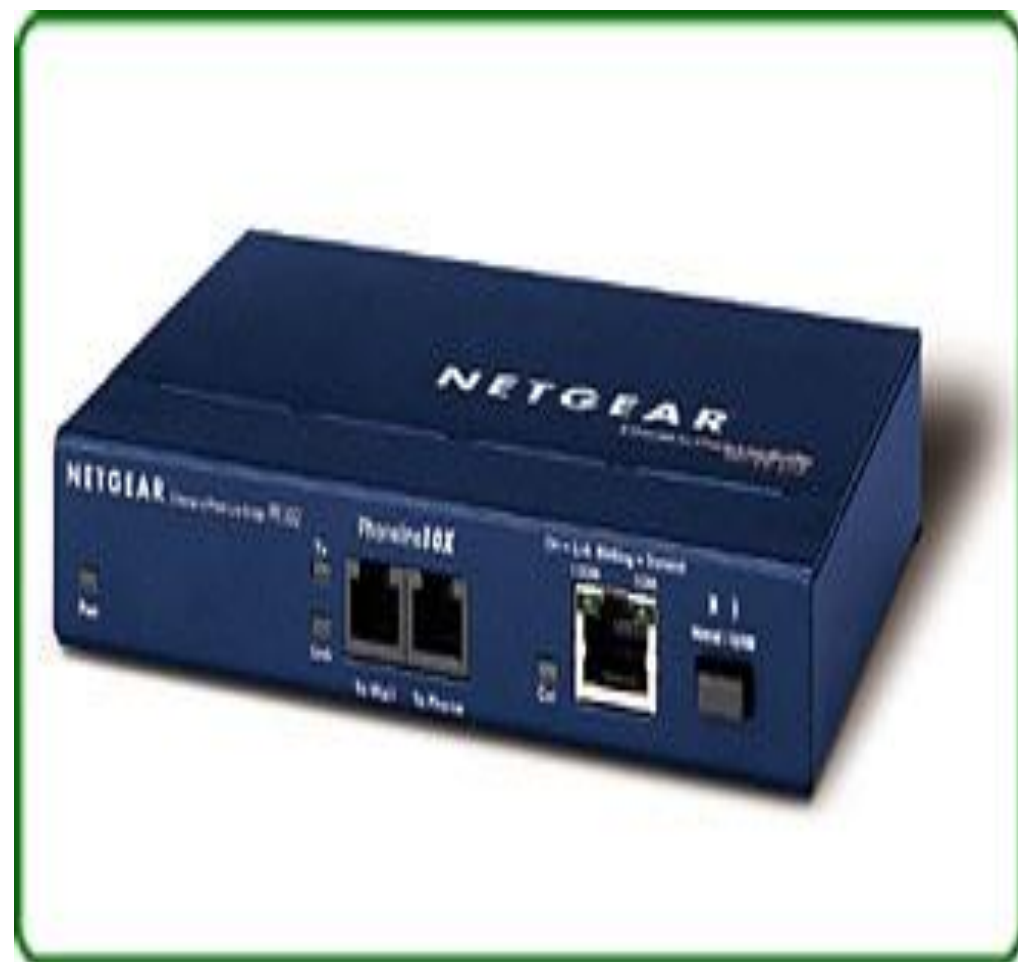
Switch

- **Switch** is a multiport bridge with a buffer and a design that can boost its efficiency(a large number of ports imply less traffic) and performance.

- A switch is a data link layer device. The switch can perform error checking before forwarding data, that makes it very efficient as it does not forward packets that have errors and forward good packets selectively to correct port only.

- In other words, switch divides collision domain of hosts, but broadcast domain remains same.

SWITCH

Computer   Computer   Computer   Computer   Computer   Computer   Computer
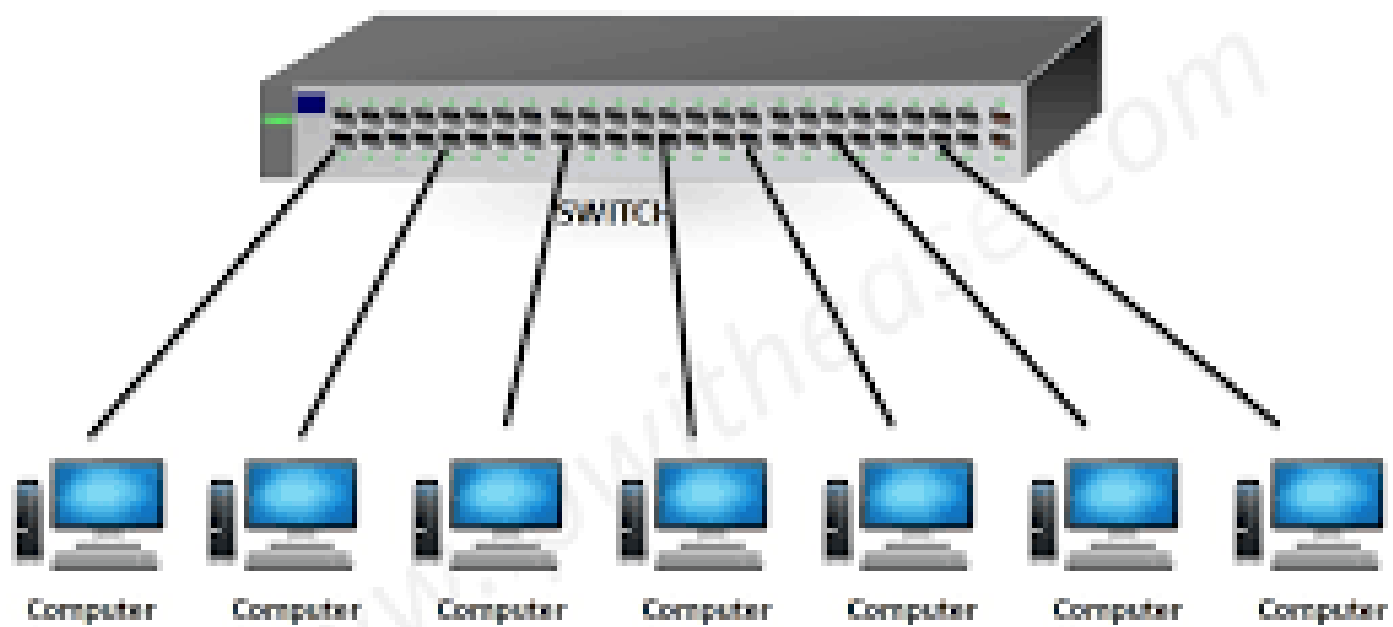
Routers

- A router is a device like a switch that routes data packets based on their IP addresses. Router is mainly a Network Layer device.

- Routers normally connect LANs and WANs together and have a dynamically updating routing table based on which they make decisions on routing the data packets.

- Router divide broadcast domains of hosts connected through it.

Router

Switch

Switch
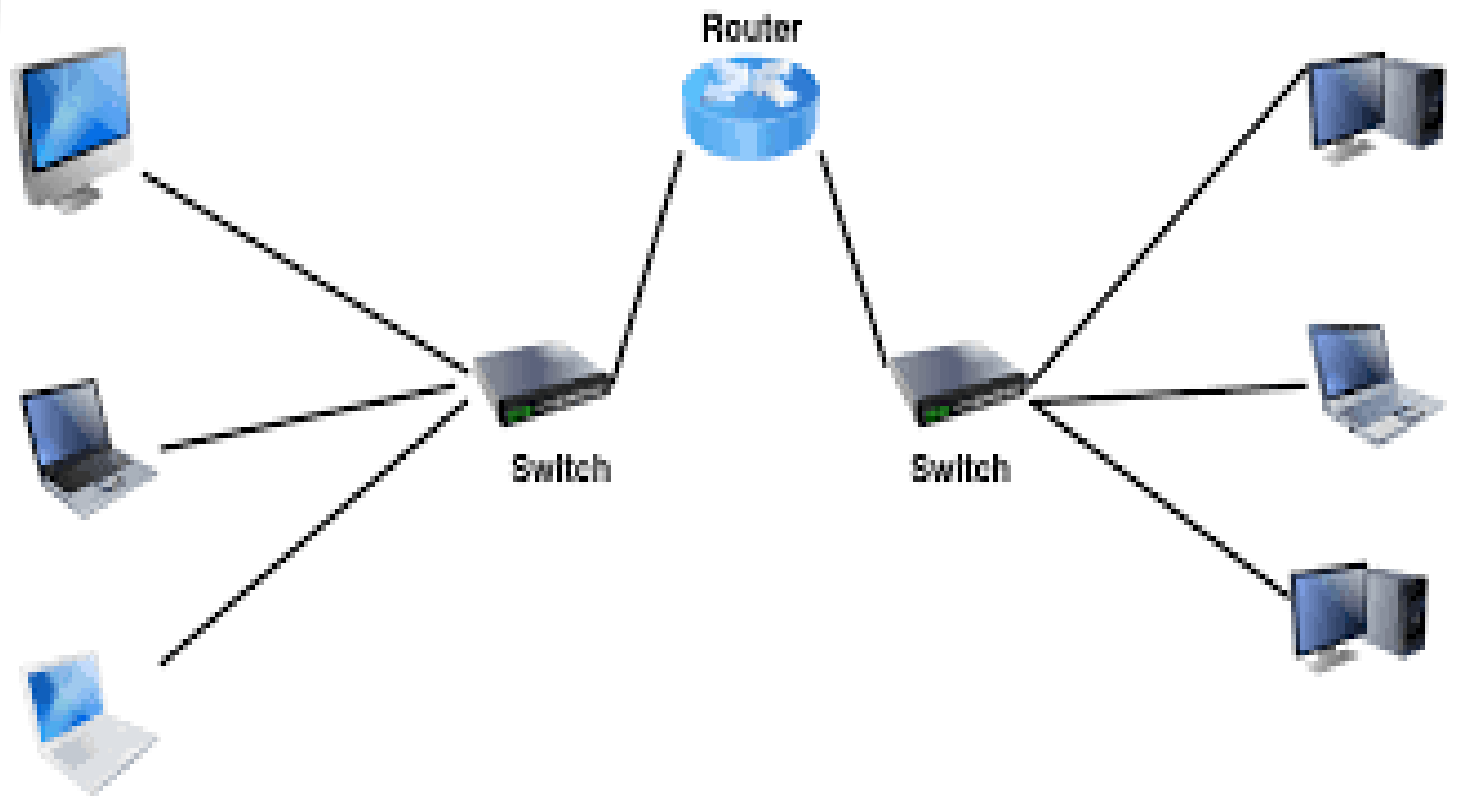
Gateway

- A gateway, as the name suggests, is a passage to connect two networks together that may work upon different networking models.

- They basically work as the messenger agents that take data from one system, interpret it, and transfer it to another system.

- Gateways are also called protocol converters and can operate at any network layer. Gateways are generally more complex than switch or router.

Gateway

LAN

WAN