Introduction to Computer Network

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Topics

- Definition, Merits, Demerits
- Network Models
    - PAN, LAN, CAN(Campus Area Network), MAN, Country Area Network, WAN
    - Topological Models(Star, Bus, Mesh, Tree, Hybrid, Ring)
    - Client/Server, Peer-to-peer and Active Network Model

Components of data communication system

- The word data refers to information presented in whatever form is agreed upon by the parties creating and using the data.
- Data communications are the exchange of data between two devices via some form of transmission medium such as a wire cable.
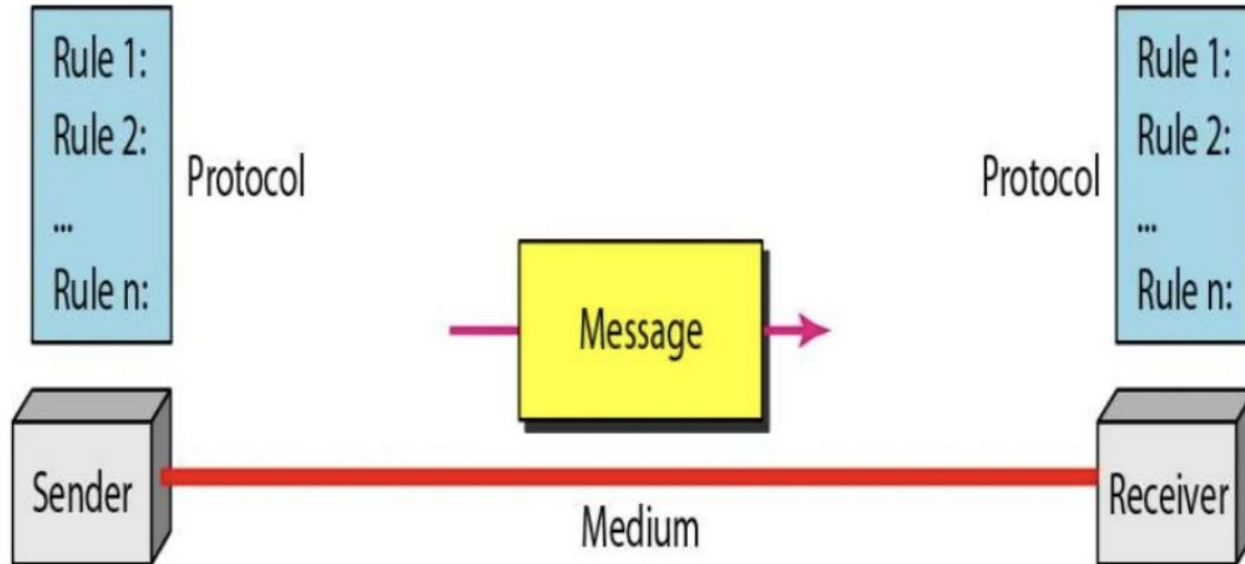
Components of data communication system

- **Message**. The message is the information (data) to be communicated. Popular forms of information include text, numbers, pictures, audio, and video.

- **Sender**. The sender is the device that sends the data message. It can be a computer, telephone handset, video camera, and so on.

- **Receiver**. The receiver is the device that receives the message. It can be a computer, telephone handset, television, and so on.

- **Transmission medium.** The transmission medium is the physical path by which a message travels from sender to receiver. Some examples of transmission media include twisted- pair wire, coaxial cable, fiber-optic cable, and radio waves

- **Protocol**. A protocol is a set of rules that govern data communications. It represents an agreement between the communicating devices. Without a protocol, two devices may be connected but not communicating. just as a person speaking French cannot be understood by a person who speaks only Japanese.
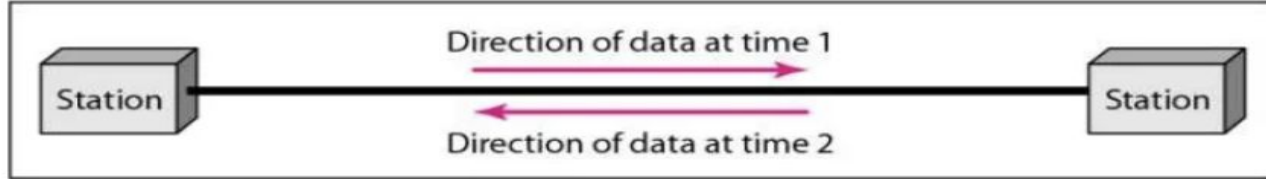
PROTOCOLS

- A protocol is a set of rules that govern data communications.

- It determines what is communicated, how it is communicated and when it is communicated.
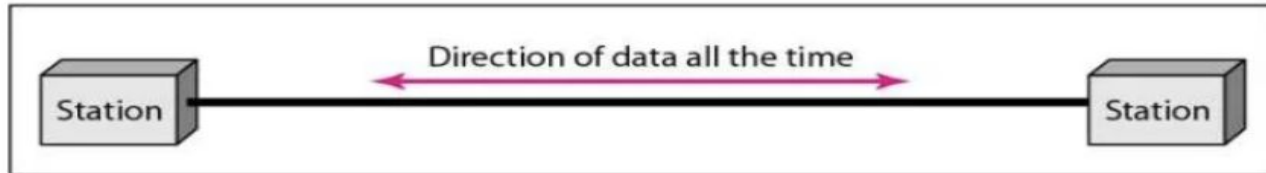
Data flow(simplex,half-duplex, full duplex)
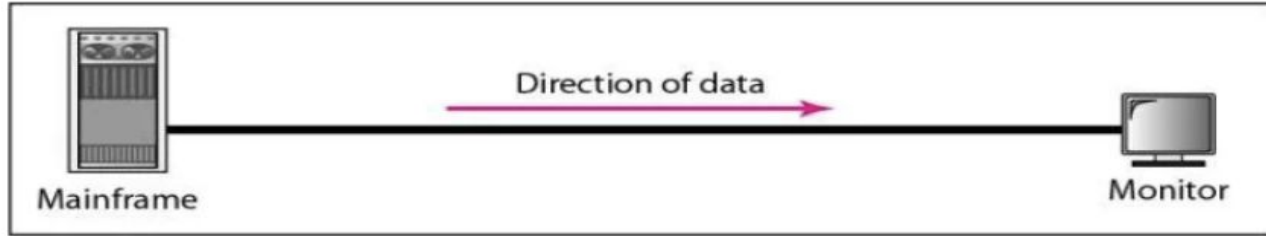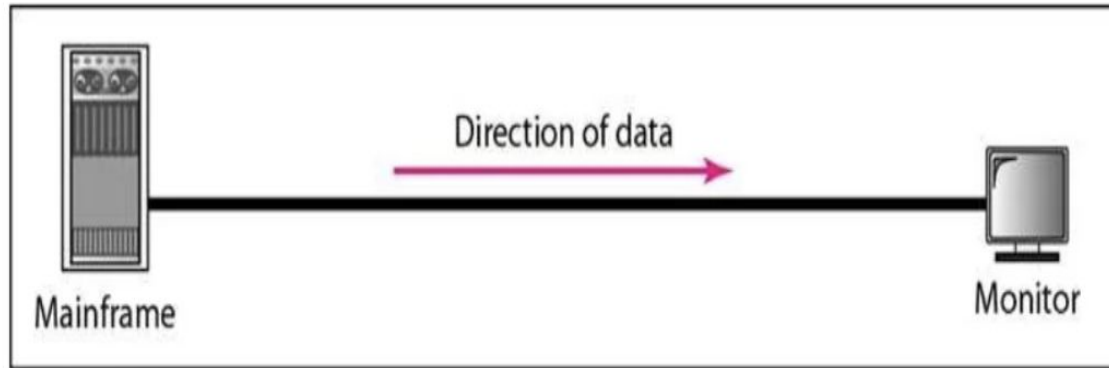

a. Simplex

b. Half-duplex

c. Full-duplex

SIMPLEX

- In simplex mode, the communication is unidirectional, as on a one- way street. Only one of the two devices on a link can transmit; the other can only receive.
- Examples:- Keyboards and traditional monitors are examples of simplex devices. The keyboard can only introduce input; the monitor can only accept output. The simplex mode can use the entire capacity of the channel to send data in one direction.

a. Simplex

HALF-DUPLEX

- In half-duplex mode, each station can both transmit and receive, but not at the same time. When one device is sending, the other can only receive, and vice versa.
- Examples:-When cars are traveling in one direction, cars going the other way must wait. In a half-duplex transmission, the entire capacity of a channel is taken over by whichever of the two devices is transmitting at the time. Walkie-talkies is half-duplex systems.
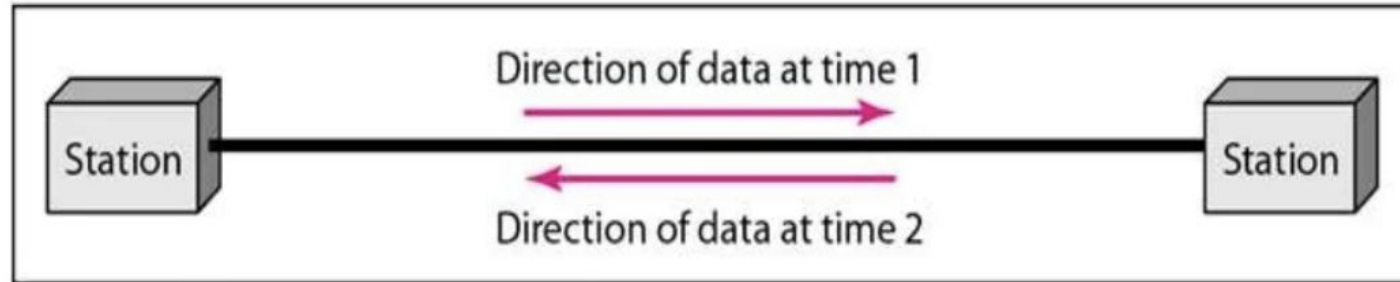
b. Half-duplex

FULL-DUPLEX

- In full-duplex both stations can transmit and receive simultaneously. The full-duplex mode is like a two-way street with traffic flowing in both directions at the same time. In full-duplex mode, signals going in one direction share the capacity of the link: with signals going in the other direction.
- Example:- full-duplex communication is the telephone network. When two people are communicating by a telephone line, both can talk and listen at the same time. The full-duplex mode is used when communication in both directions is required all the time. The capacity of the channel, however, must be divided between the two directions.
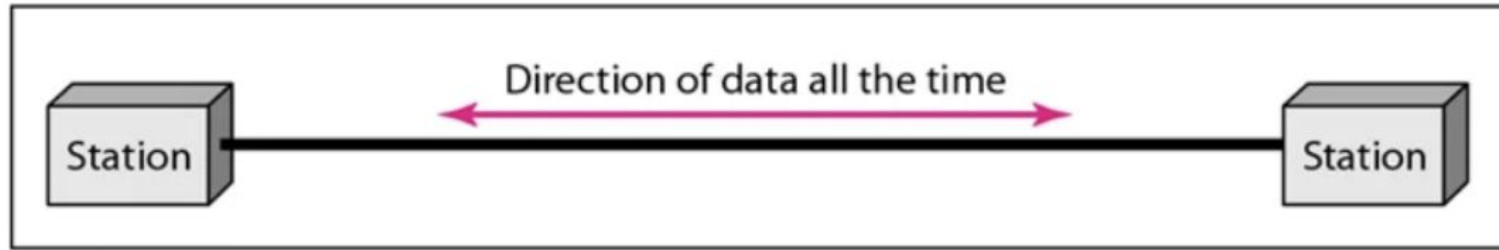
c. Full-duplex

Computer Networks

- Computer network consists of two or more computers that are linked in order to share resources, exchange data files or to allow electronic communication. The computers on a network may be linked through cables, telephone lines, radio waves, satellites or infrared light beams.
- There are two aspects of computer networks – hardware and software.
  - Hardware includes physical connection between two machines by using adaptors, cables, routers, bridges etc.
  - software includes a set of protocols. Protocols define a formal language among various components. It makes hardware usable by applications.

Advantages

- It enhances communication and availability of information

- It allows for more convenient resource sharing

- It makes file sharing easier

DISADVANTAGES

- It lacks independence.
- It poses security difficulties.

Uses of computer networks

- Business Applications
- Home Applications
- Mobile Users

Business application of network

- Resource sharing
  - The goal is to make all programs, equipments(like printers etc), and especially data, available to anyone on the network without regard to the physical location of the resource and the user.

- Communication Medium:
  - A computer network can provide a powerful communication medium among employees. Virtually every company that has two or more computers now has e-mail (electronic mail), which employees generally use for a great deal of daily communication

Business application of network

- eCommerce:
  - A goal that is starting to become more important in businesses is doing business with consumers over the Internet. Airlines, bookstores and music vendors have discovered that many customers like the convenience of shopping from home. This sector is expected to grow quickly in the future.
-

Tag and Full Name	Example
B2C - Business-to-Consumer	Ordering books on-line
B2B - Business-to-Business	Car manufacturer ordering tires from supplier
C2C - Consumer-to-Consumer	Auctioning second-hand products on line
G2C - Government-to-Consumer	Government distributing tax forms electronically
P2P - Peer-to-Peer	File sharing

Home application network

- Access to remote information
  - Many people pay their bills, manage bank accounts, handle their investments electronically.
  - Home shopping.
  - On-line newspaper which can be personalized.
  - Access to information system like world wide web, which contains information about arts,business,cooking,government,health,history,science,sports,travel
  - All the above applications involve in interactions between a person and remote database.
- Person-to-person communication
  - Electronic mail or email which allow users to communicate with no delay
  - Videoconference- which makes possible
- Interactive entertainment
  - Huge and growing industry.
    - Game playing

MOBILE APPLICATION NETWORK

- Many professionals uses desktop computers at office and want to be connected to the office network while travelling and at home also. This is possible by wireless networks, hence use of laptop, notebook computers and personal digital assistants(PDAs) is increased.
- Wireless networks are used in:- military applications, airports, banking, weather reporting

Network Models

- **On Basis of Geographical Area/Size**

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.
- The data is transferred at an extremely faster rate in Local Area Network.
- Local Area Network provides higher security.
- LANS run at speeds of 10 to 100 Mbps

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

Campus area network

- A campus area network (CAN) is a network of multiple interconnected local area networks (LAN) in a limited geographical area. A CAN is smaller than a wide area network (WAN) or metropolitan area network (MAN).
- A CAN is also known as a corporate area network (CAN).

CAMPUS AREA NETWORK

BUILDINGS

LAB

Hostel

BUILDINGS

BUILDING

Library

BUILDING

College
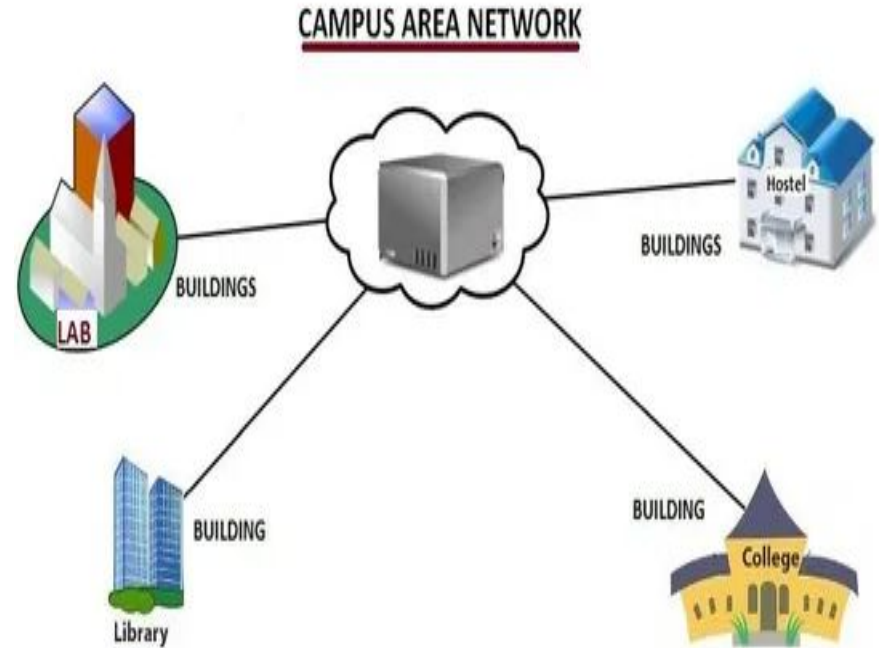
Metropolitan area network

- MAN network covers larger area by connections LANs to a larger network of computers.
- In Metropolitan area network various Local area networks are connected with each other through telephone lines.
- The size of the Metropolitan area network is larger than LANs and smaller than WANs(wide area networks), a MANs covers the larger area of a city or town.
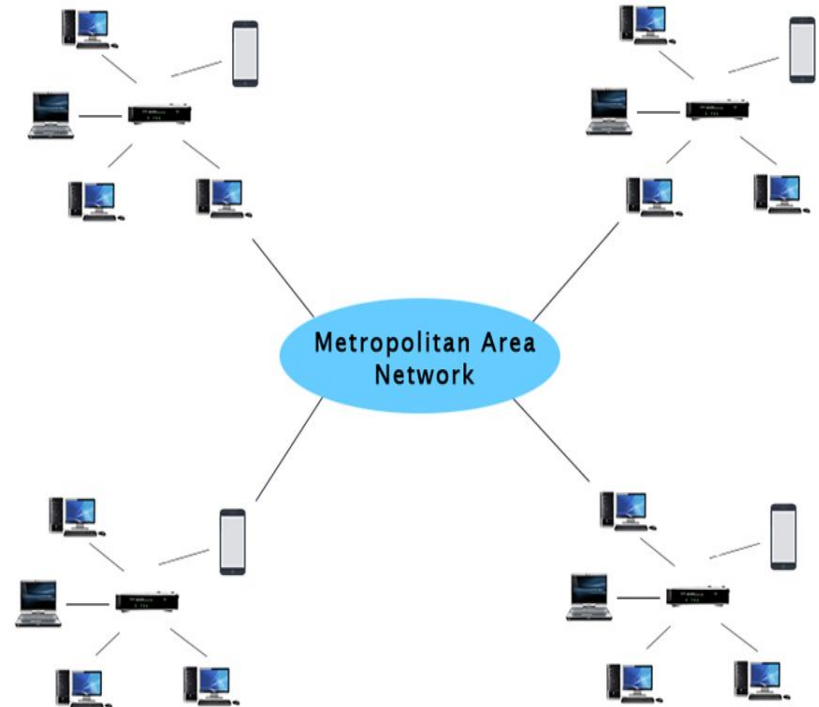
Country area network

- It's wide area network which is limited to country
- It consist of more than one MAN
- It may be extended up to thousands kms
- It is more public network owned by some public organization or governments
- Example: In Nepal NTC have CAN*

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.

Wide area network (WAN)

On the basis of Topologies

- Topology defines the structure of the network of how all the components are interconnected to each other.
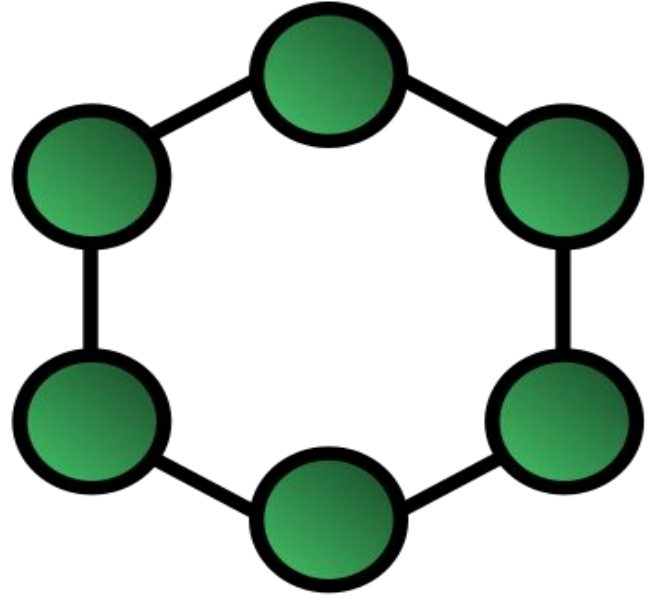
Bus topology

- The bus topology is designed in such a way that all the stations are connected through a single cable known as a backbone cable.
- When a node wants to send a message over the network, it puts a message over the network. All the stations available in the network will receive the message whether it has been addressed or not.
- The backbone cable is considered as a **"single lane"** through which the message is broadcast to all the stations.
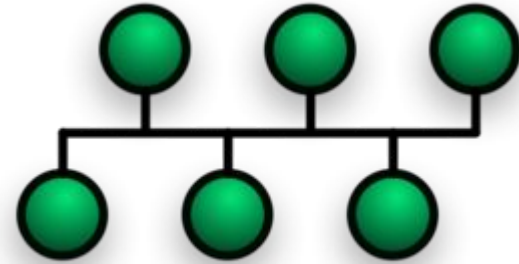
Ring topology

- The node that receives the message from the previous computer will retransmit to the next node.
- The data flows in one direction, i.e., it is unidirectional.
- A signal is passed along the ring in one direction, from device to device, until it reaches its destination.
- Each device in the ring incorporates a repeater. When a device receives a signal intended for another device, its repeater regenerates the bits and passes them along.

Mesh topology

- Mesh technology is an arrangement of the network in which computers are interconnected with each other through various redundant connections.
- There are multiple paths from one computer to another computer.
- It does not contain the switch, hub or any central computer which acts as a central point of communication.
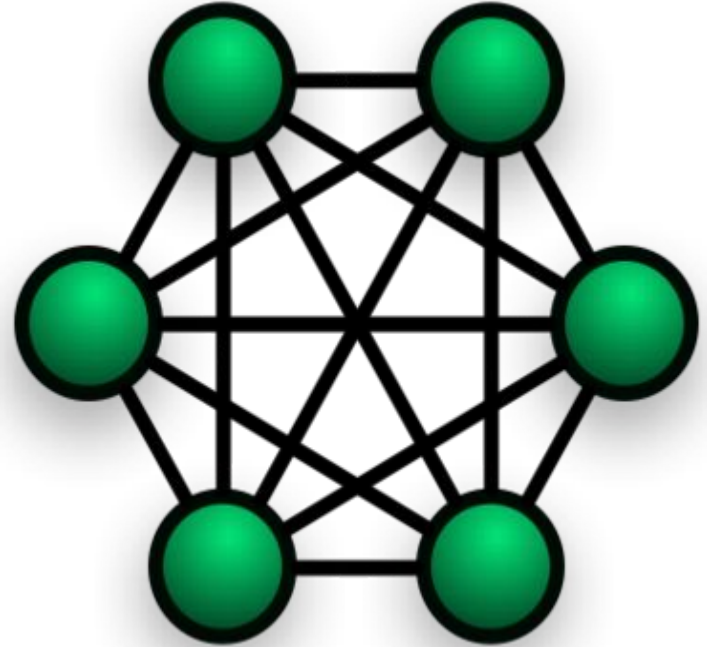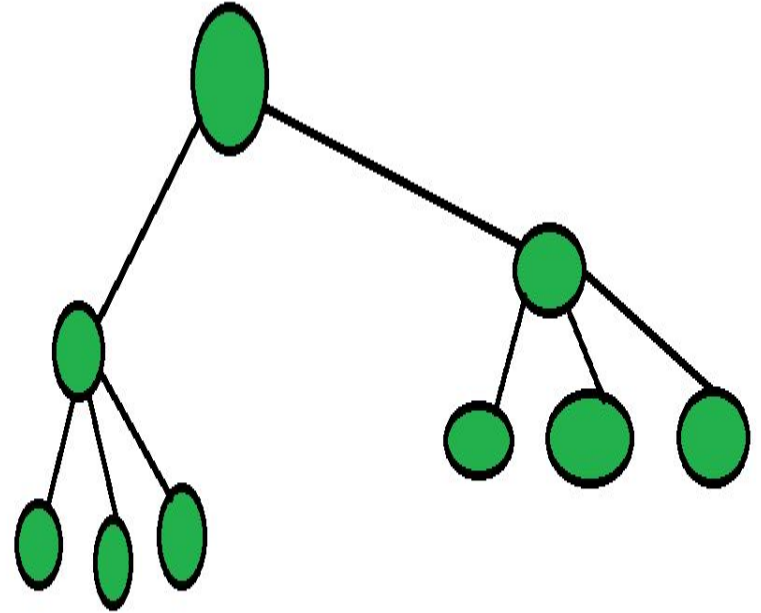
Star topology

- Star topology is an arrangement of the network in which every node is connected to the central hub, switch or a central computer.
- The central computer is known as a **server**, and the peripheral devices attached to the server are known as **clients**.
- Unlike a mesh topology, a star topology does not allow direct traffic between devices. The controller acts as an exchange: If one device wants to send data to another, it sends the data to the controller, which then relays the data to the other connected device.
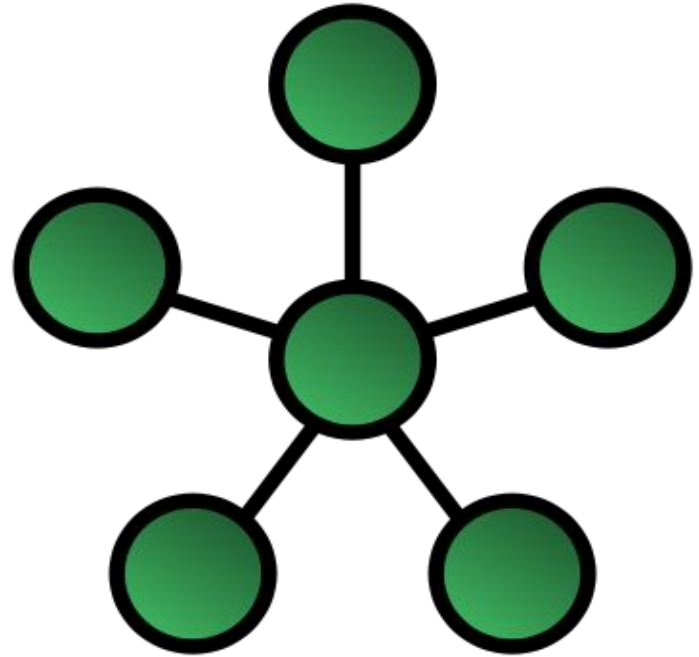
Tree topology

- Tree topology combines the characteristics of bus topology and star topology.
- A tree topology is a type of structure in which all the computers are connected with each other in hierarchical fashion.
- The top-most node in tree topology is known as a root node, and all other nodes are the descendants of the root node.
- There is only one path exists between two nodes for the data transmission. Thus, it forms a parent-child hierarchy.

Hybrid topology

- The combination of various different topologies is known as **Hybrid topology**.
- A Hybrid topology is a connection between different links and nodes to transfer the data.

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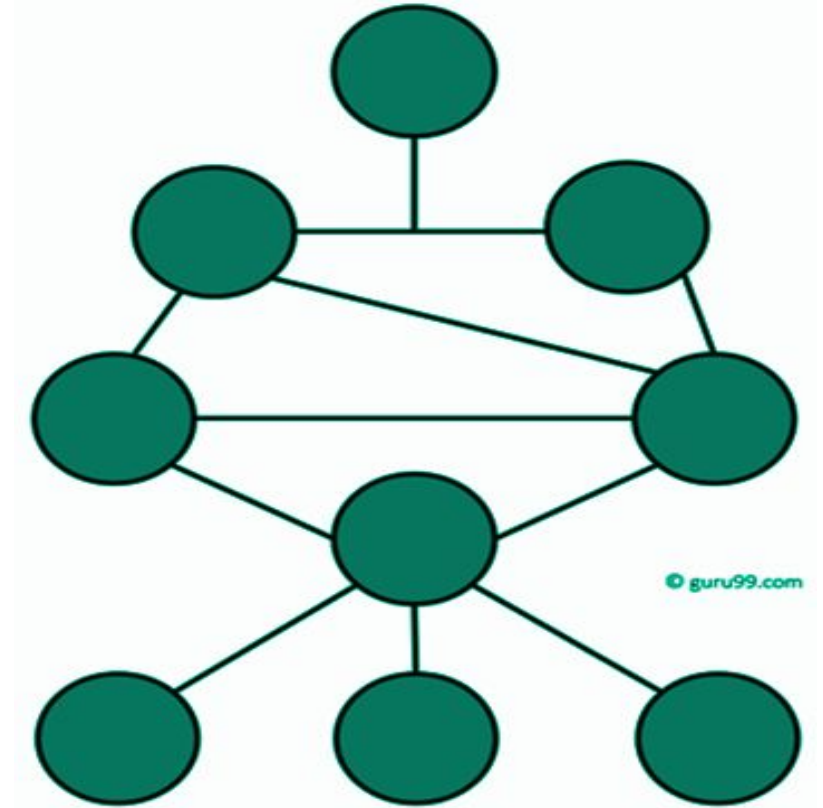
On the basis of network architecture

Peer-To-Peer network

- Peer-To-Peer network is a network in which all the computers are linked together with equal privilege and responsibilities for processing the data.
- Peer-To-Peer network is useful for small environments, usually up to 10 computers.
- Peer-To-Peer network has no dedicated server.
- Special permissions are assigned to each computer for sharing the resources, but this can lead to a problem if the computer with the resource is down.
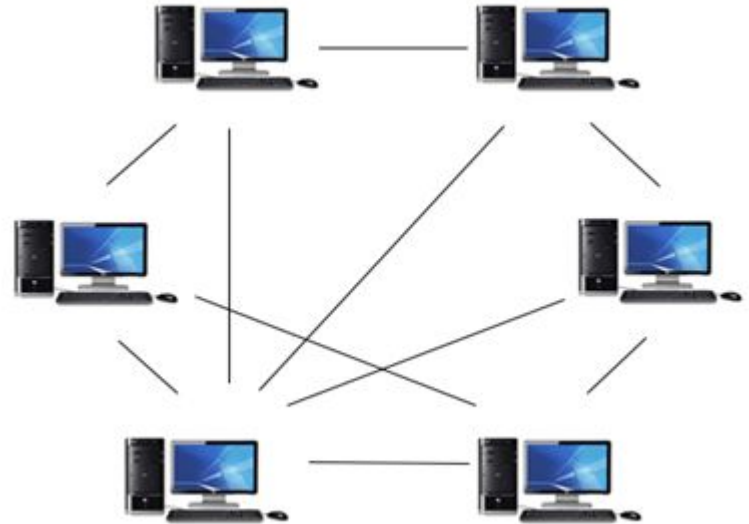
Advantage of peer-to-peer network

- It is less costly as it does not contain any dedicated server.

- If one computer stops working but, other computers will not stop working.

- It is easy to set up and maintain as each computer manages itself.

DISADVANTAGE OF PEER-TO-PEER NETWORK

- In the case of Peer-To-Peer network, it does not contain the centralized system . Therefore, it cannot back up the data as the data is different in different locations.
- It has a security issue as the device is managed itself.

Client server network

- Client/Server network is a network model designed for the end users called clients, to access the resources such as songs, video, etc. from a central computer known as Server.
- The central controller is known as a **server** while all other computers in the network are called **clients**.
- A server is responsible for managing all the resources such as files, directories, printer, etc.
- All the clients communicate with each other through a server. For example, if client1 wants to send some data to client 2, then it first sends the request to the server for the permission. The server sends the response to the client 1 to initiate its communication with the client 2.

Internet

Clients

Server

Advantage of client/server network

- A Client/Server network contains the centralized system. Therefore we can back up the data easily.
- A Client/Server network has a dedicated server that improves the overall performance of the whole system.
- Security is better in Client/Server network as a single server administers the shared resources.
- It also increases the speed of the sharing resources.

DISADVANTAGE OF CLIENT/SERVER NETWORK

- Client/Server network is expensive as it requires the server with large memory.

- It requires a dedicated network administrator to manage all the resources.