ACADEMIC PROGRAMME: BACHELOR OF SCIENCE IN COMPUTER SCIENCE
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PHYSICAL STRUCTURES

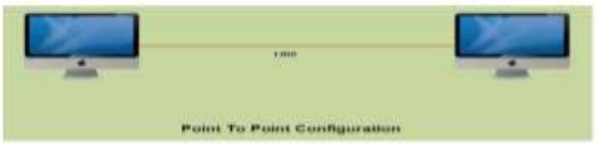
Before discussing networks, we need to define some network attributes.

Type of Connection

A network is two or more devices connected through links.

There are two possible types of connections: **point-to-point and multipoint.**

1. **Point-to-Point:** A point-to-point connection provides a dedicated link between two devices.



2. **Multipoint**: A multipoint connection is one in which more than two specific devices share a single link.

PHYSICAL TOPOLOGY

The term physical topology refers to the way in which a network is laid out physically.

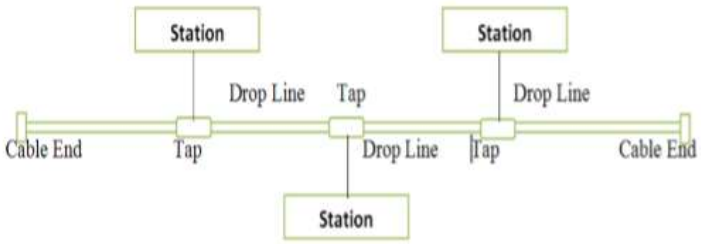
There are four basic topologies possible:

- Bus topology,
- Mesh topology,
- Star topology,
- Ring topology.

BUS TOPOLOGY

One long cable acts as a backbone to link all the devices in a network.

Nodes are connected to the bus cable by drop lines and taps.



Advantages of a bus topology

- ease of installation.
- Bus uses less cabling than mesh or star topologies.
- Only the backbone cable stretches through the entire facility.

Disadvantages

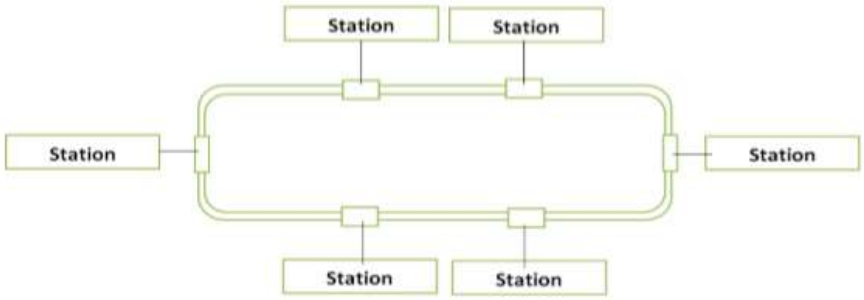
- Difficult reconnection and fault isolation.
- Adding new devices may therefore require modification or replacement of the backbone.
- A fault or break in the bus cable stops all transmission, even between devices on the same side of the problem.

RING TOPOLOGY

A signal is passed along the ring in one direction, from device to device, until it reaches its destination.

When a device receives a signal intended for another device, its repeater regenerates the bits and passes them along.

Each device in ring is linked to only its immediate neighbors.



Advantages

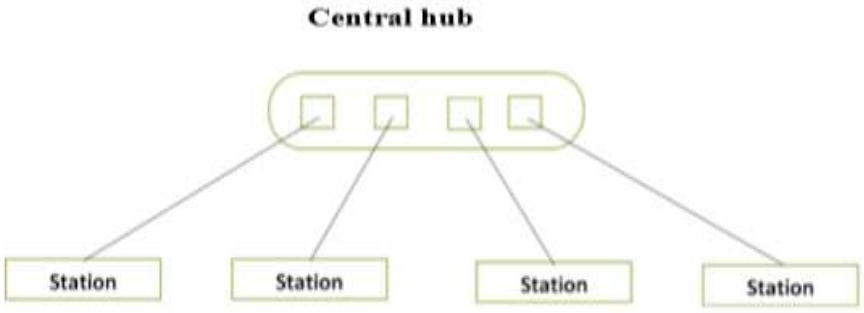
- A ring is relatively easy to install and reconfigure
- To add or delete a device it requires changing only two connections.
- If one device does not receive a signal within a specified period, it can issue an alarm.

Disadvantage

- Unidirectional traffic can be a limitation.
- A break in the ring can disable the entire network.

STAR TOPOLOGY

- In a star topology, each device has a dedicated point-to-point link only to a central controller, usually called a hub.
- The devices are not directly linked to one another.
- 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.



Advantages

- A star topology is less expensive than a mesh topology.
- easy to install and reconfigure. Far less cabling needs to be housed, and additions, moves, and deletions involve only one connection between that device and the hub.
- If one link fails, only that link is affected. All other links remain active.

- easy fault identification and fault isolation.

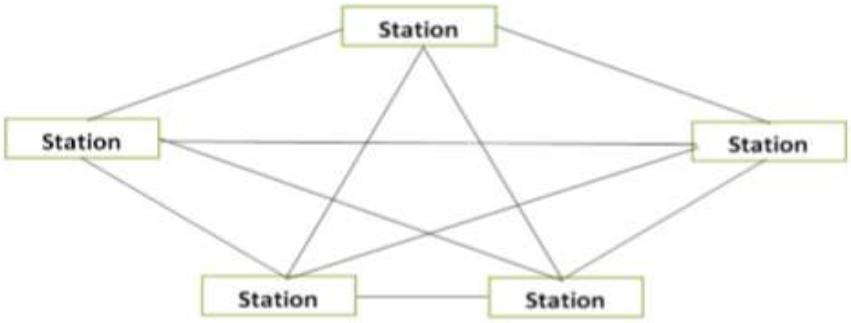
Disadvantages

- Dependency of the whole topology on one single point, the hub. If the hub goes down, the whole system is dead

MESH TOPOLOGY

In a mesh topology, every device has a dedicated point-to-point link to every other device.

The term dedicated means that the link carries traffic only between the two devices it connects.



Advantages

- use of dedicated links guarantees that each connection can carry its own data load, thus eliminating the traffic problems that may occur when links are shared by multiple devices.
- Robust. If one link becomes unusable, it does not incapacitate the entire system.
- privacy or security
- fault identification and fault isolation easy.

Disadvantages

- A lot of cabling and the number of I/O ports required
- The sheer bulk of the wiring can be greater than the available space can accommodate
- hardware required to connect each link can be prohibitively expensive.

Factors to consider when selecting a topology.

- Costs which include installation costs, troubleshooting costs and maintenance costs

- Number of users
- Physical layout of the organization
- Presence of existing cabling
- Reliability of the topology

COMPUTER NETWORKS

- A network is a set of devices/node connected by communication links.
- Computer network is a set of autonomous computer interconnected together through communication medium to facilitate communication between them.

Uses of networks/Role in business

- Facilitating communications - Sending e-mail, voice mail, fax (facsimile), doing research on internet, chat rooms, instant messaging
- Telecommuting, video conferencing, making a phone call
- Sharing a hardware resource such as a printer.
- Sharing data (EDI – electronic data interchange), information,
- Sharing software
- access information and services supported on the World Wide Web support various work processes in the organization based on the automation of specific tasks.

CATEGORIES OF NETWORKS

The categories into which a network falls is determined by **its size, scale, distances it cover, physical architecture, technology** etc. This includes:

1. Local Area Network (Lan)
2. Wide Area Networks (Wan)
3. Metropolitan Area Networks (Man)

LOCAL AREA NETWORK (LAN)

- A LAN normally limited to few kilometer or small geographical location
- In addition to operating in a limited space, LANs are also typically owned, controlled, and managed by a single person or organization.
- A local area network (LAN) is usually privately owned and links the devices within a single office, building, or campus.

- LANs are distinguished from other kinds of networks by three characteristics:
  (1) Their size,
  (2) Their transmission technology, and
  (3) Their topology.

- LANs are restricted in size, which means that the worst-case transmission time is bounded and known in advance.
- Traditional LANs run at speeds of 10 Mbps to 100 Mbps, have low delay (microseconds or nanoseconds), and make very few errors.
- Newer LANs operate at up to 10 Gbps
- Various topologies are possible for broadcast LANs.

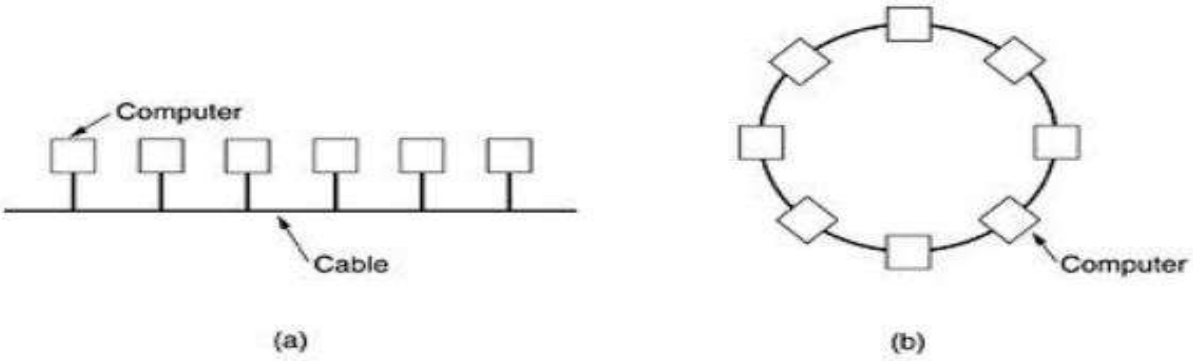


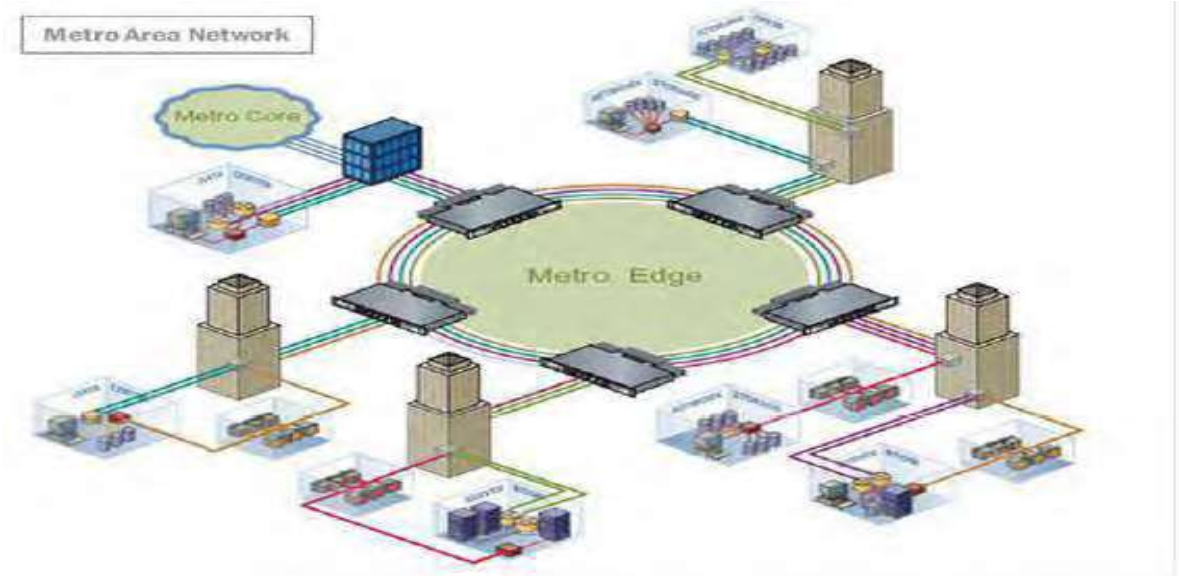
Fig.: Two broadcast networks . (a) Bus. (b) Ring.

- A wireless LAN can also be implemented using different technologies

- An arbitration mechanism is needed to resolve conflicts when two or more machines want to transmit simultaneously.

METROPOLITAN AREA NETWORKS (MAN)

- A metropolitan area network (MAN) is a network with a size between a LAN and a WAN or it spans a physical area larger than a LAN but smaller than a WAN, such as a city.



- It normally covers the area inside a town or a city. A MAN is typically owned and operated by a single entity such as a government body or large corporation.
- The best-known example of a MAN is the cable television network available in many cities. This system grew from earlier community antenna systems used in areas with poor over-the-air television reception.

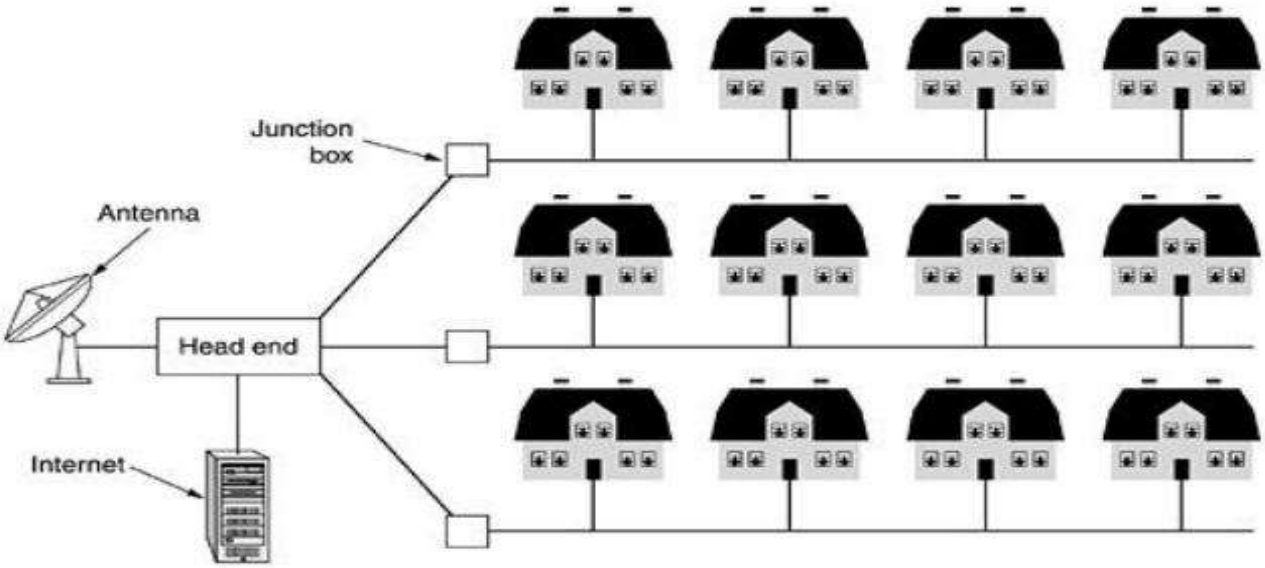


Fig.: Metropolitan area network based on cable TV.

WIDE AREA NETWORKS (WAN)

- A WAN is a network that spans more than one geographical location often connecting separated LANs
- A wide area network (WAN) provides long-distance transmission of data, image, audio, and video information over large geographic areas that may comprise a country, a continent, or even the whole world.
- WANs are slower than LANs and often require additional and costly hardware such as routers, dedicated leased lines, and complicated implementation procedures
- It contains a collection of machines intended for running user (i.e., application) programs. These machines are called as hosts. The hosts are connected by a communication subnet, or just subnet for short.
- The hosts are owned by the customers (e.g., people's personal computers), whereas the communication subnet is typically owned and operated by a telephone company or Internet service provider.
- In most wide area networks, the subnet consists of two distinct components: transmission lines and switching elements.
- The principle of a **packet-switched WAN** is so important. Generally, when a process on some host has a message to be sent to a process on some other host, the sending host first cuts the message into packets, each one bearing its number in the sequence. These packets are then injected into the network one at a time in quick succession. The packets are transported individually over the network and deposited at the receiving host, where they are reassembled into the original message and delivered to the receiving process.

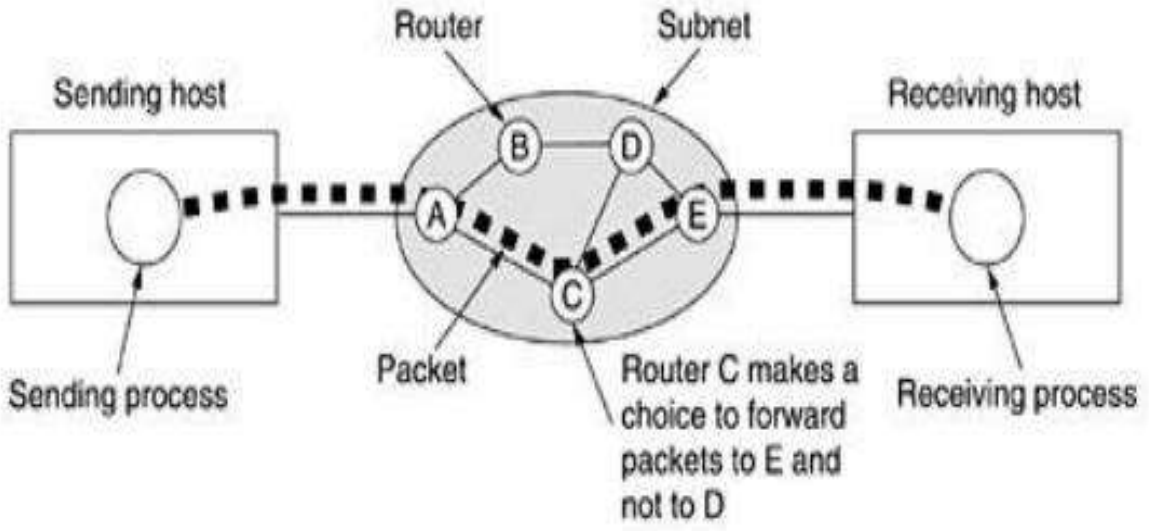


Fig.: A stream of packets from sender to receiver.

Other types of networks

Intranet

An Intranet is a network that belongs to an organization(small geographical location), and is designed to be accessible only by the organization's members, employees, or others with authorization. An intranet's Web site looks and act just like other Web sites, but has a firewall surrounding it to fend off unauthorized users. Intranets are used to share information. Secure intranets are much less expensive to build and manage than private, proprietary-standard networks.

Extranet

An extranet is a private network that uses Internet technology and the public telecommunication system to securely share part of a business's information or operations with suppliers, vendors, partners, customers, or other businesses. It is a portion of a company's network that allows customers or suppliers to access parts of an enterprise's intranet. An extranet can be viewed as part of a company's intranet that is extended to users outside the company.

Internet

The Internet is a *large, international computer network linking millions of users around the world that use the TCP/IP protocols*. A collection of local, regional and national

computer networks that are linked together to exchange data and distribute processing tasks.

Millions of computers, all linked together on a computer network.

- A home computer usually links to the Internet using a phone line and a modem that talks to an Internet Service Provider (ISP) or Online Service
- A business computer has a NIC that connects to a LAN that connects to an ISP using a broadband connection.

Internet Service Providers (ISPs)

Internet Service Provider (ISP)

§ Any company that provides individuals or companies with access to the Internet.

§ Thousands of providers including large communications companies.

• Online Service

§ Provides Internet access and value –added services

NETWORKING MODELS

The most commonly used networking models are:

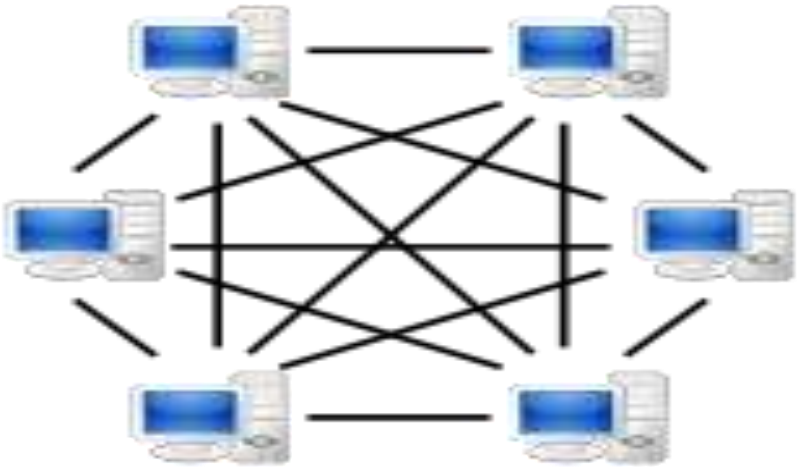
- Peer-to-peer Networking,
- Client/Server Networking,
- Centralized Computing
- Distributed Computing

Note that a combination of a couple of the above is sometimes possible

Peer-to-peer Networking (defined)

- A peer-to-peer (or P2P) computer network uses diverse connectivity between participants in a network
- Uses the cumulative bandwidth of network participants rather than conventional centralized resources
- Nodes on a peer to peer simultaneously function as both "clients" and "servers" to the other nodes on the network.

Peer-to-peer Networking (illustration below) - A peer-to-peer based network.



Client/Server Networking (defined)

- Computers interconnected in such a way that some nodes request for services while others provide services
- Those that request for services are referred to as the clients and those that provides services are the servers
- Servers tend to have a higher processing capability than the clients

Client/Server Networking (illustration) - A server based network (i.e: not peer-to-peer).

Client/Server Networking (TYPES OF SERVERS)

TYPES OF SERVERS

- File servers
- Print servers
- Mail servers

others

- web Server
- Proxy Server
- Telnet Server e.tc

Centralized Computing (Defined)

- Centralized computing is computing done at a central location, using terminals that are attached to a central computer or server.
- The computer itself may control all the peripherals directly (if they are physically connected to the central computer), or they may be attached via a terminal server.
- Alternatively, if the terminals have the capability, they may be able to connect to the central computer over the network.

Distributed Computing (Defined)

- Distributed computing deals with hardware and software systems containing more than one processing or storage element; concurrent processes; or multiple programs, running under a loosely or tightly controlled regime.
- In distributed computing a program is split up into parts that run simultaneously on multiple computers communicating over a network

Performance measures of networked systems

- Response time: time taken for response to appear on screen
- Accuracy of the information
- Throughput (volume of transmission processed in a specific unit of time)
- Availability
- Reliability and flexibility

ADVANTAGES AND DISADVANTAGES OF NETWORKS

Advantages

- Faster and easier access to information
- Better communication
- Ability to have a worldwide audience (able to advertise and market your product)
- E-commerce /E-business

Disadvantages

- Lack of privacy/confidentiality
- Children have access to pornography, harmful information, pedofiles etc.
- Easier to plagiarise information as able to copy and paste.