

Data Communication: - Data communication is the exchange of data (in a form of 0's & 1's) between two devices via some form of transmission medium such as a wire-cable).

The effectiveness of a data communication system depends on three fundamental characteristics:

(i) Delivery: The system must deliver data to the correct destination. Data must be received by the intended device or user and only by that device or user.

(ii) Accuracy: The system must deliver data accurately. Data that have been altered in transmission and left uncorrected are thus unusable.

(iii) Timeliness: The system must deliver data in a timely manner. Data delivered late are useless.

Components: A data communication system is made-up of five components.

(i) Message: The message is the information (data) to be communicated. It can consist

of text, numbers, pictures, sound or video - or any combination of these.

(ii) Sender: The Sender is the device that sends the data message. It can be a computer, work station, telephone handset, video camera & so on.

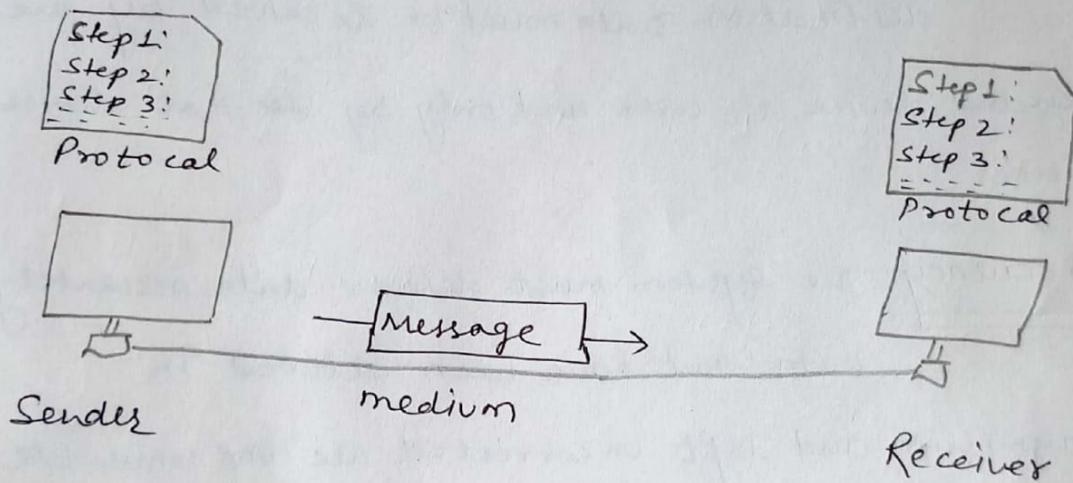


fig: Data Comm? System Components

(iii) Receiver: The Receiver is the device that receives the message. It can be a computer, work station, Telephone handset, television & so on.

(iv) Medium: The Transmission medium is the physical path by which a message travels from sender to receiver. It can consist of Twisted Pair wire, Coaxial cable, fiber-optic cable etc.

(iv) Protocol: A ~~Protocol~~ is a set of rules that govern data communication. 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.

Data representation:

- * Text - A, Prateek, # Facebook
- * Number - 1, 2, 2.5,
- * Images -
- * Audio -
- * video

Data flow:

- (i) Simplex
- (ii) Half duplex
- (iii) full duplex

Assignment - 1

1. Explain different types of Transmission media with diagrams. (guided media & unguided media).
(Twisted Pair, Coaxial cable, fibre.)
 2. Explain the classification / categories of Networks. (LAN, MAN & WAN)
 3. Differentiate between wired LAN's & wireless LAN's.
- ~~4.~~ Write short notes on Virtual LAN's.

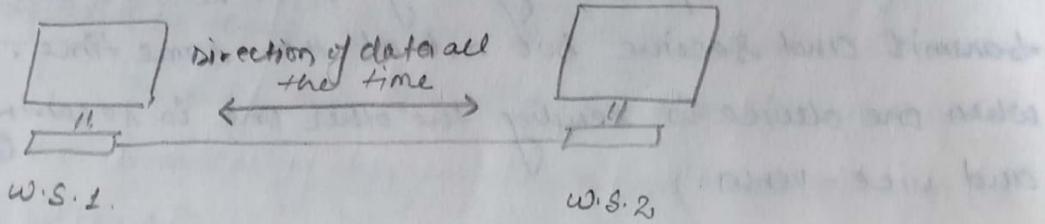
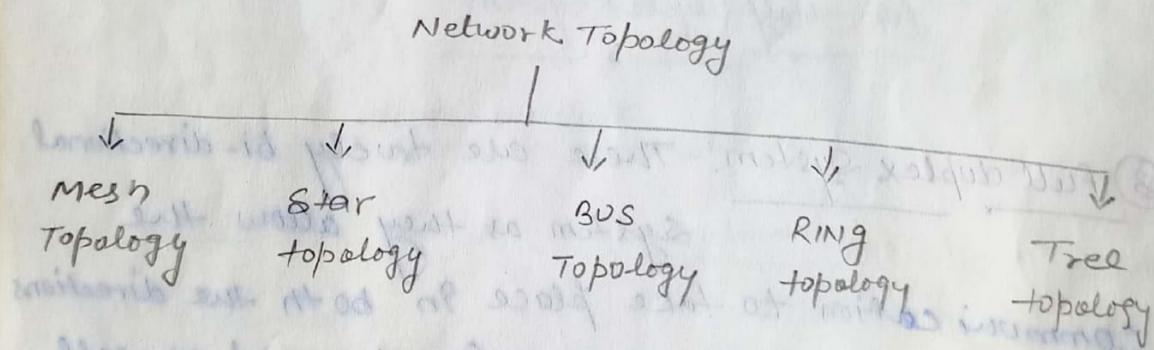


fig: Full duplex mode

Network Topology: The topology of a network is the geometric representation of the relationship of all the links and linking devices (usually called nodes) to each other. The five basic network topologies are shown in figure.



Classification of Network topology

(These five labels describe how the devices in a network, are interconnected rather than their physical arrangement. For example, having a star topology does not mean that all of the computers in the network must be placed physically around a hub in a star shape] A consideration when choosing a topology is the relative status of the devices to be linked.

Two relationship are possible:

(i) Peer to Peer

(ii) Primary - Secondary

Peer to peer "is the relationship where the devices share the link equally. The example are ring and mesh topologies."

In Primary - Secondary relationship, one device controls traffic and the other devices have to transmit through it. For example star and tree topologies.)

(i) 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.

A fully connected mesh network, therefore has $n(n-1)/2$ physical channels to link n devices. To accommodate that many links, every device on the network must have $n-1$ input/output (I/O) port.

Advantages:

(i) The use of dedicated links guarantees that each connection can carry its own data load, thus

eliminating the traffic problems than can occur when link must be shared by multiple devices.

- (2) A mesh topology is robust. If one link becomes unusable, it does not incapacitate the entire system.
(failure)
- (3) It provides security and privacy because every message sent travels along a dedicated line.

Disadvantages:-

- (1) Every computer must be connected to every other computer, installation and reconfiguration are difficult.
- (2) Cabling cost is more.
- (3) The hardware requirement to connect each link, input/output ports and cable is expensive.

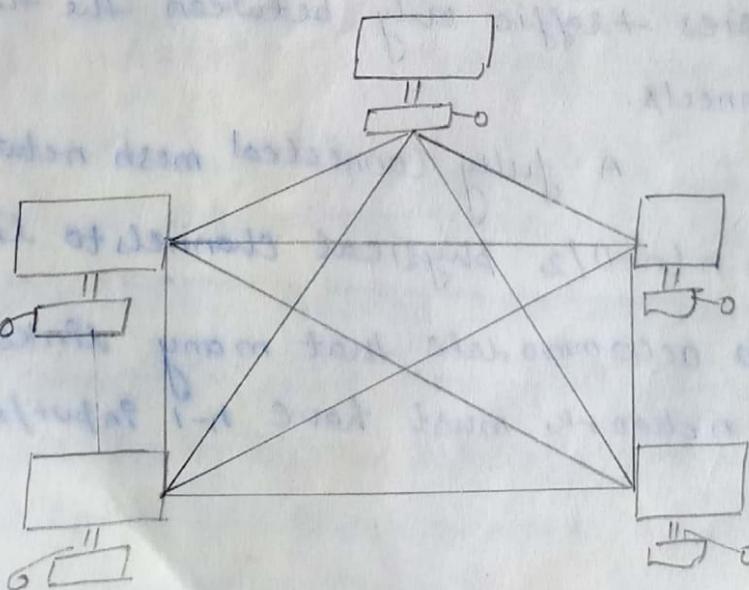


fig: Mesh topology

example 1: The T&T Corporation has a fully connected mesh network consisting of six (6) devices.

Calculate the total number of cable links needed and the number of ports for each device.

solution:-

The formula for the no. of links for a fully connected mesh is $n(n-1)/2$, when n is the no. of devices.

$$\text{number of links} = n(n-1)/2 = 6(6-1)/2 = 15$$

number of ports

$$\text{for each device} = n-1 = 6-1 = 5$$

Ans

Q2 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 each other. 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 transmits (relays) the data to the other connected device.

Advantages:

① A star topology is less expensive than a mesh topology, In a star each device need only one link and

and one I/O port to connect it to any number of others. This factor also makes it easy to install and reconfigure.

- ② If one link fails, only that link is affected. All other links remain active.

Disadvantages:-

- ① If the central HUB fails, the whole (entire) network fails.
- ② However, A star requires far less cable than a mesh, each node must be linked to a central HUB. For this reason more cabling is required in a star than in some other topologies (such as bus, ring).

- ③ Bus topology! (A bus topology, is multipoint, one long cable acts as a backbone to link all the devices in the network.)

Nodes are connected to the bus cable by drop lines and taps.) A drop line is a connection running between the device and the main cable. A tap is a connector that either splices (joins together) into the main cable or punctures the sheathing (classe fitting) of a cable to create a contact with the metallic core. (The bus topology is usually used when a network installation is small, simple and temporary.

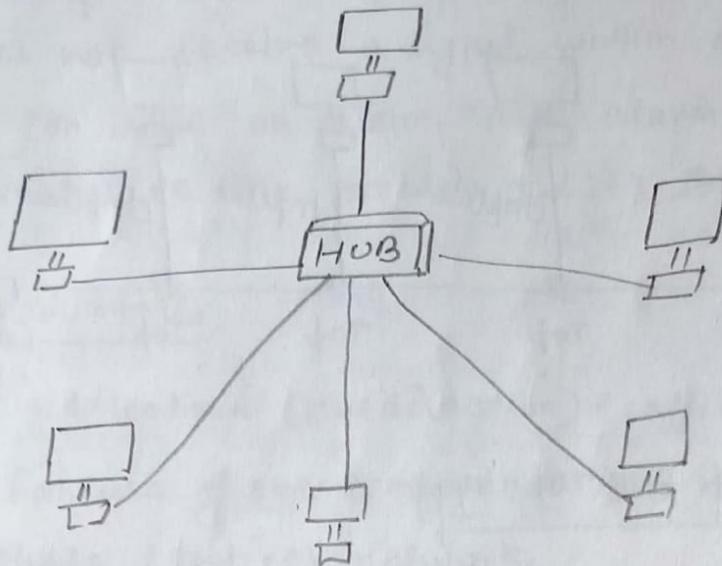


fig. star topology

Advantages :-

- ① The bus topology easy to understand and installation.
- ② A bus topology uses less cabling than mesh and star topology.

Disadvantages:-

- ① Heavy network traffic slows down the bus speed.
In bus topology only one computer can transmit and others have to wait till their turn comes.
- ② It include difficult re connection (re configuration) and fault isolatin.

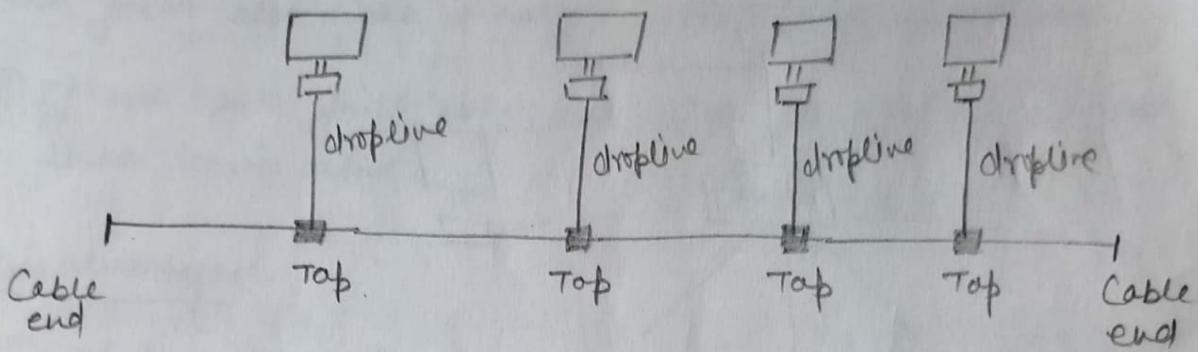


fig BUS TOPOLOGY

④ Ring topology: In a ring topology, each device has a dedicated point-to-point connection only with the two devices on either side of it. A signal is passed along the ring in one direction, from device to device, until it reaches its destination.

Each device in a ring incorporates a repeater. When a device receives a signal intended for another device, its repeater regenerates the bits (signals) and passes them along.

Advantages:

- ① A ring is relatively easy to install and reconfigure. Each device is linked only to its immediate neighbours.
- ② To add or delete a device requires moving (changing) only two connections.
- ③ Fault isolation is simplified. Generally in a ring

, a signal is circulating at all times. If one device does not receive a signal within a specified period. It can issue an alarm. The alarm alerts the network operator to the problem and its location. (5)

Disadvantages:

- ① Unidirectional (one direction) traffic
- ② Failure of one computer on the ring can affect the whole (entire) network.

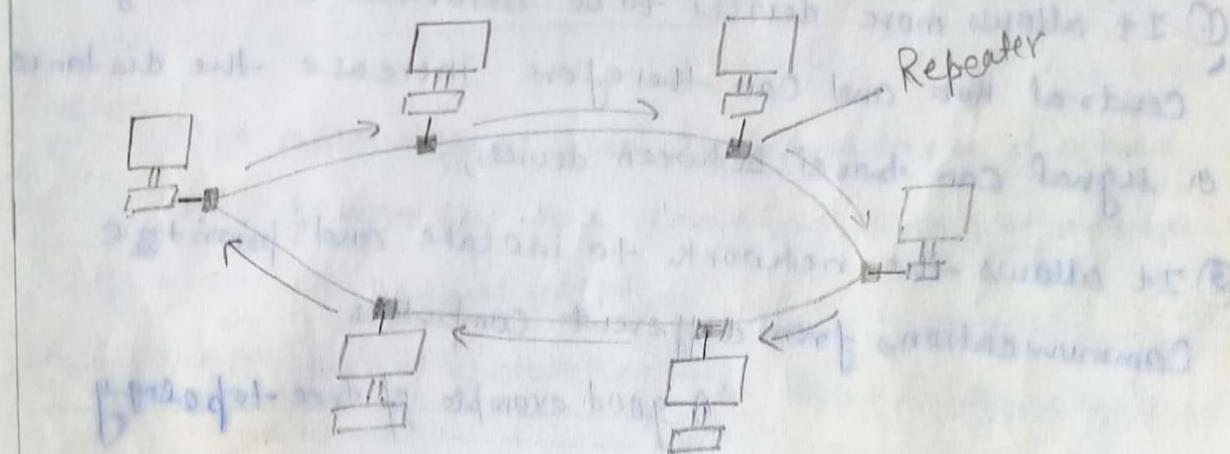


fig: Ring Topology

⑤ Tree topology: A tree topology is a variation of a star. As in a star, nodes in a tree are linked to a central hub that controls the traffic to the network. However, not every device plugs directly into a central hub. The majority of

devices connect to a secondary hub that in turn is connected to the central hub.

The central hub in the tree is an active hub. An active hub contains a repeater, which is a hardware device that regenerates the received bit patterns before sending them out. Repeater

The secondary hubs may be active or passive Hubs. A passive HUB provides a simple physical connection between the attached devices.)

Advantages:

- ① It allows more devices to be attached to a single central hub and can therefore increase the distance a signal can travel between devices,
- ② It allows the network to isolate and prioritize communications from different computers.

A good example of tree topology

Can be seen in Cable TV technology where the main cable from the main office is divided into main branches and each branch is divided into smaller branches and so on. The HUB are used when a cable is divided.)

Disadvantages:

- ① If the central HUB fails the system breaks down.
- ② The cabling cost is more)

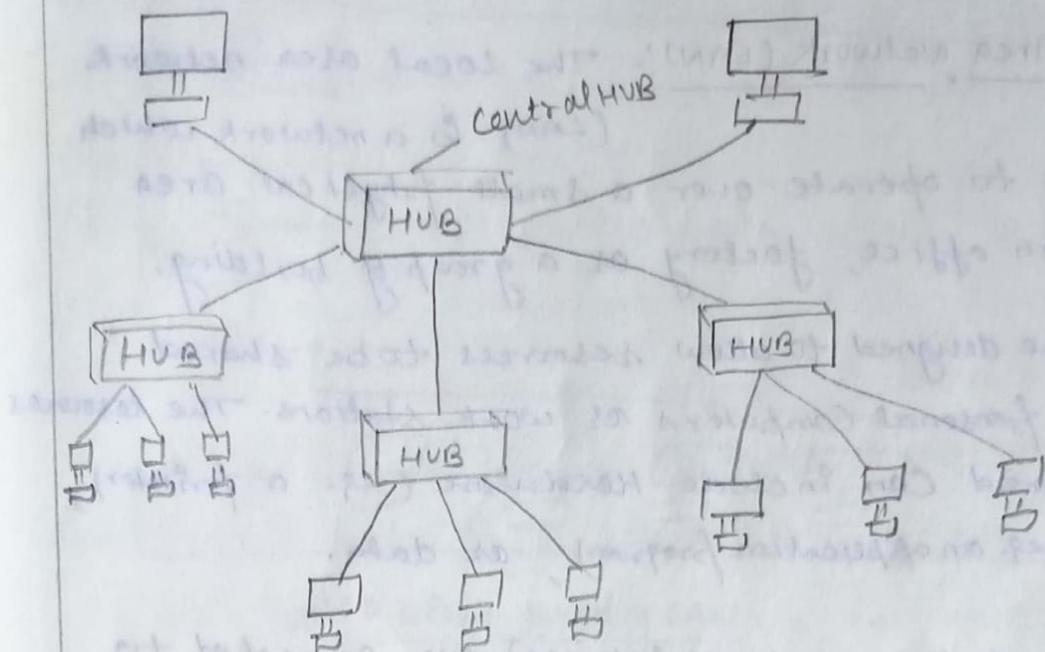


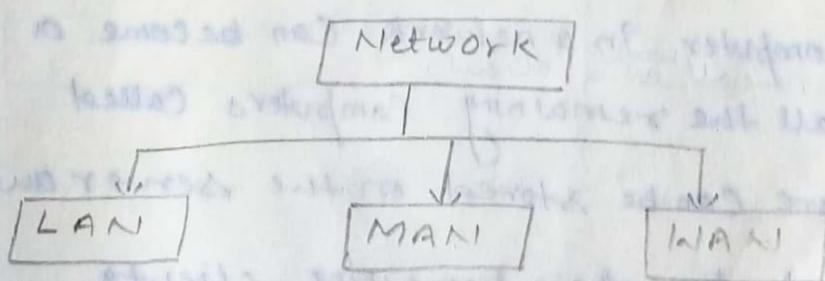
fig: Tree topology

Note: The advantages and disadvantages of a tree are generally the same as those of a star.

or Classification

✓ Categories (Types) of Networks: The various types of networks are as follows.

- ✓ i) LAN (Local Area Network)
- ✓ ii) MAN (Metropolitan area Network)
- ✓ iii) WAN (Wide Area Network)



Categories of Network

(A) Local Area Network (LAN):- The local area network

is designed to operate over a small physical area such as an office, factory or a group of buildings.

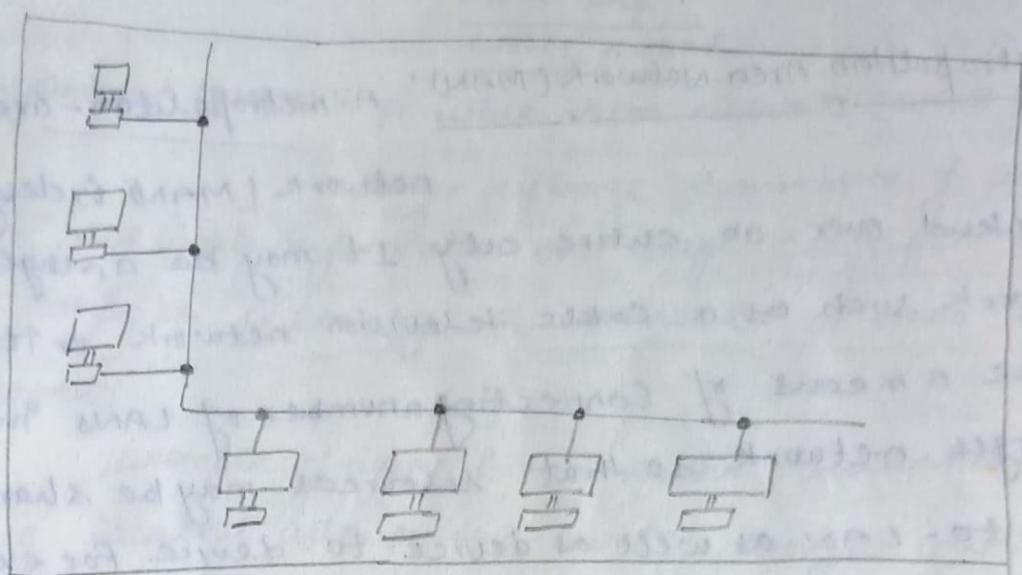
(a) LANs are designed to allow resources to be shared between personal computers or work stations. The resources to be shared can include hardware (e.g. a printer), software (e.g. an application program), or data.

(b) In LAN all the machines (devices) are connected to a single cable. Different types of topologies such as BUS, RING, star and Tree are used for LANs.

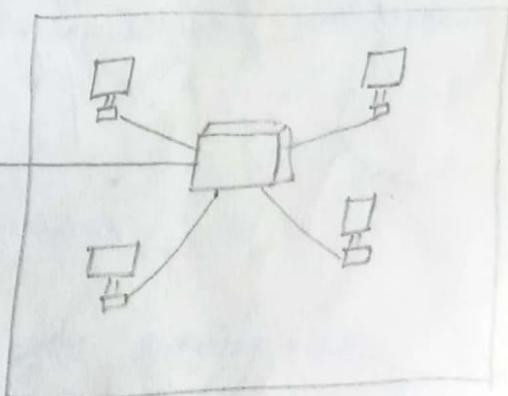
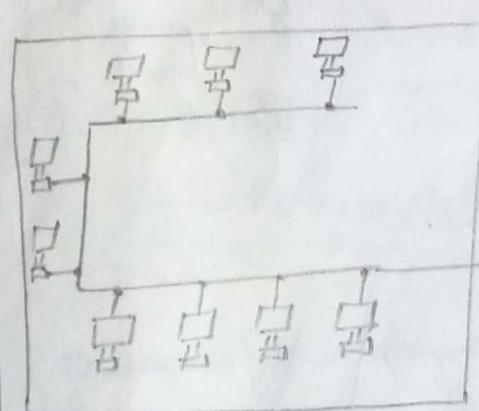
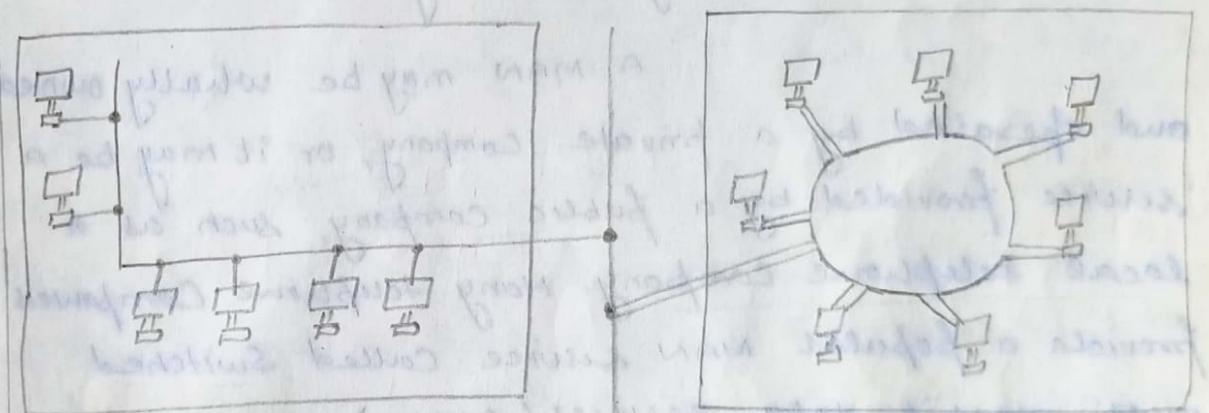
(c) Depending on the needs of an organization and the type of technology used, a LAN can be as simple as two Personal Computers (PCs) and a printer in someone's office or home or it can extend throughout a company and include voice, sound and video peripherals.

(d) Traditionally, LANs have data rates in the 4 to 16 megabits per second (Mbps) range. Today, however, speeds are increasing and can reach 100 Mbps.

(e) One of the computers in a network can become a server, serving all the remaining computers called clients. Software can be stored on the server and it can be used by the remaining clients.



(a) a single Building LAN

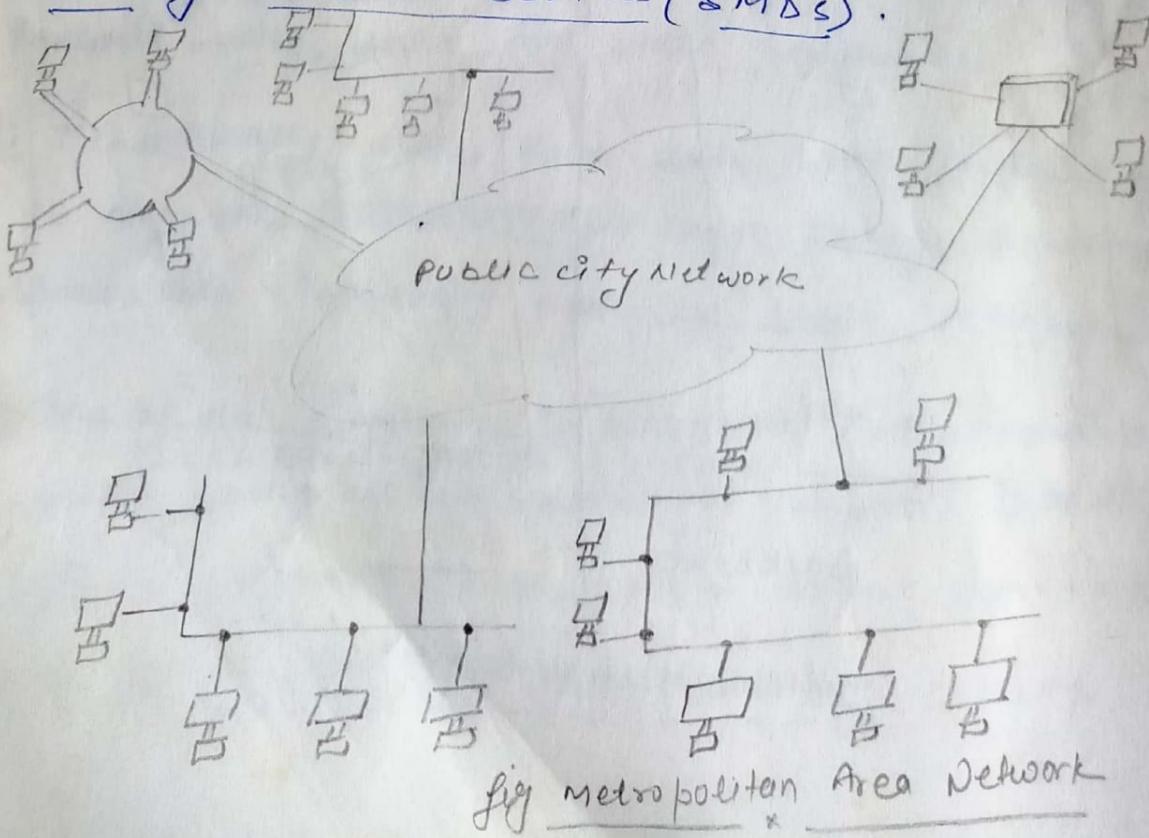


Backbone

(b) Multiple Building LAN

② Metropolitan Area Network (MAN): A metropolitan-area network (MAN) is designed to extend over an entire city. It may be a single network such as a cable television network, or it may be a means of connecting a number of LANs into a larger network so that resources may be shared LAN-to-LAN as well as device-to-device. For example, a company can use a MAN to connect the LANs in all its offices throughout a city.

A MAN may be wholly owned and operated by a private company, or it may be a service provided by a public company, such as a local telephone company. Many telephone companies provide a popular MAN service called Switched multi-megabit data services (SMDS).



wide area Network (WAN):- A wide area network (WAN) provides long-distance transmission of data, voice, image and video information over large geographic areas that may comprise a country, a continent, or even the whole world.

Example of WAN is an Airline reservation system. Terminals are located all over the country through which the reservations can be made.

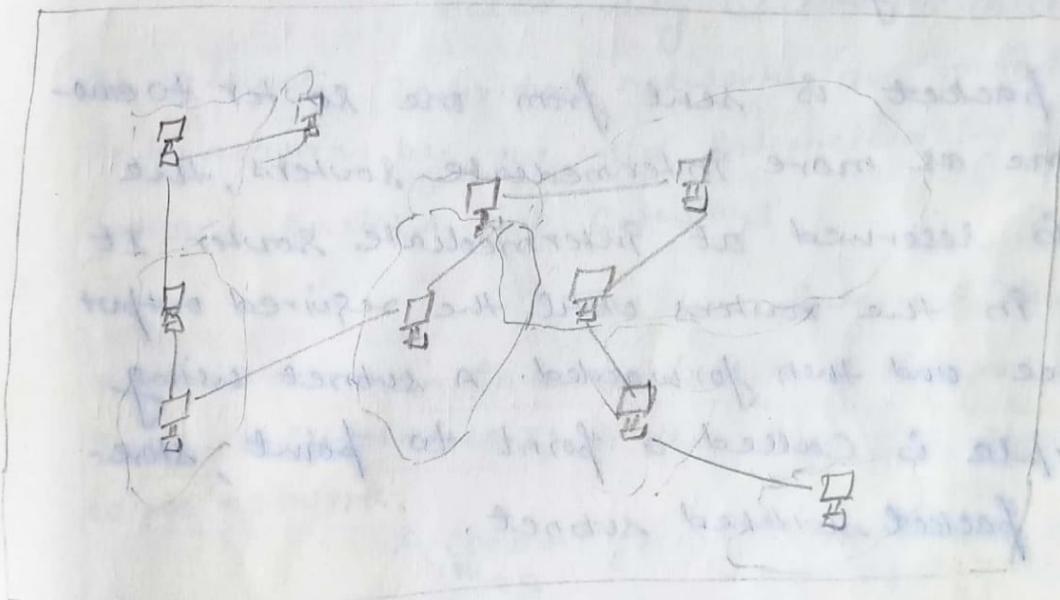


fig wide Area Network

* WAN contains of machines used for running user (ie. application) programs. All the machines (called hosts) are connected by a communication subnet.

* The function of the subnet is to carry messages from host to host. The subnet consists of two important

Components; transmission lines and switching elements.

- * Transmission lines move bits from one machine to another. The switching elements are specialised computers used to connect two or more transmission lines. When data arrive on an incoming line, the switching element must choose an outgoing line to forward them.
- * The switching elements are either called as packet switching nodes, intermediate systems, data switching exchanges or routers.
- * When a packet is sent from one router to another via one or more intermediate routers, the packet is reserved at intermediate router. It is stored in the routers until the required output line is free and then forwarded. A subnet using this principle is called a point to point, store-forward or packet switched subnet.

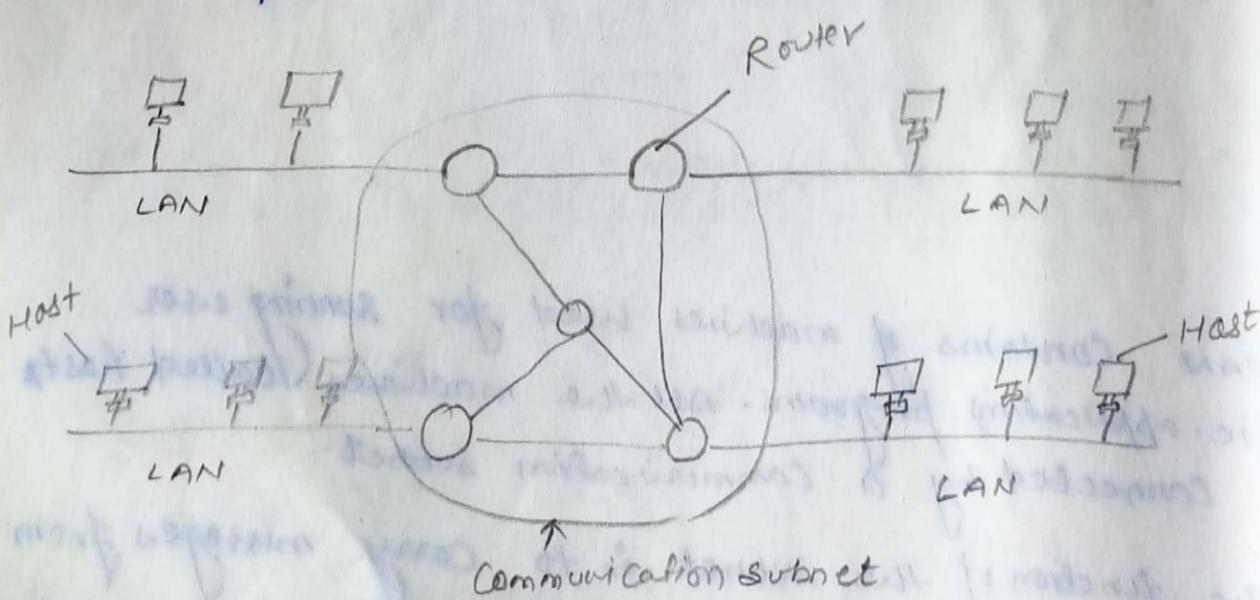


fig Communication subnet and hosts

- * In most WANs the network contains a large number of cables or telephone lines each one connecting a pair of routers.
- * If two routers which are not connected to each other via a cable want to communicate, they have to do it indirectly via other routers.

Internetworks: When two or more networks are connected, they become an internetwork, or internet. Individual networks are joined into internetworks by the used internetworking devices like bridges, routers and gateways.

The term internet (lower case i) used to mean an interconnection of Networks and Internet (upper case I) is the name of a specific world-wide network.

A common form of internet is a collection of LANs connected by a WAN.

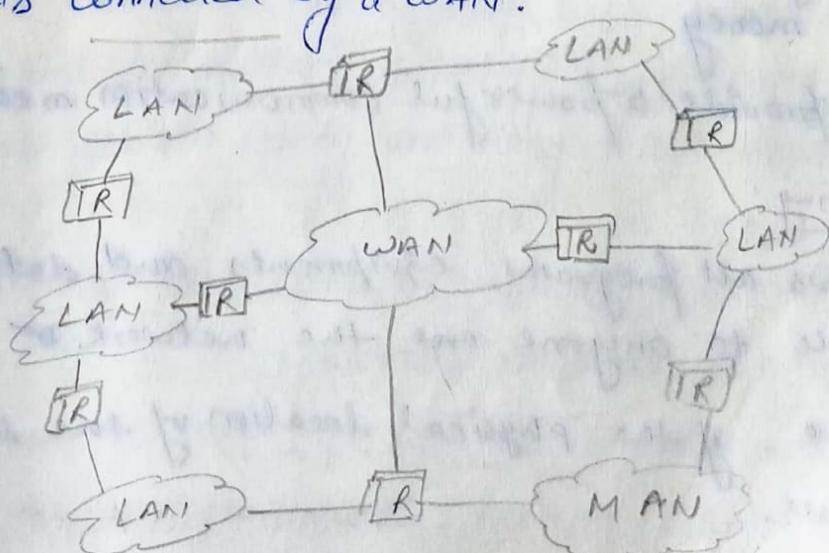


fig Internetwork (Internet)

Amp:

Goals and applications of Networks:

areas ful

The Computer Networks are playing an important role in providing services to large organisations as well as to the individual common man.

① Services Provided by the Network for Companies:

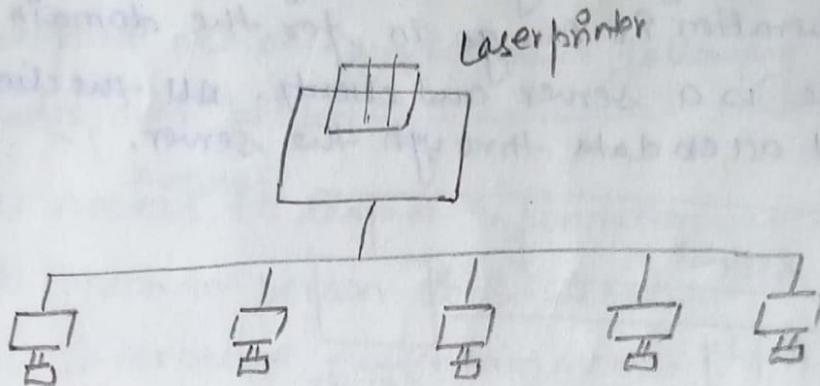
- * Many organisations have a large number of computers in operation. These computers may be within the same building, campus, city or different cities.
- * Even though the computers are located in different locations, the organisations want to keep track of inventories, monitor productivity, do the ordering and billing etc.
- * The computer networks are useful to the organisations in the following ways:
 - (i) Resource sharing
 - (ii) for providing high reliability
 - (iii) to save money (money saving)
 - (iv) It can provide a powerful communication medium.

i) Resource sharing:

(* It allows all programs, equipments and data available to anyone ^{on} the network & irrespective of the physical location of the resource and the user.)

(25) for example

An obvious and widespread example is having [a group of office computers share a common printer.]



Sharing of printer

(ii) High Reliability: It provides high reliability by having alternative sources of data. for e.g. all files could be replicated on more than one machines so if one of them is unavailable due to hardware failure or any other reason, the other copies can be used.

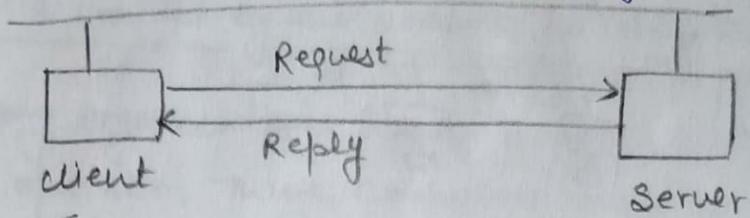
The aspect of high reliability by having alternative sources of data. for example:

(The aspect of high reliability is very important for military, banking, air traffic control, nuclear reactor safety and many other applications.)

(iii) Money saving: Computer networking is an important financial aspect for organisations because it saves money. [The organisations can use the workgroup model (peer to peer) in which

all the PCs are networked together and each one can have the access to the other for communicating or sharing purpose.

[The organisation, if it wants security for its operation it can go in for the domain model which there is a server and clients. All the clients can communicate and access data through the server.]



(workstation) fig: client-servermodel,

client: The individual work stations in the network are called as clients.

Server: The central computer which is more powerful than the clients and which allows the clients to access its software and database is called as the server.

(iv) Communication Medium:

A Computer network provides a powerful communication medium among widely separated employees. Using network it is easy for two or more employees, who are separated by geographical locations to work on a report, document and research & development simultaneously such that (for example) on-line.)

② Networks for people: (Starting in 1990s, the computer network began to start delivering services to the private individuals at home. The computer networks offer the following services to an individual person:)

- (a) Access to remote information
- (b) Person to person communication
- (c) Interactive entertainment.

(a) Access to Remote Information: (Access to remote information involves interaction between a person and a remote data base) Access to remote information comes in many forms like:

- * Home shopping, paying telephone, electricity bills, e-banking, on line share market etc.
- * World wide web which contains information about the arts, business, Government, health, history, science and sports etc.)

(b) Person to person Communication: Person to person communication include:

- * Electronic-mail (e-mail)
- * Real time e-mail, i.e. [video conferencing allows remote user to communicate with no delay by seeing and hearing each other]

✓ * worldwide newsgroups in which one person posts a message and all other subscribers to the newsgroup can read it or give their feed backs.) for ex: facebook

(c) Interactive entertainment! (Interactive entertainment

Includes:

✓ * multiperson real-time simulation games.

✓ * Participation in live TV programmes like quiz, contest, discussions etc.]

In short, the ability to merge information, communication, and entertainment will surely give rise to a massive new industry based on computer networking. (3) Other applications! as like

(3) Manufacturing (ex CAD/CAM) (1) Marketing & sales (2) financial services
Cellular Telephone (mobile appl'') (4) Electronic data interchange (5)

(2) Network functions!: Following are some of the important functions that a network needs to perform:

- (i) switching
- (ii) Routing
- (iii) flow control
- (iv) speed
- (v) Security
- (vi) Back-up
- (vii) failure monitoring
- (viii) Traffic monitoring
- (ix) Internetworking
- (x) Network management