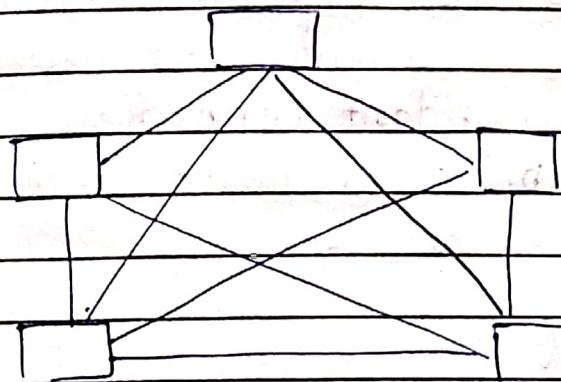


topologies

## #) Mesh Topology

- In Mesh Topology, every device has a dedicated point-to-point Communication/Link to each other device
- The term dedicated means link carries traffic only between the two devices it connects.
- A fully connected mesh Network has  $n(n-1)/2$  no. of cables to link devices
- To accomodate these many links, every device on the network must have  $(n-1)$  ports



Mesh topology for five devices

### Advantages

- A Mesh Topology is robust. If one link becomes unusable, it does not incapacitate the entire system.
- Privacy or Security - When every Message travels along a dedicated line, only the intended recipient sees it.
- Point-to-point link make fault identification and fault isolation
- Scalability is simple
- It can manage high level of traffic when setup

is complete.

- Easy to add new devices.
- Can operate without a complete set of web

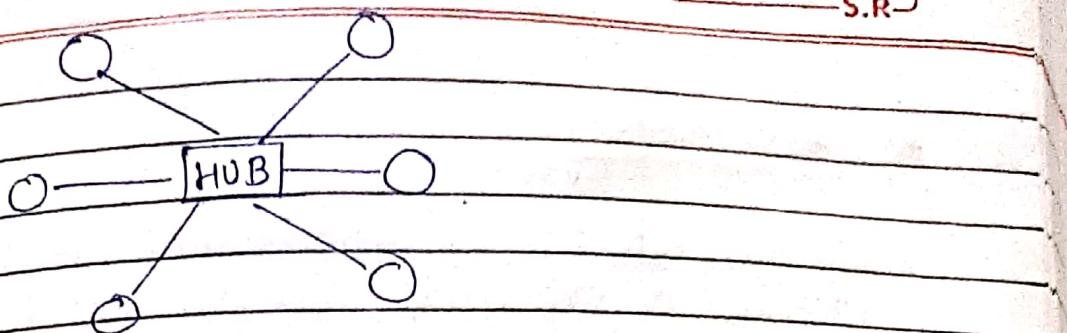
### Disadvantages

- The cost of implementing Mesh topology is higher.
- Complex structure.
- More Power Consumption
- Each node has increased workload
- Risk of redundant connection
- Time Consuming to build & Maintain

#)

### Star topology

- In this star topology, each device has a dedicated point-to-point link only to a central controller usually called as hub.
- The controller acts as an exchange. If one device wants to send data to another, it sends the data to hub, which then relays the data to another device.
- The devices are not connected to each other directly.
- It also has point-to-point communication between devices.
- No. of cables is equal to no. of devices(n)
- Port = 1/device i.e. total =  $1 \times n$ .



### Advantages

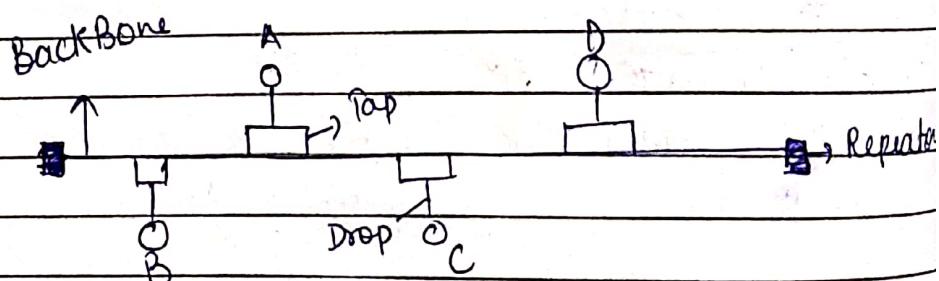
- Centralized Network - It helps to monitor the network by using a centralized computer, hub.
- User friendly
- Reliable
- Highly Efficient
- Easily manageable
- Safe to use
- Multiple stars can be created to extend the network reach.
- Security

### Disadvantages

- High cost because of hub
- Everything depends on central device
- Prone to damage
- High maintenance
- Immobile Network System
- If hub has some problem than whole system goes down
- Extra hardware requires
- Requires more cables than linear bus.

## #) Bus Topology

- A Bus topology is multipoint. One long cable act as backbone to link all the devices in the network.
- As a signal travels along the backbone, some of its energy is transferred into heat. Therefore, it becomes weaker and weaker as it travels farther and farther.
- It has a Terminator or repeater at the end of the backbone which increase the strength of signal. If we need more length than actual length of backbone then it will work.
- There are more chances of collision because when all devices starts transmission at the same time then there will be more chances of collision.
- No. of Cables = No. of device ( $n$ ) + 1 <sup>for Backbone</sup>
- Port =  $1 * n$



## Advantages

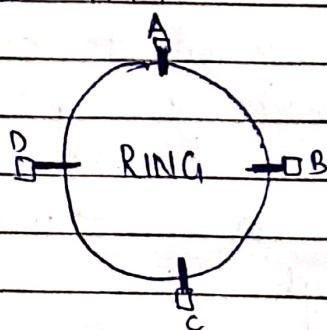
- It is easiest network topology used for connecting devices in linear way.
- It works very efficiently.
- Length of cable required is less than star topology.
- Very cost-effective.
- Easy to understand topology.
- Easy to expand by joining two cables together.
- It is easy to connect or remove devices in this topology.
- cheap

## Disadvantages

- It is not great for large networks.
- Identification of problems becomes difficult when system goes down.
- It is slow as compared to other topologies.
- No security for devices & data.
- If the main cable is damaged, whole system fails.
- Need of terminators on the both end of wires.
- Packet loss is high.
- Low reliability.

## #) Ring Topology.

- In ring topology, each device has a dedicated point-to-point connection with the only 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.
- A number of repeaters are used in ring topology with a large number of nodes. To send data & to prevent data loss, repeaters are used in this network.
- It is used in LAN and WAN depending on the card of network in the computer.
- In this, data travels in unidirectional form i.e. only in one direction.
- It uses tokens to control collision of data.
- Ports =  $1 \times n$
- No. of cables =  $n + 1$



### Advantages

- It is cheap to install and expand.
- Minimum collision.
- Speed to transfer data is high.
- Easy to manage.

- Equal access to resources.
- Data flows in unidirection which reduces the chances of packet collision.

### Disadvantages

- It doesn't provide security.
- less reliable
- Total dependence on one cable
- They were not scalable.
- It is slower in performance.
- If wire is damaged for one device, whole system will fail.

## Difference b/w Point-to-point Communication & Broadcast N/w (Multipoint)

Point to point	Broadcast N/w.
1. The channel is shared by two devices.	1. The channel is shared by multiple devices or nodes.
2. There is dedicated link b/w two devices/Nodes.	2. Link is provided all times for shared connection among nodes.
3. There is one transmitter and one receiver.	3. There is one transmitter and many receivers.
4. The smallest distance is most imp. to reach the receiver.	4. The smallest distance is not imp. to reach the receiver.
5. It provides security & privacy because the connection is <sup>not</sup> shared.	5. It doesn't provide security & privacy because the connection is shared.

- |   |  |
|---|--|
| 6. The entire capacity is reserved between the connection of nodes. | 6. The entire capacity is depend on quick sharing. |
| 7. Example - Telephone  | 7. Example - Radio                                 |

## 2) OSI Model

- OSI stands for Open System Interconnection. It is a reference Model that describes how inf. from a software applications in one computer moves through a physical medium to software application.
- OSI consist of seven layers and each perform a particular network function
- OSI model divides the whole task into seven manageable tasks
- Each layer is self contained so that task assigned to each layer can be performed independently.
- OSI model divides into upper layer or lower layer
  - Upper layers deals with application related issues and they are implemented only in the software.
  - lower layer deals with data transport issues (Responsibility of Network)

OSI divides into Seven layers :-

	Application
	Presentation
	Session
	Transport
	Network
	Data Link
	Physical

### Physical layer :-

- It provides a physical medium through which bits are transmitted.
- It is lowest layer of OSI Model.
- It establishes, maintains & deactivates the physical connection.
- It specifies the mechanical, electrical & procedural network interface specifications.

### Functions

- Signal - It determines the type of signal used for transmitting the inform.
- Topology - defines the way how network devices are arranged.
- Lineup Configuration - It defines the way how two or more devices are connected physically.
- Data transmission - It define the data transmission mode between the two devices of network.

### 2) Data Link :-

- It is used for error free transfer of data frames.
- It defines the format of data on network.
- It provides a reliable and efficient communication between two or more devices.
- It is mainly responsible for unique identification.
- Support Simplex, half-duplex or full duplex communication.
- Handle errors.

#### functions :

- Node to Node delivery
- Flow Control
- Error Control
- Access Control
- Frame - unit of communication

### 3) Network layer :-

- It implements routing of packets through the Network.
- It defines the most optimum path the packet should take from the source to destination.
- It handles congestion in the Network.
- Facilitates interconnection b/w heterogeneous Networks.

#### functions

- Host to Host delivery
- Logical Address

- Routing : decide the route.
- Fragmentation: Unit of Communication Packets
- Congestion Control.

#### 4) Transport Layer:

- It is used to provide a reliable mechanism for the exchange of data between two processes in different computers.
  - It ensures that data units are delivered error free.
  - It ensures that there is no loss or duplication of data units.
  - Provides connectionless or connection oriented service.
  - Multiplex multiple connection over a single channel.
- Function
- Reliability
  - Flow Control
  - In order delivery
  - Multiplexing / Demultiplexing

#### 5) Session Layer

- It provides mechanism for controlling the dialogue between the two end systems. It defines how to start, control & end conversations b/w applications.
- This layer requests for a logical connection to be established on an end-user request.
- Any necessary log-on or password validation is also handled by this layer.

- Session Layer is also responsible for terminating the connection.
- This layer provides services like dialogue discipline which can be full or half duplex.
- It also provide checkpoint mechanism.

#### 6) Presentation Layer

- It defines format in which the data is to be exchanged b/w the two communicating entities.
- Also handles data compression and data encryption function.
- Code Conversion
- Encryption / Decryption
- Compression

#### 7) Application Layer

- It interacts with application programs & is the highest level of OSI Model.
- It contains management function to support distributed application.
- Example - file transfer, electronic mail, remote login etc

## #) LAN (Local Area Network)

- A LAN is a private Network that connects computers and devices within a Limited area like residence, an office, a building or a campus.
  - LAN can also extend to a few kilometers when used by companies where a large number of computers share a variety of resources like hardware, software and data.
- Characteristics/features
- Network size is limited to small area i.e. few kilometers
  - Data transfer rate is High.
  - It uses only one type of transmission medium
  - No. of computers connected to a LAN is usually restricted.
  - It is distinguish from other networks by their topologies.

### Advantages of LAN

- Inexpensive transmission media.
- It is used to high transmission rates.
- A large size of interconnection between devices.
- It is flexible & growth oriented.
- It allows file sharing.
- It provides full proof of security system.
- It can simplify the physical association of a device.

## Disadvantages

- Cost of Implementation is high
- Area coverage is limited
- Sewer crashing damage the connections b/w computers.
- It does not offer good Privacy
- It is not able to secure centralized data repository.
- It requires constant LAN administration

## ##) MAN (Metropolitan area Network)

A MAN is consisting of a computer Network across a entire city, or region. This type of Network is larger than a LAN which is mostly limited to a single building or site.

It allows you to cover an area from few miles to tens of miles.

### Characteristics

- It mostly covers towns & cities in a max. 100 km range
- Mostly used in optic fibres, cables.
- Transmission Speed is High
- MAN ownership is private or public.

### Advantages

- It offers fast communication using high speed carrier.
- It uses fiber optics, so, it has high speed than WAN.
- It is less expensive.
- On MAN, we can send local emails fast & free.
- User can share their Internet Connection.
- It has high security than WAN.
- It is faster way to connect two fast LAN together.

### Disadvantages

- It is difficult to manage.
- Internet Speed may varies in Copper Wires, Fiber optics
- There are higher chances of attacking hackers.
- It requires more wires.

### # WAN (Wide Area Network)

WAN is another important Computer Network that spread across a large geographical area. WAN Network System could be connection of a LAN which connects with other LAN's using telephone line & radio waves. It is mostly limited to an enterprise or an organization.

It is a network that provides long distance transmission of data, voice, images, video and any type of information transmission. WAN are the most extensive range of Computer network.

### Characteristics

- The software files will be shared among all the users; therefore all can access to the latest file.
- Any organization can form its Global integrated Network using WAN.

### Advantages

- It covers larger geographical area.
- It provides incredible speed as their bandwidth is high.
- Data & Information stored in centralized N/w.
- Their ownership can be public or private.
- Update & Upgrade of Software & application are very easy & efficient.
- It also help in business like transportation, Computer Networking etc.

### Disadvantages

- They are very expensive.
- Maintenance & Initial setup is complex.
- Connectivity issues occur.
- Slower than LAN.
- Propagation time delay.
- Complex Design.

- low data transfer Rate.

## #) Differences B/w LAN, MAN, WAN

LAN	MAN	WAN
1. stands for local Area N/w	1. Stands for Metro- plitan Area N/w	1. Stands for Wide Area N/w.
2. It is used for small area like office, campus	2. It is used for cities, or region	2. It is used for large area like country.
3. Transmission speed of data is high.	3. Transmission Speed of data is average.	3. Transmission Speed is low.
4. LAN network ownership is private	4. MAN ownership is public or private.	4. WAN ownership is public or private.
5. Easy to maintain	5. Difficult to maintain than LAN	5. Difficult to maintain than LAN MAN.
6. Error Rate or Setup Cost is low	6. Error Rate or Setup Cost is average.	6. Error Rate or Setup Cost is very high.

## II) Transmission Impairments

It occurs when the received signal is different from transmitted signal.

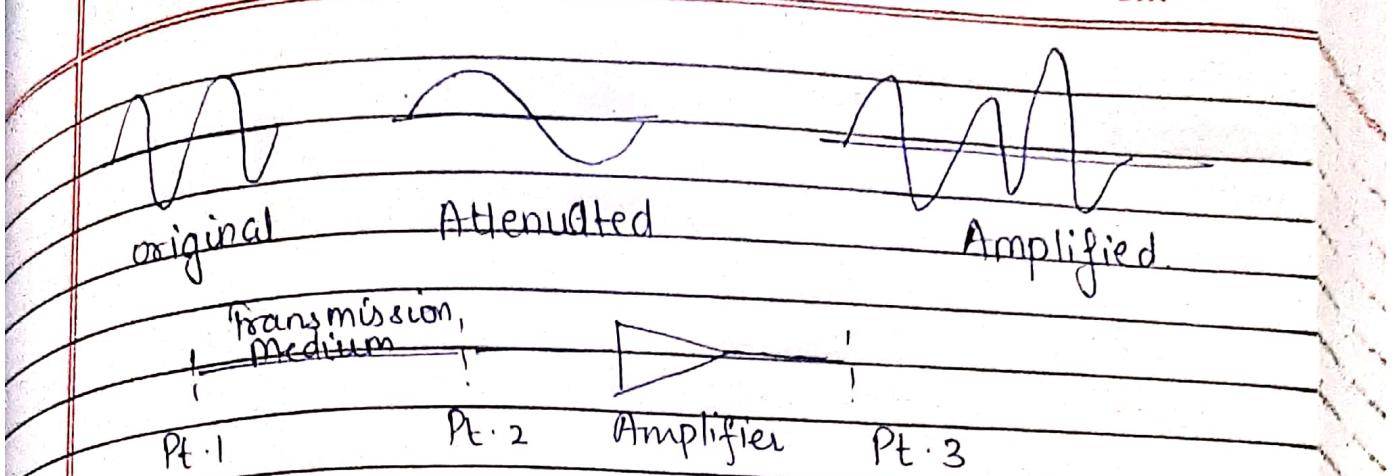
Analog Signal -

- It is a continuous wave denoted by a sine wave and may vary in Signal Strength or frequency.
- In Analog signal due to transmission impairment the resulting received signal gets different Amplitude.
- This imperfection cause Signal Impairment.
- It means signals that are transmitted to medium are not same when they are received by the medium. These impairments tend to deteriorate the quality of analog & digital signals.

Causes :-

### (i) Attenuation :-

- It means loss of energy i.e. weaker signal. When the signal is transmitted through a medium it loses energy so that it can overcome by the resistance of Medium.
- Amplifiers are used to amplify the attenuated signal which gives the original signal back & compensate for this loss.
- It is measured in decibels (dB).
- It measures Relative Strength of two Signals at different pt.

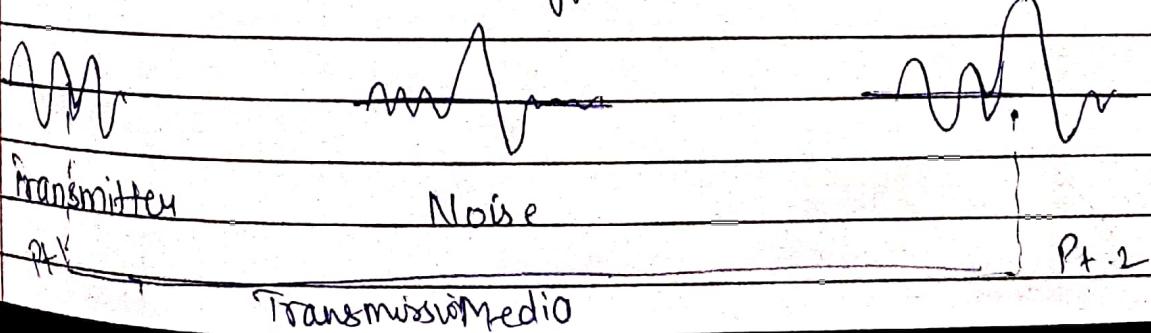


### ② Distortion

- It means change in shape of Signal.
- It is seen in Composite Signals made up with different frequencies.
- Each frequency Component has its own propagation speed travelling through medium.
- Every component arrive at a different time which leads to distortion.
- They have different Phases at Receiver End or Sender End.

### ③ Noise

- The Random or unwanted signal that mixes up with original signal is called Noise
- Induced Noise - Comes from sources such as motors.
- Thermal Noise - Movement of electrons in wire creates extra signal.
- Impulse - Signal with high Energy.
- Crosstalk - One wire affects another wire.



## #) Frequency - Division Multiplexing (FDM)

- It is technology in which frequency technology is used, signals with different frequencies are merged in a composite signal and then broadcast over the link using this technique.
- It is mostly used when the link's bandwidth is greater than the ~~total~~ bandwidth of the signals to be delivered.
- The transmission line in FDM is separated into three segments, each of which represents a channel that carries one transmission.

### Advantages

- It is simple to send a huge number of signals at the same time.
- FDM multiplexing demodulation is simple.
- The transmitter and receiver do not need to be synchronized for proper functioning.
- When gradual narrowbanding fading occurs, just one channel is affected.

### Disadvantages

- Bandwidth must be quite large.
- When employing FDM, there is problem called crosstalk.
- A vast no. of filters required.

## ④) Wavelength-Division Multiplexing (WDM)

- It ~~is~~ is an analog technique in which many data streams of different wavelength are transmitted in light spectrum.
- If wavelength increases, the frequency of the signal decreases.
- The Prism is principal multiplexer in WDM technology and it combines the numerous optical signal, which is subsequently delivered through an optical fiber connection.

### Advantages

- It is ~~very~~ simple to set up.
- It allows several signals to be broadcast at the same time.
- This method ensures the high level of security.
- Less expensive and simple to expand.

### Disadvantages

- Because optical equipment is used, the cost will be high.
- Because bandwidth utilization might be wasteful, wavelength adjustment can be challenging.
- The Biggest issue with this method is Scalability.

## #) Time Division Multiplexing (TDM)

- It is a technique for combining many channels into a single channel. TDM is a digital multiplexing technique.
- The total available time on the channel is shared among the many channel users.
- The Channel/Link is separated by time rather than the frequency in this strategy.
- The time frame is divided into slots.  
It is of two types

### ① Synchronous :-

- In this, the input is connected to a frame. If there are 'n' no. of connections, then the frame is divided into 'n' time slots.
- One slot is allocated to each input line.

### Advantages

- Simple to use
- Using this strategy, you get a good result.

### Disadvantages

- The transmission link capacity must always be greater than the total capacity of input lines in the Multiplexing.

### ③ Asynchronous:

- The sampling rate is different for each of the signals and a common clock is not required.
- It is also known as Static Time Division multiplexing (STATMUX).

#### Advantages

- (More) Efficient use of transmission capacity.
- Time slots are allocated dynamically to increase bandwidth efficiency.

#### Disadvantages

- Frames of various sizes used.
- This method does not guarantee a specific waiting time.

### #) Difference B/w TDM, FDM

#### TDM

- TDM has low conflict.
- Wiring in TDM is simple.
- TDM is efficient.
- Time is shared in TDM.

5. Synchronization Pulse is mandatory in TDM.

- Works well with both analog & digital signals.

#### FDM

- FDM has high conflict.
- Wiring in FDM is complex.
- FDM is quite efficient.
- Frequency is shared in FDM.

5. Guard Band is mandatory in FDM.

- Works only with analog signals.

## #) Twisted Pair Cable

Wires are twisted together in pair. Each pair consist of a wire used for positive data signal and a wire used for negative data signal. Because the wires are of opposite polarities, they are 180 degrees out of phase. Any noise that appears on positive/negative wire of the pair would occur on the other wire. When the noise appears on both wires, it cancels or nulls itself out at the receiving end.

## #) Co-axial Cable -

It consists of two conductors. The inner conductor of the coaxial cable is contained inside the insulator with the outer conductor weaves around it providing a shield. An insulating protective coating called a jacket covers the outer conductor. The outer shield protects the inner conductor from outside electrical signals.

## #) Optical Fibre Cable -

It consists of thin glass fibre that can carry information at frequencies in the visible light spectrum. Typical optical fibre consists of a very narrow strand of glass called cladding.

## Characteristics

### Straight pair cable

Signal transmission	Take place in the electrical form over the metallic conducting wire.
External magnetic field	Affected to external magnetic field
Bandwidth	Low Bandwidth
Electromagnetic Interference (EMI)	EMI can pass through.
Data Rate	Low Data Rate
Noise Immunity	Low Noise Immunity
Cost	Very low Cost
Repeater Spacing	Repeater Spacing is 2-10 km

### Coxial cable

Signal transmission	Takes place in the electrical form over the inner conductor of the cable
External magnetic field	Less affected to external magnetic field
Bandwidth	High Bandwidth
Electromagnetic Interference (EMI)	EMI is reduced to shielding
Data Rate	Moderately High Data Rate
Noise Immunity	Higher Noise Immunity
Cost	Cost is Moderate
Repeater Spacing	Repeater Spacing is 1-10 km

### Optical Fibre

Signal transmission	Takes place in an optical form over glass fibre.
External magnetic field	Not affected to external magnetic field.
Bandwidth	Very High Bandwidth
Electromagnetic Interference (EMI)	EMI is not present
Data Rate	Very High Data Rate
Noise Immunity	Highest Noise Immunity
Cost	Cost is expensive
Repeater Spacing	Repeater Spacing is 10-100 km.

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## #) Circuit Switching

It is defined as the method of switching which is used for establishing a dedicated communication path between the sender and the receiver. The link established between the sender and receiver is in the physical form.

### Advantages

- Bandwidth used is fixed
- Quality of communication is increased
- Rate at which the data transmitted is fixed
- No time is wasted in waiting
- It is preferred when the communication is long and continuous

### Disadvantages

- The utilization of resource is not full
- Expensive
- Bandwidth requirement is more

## #) Packet switching

It is defined as switching connectionless network where the messages are divided & grouped together and this is known as packet. Each packet is routed from the source to the destination as individual packets. The actual data in these packets are carried by the payload.

### Advantages

- Multiple users can use the same channel while transferring the packets.
- No requirement for massive storage space.
- No delay in delivery of packets.

### Disadvantages

- Expensive
- Connectivity issues may lead to loss of information & delay in the type of delivery of the information.

## H) Difference B/w Packet Switching & Circuit Switching

### Circuit Switching

- A circuit needs to be established to make sure that data transmission takes place.
- A uniform path is followed throughout the session.
- It is most ideal for voice communication.
- Data to be transmitted is processed at the source itself.

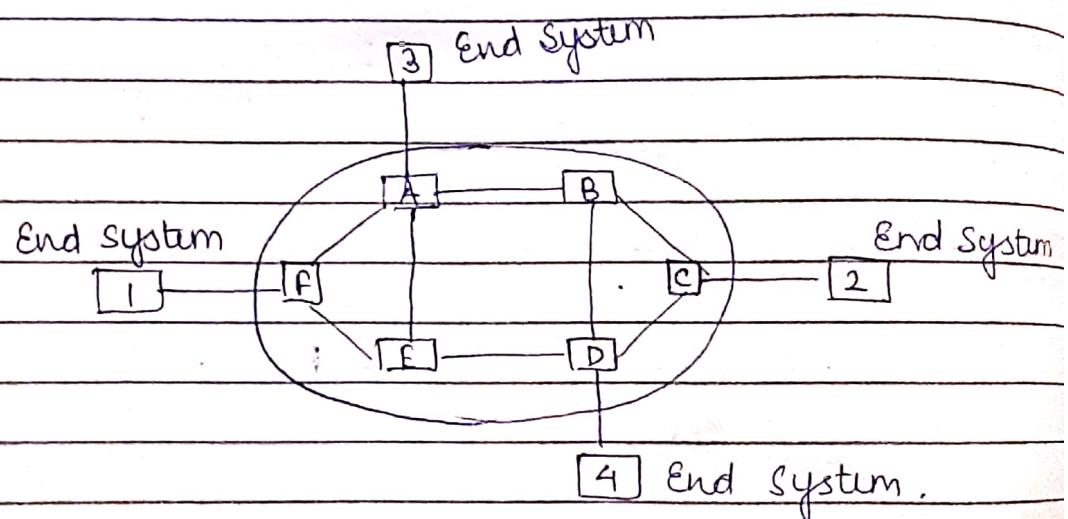
### Packet Switching

- Each packet containing the information that needs to be processed goes through the dynamic rule.
- There is no uniform path followed throughout session.
- It is used mainly for data transmission as the delay is not uniform.
- Data is processed and transmitted at the source as well as at each switching station.

#)

## Virtual Network

It is computer Network providing connection oriented service. It is a Connection-oriented Network. In Virtual Circuit Resource are reserve for the time interval of data transmission between two Nodes. This Network is high reliable medium of trans.



### Advantages

1. Packets are delivered to the receiver in the same order sent by the sender
2. Virtual circuits is a reliable network circuit
3. There is no need for header in each packet
4. Single global Packet header is used in virtual

### Disadvantages

1. Virtual circuit is costly to implement.
2. It provides only connection-oriented service
3. Always a new connection set up is required for transmission.