

Physical Layer

Functionalities

1. Cables and Connection :-

Physical layer manages hardware so we need a connection either wired or wireless to send data.

2. Physical Topologies :-

It also manages that how we should connect computers in a network.

3. Hardwares (Repeaters, hubs) :-

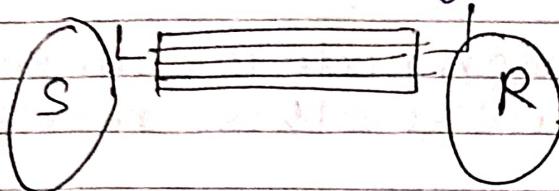
- Repeaters are used if there is attenuation of signals so to up the signal we use repeaters. it has two ports.
- hubs are multiport repeaters.

4. Transmission mode :-

- Simplex :- Sender can send the data but sender cannot receive the data.
- Half-Duplex :- Sender can send data and also can receive data but one at a time.
- Full Duplex :- Sender can send data and also can receive data simultaneously.

5. Multiplexing:

The channel we are using if machine increases then we do not need to buy a new channel we can divide the frequency of the channel to send multiple signals to a channel

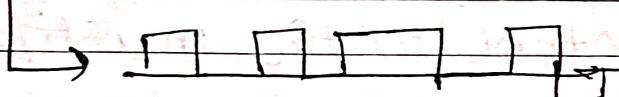


6. Encoding:-

Suppose we are sending voice then sound is wave/ analog signal so we have to encode it into digital signal or vice versa

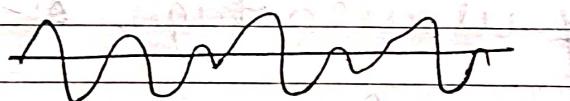
from datalink

↓
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to datalink

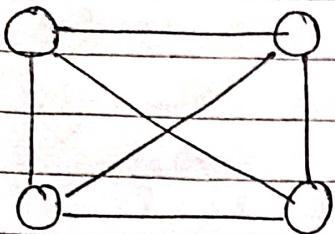
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Topology:-

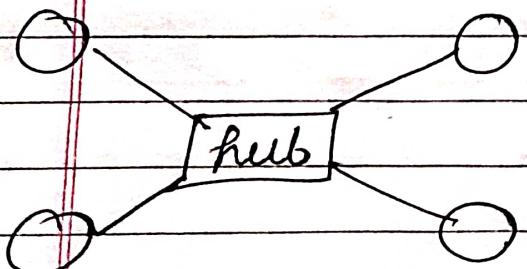
It tells about the physical layout of computers in a network

① Mesh topology:-



- Each node is connected with all the other nodes.
- Number of cables $\rightarrow nC_2$
 $n \times (n-1)$
- Number of ports $\rightarrow n-1$ where n is number of each node.
- Reliability:- if single failure occurs then also data can be transmitted by other path.
- Cost is high because multiple devices are connected with multiple cables.
- Security is also high.

② Star topology:-



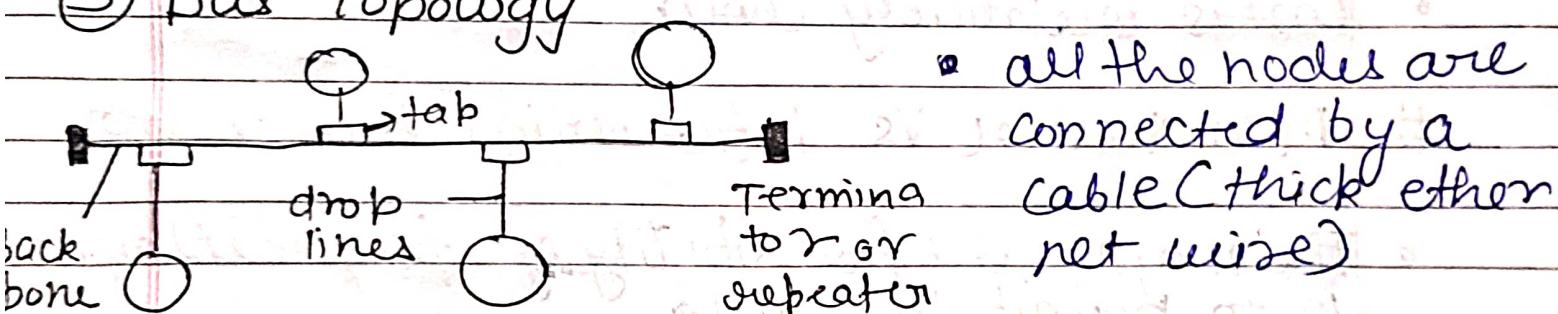
- here is a centralised device
- All the nodes are connected to each other via hub (hub is a multi port repeater).

- number of cables are n
- number of ports for each node is 1

Ports	1
Data	1

- Reliability is less in the case of star topology because if hub breaks down then the entire system will shut.
- Cost is genuine (less than mesh).
- Security is high also low here because hub work in a broadcast way it send the message to all the nodes.
- it is point to point communication.

③ Bus Topology

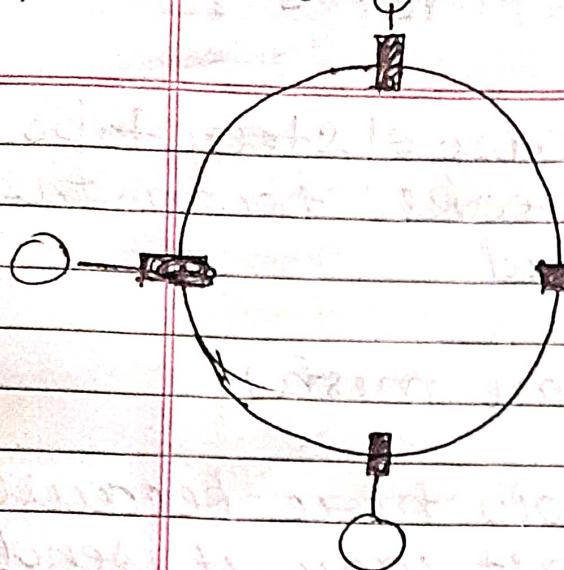


- Tap is a electrical device which connect node and backbone wire.
- number of cables :- $n + 1$
- number of ports is 1 for each node
- Reliable :- it is not reliability.
- Security :- it is not secure because cable cannot filter traffic.
- Cost :- it is cheap as mesh than
- Collision can occur max (n)

4. Ring Topology

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- Single device work as monitor who monitors the entire nodes
- number of cables = $n + 1$
- number of ports = 1
- It is not reliable
- Security also less
- Cost is relatively low

Manchester vs Differential Manchester

- The major responsibility of physical layer is to transmit the data.
- The data which comes from datalink layer is in the binary form.
- we can transmit the data to digital signal or analog so we need to encode the data from digital to analog or analog to digital or digital to digital.
- To convert digital to digital we used manchester encoding.

• Manchester

$1 \rightarrow$

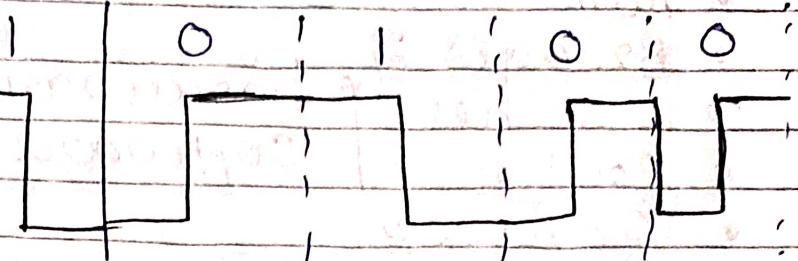
data \Rightarrow

1 0 1 0 0

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0 \rightarrow

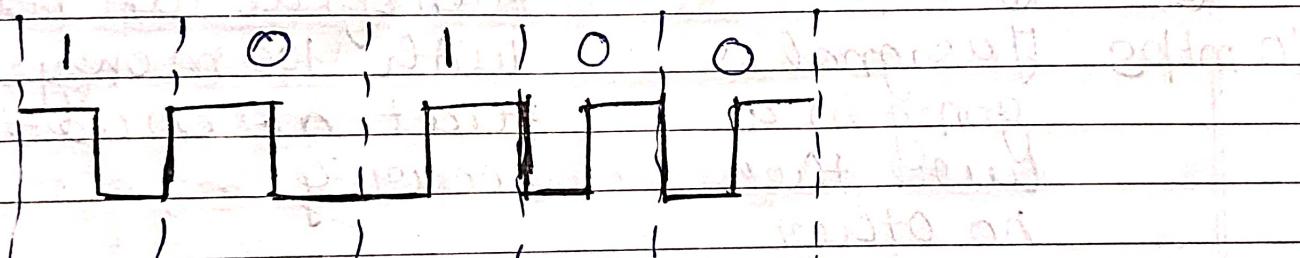


method of doctor thomas.

• Differential manchester.

0 \Rightarrow

1 \Rightarrow



- # Various Devices in Computer Networks.
- Cables
 - Repeaters } they are completely hardware
 - hub
 - Bridges } hardware as well as
 - Switches } software
 - Router
 - Gateway
 - IDS // Inusion detection System } Security
 - firewall } based on security
 - Modem // modulation/ demodulation
used to convert digital to analog or vice versa

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Types of Cables

1. Unshielded twisted pair cable :-

- 10 Base T → 100m If wire len is 100 m
then signal can transmit with 100 m only after flat attenuation occurs
- 10 mbps If a signal is going in a wire then no other signal can go there

• 100 Base T

2. Coaxial Cable

3. Fibre optical Cable → 100Base Fx ($\approx 2 \text{ km}$)

Attenuation :- Signal get low after a particular distance.

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Note:- If there are n devices on a wire then maximum collision is n.

Repeater:-

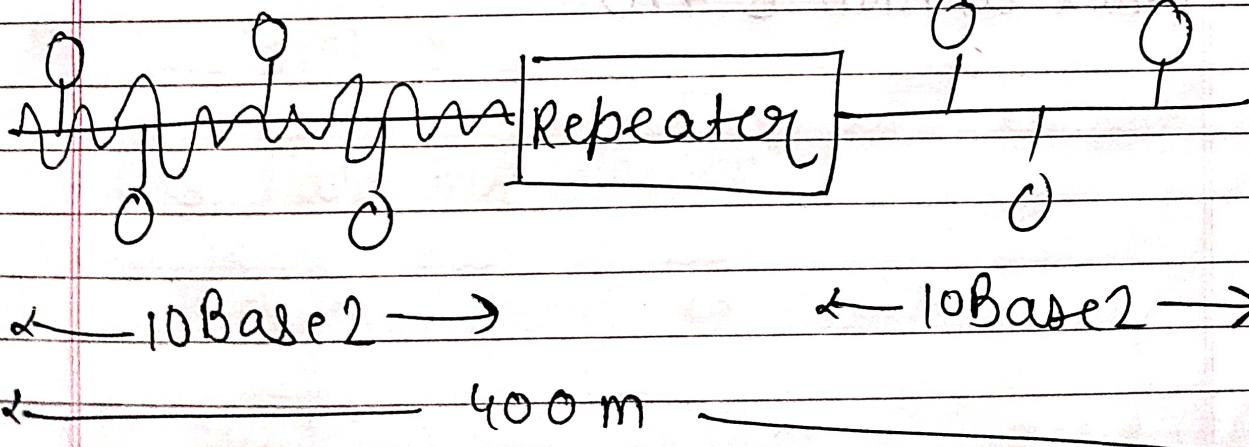
- It is purely a hardware, it work on physical layer only.

Q Why we should use repeater:-

- Let say we created a 200m LAN now if a signal move then it can transmit only upto 200m after that the attenuation occurs so to regenerate the signal we use repeater.
- So to regenerate the signal we use repeater.

Q Why we cannot use amplifier

- Because amplifier can regenerate it increase upto 2x or 4x but repeater just regenerate it.

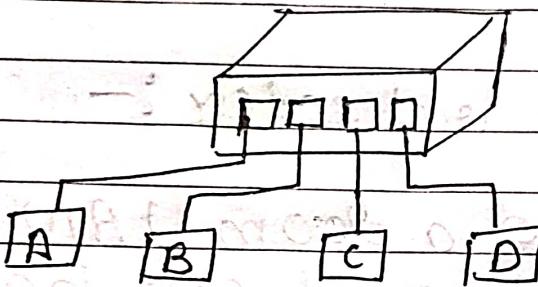


- it is a two port device
- it will forward the data
- No filtering

- Collision domain :- n

Hub :-

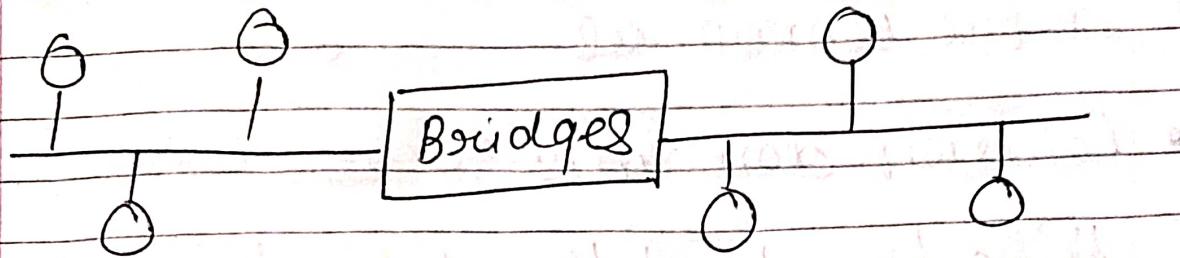
- it also work on only physical layer
- it is multi port Repeater



- Repeater will not tell anything if there is a fault in wire but this is the extra functionality of a hub because it is dedicated devices
- Hub will forward the data.
- No filtering
- Collision is also possible within hub (max collision is $\rightarrow n$)

Bridges:-

- Bridges are used to connect to 2 LAN. we can use hubs also connect 2 LAN but in bridges we can connect two different LAN



- it forward the message to other nodes.
- filtering if message is to be send to left of bridge only then also message will go the bridge then bridge will decide that it will forward or not
- it work in Datalink layer.
- there are two type of bridges
 - Static
 - dynamic
- Collision domain → there is no collision in the bridges because they store and forward ~~no~~ technique
- Bridges ^{use} data unit protocol to remove loop.

Switches →

- it is Datalink device
- it has ^{is} multiports ~~as~~ bridge
- in switches we connect different other

devices then switches are connected to router further

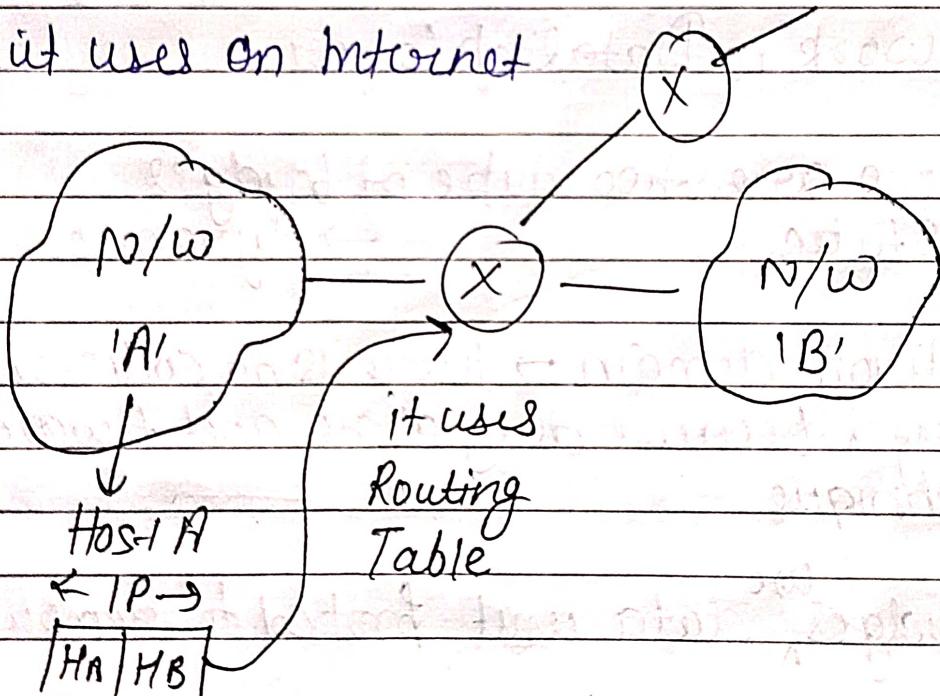
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- Full duplex links are here
- Traffic is minimal
- Collision domain is zero
- Hubs broadcast the data but switch can filter

Router:-

- it works on three layers \rightarrow physical, datalink, Network Layer
- it uses on Internet

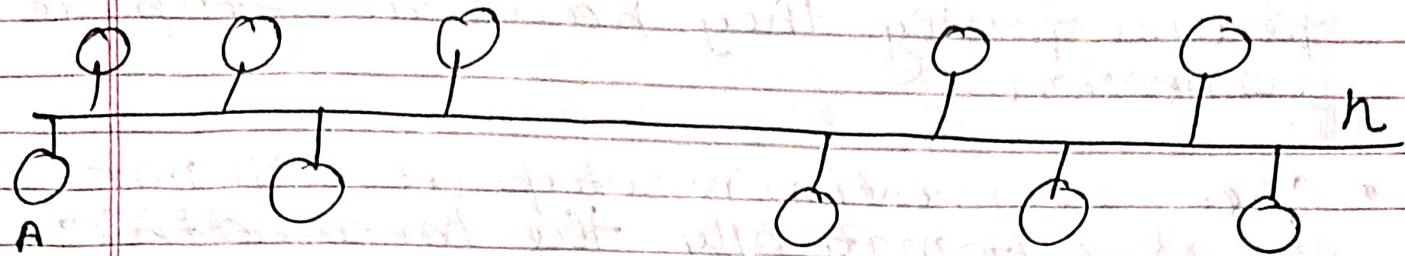


- Yes it forward the message
- It can filter the packets using its routing tables
- flooding :- If router get confused

then they can broadcast the message.
there is no collision because they use
store and forward protocol

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Collision Domain Vs Broadcast Domain



• Collision domain:-

Let say we want to send a packet to C and at the same time other nodes also shared then collision will occur. This collision. max collision $\rightarrow n$

• Broadcast domain:-

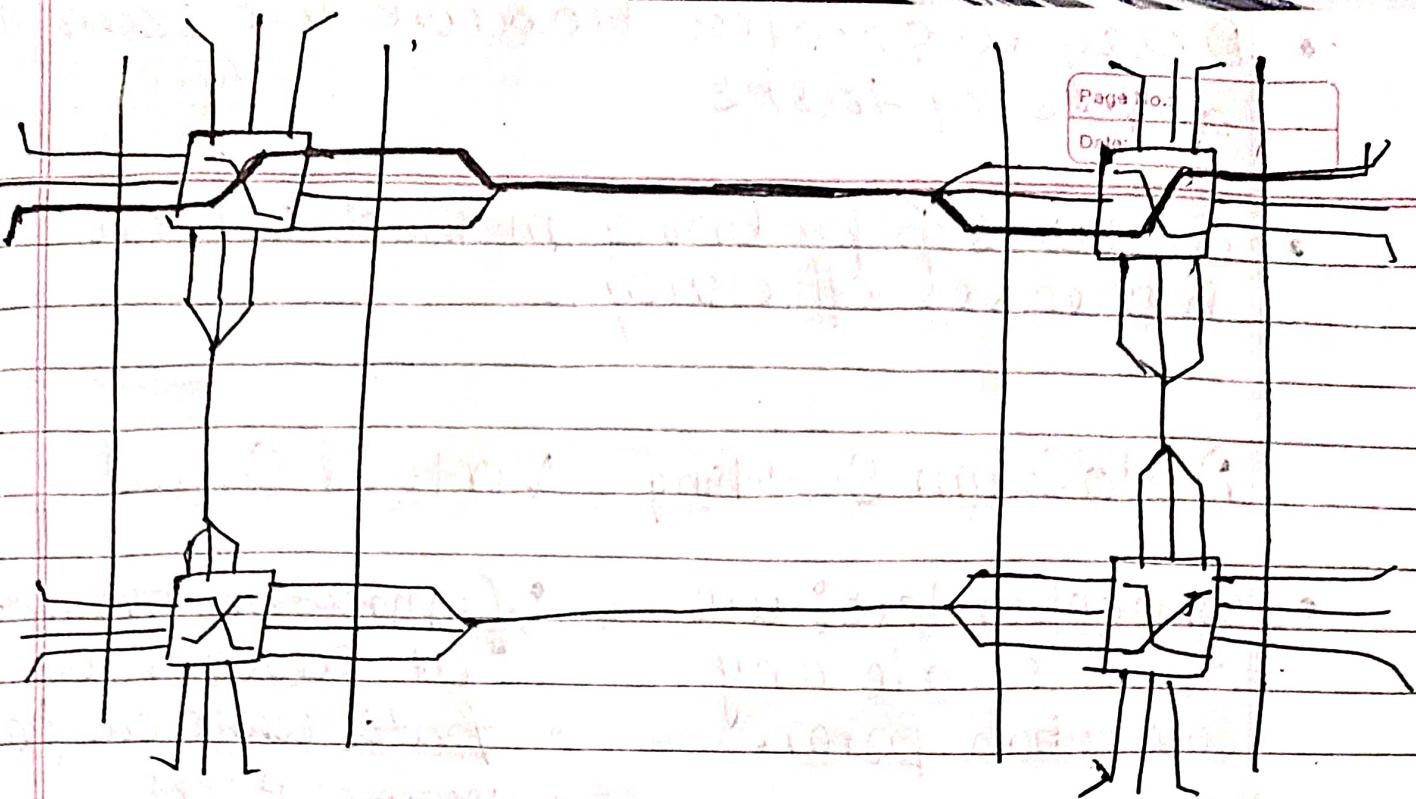
if A wants to send C then A will send to all the nodes. so max broadcast domain = n

Device name	Collision Domain	Broadcast domain
Repeater	No change	No change
Hub	No change	No change
Bridge	Reduce	No change
Switch	Reduce	No change
Router	Reduce	Reduce

Circuit Switching →

- It is developed for connecting in Telephone Exchanges.

- If one user wants to call the other person firstly they have to setup the connection
- Once a connection is setup it will not break automatically the bandwidth is reserved in this case.
- Even if none of them were choosing the data but they did not cut the phone or telephone network then there is a waste of bandwidth.
- It is Physical Layer.
- A dedicated path is created
- Contiguous flow
- No headers as data is not divided so headers are not required.
- Data will never go out of focus
- Efficiency loss
- Delays less



Packet Switching

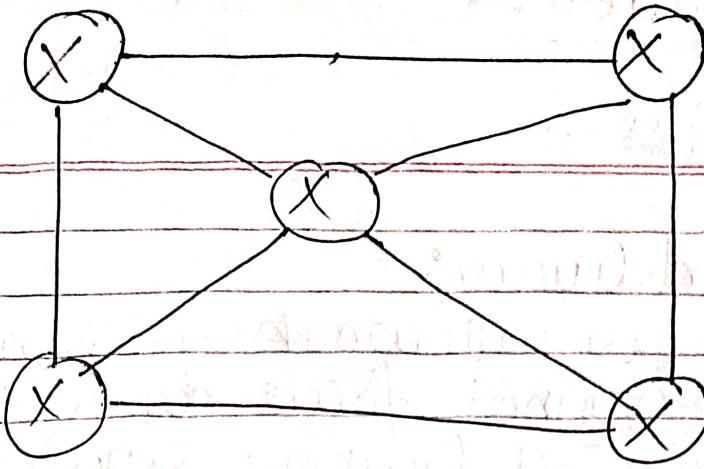
- We transmit the data here in the form of packets.
- we divide the contiguous data into packets then transmits those data
- it work on Datalink and Network layer
- There are two types of packet switching
 - ↳ Datagram switching
 - ↳ Virtual Circuit
- it use store and forward method.
- It uses routing table to know that which route it has to take.
- Efficiency is greater because it do not reserve the entire bandwidth

- Delay is greater because we have to do lots of tasks
- it uses pipelining method which increases efficiency

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DataGram Switching Virtual Circuit

- | | |
|--|--|
| • Connection less: we cannot create any connection prior. | • Connection oriented: it reserves the path while one packet routes itself |
| • No Reservation | • Reservation |
| • Out of order: routers may be different so out of order is possible | • Some order: because first packet already reserved |
| • High overhead: every packet must have header | • Less overhead: only one packet must have header other will follow them |
| • Packet loss increase | • Packet loss ↓ |
| • Used in Internet | X.25 ATM |



Message Switching.

- It is predecessor of Packet Switching.
- Store & forward
- Hop by Hop delivery

Circuit Switching



Message Switching



Packet Switching

Types of Casting →

- | • Unicasting | Broad Cast | Multicast |
|-------------------------------|------------------------------|-------------------------------|
| → One to One
communication | One to many
Communication | many to many
Communication |