

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. Hardware (Repeaters, hubs):-

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

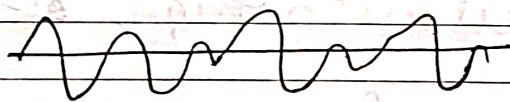
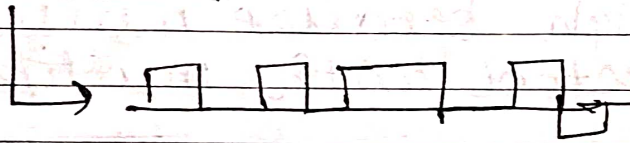


6. Encoding:-

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

101011010011



To datalink

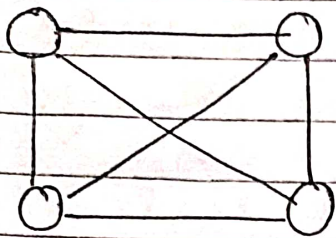
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Topology :-

It tells about the physical layout of computers in a network

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① Mesh topology :-



- Each node is connected with all the other nodes.

- Number of cables $\rightarrow \frac{n \times (n-1)}{2}$

- Number of ports :- $n-1$ where n is number of nodes.

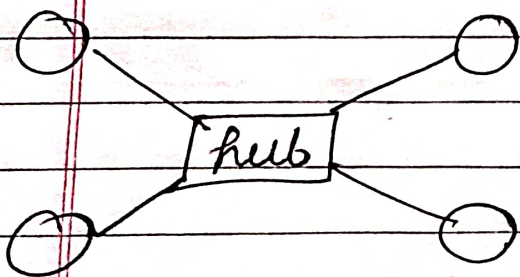
- Reliability :- if single failure occur then also data can be transmitted by other path.

- Cost is high because multiple devices are connected with multiple cables

- Security is also high.

- It supports point-to-point communication (dedicated)

② Star topology :-



- here is a centralised device

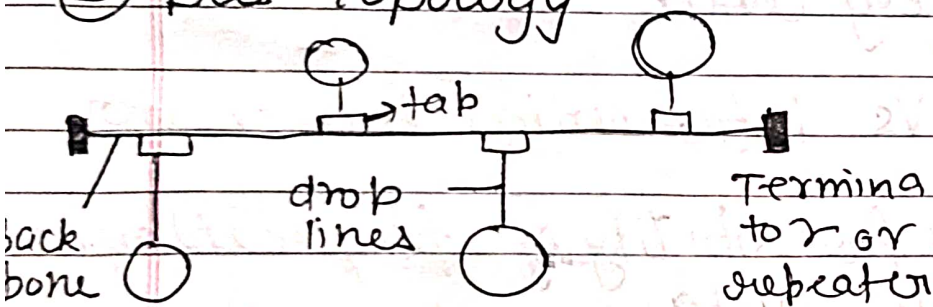
- All the nodes are connected to each other via hub (hub is a multi port repeater)

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

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- 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



• all the nodes are connected by a cable (thick ether net wire)

• 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

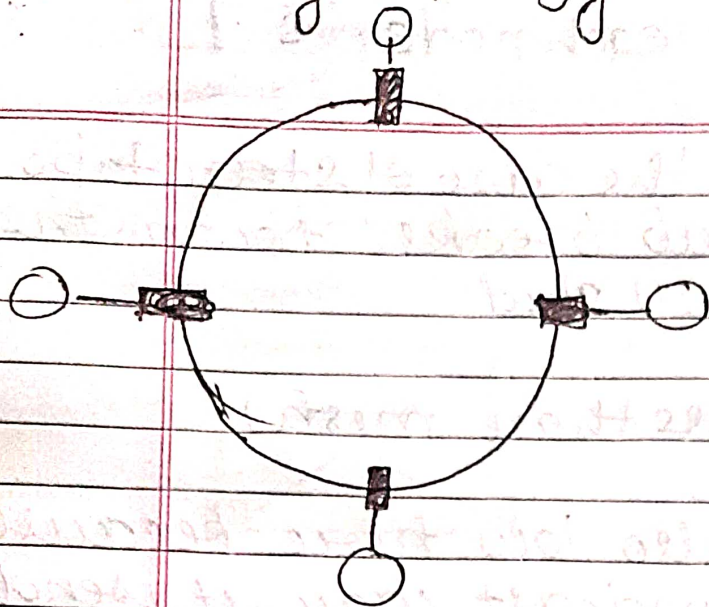
• Cost :- it is cheap as mesh than

• Collision can occur $\max(n)$

4. Ring Topology

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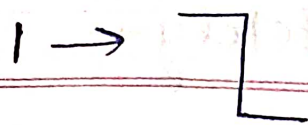


- Since one device works as monitor who monitors the entire nodes
- number of cables = $n+1$
- number of ports = 1
- It is not reliable
- Security also less
- Cost is relatively low

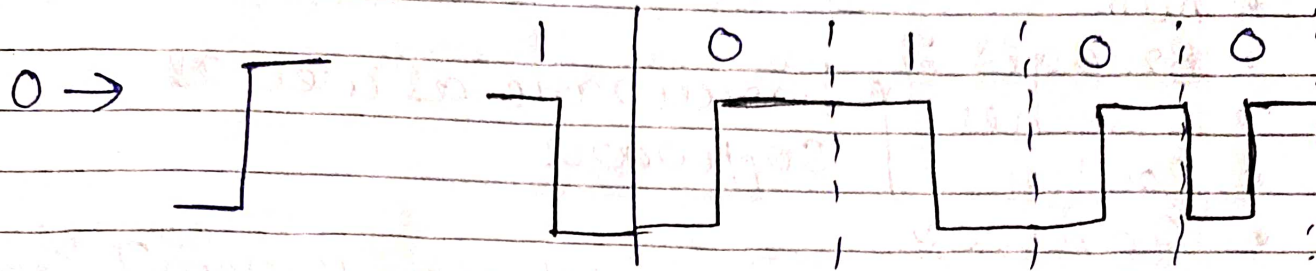
Manchester Vs Differential Manchester

- 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

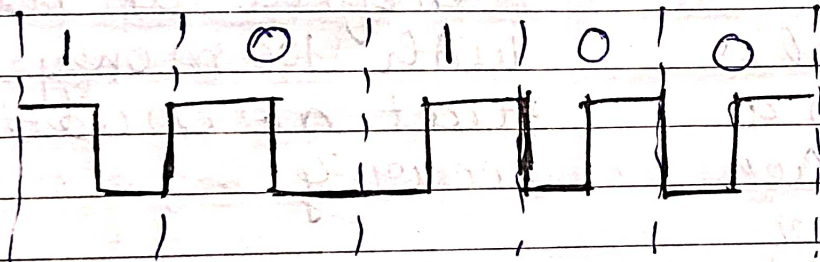


data ⇒
1 0 1 0 0



method of doctor thomas.

• Differential manchester.



Various Devices in Computer Networks.

- Cables
- Repeater
- hub
- Bridges
- Switches
- Router
- Gateway
- IDS // intrusion detection system
- Firewall
- Modem // modulation / demodulation used to convert digital to analog or vice versa

Types of Cables

1. Unshielded twisted pair cable :-

- 10 Base T → 100 m & if wire len is 100 m then signal can transmit with 100 m only after that attenuation occur
- 100 Base T

2. Coaxial Cable

- 10 Base 2
- 10 Base 5

3. Fibre optical Cable → 100 Base Fx (≈ 2 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.

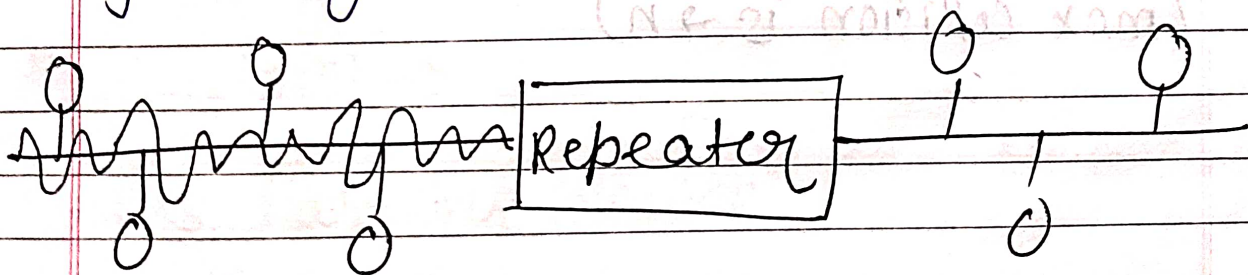
Q why we should use repeater :-

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

- So to regenerate the signal we use repeater.

Q why we cannot use amplifier

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



← 10Base2 →

← 10Base2 →

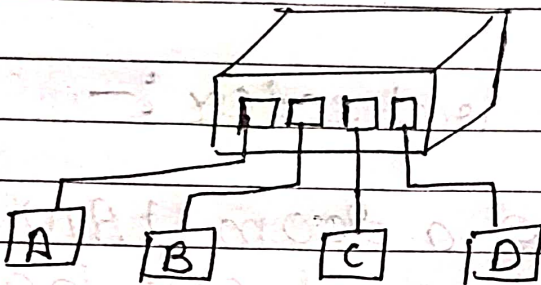
← 400m →

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

• Collision domain :- n

Hub :-

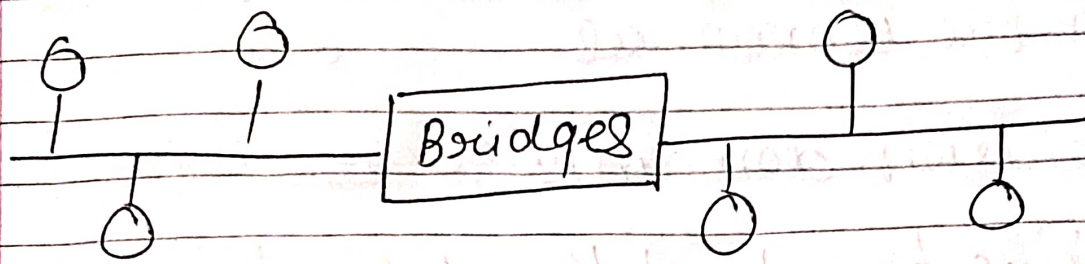
- it also work on only physical layer
- it is multiport Repeater



- 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 2 LAN. ² 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 ~~me~~ technique
- Bridges ^{use} data unit protocol to remove loop.

Switches →

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

devices then switches are connected to router further

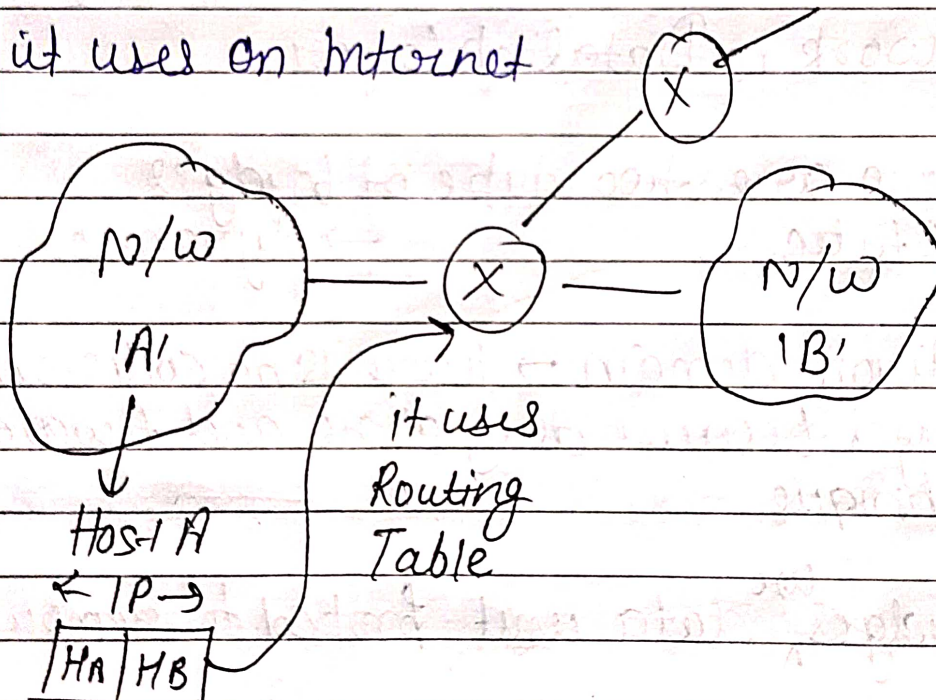
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- Full duplex links are here
- Traffic is minimal
- Collision domain is zero
- Hubs broadcast the data but switch can filter

Routers:-

- it works on three layers → physical, datalink, Network layer
- it uses on internet



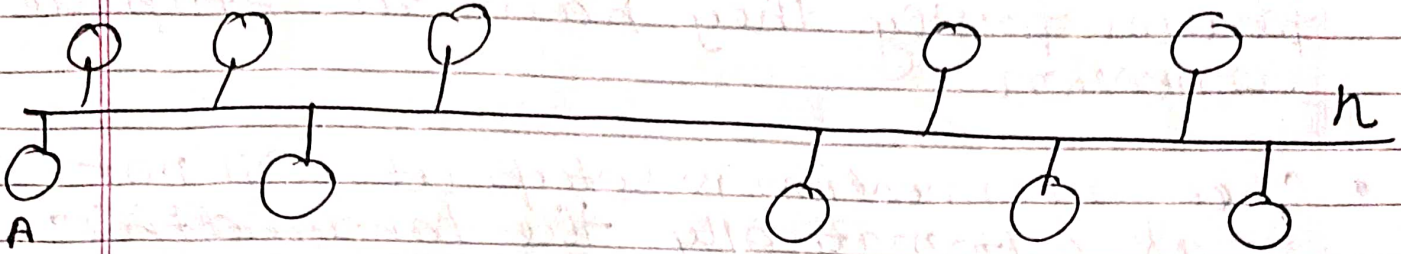
- Yes it forward the message
- It can filter the packets using its routing tables
- Flooding:- If router get confused

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~~ A 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

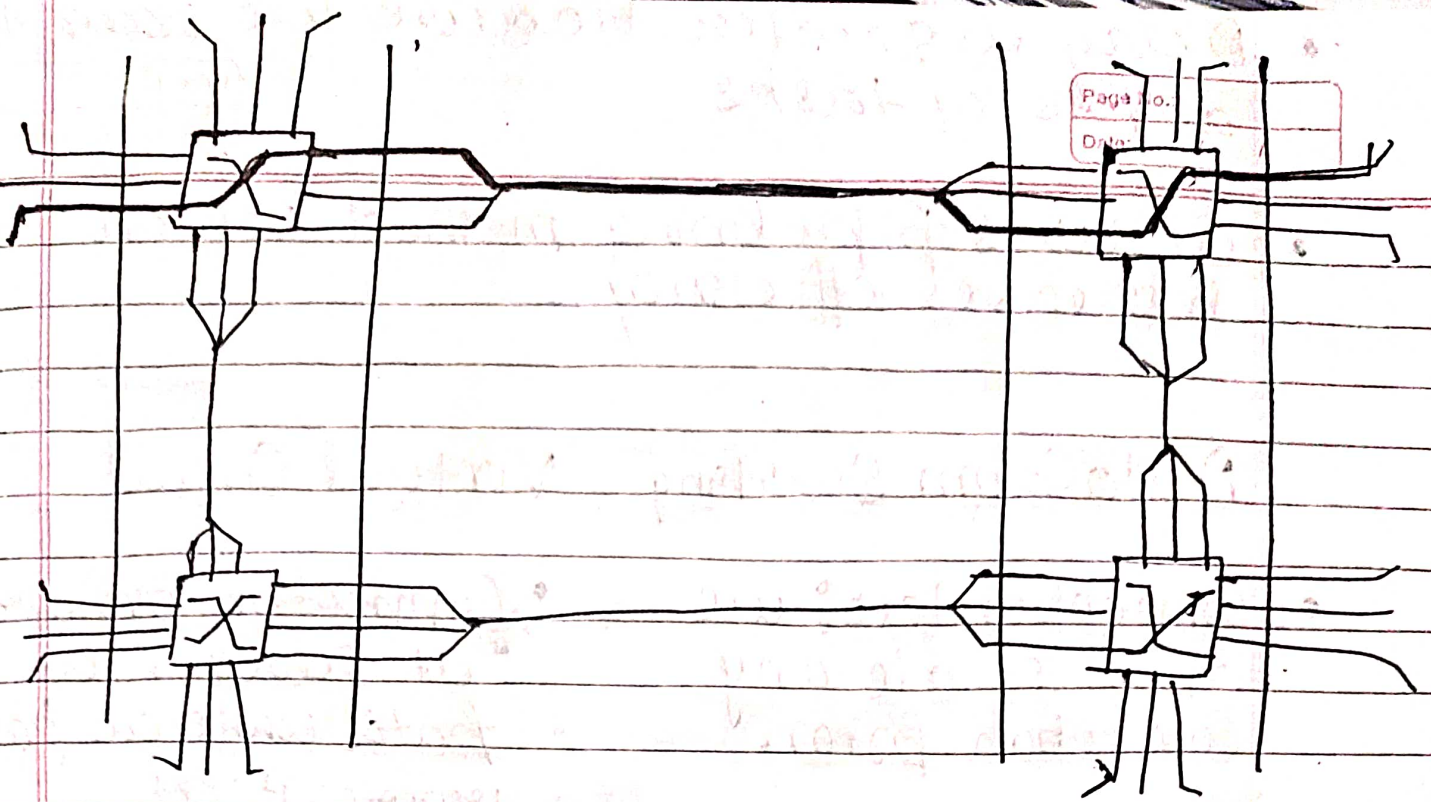
Device name	Collision Domain	Broadcast domain
Repeater	No change	no change
Hub	No change	No change
Bridge	Reduce	no change
Switch	Reduce	no change
Router	Reduce	Reduce

Circuit Switching →

- It is developed for connecting in Telephone Exchanges.

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- 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 sharing the data but they did not cut the phone or telephone network then there is a wastage 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 flow.
- Efficiency loss.
- Delays less.



Packet Switching

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

- Delay is greater because we have to do lots of tasks

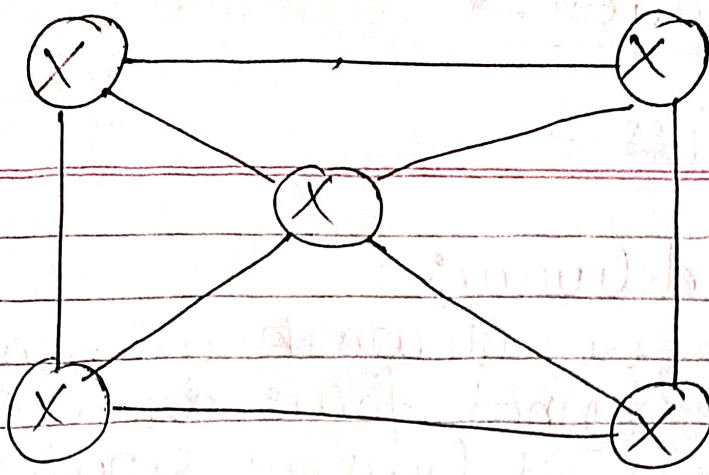
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- it uses pipelining method. which increases efficiency

DataGram Switching Virtual Circuit

- | | |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> • Connection-less: we do not create any connection prior. • No Reservation • Out of order: routes may be different so out of order is possible • High overhead: every packet must have header • Packet loss increase • Used in Internet | <ul style="list-style-type: none"> • Connection oriented: it reserves the path while one packet routes itself • Reservation • Same order: because first packet already reserved • Less overhead: only one packet must have header other will follow them • Packet loss ↓ • 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 →

- | | | |
|----------------------------|---------------------------|----------------------------|
| • Unicast | Broad Cast | Multicast |
| → One to One Communication | One to many Communication | many to many Communication |