2nd July.

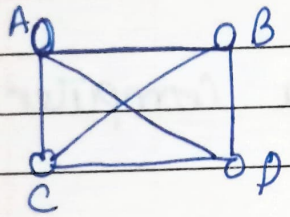
[TOPOLOGIES]

Topologies means how devices are connected with each other

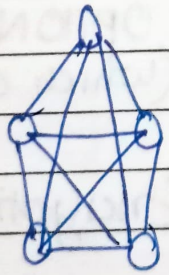
① Mesh ② Star ③ Bus ④ Ring

1.) [MESH]

All devices are connected with each other



Edges are Cables
Nodes are Devices



No of Cables = $\frac{n \times (n-1)}{2}$

No of PORTS = $n \times n-1$

* Mesh topology has HIGH RELIABILITY
* It has HIGH COST, HIGH COMPLEXITY as many ports & wires are used
* HIGH SECURITY, HIGH MAINTAINANCE
* POINT-to-POINT / dedicated CONNECTION

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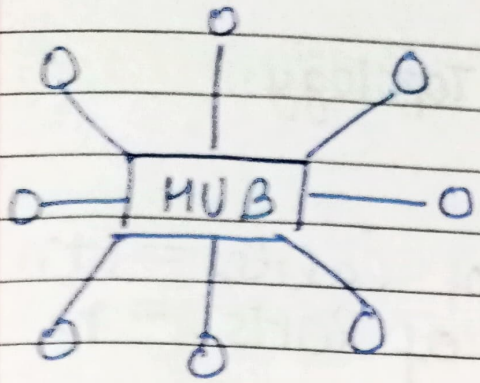
2) STAR



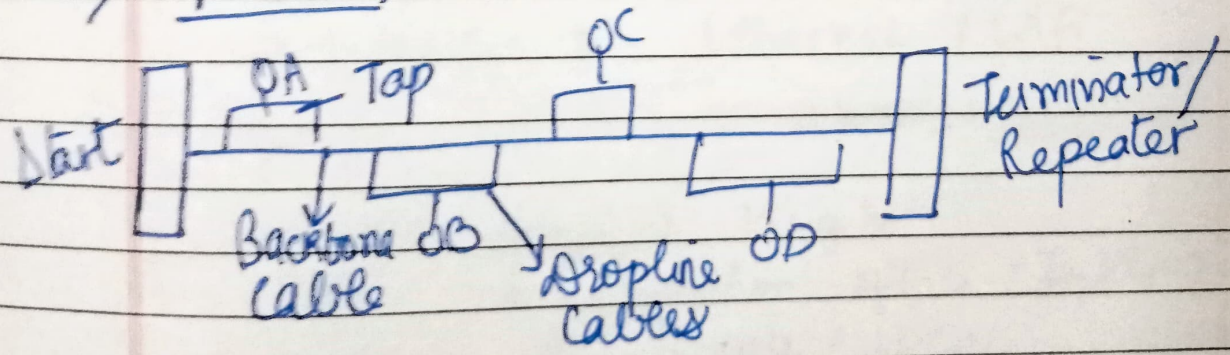
No of Cables = No of Devices

No of cables = n

No of ports = n

* RELIABILITY = Less
* COST = Less than Mesh
* SECURITY = Less
* MAINTAINANCE = Less than Mesh

3) BUS



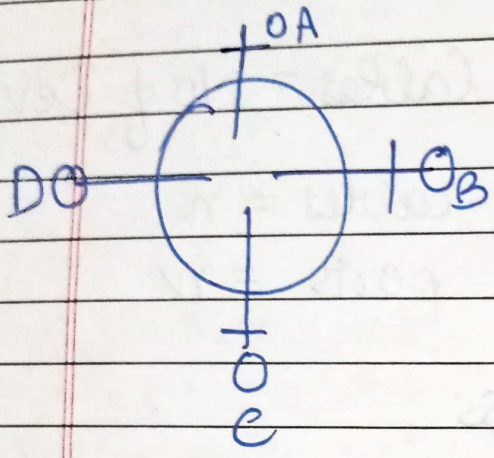
No of Cables = 1+n

No of Ports = n

* SECURITY = Less
* RELIABILITY = Less
* COST = Less

(4) RING

Join Ends of Bus Topology.



* No of Cables = 1+n
* No of Ports = n
* 2Way Communication
* Less colision than Bus Topology

Types of Computer Networks.

* PAN (PERSONAL AREA NETWORK)

1. Technology ⇒ Bluetooth, Infrared, Zigbee(IOT
2. Range ⇒ 1-100 metres
3. Transmission speed ⇒ Very High
4. Error Rate ⇒ Less
5. Cost ⇒ Less
6. Area ⇒ within room
7. Maintainance ⇒ Less
8. Ownership ⇒ Private, Local

* LAN (LOCAL AREA NETWORK)

1. Technology ⇒ Ethernet & Wifi
2. Range ⇒ upto 2kms
3. Transmission speed ⇒ High
4. Area ⇒ within office / building
5. Ownership ⇒ Private / LOCAL
6. Error Rate ⇒ less
7. Cost ⇒ More than PAN
8. Maintainice ⇒ Less but more than PA

* CAN (Campus Area Network)

1. Technology → Ethernet, Wifi
2. Range ⇒ 1-5 km
3. Transmission speed ⇒ less than PAN, LAN
4. Area ⇒ within University
5. Mauteinance → Moderate
6. Cost → Moderate
7. Error → more than PAN & LAN
8. Ownership → Private / Local

* MAN (Meteropolitan Area Network)

1. Technology ⇒ FDDI (Fiber), CDDI (Copper)
2. Range → 5 - 50 kms.
3. Tranission Speed ⇒ Average
4. Area → within city
5. Maintainance → High
6. Ownership → Private / local or Public global
7. Error Rate → High
8. Cost → High

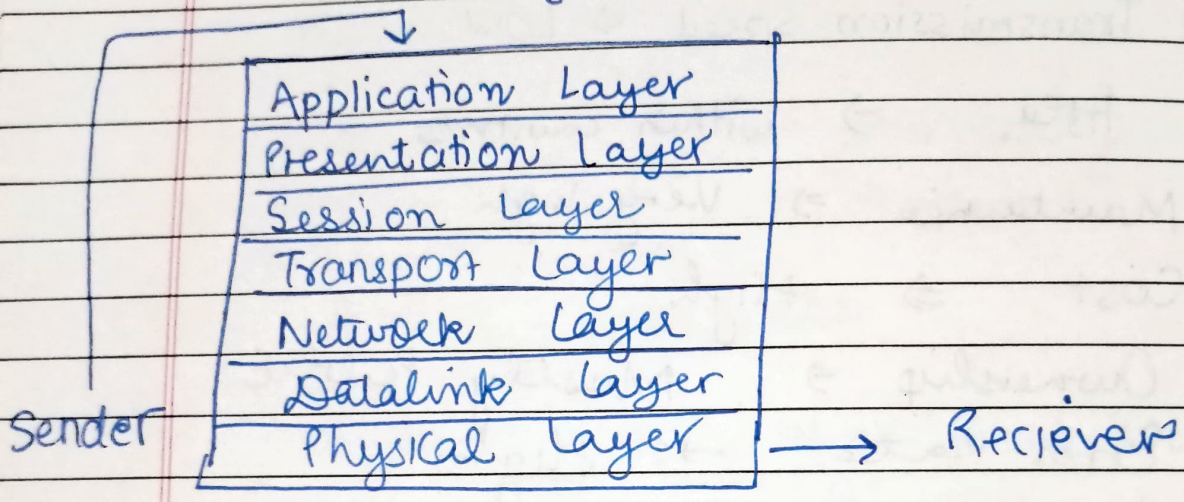
* WAN (WIDE AREA NETWORK)

1. Technology ⇒ Leased line, Dialup
2. Range ⇒ Above 50 kms
3. Transmission Speed ⇒ LOW
4. Area ⇒ within countries
5. Mountanie ⇒ Very high
6. Cost ⇒ High
7. Ownership ⇒ Mostly Public
8. Error Rate → High.

8 July 2025

OSI MODEL (Theoritical Model)

* Open System Interconnect
* It has 7 layers.



① Application layer

Web surfacing (Internet)
Chrome, Edge, Firefox, http, https
FTP, Smtp, Telnet

② Presentation Layer

Convert data recieved from app. layer into machine language

Functions
① Conversion
② Compression
③ Encryption (for data security)

3. Session Layer

Establish connection b/w Sender & Reciever

Functions / steps

1. Authentication : Username & password.
2. Authorization
3. Track of files : It keeps a track of files sended & recevied. Here track is in the form of Datapackets.

4. Transport Layer

Reliability of communication
ensure data message is transferred

Functions

1. **Segmentation**
transport layer converts data packets into segments
eg. Text / Image → Datapackets → Text, Image → Segments

2. **Flow Control**
Controls the amount of data transferred

3. **Error Unit**
There are various error detection / errow correction algo

9 July, 2025

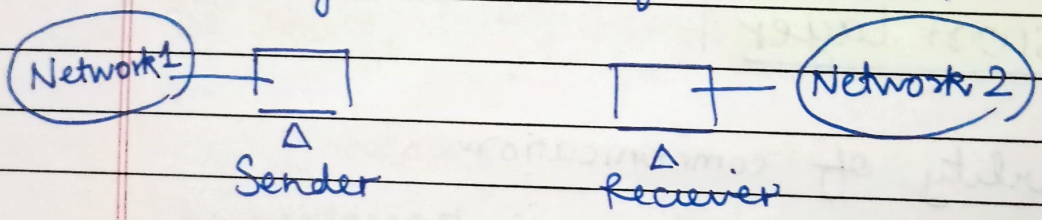
~ transport layer contd ~ [PROTOCOLS USED]

* TCP → Transfer Control Protocol
* UDP → User Datagram Protocol

UDP → ~~Not~~	TCP
(1) No feedback system	(1) Feedback system
(2) Connection ~~less~~	(2) Connection oriented
(3) Simple in nature	(3) Complex in nature

(3.) NETWORK LAYER

This layer consists of a network



Network layer decides the path of data transfer. It plays role in Routing

FUNCTIONS

(1) Logical Addressing OR ~~Mac Addressing~~ (2) Path Determination

Protocols

(1) OSPF → Open Shortest Path First
This helps in routing & deciding the shortest path for transfer

(2) BGP → Border Gateway Protocol

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(6.) DATALINK LAYER

→ Receive packets from network layer
packets → IP address

→ NIC is used in embedding
→ MAC Addressing is used in this layer

14 July.

(7.) PHYSICAL LAYER

Convert data recieved from data link layer into signals

This is the layer where actual communication takes place

binary → signals (electrical / light signals / Radio wave)

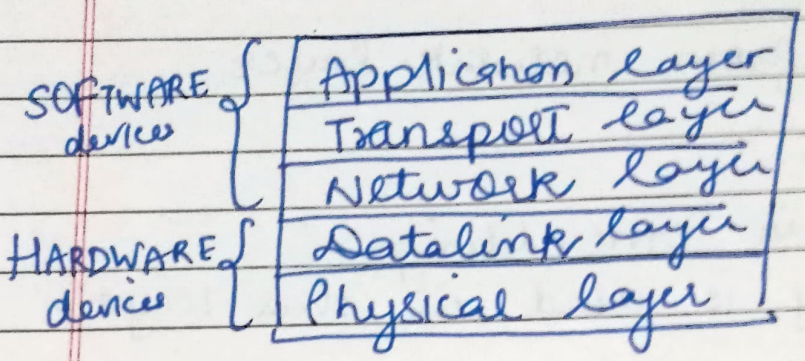
Eg. copper → electrical
optical → light signal
Air/vaccum → Radio

TCP/IP

* PROTOCOL USED here is Ethernet

14 July

TCP / IP (5 layer)



① Physical layer

binary code → signals

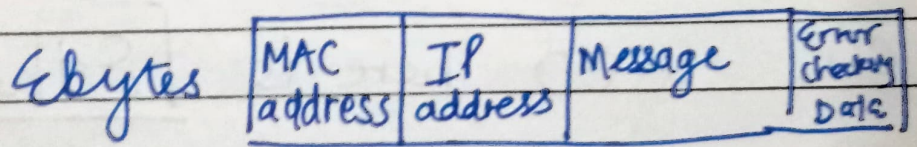
This is the layer where actual communication takes place

② Datalink layer.

MAC — Medium Access Control

LLC — Logical Link Control

Data Encapsulation



LLC — Flow Control

Error Control

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③ Network Layer

IP address	Message

i) Logical Addressing
ii) Routing - decides route of data packet
iii) Path Determination
↳ best path to transfer data

④ Transport Layer

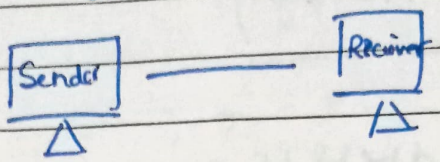
TCP
Transmission Control Protocol.
It ensures
① Connection Establishment
② Data Transfer
③ Connection Termination

UDP
User Datagram Protocol
Sequencing of Data not present

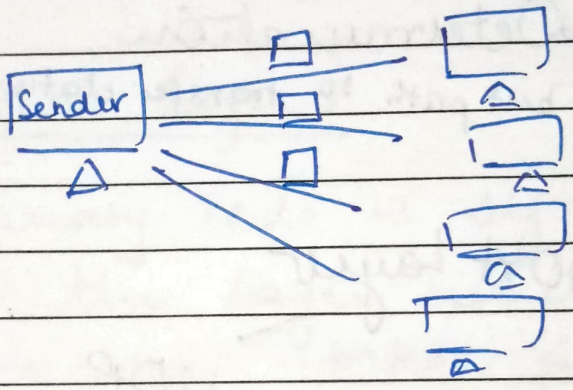
— Data transfer should be ① error free, ② ordered sequence, ③ Retransmis
④ Duplicate Data packets ⑤ Congestion Throttling

15 July

✡ Unicast : One-to-One



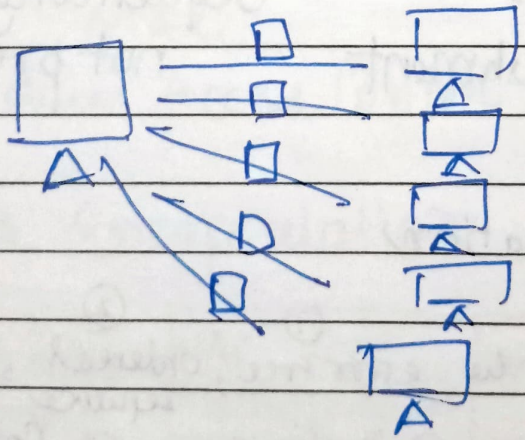
✡ Multicast : One-to-Many.



Here data transfer is to many (not all)

✡ Broadcast : One-to-all

Data tranfer will be to all



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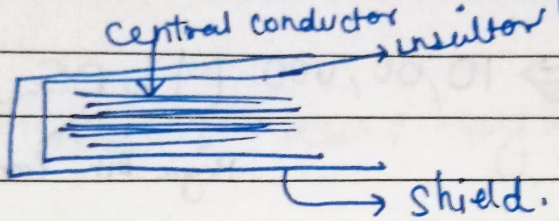
Types of Cables

① Co axial - cables

It is a type of copper cable built with a Metal shield

Used in cable tv companies / cables at home



② Twisted Pair Cables

Cable used particularly for ethernet connecti
It consists of insulated copper wires that are twisted together

Types
- UTP — Unshielded Twisted pair
- STP — Shielded Twisted pair

③ Fibre Optic Cable

These cables used for long distance & high performance

thin glass / plastic cables.

Ethernet

It is a widely used Networking technology used in (LAN) areas.

It is a wired technology.

It belongs to tech. standard IEEE 802.3

10 ⟺ 10,00,000 Mbps

Mega Bit per second

(Evolution of Ethernet)

Standard ethernet	Fast	Gigabit	10-Gigabit
10Mbps	100Mbps	1Gbps	10Gbps

✡ Ethernet Frame Format

64-1518 bytes

7BYTE	1BYTE	6BYTE	6BYTE	2Byte	46-1500	4Byte
Preamble	Start Frame Deniliter	~~Destination~~ Address	Source Address (MAC)	length	Actual Data / Padding	Frame Check Sequence (CRC)

14 Byte
Ethernet Header

Significance

✡ Preamble & SFD ensure Reliable communication & used for synchronization

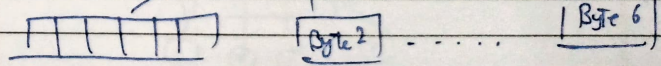
✡ Minimum Frame length = 512 bits or 64 Bytes

Maximum Frame length = 12,144 bits or 1518 bytes

✡ CRC checks Redundancy & controls error

Ethernet Address
↓
MAC Address
6 Bytes → 48 bits

Eg. 06:01:02:1e:4B



Fast Ethernet	Gigabit Ethernet
① 1995	① 1999
② Speed is 100 Mbps	② 1 Gbps
③ defined in IEEE 802.3U	③ IEEE 802.3z 802.3 ab
④ Cables used 100 Base T4 (4 Twisted pair) 100 Base TX (2 cables) 100 base FX (fibre optic)	④ Cables used 1000 Base SX · Short Wavelength fibre optic cable 1000Base LX Long Wavelength fibre optic 1000 Base T Twisted pair cable

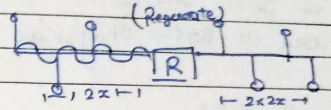
16 July

DEVICES IN COMPUTER NETWORKS

(1) Repeaters (2) Hubs (3) Switches (4) Bridges (5) Router

1 REPEATER

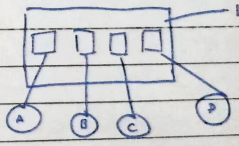
2 port devices, works in physical layer



→ No filtering
→ Collision can be there
→ Maximum collision = n (no. of devices) on both sides
→ BUS TOPOLOGY

2 HUBS

→ Used in Physical Layer
→ It is a Multiport Device



→ Forwarding
→ No filtering
→ Collision can occur in
→ Hubs used in STAR TOPOLOGY.

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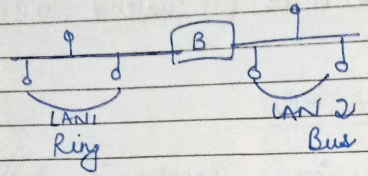
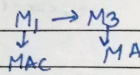
(3.) BRIDGES



→ It is a 2 port Device
→ It is used in Both Physical & Datalink Layer



→ filtering of message
→ less collision as compared to repeaters & hubs.

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Questions.

Q1. Which of the following is not a function of Network Layer

(a) Logical Addressing (c) Flow Control
(b) Routing (d) Error detection

Q2. Which of the following is connectionless protocol

(a) TCP (b) UDP (c) HTTP (d) FTP

Q3. Which of the following is a characteristic for star topology?

(a) All device connected to single cable
(b) Each device connected to every other dev
(c) Central device managing comm
(d) less fault tolerance.

Q4. Which of the following is not a network edge
(a) Smartphone (b) Server (c) Switch (d) PC

Q5. Which topology needs multipoint comm
(a) Star (b) Bus (c) Ring (d) Mesh

22 July.

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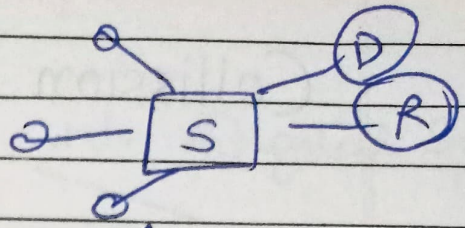
After bridges continued

4. SWITCHES



→ It is used in physical layer & data link layer

→ Multiport bridge

→ We can use switch to connect with Routers

→ Less Collision

→ It sends message only to Destination

→ No Broad casting means filtering

→ It is full Duplex / Bidirectional A ⇌

5. ROUTERS

→ Connect different networks

→ Used in Physical, Datalink, Network layer

→ It keeps info of both MAC address & IP address

→ Controlled with Software

→ It Provides Filtering

→ less / Minimum Collision (Least)

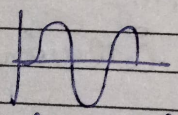
Collission Domain Vs Broadcast Domain

Repeater	No change	No change
Hubs	No Change	No change
Bridges	Reduce	No change
Switch	Reduce	Reduce
Router	Reduce	Reduce

Physical Layer.

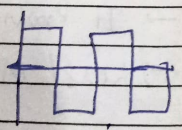
DDL → send → Signals

① Periodic (Analog)
② Floating value
③ Values cant be easily differentiable
④ Continous values

→ 

→ In case of Regeneration noise can be introduced
→ More error

② Digital (Non Periodic)
② Discrete values
③ Value can be differentiable
④ ~~Discrete values~~

→ 

→ NO noise
→ Less Error

23 July.

DATA ENCODING.

Converting Binary Data into Digital Signals

UNIPOLAR
(Single voltage other than 0)
(+A) and (0)
Return to zero (RZ)
Not Return To Zero (NRZ)

Unipolar NRZ
Each 0 → Off Pulse
Each 1 → On pulse

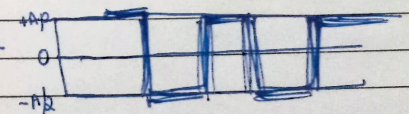
Unipolar RZ
Each 0 → Off pulse
Each 1 → On pulse
Each time → T_b.
bit duration

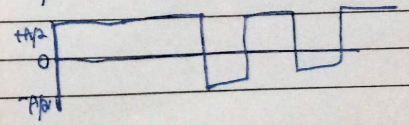
POLAR
Two voltage other than 0
$+\frac{A}{2}, -\frac{A}{2}, 0$
RZ | NRZ | Manchester | differential manchester

Polar RZ
$+\frac{A}{2}$ logic 1
$-\frac{A}{2}$ logic 0
Bit time $\frac{T_b}{2}$

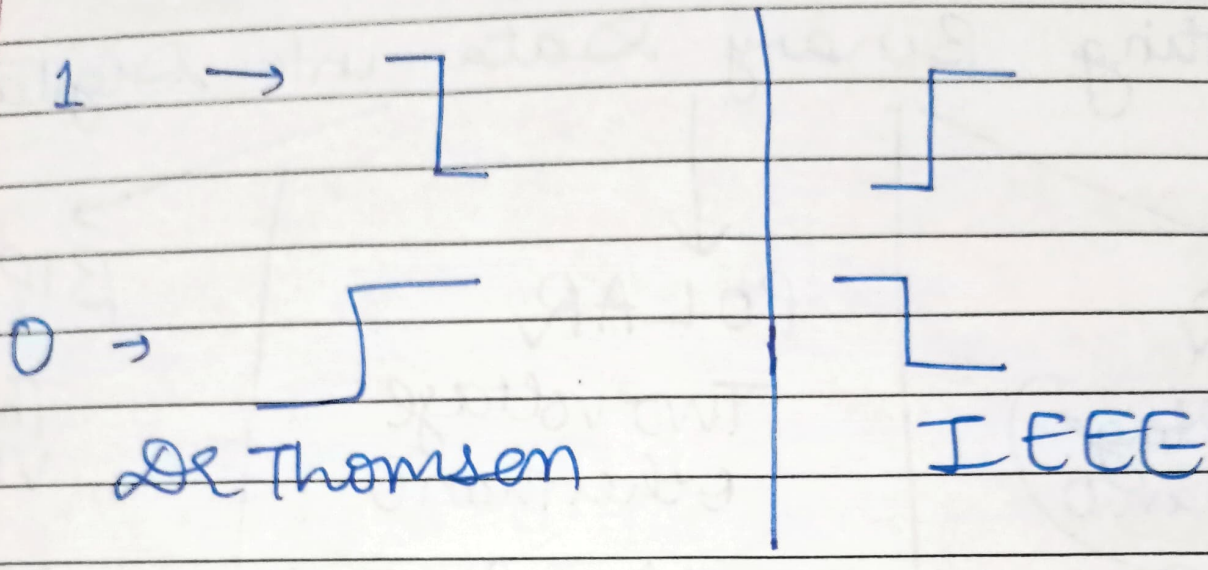
BIPOLAR
Three voltage
+A, -A, 0

Ques 1 1 0 1 0 1

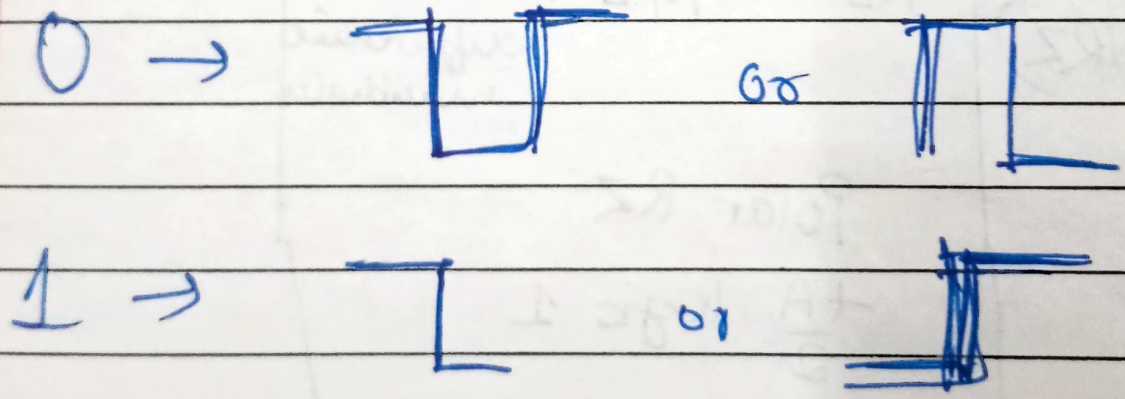
Polar NRZ 

Unipolar NRZ 

Manchester Encoding



Differential Manchester



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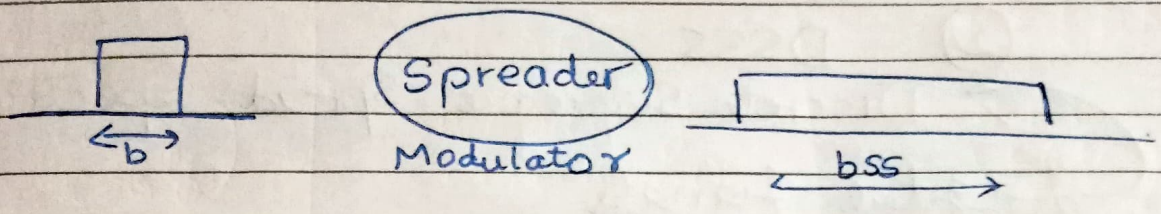
SPREAD SPECTRUM.

It is the phenomena of increasing the bandwidth of a signal



(1) B.W Ulitilization

Multiplexing

- FDM — Frequency Device Multiplex
- TDM — Time
- CDM — Code
- WDM — Wide

(2) Multiple Access

- FDMA (Freq)
- TDMA (Time)
- CDMA (Code)
- SDMA (Space)
- IDMA (Interval)

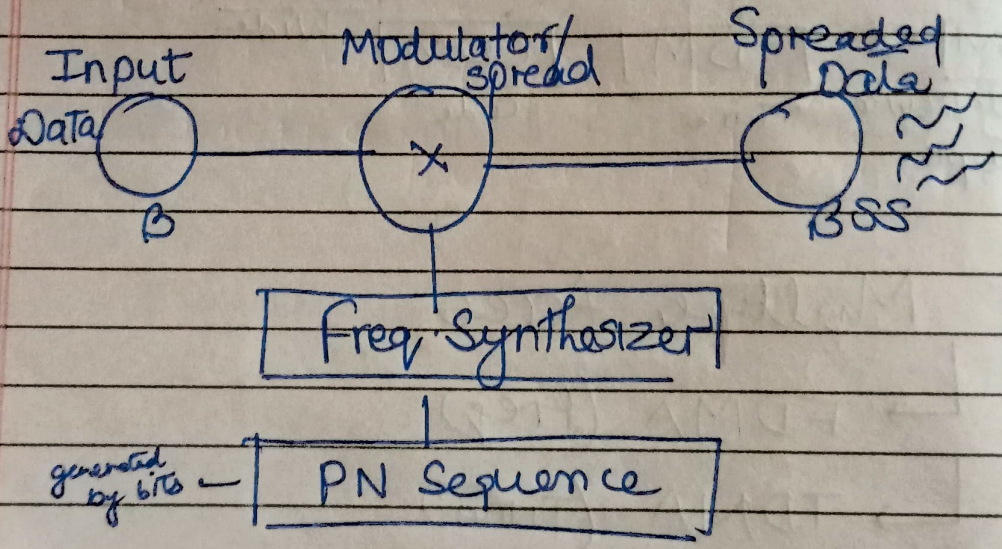
Analog Signals

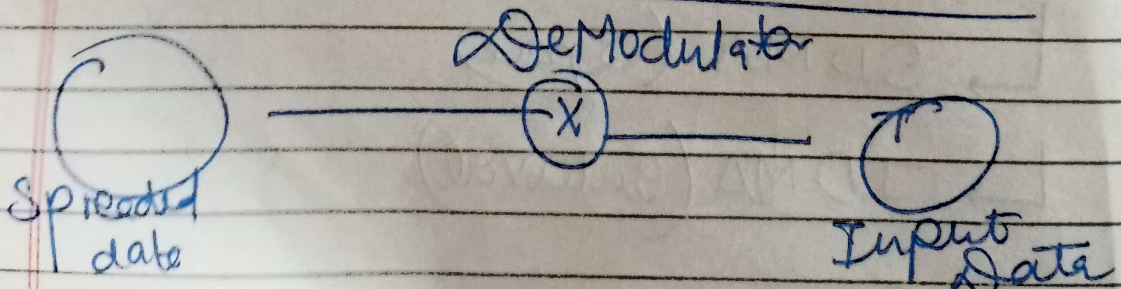
① FHSS
Frequency Hopping Spread Spectrum

② DSSS
Discrete Sequence Spread Spectrum

Digital Signals

Block Diagram of Spread Spectrum





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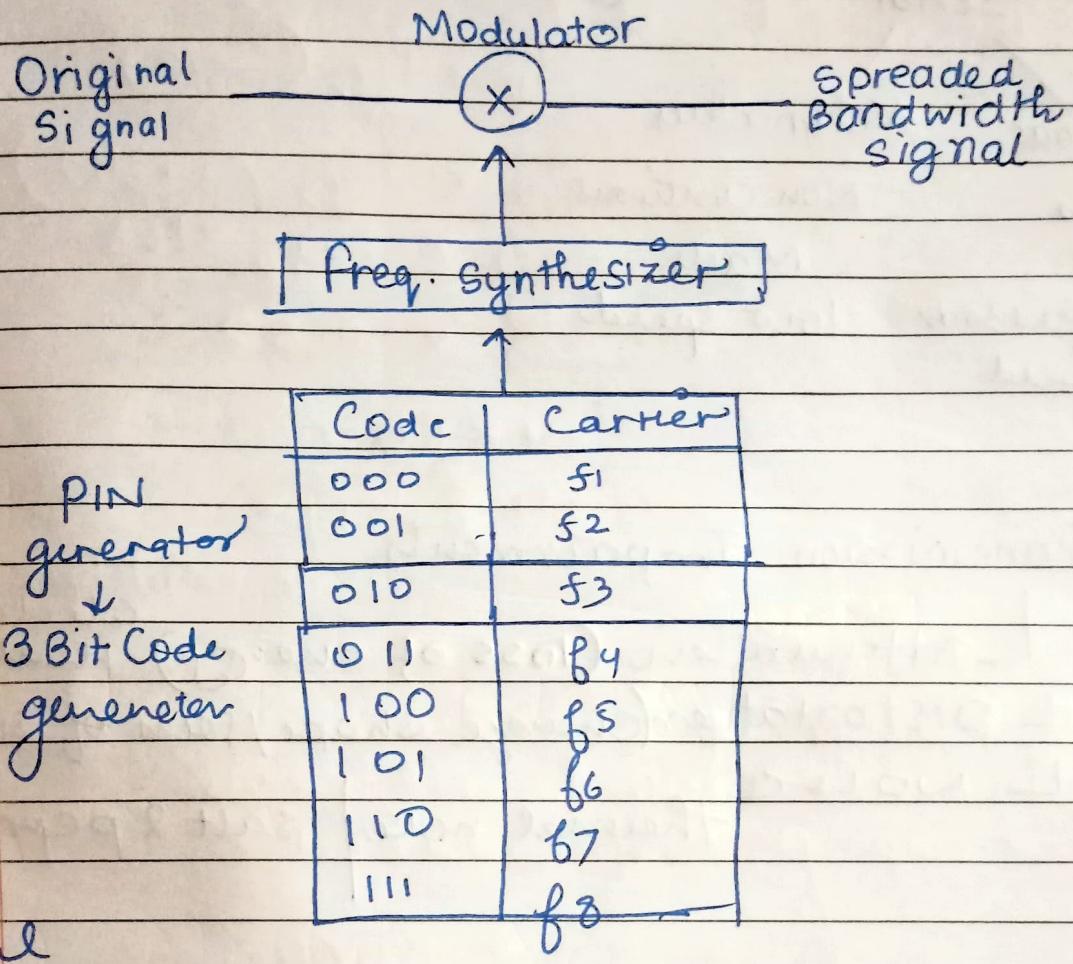
FHSS



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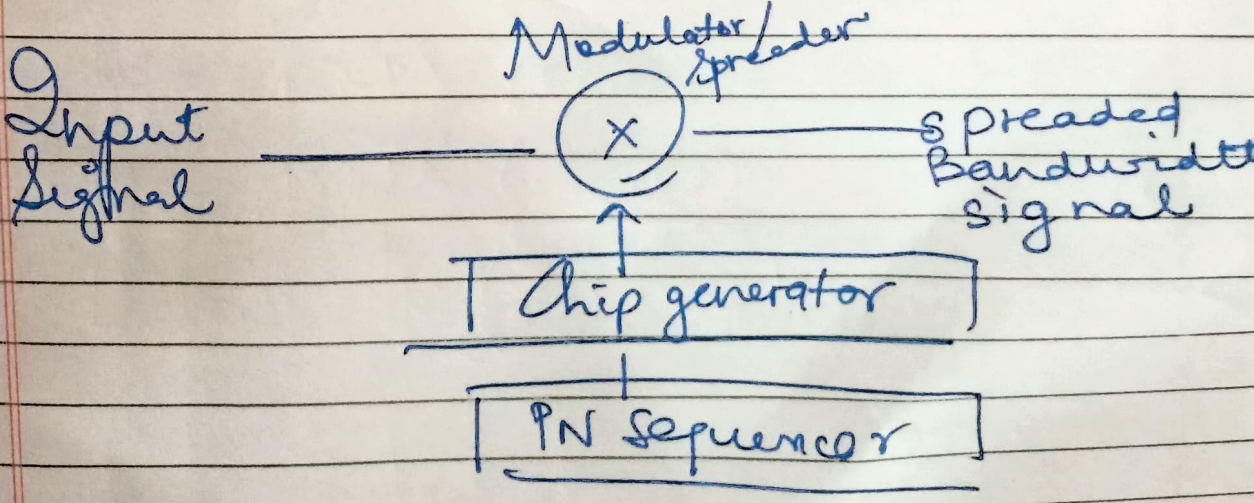
DSSS – Direct Sequence Spread spect

Block Diagram of DSSS



Communication

Serial — Parallel

Serial: Synchronous, Asynchronous

Synchronous: Continuous phone call; Wait for feedback; High speed

Asynchronous: Non continuous; Mails; low speed

Transmission Impairments

- Attenuation (loss of energy) — Electrical signals → Heat
- Distortation (change shape/form of signals)
- Noise — Thermal noise | salt & pepper noise

30 Jul

Nyquist and Shannon Formulas.

Data Rate Limits → How fast data can be transferred

Nyquist	Shannon
↓	↓
Noiseless	Noisy Channel
Bit Rate = 2 × Bandwidth × $\log_2(L)$	Bit Rate = Bandwidth × $\log_2(1+SNR)$
L → no of levels	

Q. For a noiseless channel, bit rate = 265 Kbps, bandwidth = 20 KHz find no of levels.

Bit Rate = $2 \times BW \times \log_2 L$

265 Kbps = $2 \times 20\,KHz \times \log_2 L$

$265 \times 1000 = 2 \times 20 \times 1000 \times \log_2 L$

$L = 98.7 \approx 100$ levels

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Q2. Suppose B.W = 3000 Hz SNR = 3162
find capacity of medium?

Capacity = $BW \times \log_2(1+SNR)$

$= 3000 \times \log_2(1+3162)$

$= 3000 \times \log_2 3163$

$= 3000 \times 11.62$

$= 34860$ bps

$= 34.8$ Kbps

≈ 35 Kbps.

Q3. If Range of spectrum is between 3 MHz and 4 MHz. SNR = 24db
Find capacity of channel?

Sol. Capacity = $BW \times \log(1+SNR)$

$= 1 \times 10^6$

B.W = 4-3 = 1

K = 10^3

M = 10^6

G = 10^9