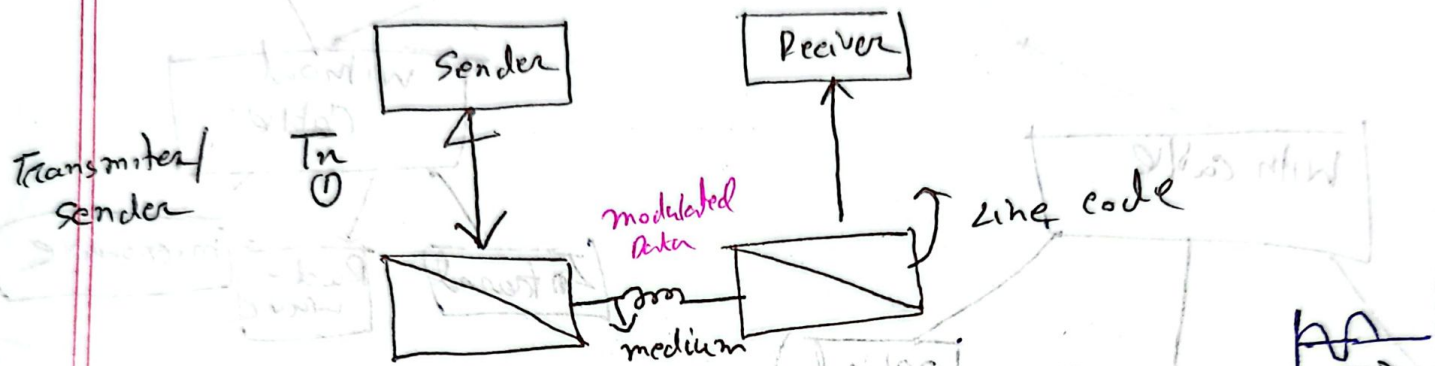
01-09-24

* Data can be anything [audio, video, text]
* কোন Generation এ কোন Network কেমন?



Binary Bit → Signal (electronic signal / analog)

Line code
- Rz
- NRz
- Polar
- Bipolar
- Vn Polar
- MAB

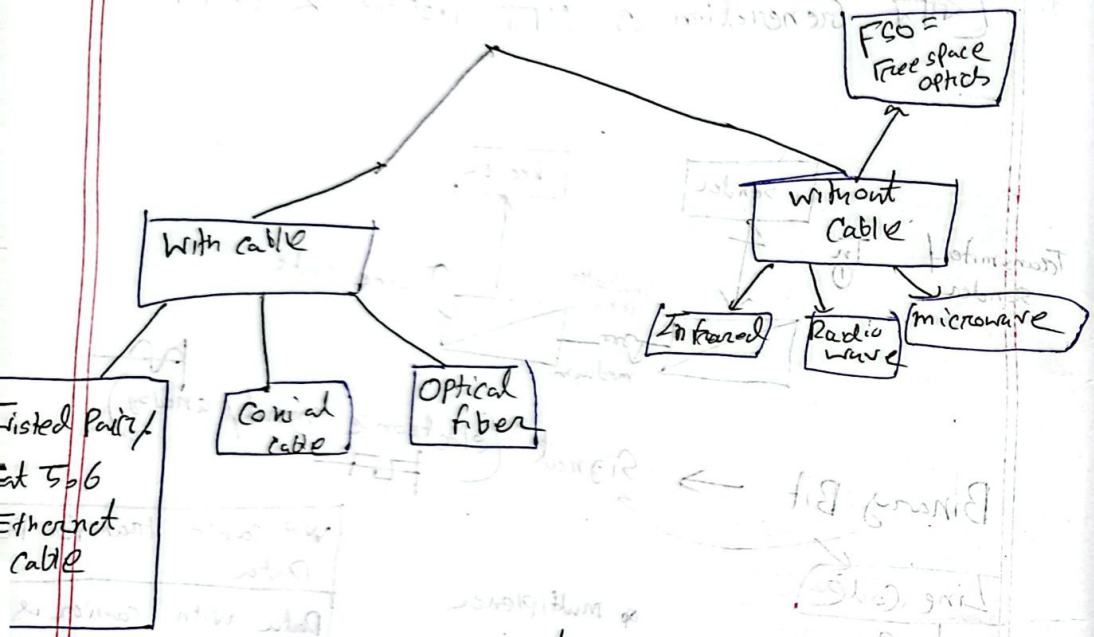
* multiplexer
* Demultiplexer.

We can't transfer Ra Data
Data with carrier is Modulated Data
Receiver এ যেটা Demu Demultiplexer

* WDM → Web length Division multiplexer.
  - Cwpm
  - Dwpm

05.09.24

Transmission media:

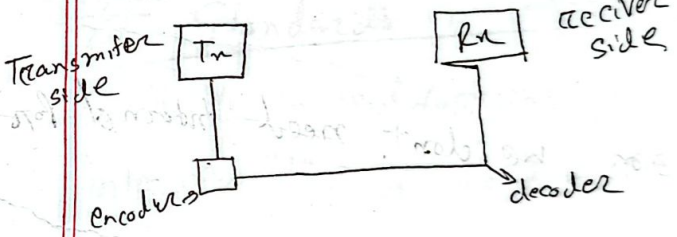


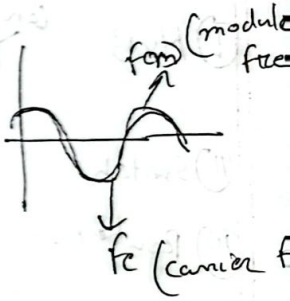
In Datacom system model data travels sender to receiver. Between sender to receiver there is a physical link to any data. its known as transmission media. Data can be in any form, text, image numbers. But in transmission media it converted into electromagnetic signal.

2) Analog Data:

Analog to Analog:

Analog to digital:

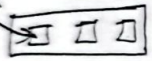




Digital to Analog:

Moving Bits through Signal:

For networking we need 3 devices:

(i) Hubs 

(ii) Switch

(iii) Router.

For specific region we don't need internet for communicate.

a) Simplex
b) Half - duplex
c) Full - duplex

Network is a set of device often referred as nodes, connected by link (communication channel

Important for a network:

(i) Performance.

(ii) Reliability.

(iii) Security.

Standards in Networking:

Standards in networking ensures interconnection interoperability of hardware & software compone

(i) De Facto standard: standards that have b traditionally used and mean by fact or by c These standards are not approved by any or body but are adopted widespread use.

(2) De Jure Standards:

(i) by law or regulation,

(ii) Standards are legislated and approved by an body that is officially recognised

Prev Mid 3m

The word data refers to information presented in whatever form is agreed upon by the parties creating & using the data.

A data Communication System has 5 components. Discuss them with figure.

DataCom: In datacom we transfer information in analog or digital form between 2 parties over a distance. network via some transmission media

The datacom system typically consist of several compo that work together to facilate the transmission & reception of data.

1) Message: It's the actual data/information that needs to be transmitted from a source to dest It could include text, audio, video or any other form of digital to analog data that being exch between communicating entities.

2) **Sender (transmitter):** any device that is capable of sending messages. it's responsible for encoding the message into a suitable format for transmission & initiating the process of sending data across the channel. it also performs error check, encryption.

3) **Receiver :** The receiver is the device or system that recive transmitted message. it's responsible for decoding message, delivering it. can also perform task such as error detection & correction. It plays crucial role in interpreting the info send by sender.

4) **Transmission medium:** It's the physical or logical path by which message travels from sender to reciver. it can be both wired or wireless. Physical link is known as transmission media or commu channel.

(before diagram)

5) **Protocol:** A set of rules & convention that govern format & behaivior of communication between m Sender & reciver. it defines how data is forma transmitted & recivere.

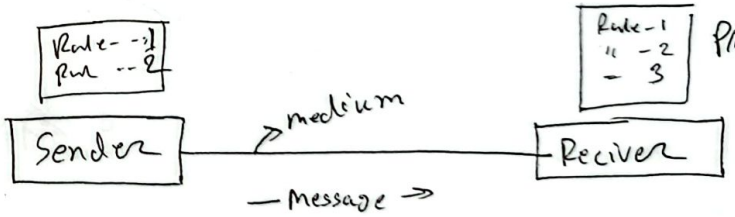


Fig: Components of data Com system

Data Flow (Simplex, Half-duplex, Full-duplex):

Simplex: Only one devices sends the data & other only one recives it.

- Direction of communication: Unidirectional (sends only)

- Performance:

  Advantages: Simplicity & lower latency for transmitting side

  Disadvantages: lack of interactivity, limited feedback & less flexiblity.

- Example:

2) Half-Duplex: Both station can transmit as well as receive but not at same time

- Direction of communication: Bidirectional

- Performance:
  - (i) Advantages: Allow 2 way communication but not simultaneously.
  - (ii) Disadvantages: Potential for delay because each device had to wait

Example:

3) Full-Duplex: Both station can transmit & receive at the same time,

- Bidirectional (simultaneously)

- (i) Advantages: Interactive & real-time co
  Supports dynamic exchange of information
- (ii) Disadvantages: Complexity may introduce latency. Require more sophisticated Protoco

Example:

LAN, MAN, WAN Comparisson.

WAN	LAN	MAN
Wide area network	i) Local area network	i) Metropolitian area network
Typically cover large area like state or country	Connects with small or specific area	Cover larger area than Lan but smaller than lan. like city
For data transfer low bandwith	High bandwith	moderate bandwith
have Distributed ownership model	Owned by individual	can be Private or Public
have longer coverage upto 100000 km Sometimes Stretchs Globally	limited between 100 - 1000 meter	Usually stretch upto 100 km
Set-up cost is higher than Wlan, Man	low - setup cost	moderate setup cost
Can get lower data speed 10-20 mbps	Gets higher data speed 10/100/10000	Get upto 1000 mbps

Bandwith: maximum rate of Data transfer across a Path

Physical Topologies:

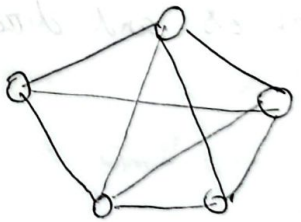
i) Point to Point
ii) Mesh
iii) Star
iv) Bus
v) Ring
vi) Tree
vii) Hybrid

Point to point: 2 devices are directly connected

Mesh: every device in the network is connected. every other devices either through direct or indirect connetion.

Full connected: Each node is connected to each oth

Partial: some nodes of the network is co with more than one node.



Advantages:

(I) Data can be transmitted difference device simultaneously

(II) network can be easily expanded,

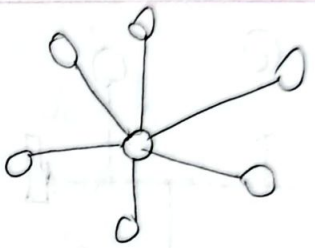
(III) message travel along dedicated path

Disadvantages:

(I) more expensive because higher length of cable

(II) setup and maintainance is tough

Star: All devices are connected with the central hub or switch. each devices has it's own dedicated line. The hub manages and directs traffic between devices.



Advantages:

(I) Easy to manage & setup. adding or removing devices doesn't entrupt entire network

(II) low setup cost

(III) Centralized Management

Disadvantages:

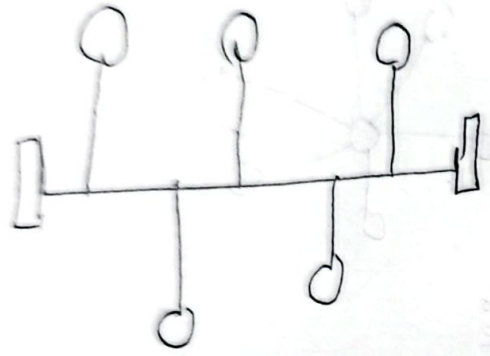
(I) If the hub/switch fails entire system f

(II) Can be costlier than ring & bus because more cable and central hub

(III) Hub Performance limitation,

Commonly used in small office lans where all com Printer & other devices connected with eachother

3) Bus :



All devices are connected to a single central cable also known as backbone. Data travels to devices through the cable.

① Its a multipoint. Devices share responsibility for getting data from one point to another.

Advantages:

① Easy to setup & doesn't require much cable

② low cost, needed lesser hub & cable

③ good for small network

Disadvantages:

① limited scalability, works for small network

② Single point failure. if one point fail entire network down

③ Can occur delays.

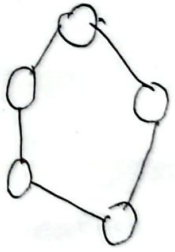
④ Difficult to trouble shoot

Commonly used in lan.

Ring Topology:

Each device is connected with 2 devices forming a circular Path. Data travels (one, uni, both) direction.

① Each device act as repeater, amplify & move forward.



Advantages:

(i) Easy to install
(ii) Handle high volume network traffic.
(iii) Easy to trouble shoot. If device fails easy to detect failed location.

Disadvantages:

(i) If one node fails entire network can fails.
(ii) The more devices adds one data pass's slower.
(iii) Expensive than bus/star.

Prac mid 7.5

// What topology is used for varsity lab?

Star topology is generally the best option due to its advantages in performance, scalability, reliabil

1) Centralized Management:

(i) As each computer in lab will be connected with central switch, it's easier to manage instr Can set permission, control and troubleshoot.

ii) Fault tolerance: if one computer fails doesn't e the rest of the network lab can continue function.

(ii) If the central switch fails it can be qu fixed or replaced.

iii) Scalability: (i) Easy to add more computer to the lab Connecting them to central hub without disrupting co

(ii) maves it flexible to expand if the number of co in lab increases

Security: hub can implement security measure like firewall or network monitoring tool

i.e. For a University star topology offers
Performance, ease of management, Scalability, & single failure doesn't affect whole network

4) Performance: each device is directly connected to the central hub communication speed is higher. Data transmission between 2 computer doesn't have to pass through multiple device, reducing latency.

5) Trouble Shoot:
As connection is independent troubleshoot straight forward if a PC or cable fails the rest of the network remain unaffected

Alternatives:

Bus topology: less expensive & simple but single failure can bring down entire network, less suitable

Tree topology: Suitable for large University campus but over complicated for a single lab,

Mesh: offers fault tolerance & redundancy but is expensive and overly complex for CSE lab, which may not require such high level of redundancy.

Difference between IP & Mac Address?

IP	Mac
(I) IP is Internet Protocol	(I) mac is media access control
(II) IP is logical address	(II) mac is physical address
(III) It can be change by ISP	(III) fixed for one device
(IV) has various classes A, B, C, D, E	(IV) No class concept
(V) applicable on network OSI model	(V) Applicable on Data link OSI model
(VI) IPv4 32 bit IPv6 128 bit	(VI) length is 48 bit
(VII) Provided by ISP	(VII) Provided by manu

Prev 7m 9,6

7 layer of OSI model:

(I) Physical layer → ~~network Process application~~ Hub, Repeater, modem, Wire, Cable

(II) DataLink layer → ~~encryption, Presentation~~ Mac address

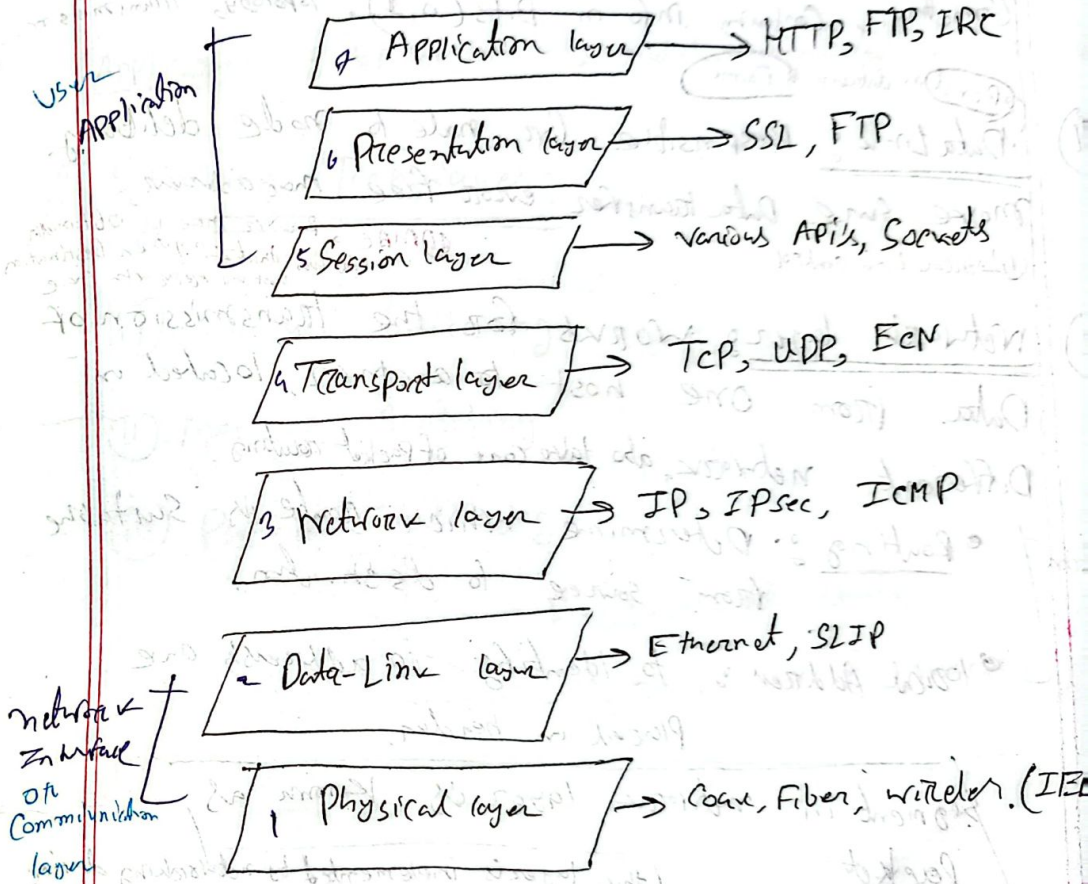
(III) network layer → ~~Interhost comm~~ Router, logical address

(IV) Transport layer → end to end connection, flow control

(V) Session layer → Interhost Communication

(VI) Presentation layer → encryption, decryption, Data representation

(VII) Application layer → network Process application



- 1-4 layer related to Communications techno
- 5-7 related to user Applications.

I) Physical layer: lowest layer. Responsible for Physical Connection, Contains info in Bits (0, 1). Topology, transmission

II) Data Link: Responsible for node to node delivery (Packet in datalink is Frame)
move sure Data transfer error free. mac address,
(i) Logical Link control
(ii) MAC → Reciver mac is obtained by which has that IP given Destination host will reply with mac

III) Network layer: works for the transmission of Data from one host to another, located in Different network, also take care of Packet routing
- Routing: Determine which route is suitable from source to destination.
- logical Address: to identify IP address is one Placed in header.

Segment in network layer is known as packet (this layer is implemented by networking device such as router.

Transport: Responsible for end to end delivery of Complete message. Data in this layer known as segments Performs segmentation & also implements Flow & error control to ensure Proper transfer (sender side). Adds Source & Destination Port number in header

5) Session layer: this layer allows 2 systems to start communication with each other in half dup or full dup

6) Presentation: Also known as translation layer (Ascii to (Encryption / Decryption), Compression (reduces number of bits)
Cipher Plain text

7) Application: top of the OSI model, implemented by network

Switching Techniques:

(I) Circuit Switching

(II) message Switching

(III) Packet switching
- Diagram switching
- Virtual circuit switching

Differences between Circuit message & Pacvet

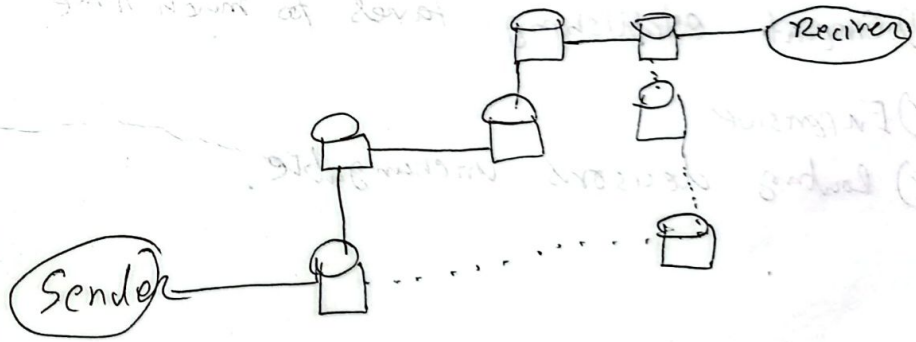
Circuit	message	Pacvet
(I) There is a dedicated Path	(I) No dedicated Path	(I) No dedicated Path
(II) Connection by establishing a dedicated path	(II) between each node along the route a link is generated	Node to Node
(III) No routing	Message travel seperate Paths to their destin	(III) To carry the destination Pacvets have an autonom Path
(IV) Transfer entire messe data segmentation	~~Ent~~ entire messa	Into Pacvets
(V) Bandwith reservation	No	No
(VI) Telephone	Telex system	Internet & Ethernet

Circuit Switching:

(I) Establishing a Circuit: logical connection before 2 ends.. Dedicated Path for data to travel 1 to other end

(II) Transferring Data: After connection entire Data travels over the dedicated Path to destination.

(III) Disconnecting the circuit: For security reason, after transfer is completed connection disconnected



The process of moving the Data Pacvet towards net Destination by forwarding them from one Port to the is called Switching.

Advantages:

(I) Dedicated Path
(II) No header overhead.
(III) Data transmitted without delay.
(IV) Always reaches destination
(V) no ordering required.

Disadvantages:

(I) Channel is blocked for 2 ends only
(II) inefficient utilizing system resources
(III) Circuit establishing takes too much time
(IV) Expensive
(V) Routing decisions unchangable.

Packet Switching:

(I) entire message is divided into multiple small sized packets.
(II) dividing single message onto smaller si
Packet is called Packetization.
(III) Small message is sent one after another
(IV) reduces total time

Difference between Bandwidth & Data Rate?

Bandwidth	Data Rate
(I) Carrier Channel that can Carry data	(I) amount of data transmitted during a specific period
(II) The difference between the range of frequencies	(II) Speed of the Data transmission
(III) measured in Hz, KHz, MHz	(III) normally measured in Mbps
(IV) Term in Physical layer of OSI Model	(IV) Common in all layer

Why Packet Switch better than Circuit Switch?

Its easier and more affordable than circuit Switch, since all the bandwidth can be used at once Packet Switch is more efficient because it doesn't have to deal with a limited num of connection that may not be using all the bandwidth.

06-10-24

Modulation is the Process of changing the Parameter of carrier Signal in accordence with the sta values of modularity signal.

Types of modulation::

(I) Amplitude modulation;
The height of the carrier signal is varied to represent the data being added to the signal.

(II) Frequency modulation: The frequency of the carr Signal is varried to reflect changes the frequency of the data.

(III) Phase modulation: The Phase of the carrier Signa varied to reflect in the

fre... unchanged while Phase is change

A_m = Amplitude of modulating signal

f_m = Modulating signal frequency

(i) Modulating freq / signal:

$$= m(t) = A_m \cos(2\pi f_m t)$$

(ii) Carrier Signal:

$$= C(t) = A_c \cos(2\pi f_c t)$$

(iii) Main / final signal: (final amplitude of modulating signal)

$$= S(t) = [A_c + A_m \cos(2\pi f_m t)] \cos(2\pi f_c t)$$

Modulation Index:

$$M = \frac{A_m}{A_c}$$

Carrier Power:

$$P_c = \frac{A_c^2}{2R}$$

Resistance:

R এর value না থাকলে

$R = 1$

A_c = Amplitude of carrier signal

f_c = Carrier signal frequency

(VI) One side Band Power = $\frac{\text{Total side}}{2}$

(VII) Carrier Power

$P_c = \frac{A_c^2}{2R}$

(IV) Transmitting Power

$P_t = P_c\left(1 + \frac{m^2}{2}\right)$

(V) Modulating Index = $A_c\left[\left(\frac{A_m}{A_c}\right)+1\right]\cos(2\pi f_m t)\cos(2\pi f_c t)$

(VI) Total side Band Power = $P_T - P_c$

SNR

$S/N = \frac{\text{Signal Power}}{\text{Noise Power}}$

Power level db = 10 log bp

$S/N = \text{Power} = I^2R = \frac{V^2}{R^2} \times R = \frac{V^2}{R}$

Channel Capacity = $B_w \log_2\left(1 + \frac{S}{N}\right)$

Sampling frequency = $F_e - 2f_m$

$\omega_m = 2\pi f_m$

Noise factor / figure = $F = \frac{S/N \text{ in}}{S/N \text{ op}}$

$S/N = 10\log_{10}\left(\frac{V^2}{R}\right)$

$P_{OSB} = \left(P_c + \frac{m^2}{2}\right) \times \frac{1}{2}$ → Power of one side Bandwidth

Math:

1) A modulating signal $m(t) = 10 \cos(2\pi \times 10^3 t)$ is amplitude modulated with a carrier signal

$$C(t) = 50 \cdot \cos(2\pi \times 10^5 t)$$

Find out,

(i) Modulation Index

(ii) Carrier Power

(iii) Transmitting power

Ans:

Given,

$A_m = 10$

$f_m = 10^3$

$A_c = 50$

$f_c = 10^5$

(i) modulation index $= m = \frac{A_m}{A_c} = \frac{10}{50} = 0.2$

$= 20\%$

Power ও
watt এবং

(II) Carrier Power $P_c = \frac{A_c^2}{2R} = \frac{(50)^2}{2}$

$= 1250$ watt

$= 1.25$ kw

R এর value না থাকায়

$R = 1$

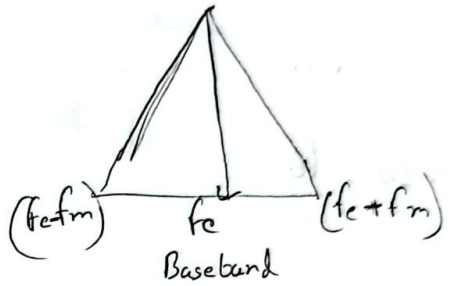
(III) Transmitting power $= P_t = P_c\left(1 + \frac{m^2}{2}\right)$

$= 1250\left(1 + \frac{(1.2)^2}{2}\right)$

$= 1275$ watt

$= 1.275$ kw

2



$\therefore$ Bandwith $= f_c + f_m - f_c + f_m$

$= 2f_m$

$\therefore$ Bandwith $= 2f_m$

Question 2:

The equation of Amplitude wave is given by

$S(t) = 20\left[1 + 0.8\cos(2\pi \times 10^3 t)\cos(4\pi \times 10^5 t)\right]$

$S(t) = A_c + \left[A_m \cos(2\pi f_m t)\right] \times A_c \cos(2\pi f_c t$

Find out,

(I) Carrier Power

(II) Total side band Power

(III) System Bandwith

(IV) modulation index.

Bandwidth frequency for
audio is 300 Hz

Given,

$A_c = 1 \times 20 = 20V$

$A_m = 0.8 \times 20 = 16$

Answer:

① Carrier Power $P_c = \frac{A_c^2}{2R} = \frac{(20)^2}{2 \times 1}$

$= \frac{400}{2} = 200$ watt

ii) Modulation index $m = \frac{A_m}{A_c} = \frac{16}{20} = \frac{1}{5} = 0.8$

$= 80\%$

Total Bandwith $= 2fm$

$= 2 \times$

② ~~Total side bandwith~~

Transmitted Power $P_t = P_c \left(1 + \frac{m^2}{2}\right)$

$= 200 \left(1 + \frac{(.8)^2}{2}\right)$

$= 264$ watt

∴ Total side bandwith $= P_T - P_c$

$= 264 - 200$

$= 64$ watt

∴ One side bandwith $= 64/2 = 32$ watt

Q30

A broadcast transmeter radiates 20 km. when modulation Percentage is 75

Find out, ① Carrier Power

② Power of each side band pa

① Given,

$m = 0.75$

$P_t = 20\ kw$
$= 200000\ watt$

we know, $P_t = \left[P_c\left(1 + \frac{m^2}{2}\right)\right]$

$200000 = P_c\left(1 + \frac{(0.75)^2}{2}\right)$

$\therefore P_c = \frac{20000}{1.28} = 15625\ watt$

$\therefore P_{OSB} = \left[P_c \times \frac{m^2}{2}\right] \times \frac{1}{2}$

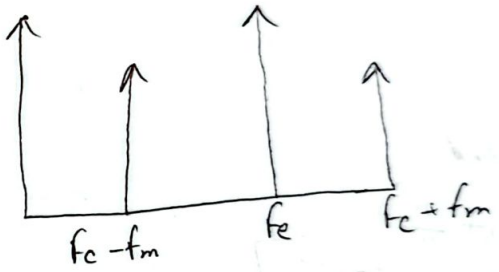
$= 15625 \times \frac{(0.75)^2}{2} \times .5$

$= 2197.26\ watt$

$= 2.197\ kw$

Q.4:

A 320 watt carrier is simultaneously modulated by 2 audio wave with modulation percentage of 45 and 60 respectively what is the side band power radiated.



$P_T = P_c + P_{LSO} + P_{USB}$

Case 01: Here,

$P_c = 320\ watt$

$P_T = P_c\left(1 + \frac{m^2}{2}\right) = 320\left(1 + \frac{(0.45)^2}{2}\right)$

$\therefore P_T = 352.4\ watt$

∴ Side band Power $P_{SB_1} = P_T - P_c$

$= (352.4 - 320$

$= 57.6$ watt

$= 32.4$ watt

∴ $P_{SB} =$

Case 2: Here

$P_c = 320$ watt

$P_T = P_c \left(1 + \frac{m^2}{2}\right)$

$= 320 \left[1 + \frac{(0.6)^2}{2}\right]$

$= 377.6$ watt

∴ Side band power, $P_{SB_2} = (P_T - P_c)$

$= 377.6 - 320$

$= 57.6$ watt

∴ $P_{SB} = P_{SB_1} + P_{SB_2}$

$= 32.4 + 57.6$

$= 90$ watt (radiated power)

Outline the major Protocols is IEEE 802.11 Standard to the Promote effetive Commiunication in terms of data rate, bandwith and frequency Comparison.

Key Protocols in the IEE 802.11 family are:

	Pros	Cons
802.11a	Operates in 5 GHz band with Data rate upto 54 mbps & narrow range. Maximum speed is fast. regulated freq Prevent signal interfere from other Devices.	Highest cost, shorter range signal that is more easily obstructed.
802.11b	Operates is 2.4 GHz and maximum datarate 11 mbps. Cost is low, signal range is good & not easily obstructed.	Slowest maximum speed. home appliance may interfere on unregulated freq band.

	Pros	Cons
802.11g	Combine benifits of 802.11a & 802.11b. With 54 Mbps data rate in 2.4 GHz band Maximum speed, signal range good. not easily obstructed	Costs more tha 802.11b appliar may interfere on Unregulated signal fr
802.11n	Speed upto 600 Mbps using multiple antennas (MIMO) Operates in 2.4 GHz & 5 GHz Fastest max speed best signal range. more resistant to signal interference from outside sources.	Standard is not yet finalize, cost more than 802.11g multi Signal may reactu interrere with nearby 802.11 b/g based networks
802.11ac	Operates in 5 GHz, data rate upto 1 Gbps Provide wider bandwith channel and more MIMO stream	

Packet Switch Math:

For Packets

(I) File size = header + given File size

(II) Transmission Delay:

$$TDelay = \frac{File\ Size}{Bandwidth}$$

(III) Total time taken:

Total time = number of host (including receiver) × Transmission Delay

Data Rate = Bandwidth

(I) যদি More than 1 Packet থাকে তাহলে যেটা করতে হবে

(I) Total message size / no Packet = Per Packet size

(II) Per Packet size + header

(I) Bandwidth per person:

$$Bpp = \frac{Total\ Bandwidth\ or\ Filesize}{number\ of\ users\ or\ Packet}$$

For Circuit Switching

(II) Transmission Delay

(III) Time to send file = File size + TD

For more than 1 packet:

As at the first we calculated 1 Packet ~~Size~~ Time

So now we have to calculate the remain Packet ~~Size~~ Time also.

Time for remaining Packet = (no of remaining Packets ×

∴ Total time = Per Packet + Remain

Observation:

- When Data is sent in 1 Packet, total time take

Conclusion:

- total time decreases with Packet size is but only up to a certain limit
- If Packet size reduced beyond limit then time start increasing

Network Bandwidth 1 mbps, message size 1000 bytes, has to be send, Packet-Switch technique, header 100 by

Now Calculate minimum time for

1) 1 Packet
2) 10 Packet
3) 20 Packet

(1) given,

Size = 1000 bytes.
Bandwidth = 1 mbps
header = 100

For 1 Packet.

File = 1000 + header
= 1100

Transmission Delay = $\frac{1100 \times 10^{-6}}{}$ = 1100 μsec
= 1.1 msec

∴ total time taken = no of host × TD

$= 4 \times (1.1)$

$= 4.4$ msec. + rs

(II) For 10 Packet

Per Packet = 1000 / 10

= 100

∴ File size = 100 + header

= 200

TD = 200×10^{-6}

= 0.2 msec

Total time for 1 Packet = 4 + 2

= .8 msec

For rest of the Packet = 9 × .2

= 1.8 ms

= 2.6

(III) For 20 Packet

Per Packet = 1000/20

= 50

File size = 100 + 50 = 150

TD = $\frac{150}{1000}$ = 0.15 msec

Tot. time for 4 Packet = 0.15 × 4

= 0.6

" " " rest " = = 0.6 + 19

= ~~4.4~~ 2.85 +

= 3.45

∴ observation, when data taken 1 Packet time is = 1.5

" " 5 " " " = 5.5

" " " 20 " " " = 3

" " "

Lecture 7

1) Signal: is a electro magnetic wave that can information through physical medium.

Transmission Impairment:

Analog Signal travels through transmission media which tends to fade the quality. this imperfection cause Signal impairment.

(I) Attenuation: loss of energy. Strength of signal decreases. with increasing distance. messured in (dB)

(II) Distortion: changes in the form or shpe of signal

(III) Noise: Random or unwanted signal mixing with the orginal signal. called noise

Modulation: The process by which data / info is converted into electrical / digital signals for transferring that signal over a medium call modulation

Types of modulation: Am, FM, PM

(I) Amplitude modulation: The height of the carrier signal varied to represent the data being added to signal

(II) Frequency modulation: The frequency of carrier signal is varied to reflect changes the freq of data

(III) Phase modulation: the phase of carrier wave is varied to reflect changes in data frequencies.

Digital: ASK, FSK, PSK, QAM

(I) Amplitude shift keying: The amplitude of carrier wav is varied to represent binary data, High = 1 Low = 0

(II) Frequency shift keying: The frequency of carrier wa is varied between 2 discrete values to repre binary data.

(III) Phase shifting key: The phase of carrier wave changed to represent binary dat in simplest

(IV) Quadrature Amplitude Modulation

QAM is used to encode multiple bits per signal to v Both amplitude & carrier wave.

Difference between Analog & Digital

Analog	Digital
(I) Used to communicate in continuous function time	(I) transmit data in discrete function time
(II) Represents data in Continuous range of value	(II) use descrete value 0 & 1
(III) Bandwidth low	(IV) Bandwidth high
(IV) Better suited for audio video	(IV) electronic prosses data, storage
(V) easily influenced with noise	(V) more reliable
(VI) less accurate	(VI) noise free, high accurency
(VII) require more power	(VII) less power
(VIII) Used in landline phone, radio	(VIII) Computer, Laptop

Wireless: refers to the method of transferring data between computing device without any Physical connection.

Differences between wired and wireless

	Wired	Wireless
(I)	high Bandwidth	low Bandwidth
(II)	low Bandwidth variablity	high Bandwidth variablity
(III)	Can listen on wire	hidden terminal proble
(IV)	high power machine	low power
(V)	high resource	low resource
(VI)	low delay	high delay
(VII)		Proximity

Application of wireless :

Business & Remote Work : Wireless enables remote access to email, cloud based suites, video conferencing tools. industries like logistics use wireless to update data, access real-time info & coordinate tasks in field.

Government : Govt application in center around inspection & work orders eg; food service, child care,

Emergency Services : facilates communication during natural disaster or emergency helping with coordination between responders & affected Population

Public Safety : Police, fire, ambulances rely on wireless network for quick & reliable communication

Health Care : Remote monitoring wireless sensors monitor Patient & transmit data to Providers.
Telemedi : enables Patient to consult doctors remotely via voice, video call in remote, area.

Market Research : Automatic survey Process has enable Company to get data for their queries more accurate and quickly,

E-commerce & Credit card : Consumer can Browse Order Products through e-commerce app.
Retail shop use wireless Payment (PoS) to process Credit/debit transaction, mobile banking

E-mail : helps to keep in touch with colleagues

Transportation : wireless network supports GPS for navigation system. Realtime route planning & location Connects vehicle to vehicle for traffic management.

Line Coding

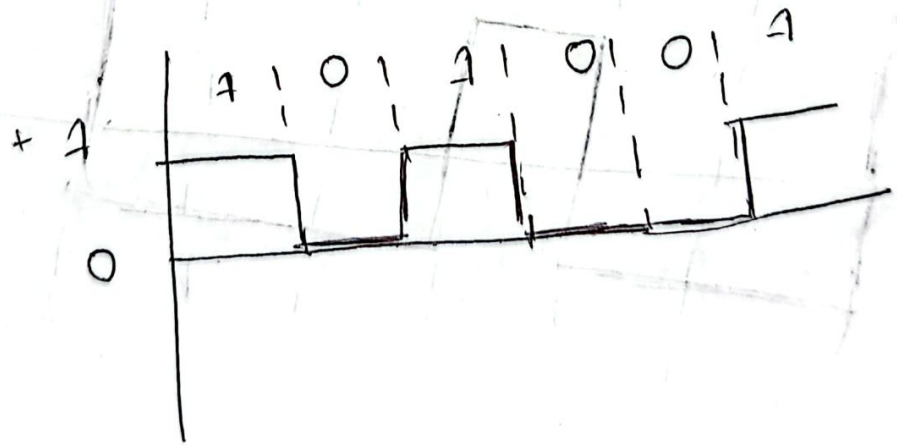
5 types of Line Coding:

(I) Unipolar
(II) Polar — NRZ (L, I) [No return zero]
                Rz (Return zero)
(III) Bipolar
(IV) multilevel
(V) Multi-transition.

Convert a digital data to a digital signal using encoding & technique to decode that signal is called line coding

Unipolar : given: 1 0 1 0 0 1

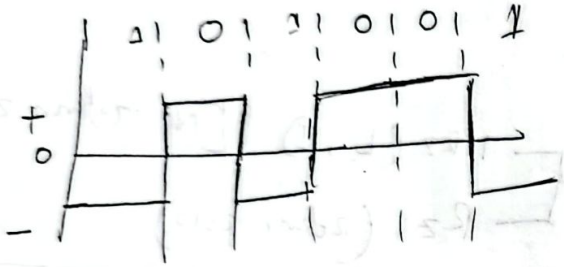
1 → + voltage
0 → zero "



(ii) Polar → NRZ (L)

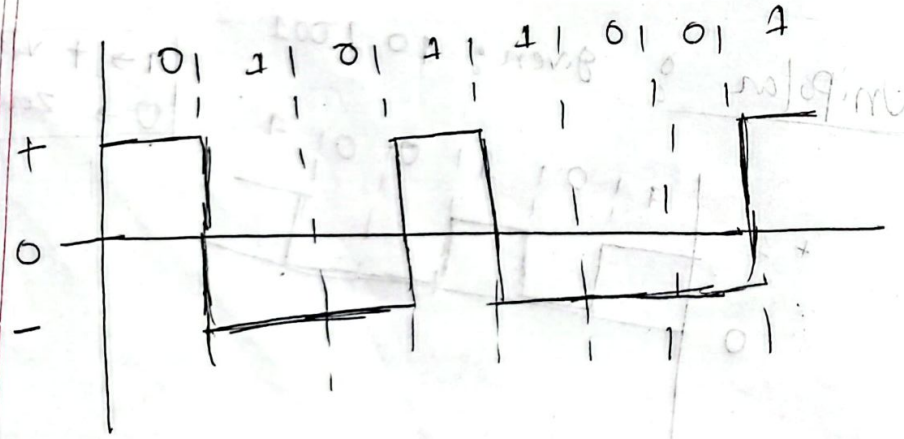
1 = − voltage
0 = + voltage

given = 1 0 1 00 1



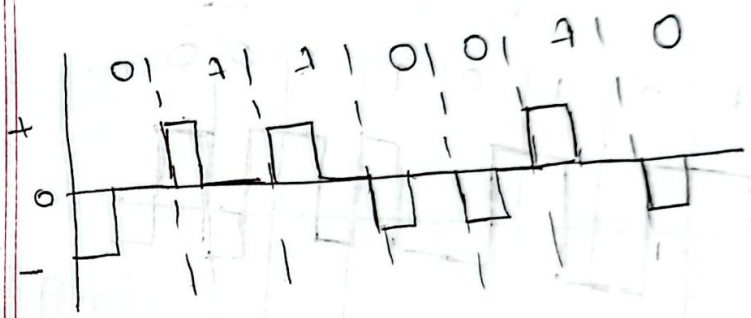
NRZ (I) invert :

1 = transition
0 = No transition



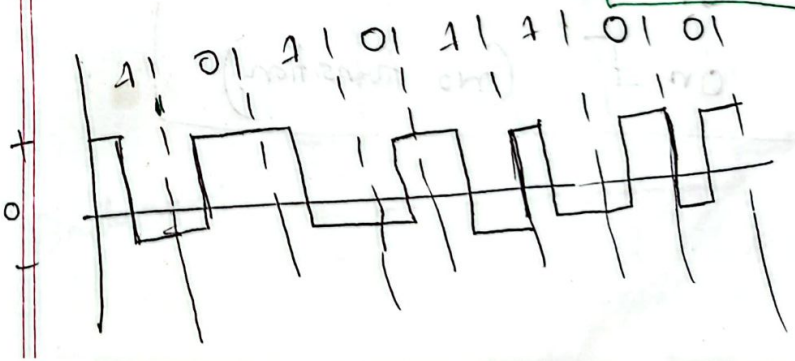
RZ :

0 = − to zero
1 = + to zero



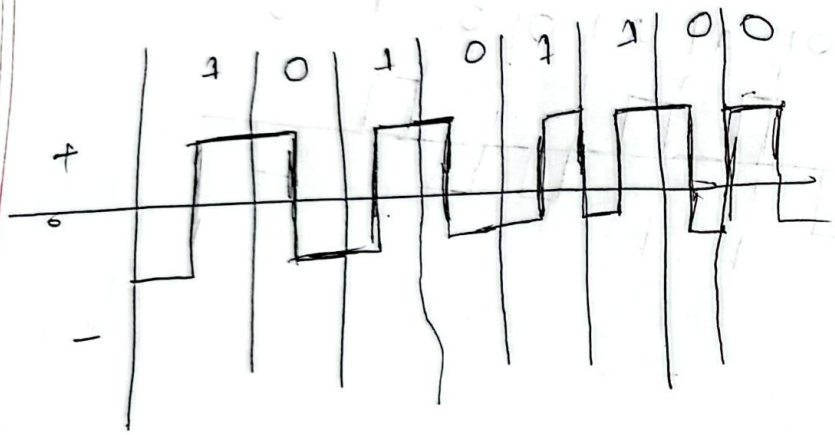
(iii) Manchester (Bra, thomas)

0 = − to positive
1 = + to negativ



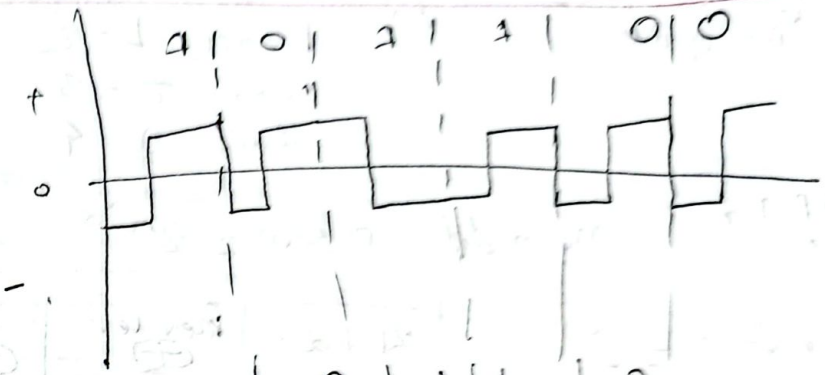
Manchester (IEEE):

0 = + to neg
1 = − to pos



Differential Manchester:

0 = ⊓ or ⊔ (transition)
1 = ⊓ or ⊓ (no transition)

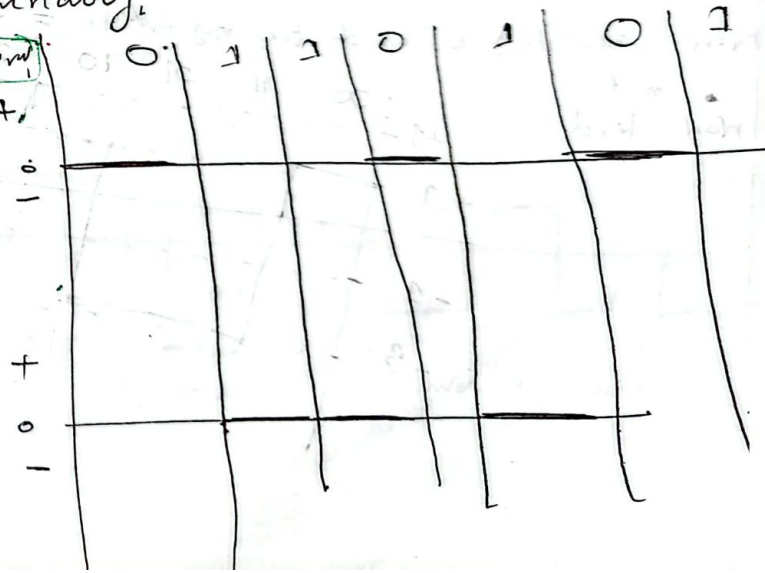


Bipolar:

(i) AMI = Alternate Mark Inversion.

(ii) Pseudo tarnary.

0 = zero Voltage level
1 = Alternative
AMI.



Multilevel

2mBnL — m = length of binary pattern (binary data); n = length of signal pattern; L = number of level in signaling

Binary L = 2
Ternary T = 3
Quad Q = 4

2B1Q

No of data pattern = 2^m

Data pattern = 2^2
= 4

2B1Q	Prev lev (+)	Prev lev (−)
00	+1	−1
01	+3	−3
10	−1	+1
11	+3	+3

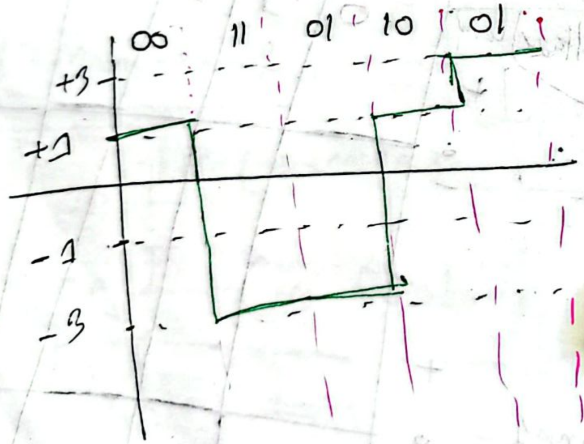
Given Data,

0011011001

(1) Now according to len of binary pattern = 00 11 01 10 01

(2) Now no of level

00 11 01 10 01



First +1 weight থাকলে কিছু করা লাগবেনা

2nd এ আগেরটা +1 weight থাকলে Code invert করবে

8B6T (mBnL)

m = length of binary pattern; n = length of signal pattern; L = 3

no of Data pattern = 2^m = 2^8 = 256
" " Signal " = L^n = 3^6 = 729

Redundant = 729 − 256 = 473 → Used in synchronization, error detection, DC balance

Mapping table:

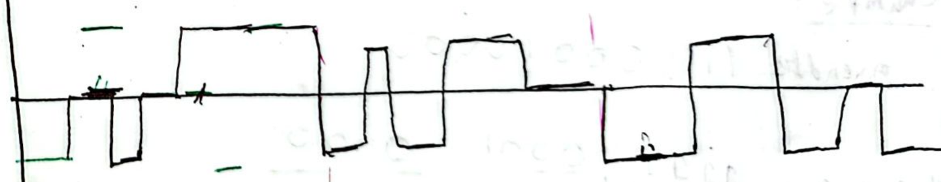
Data	Code	Data	code
00	−+00−+	50	+−−+0+
11	+0−0++	53	−+−++0
0A	+0+−0−		

weight = 0 (00, 11, 0A); weight = +1 (50, 53)

Given Data : 00010001 01010011 01010000

(1) Divide in 8 bit

00010001 (11) | 01010011 (53) | 01010000 (50)



− 0 − 0 + + | − + − + + 0 | inverted code: − + + − 0 −

Block Coding

4B\5B → প্রতি 4 bit কে table থেকে 5 bit এ convert

Block coding is done with 3 steps

1. Division → 1st এ given data কে 4 bit করে ভাগ করবে.
2. Substitution →
3. Combination

Example:

Given data 1111 0001 0000

Step 1: 1111 0001 0000

Step 2:

i) 1111 → 11101
ii) 0001 → 01001
iii) 0000 → 11110

Mapping table

4 bit	5 bit
0001	01001
0000	11110
0010	10100

Step 3:

Combination: 11101 01001 11110

- 3টার বেশি 0 থাকলে signal Flat হবে
- leading can't be 0 start with 0

used to improve Ami

Scrambling

B8ZS

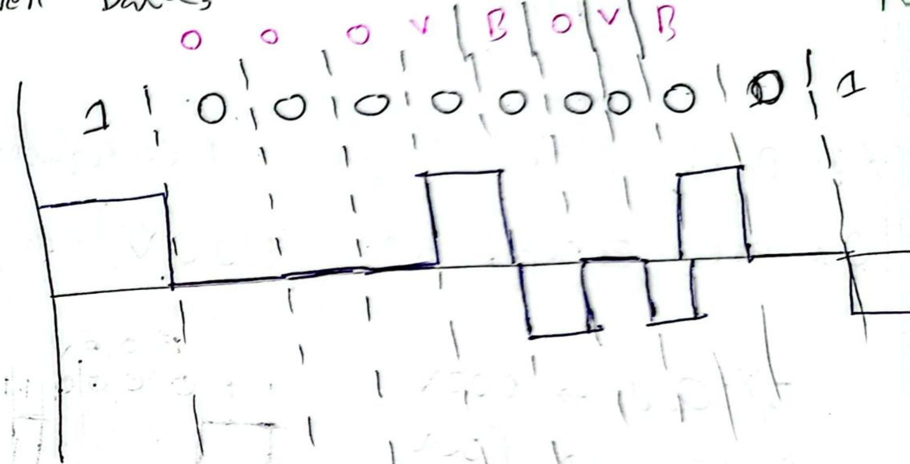
Bipolar with 8 zero Substitution.. 8 consecutive 0s are replaced by 000VB0VB

V (violation) → Same as last non zero level.

B (Bipolar) → Oposite to last non zero.

As উন্নত AMI এর improve version, 1 হলে last non...

Given Data,



According to normal AMI:

0 = zero level

1 = Alternative

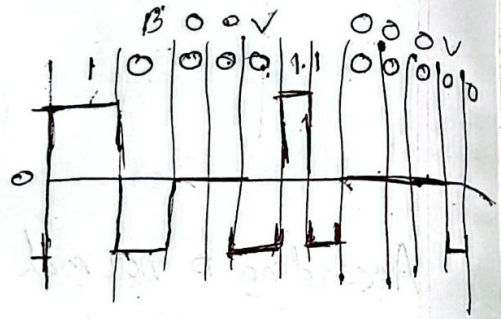
HDB 3

High Density bipolar 3 zero.. 4 consequtive

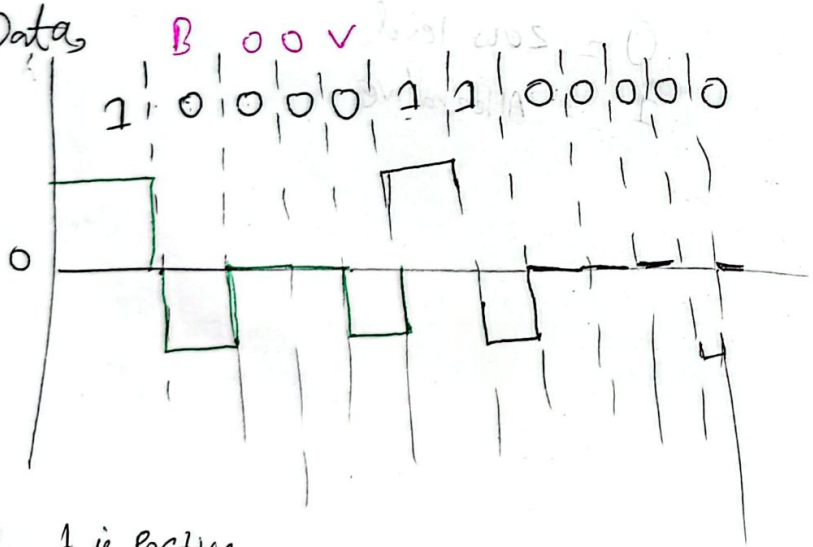
0's are replaced with 000V or B00V

Odd → 000V

Even → B00V



Given Data



let assume 1 is Positive,

CWC

1) Optical wireless communication.

Frequency → no of wave cycle

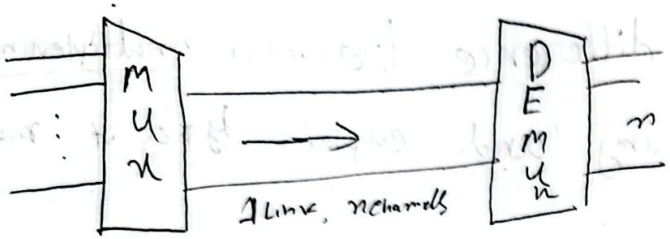
Wavelength → Distance between adjacent waves

Wavelength ↑ frequency ↓

CT → 3

Show the difference between multiplexing & demultiplexing and explain types of multiplexin

Multiplexing	Demultiplexing
(1) Combine multiple signal into one for transmission over a single medium/chan	Separates combined signal into individual signal for further Process. (1 input n output
(2) Efficient utilization of Communication channel	Recover individual signal at receiver end.
(3) Device used is called. ~~De~~Multiplexer (Demux)	Demultiplexer (Demux
(4) Follows many to one	(4) One to many.
(5) Widely used in telecom to combine audio vide to broadcas.	Separating audio video signal at receiver.



Types of Multiplexing

(I) Time Division multiplexing (TDM) : Assign Different time slot for each signal

(II) Wavelength Division (WDM) : It use different light wavelength for optical communication onto single optical fiber

(III) Frequency Divisn... (FDM) : Allocates available bandwidth of a single transmission medium is sub-divide into several channel. different freq bands for each signal

- Synchronous TDM
- Asynchronous TDM

Advantages

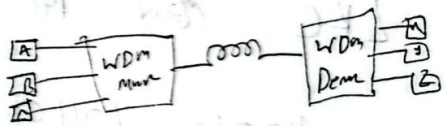
(I) High aggregate bit rate without high speed electronics or modulation

(II) Low dispersion penalty for aggregate bit rate.

(III) very useful for upgrades to install fibres.

What is wavelength Division multiplexer (WDM)? Discuss Key advantages & challenges of WDM as a multiplexing technique.

WDM is a fiber optic technology that increases bandwidth by sending data at different frequency over a single optical fiber. it's used to increase capacity of single fiber.



Advantages:

(I) Allows Simultaneous transmission of multiple signals

(II) Can add more signal / wavelengths without alteration infrastructure

(III) Reduce the need of multiple fiber (low cost)

Challanges:

(i) Complexity; requires precise signal control and separation

(ii) Cost: Initial cost; can be expensive.

(iii) Signal may loose for over long distance, require amplifier.

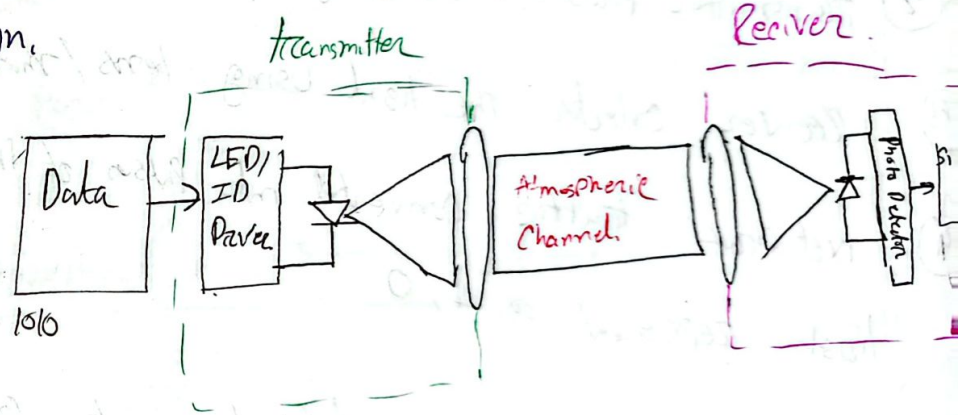
loss, crosstalk and non linear effects are potential problem.

4 binary data set, 6 bit data blocks calculate LRC row for Parity even.

110010 101101 001110 100011

```
110010
101101
001110
100011
------
111000
110010
------
000000
```

Describe the main elements and mechanisms of Free Space optics (FSO) and examine how it might improve Communication in optical wireless network design.



Main elements:

(i) Transmitter → converts a signal into optical signal / LED

(ii) Free space medium → Atmosphere acts as medium for transmitting optical signal

(III) Receiver: Captures & converts signal back into electrical signal.

Mechanism:

(2) transmitter projects carefully aimed light pulses to air

(3) Receiver collects the light using lens / mirror

(4) network traffic converted into pulses of invisible light represent as 1, 0

(4) received signal converted back into copper & connected to the network

(5) reverse direction data transported the same way a full duplex,

T30 Challenges: (I) weather dependencies
(II) Atmospheric attenuation
(III) Range.

Advantages in wireless optical

(I) Support highsped data transmission (supports gigabit

(II) Eliminates physical cable (low cost) infrastructure

(III) Faster installation, & suitable for temporary/emer setup

(IV) No permit needed, Mobility, No. Fee, no disc

Improvement in communication:

(V) Reduced RF spectrum congestion,

(VI) Secure communication: ensure better security

(VII) Effective in Remote area. bridges connectivity.

(VIII) Backup for existing network like under fiber connection failure

Of 4 Syllabus + mid term 2 theory,

basic of datacom.

Network, topo, OSI

Data com model

Comp, 5 Components,

wired, wireless,

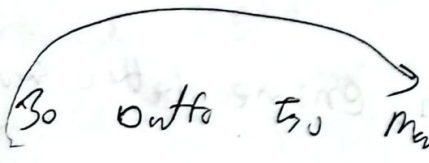
com media.

FDM, TDM, math,

Modulation 3 technique, math, after midterm,

SNR, Noise, Cth math,

Flow control, SR, GO back,



Theory → 20

One WDM 2 types

multiband encoding.

Channel

(I) Noisy channel / shannon capacity → $C = \text{bandwidth} \times \log_2(1+$

(II) Noiseless channel

$$\text{bitrate} = 2 \times \text{bandwidth} \times \log_2 L$$

[L = no of signal lev

Consider a noiseless channel with a bandwidth of 20 khz, we need to send 280kbps on channel, How many signal level are required

Ans Given,

Bandwidth = 20 khz

Bitrate = 280 kbps

$\therefore 280 = 2 \times \log_2$

$\Rightarrow \log_2 L = \frac{280}{2+20}$

$\therefore \log_2 L = 7$

$\therefore L = 2^7 = 128$

Consider a extremely noisy channel in which SNR is almost zero. Calculate capacity ch

$\therefore C = \text{Bandwidth} \times \log_2(1+SNR)$

$\therefore C = 0$

Extremely অনেক [illegible] হবে channel এ signal নেই So Ans = 0

Assume $SNR_{dB} = 36$ & BD of the ch is 2 MHz. Calculate capacity.

$SNR_{dB} = 10 \log_{10} SNR$

$\Rightarrow \frac{36}{10} = \log_{10} SNR$

$\Rightarrow SNR = 10^{3.6}$

$= 3981$

$C = BD \times \log_2(1+SNR)$

$= 2 \times \log_2(1+3981)$

$= 23.92 \text{ mbps} \times 10^6 \text{ bps}$

$= 24 \times 10^6 \text{ bps}$

4) Signal power = 2 mW, Noise power = 1.95 mW. Find max data rate and Shannon capacity, when Bandwidth range 300 to 3400 MHz

$\Rightarrow SNR = \frac{\text{Signal Power}}{\text{Noise Power}} = \frac{2}{1.95} = 1.03$

$C = BD \times \log_2(1+SNR)$

$= 3100 \times \log_2(1+1.03)$

$= 3156.97 \text{ mbps}$

BD = 3…

What is FDM ?

available bandwidth of a single transmission mediu
is sub-divided into several channel.

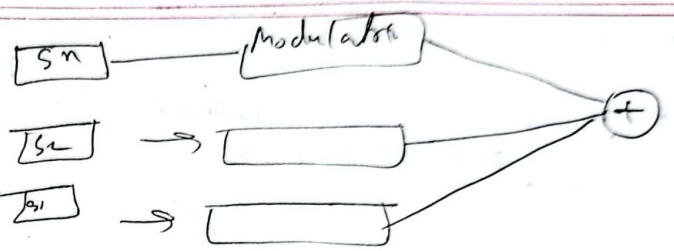
example : Bandwidth 1 mobs user 10. Be used only
10 kbps.

Advantages:

(I) Used for Analog signal.
(II) Simple & easy modulation
(III) large number signal can be sent through FDM simulta
(IV) Doesn't need synchronization between sender & receiver.

Disadvantages:

(I) Used in low-speed channels.
(II) Suffer crosstalk
(III) large number of modulator required
(IV) Require high bandwidth



What is TDM ?

Assign Different time slot for each slot for each

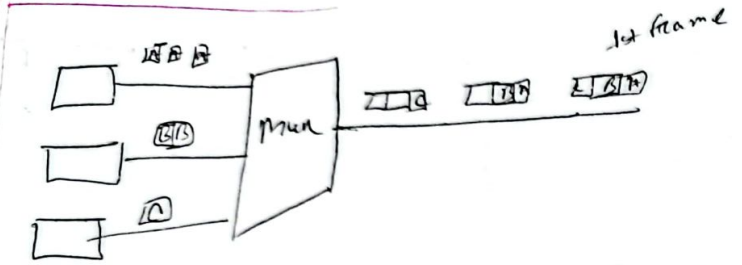
TDM is Prefered:

(I) Signal are digital
(II) Possiblity of wideband fading

FDM is prefered:

(I) Signal are analog.
(II) Synchronization not used.
(III) Possiblity of narrow band fading

Synchronous TDM

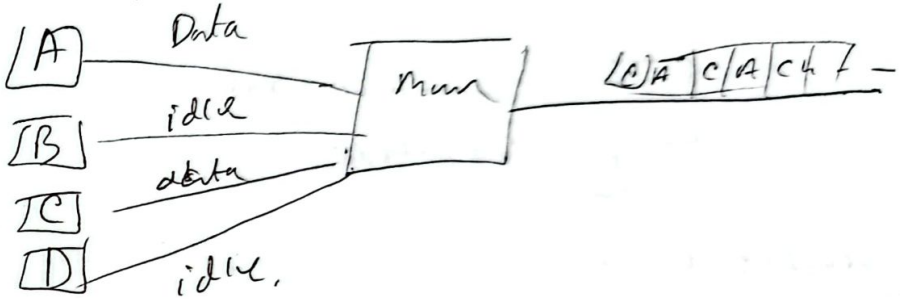


Slots are Pre assigned to every device, time slot is given according to if the device contain data or not, not data slot empty. Sented data is time slots are organized in the form of frame, no data in empty slot transmitted.

Asynchronous TDM

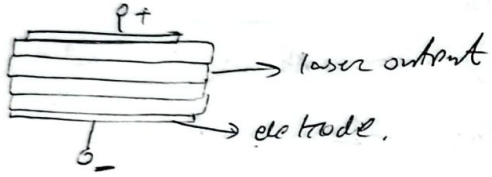
Also known as statistical TDM.. time slots are not fixed, time slot is allocated to only those device which have data... this multiplexor sent only data from active workstation,

(I) Speed of input can be greater than capacity.
(II) Contain only data frame no empty slots
(III) Slot Contains address part to identify source



CWDM

CWDM is more cheaper & simpler than DWDM. Saves upto 30%. CWDM got wide channel space.



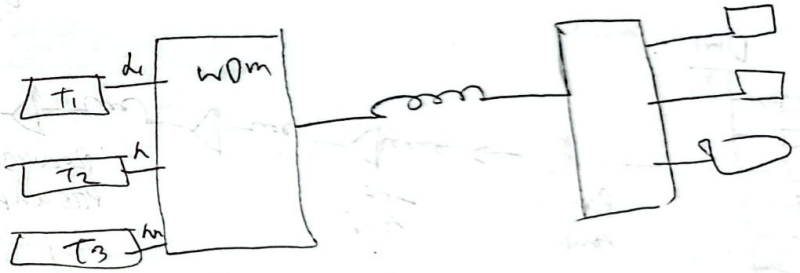
Cost effective Because:

1. less expensive uncooled lasers,
2. less precise ~~wave~~ laser used
3. CWDM components use less space.
4. Passive components are low cost

DWDM

Dense WDM utilise closely spaced channels. Space reduced to 1.6nm. & less.

- Cost effective way to increase capacity without replacing fiber.



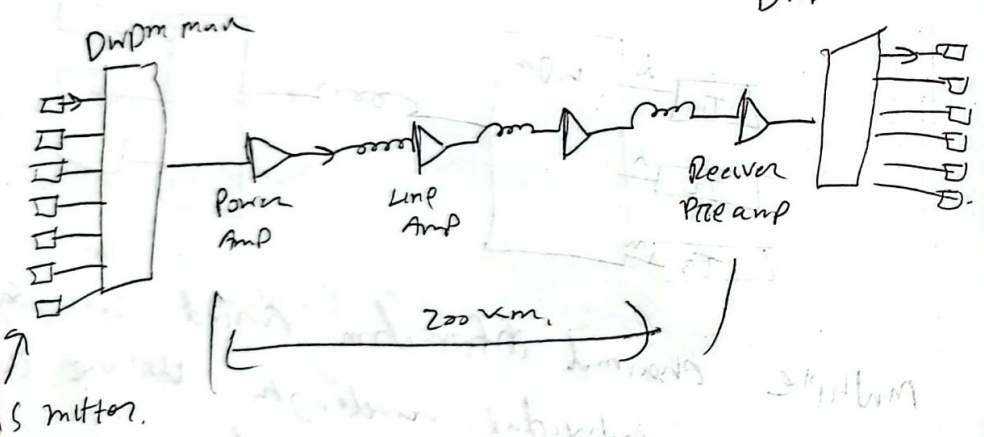
Multiple channel information carried over fiber using individual wavelength. Unlike Channels are much closer together.

DWDM Advantages

① Great fiber capacity.

② easier network expansion.

- No new fiber need,
- Just add a new wavelength
- incremental cost low,
- no need to replace many components like amplifier,



Each wavelength behaves as if it has own virtual fiber

Optical amp needs to overcome losses in mux/dem

150

LED Design & Bandwidth

LED Design involves the arrangement & structure of led to achieve spec lighting purpose. Bandwidth = capacity of a system to transfer data,

Blue Led + Phosphors = Creates white light

① Blue is fast (20 MHz)

② Phosphor slow (2MHz)

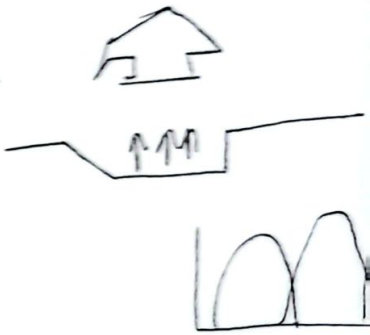
③ low cost & simple,

RGB type?

① Enables WDM

② 15 MHz per led chip

③ High cost



The RGB model is efficient for data. Particularly in transmitting visual data images videos DTT