TCP/IP (Model)

Physical layer — The physical layer covers physical Interface b/w a data transmission device. It is concerned with specifying the characteristics of transmission medium (Signal levels, data rates)

Network Access layer — This layer is concerned with access to and routing data across network for 2 end system attached to same network. (Services priority)

Multiple Inter Connected Network.

IP — The IP is used at this layer to provide routing function across multiple networks

Router — It is a processor that connects two network & whose primary func. is to relay data from one network to other from src to dest end system.

Transport layer (TCP) — The transport layer provides end to end reliable service. Ordering of data Include Destination port, Sequencing No., check Sum (T.U)

Application — The application layer contains logic needed to support various user application layer (Police Walkie)

Data Transmission

Guided Media — The waves are guided along a physical path (twisted, coaxial, & optical fibre)

Unguided Media — Also called wireless. provide means from transmitting electro magnetic wave. but do not guide them.

Direct Link — The term direct link is used to refer transmission path blw devices in which signal propagates directly from transmitter to reciever with no intermediate device other than repeater or amplifier.

Point to point — If it provides a direct link blw 2 devices & those are only 2 devices sharing medium.

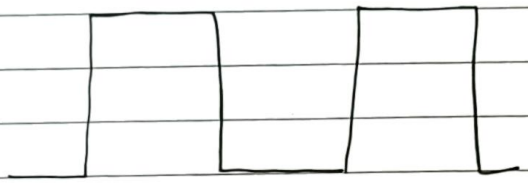
Multipoint — In a multipoint guided configuration more than 2 devices share same medium.

Simplex — Transmitter Sends Reciever Recieves (T.V)

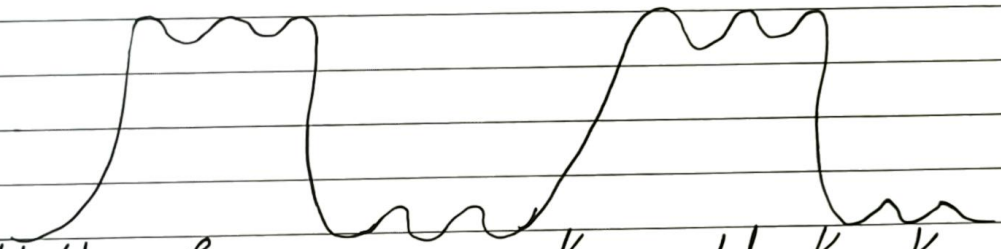
Half duplex — Transmitter & Reciever both communicate one at a time. (Police Radio)

full duplex — both station may transmit simultaneously (Mobile phones)

☆ Signals consist of different frequencies
Suppose Signal



In reality this is achieved by doing this



Multiple frequencies ko add kar ke we can achieve any desired Signal.

Analyse → Two domains → Time
→ frequency

→ achieved by doing fourier transformation

Time domain

General wave

$$s(t) = A \sin(2\pi f t + \phi)$$

A → peak Amplitude

f frequency.

Sinusoid

A func with the form of preceding Eqn is called sinusoid (Rel to phase)

$$\left\{ \begin{array}{l} V = f\lambda \\ f = 1/t \end{array} \right\} \longrightarrow \bigstar$$

Frequency Domain

You can see the different frequencies that made your signal

$$s(t) = 4/\pi \left[\sin(2\pi f t) + 1/3 \sin(2\pi (3f) t \right.$$

★ If other frequencies are multiple of first frequency so Each multiple is reffered to as harmonic.

It is Imp to note that signal travels with the fundamental frequency

$$T = 1/f$$

Spectrum The Range of freq it contains In this case Range f to 3f

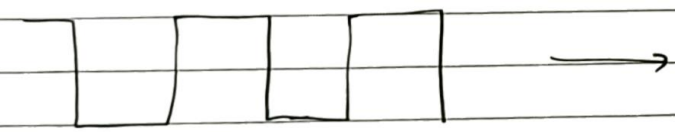
Absolute Bandwidth Width of Spectrum = f to 3f = 2f

Some Signal contains Infinite Bandwidth But Most of the energy is contained in narrow band of freq.

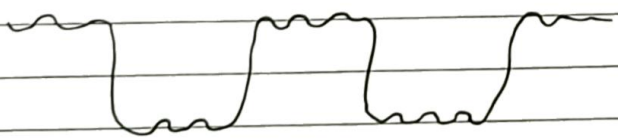
dc component If a signal includes some component of o freq dc component

Most Imp ↓

See



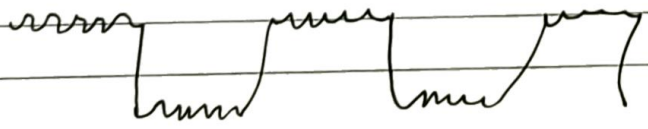
desire



less accurate

f - 3f (less Bandwidth)

More accurate



f - 3f - 5f (More Bandwidth)

CLASS.
Date :
Page :

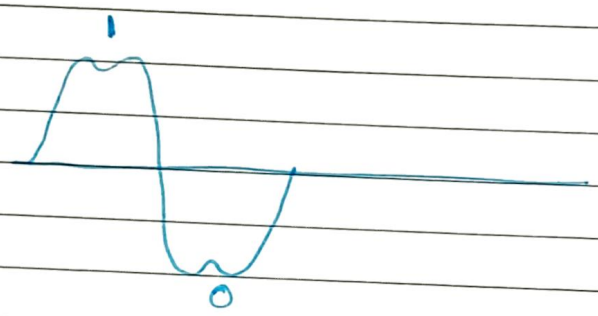
Calculate

Case-1 $f + 3f + 5f$ $\quad f = 10^6$

Bandwidth = $4\ MHz$

Signal freq = $1\ MHz$

$T = 10^{-6} = 1\ \mu s$ (wave complete)



Each bit = $0.5\ \mu s$ ⟶ Recieve.

Data Rate = bits 1 sec mein jitni recieve ho.

1 μs mein 2 bits recieve honge.

1 sec mein 2×10^6 bits or 2 Mbps

Advantages: Digital signal convey with less Noise & distortion

Digital Data is easily compressible

Encryption & compressed

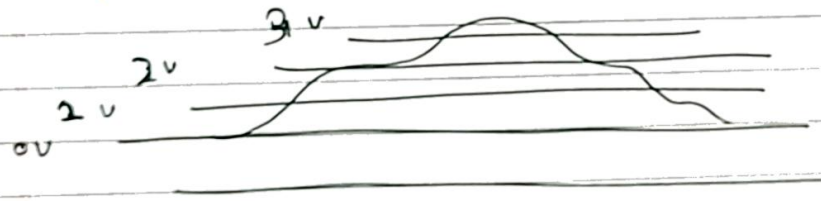
less Expensive to set up // long distance

Disadvantage: Sampling (process of measuring instantaneous values of continous time signal (Analogue) in a discrete form (Digital)

→ cause loss of error.

higher bandwidth required

Digital Systems processing is complex



Analogue signal

↓

convert

Har ek instance ke liye main bit pattern generate karunga - 4 V → 2 bits lagegi

↓

Digital conversion.

Generalise Result

B – Bandwidth

2W / (H_2) / → / Bandwidth / → **

W / Samples Psec / 2B Samples / sec.

Max Data Rate

Analogue & Digital

* Analogue is a continously varied Electro magnetic wave that may be propagated over a variety of media.
* A digital signal is a sequence of voltage pulses that may be transmitted over a wire medium.

Digital — Modem (carrier freq ↓) — Analogue

Analogue — Codec (coder / Decoder) — Digital

Repeater: Re creates the pattern of 0 & 1 from signal & again sends it. thus Attenuation & Noise are overcome.

$$C = B \log_2 (1 + SNR)$$

SNR ↑↑ ⟶ Bandwidth ⟶ capacity ↑↑

Error free

SNR ↓↓ ⟶ Bandwidth ⟶ capacity ↓↓

$$\frac{C}{B} = \log_2 (1 + SNR) \Rightarrow \text{spectral Efficency}$$

Expression E_b / N_o

E_b — Energy per bit

$E_b = S T_b$ (S → signal power)
(T_b → Time to send one bit)

$R = 1 / T_b$

Bit Error Rate ⟶ func of this ratio

data Rate ↑↑↑
Signal power ↑↑↑] $\frac{E_b}{N_o}$ ⟶ const

Bits lagegi $2^3 = 8$ — 8 Voltages — 3 bits

toh abb b bits bhejna ho toh 2b bandwid

nbits bhejni ho: 2nb bandwidth.

Sample Voltages = 8 bits req = 3 (n)

$$C = 2B \log_2 M$$

M → No of voltages Ya discrete level.

Shanon Capacity formula.

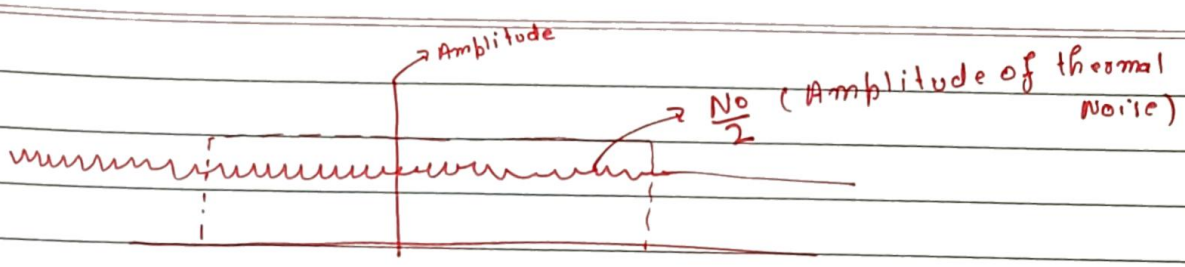
→ Relate data rate, Noise, Error rate

Signal to Noise Ratio

$$SNR = \frac{\text{Signal power}}{\text{noise power}}$$ → ☆

Data rate ↑↑ → Error or Noise Ka effect

Ke liye signal st ↑↑ overcome Karne



N_0 (Noise power density) = $\underline{kT}$ (watt/Hz)

k - Boltzman const (1.38×10^{-23}) J/K
T - Temp in K

Noise (in Bandwith) = Noise in watt

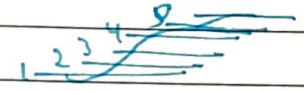
$$\underline{N = kTB}$$

$$\underline{In\ dB\ (10\log_{10})}$$

$$N = 10\log_{10} K + 10\log_{10} T + 10\log_{10} B$$

Nyquist Bandwidth.

Suppose You like to convert Analogue to degital so You have to represent diff V level



→ 8 Voltage level

Each V Ko represen Karne Ke liye Kitni

Transmission Impairements.

Attenuation - Strength of a signal falls off with distance over any transmission medium.

P_y → Transmits P_{1000} → Recieve

Attenuation in decibel $N_y = \log_{10} \frac{P_{1000}}{P_y}$ → Always -ve.

Delay Distortion - Signal mein hoti hai Different freq hoti hai (Different Speed mein reciever hoti hai (Inter symbol Interference ho sakta hai)

Noise - Any additional unwanted signal that are inserted somewhere b/w transmission & Reception.

White Noise - Noise is due to thermal agitation of electron. present in all electronic device & transmission media.

The more Bandwidth the More Noise

- Synchronization b/w Transmitter & Reciever is must.
- Error detection & correction.
- Recovery. → Transffering data (Network disturb so vahi se start hona chahiye)

Networks.

LAN Network confined to a relative small area. Generally limited to Geographic area such as office building.

WAN Cover large Geographical Area. It consist of number of inter connected switching Node

Node (There purpose is to recieve & send data to another Node until it reach their destination).

Communication Model

Fundamental purpose → exchange of data

Source Generates data to be transmitted

Transmitter Converts the data in a way so that it can be transmitted

Transmission system It can be a single transmission line or a complex network connecting source & dest.

Reciever Re convert the data into its orignal form & also recieve signals.

Dest Display or Recive the data from Reciever

Communication Tasks.

* Transmission system utilisation refers to need to make efficent use of facilities that are typically shared among a no. of devices.
* Signal generation is req.

Multiple channels ke through different data rates pe data bheja jaa sakta tha const data rate.

rence
&
N

- LAN is relatively for small area
- Maintenance & Owned by the same organ-
- Internal data rates of LAN are greater

Protocol / Architecture

feature

Syntax - Concerns the format of data blocks

Semantics - Control Information for coordination & Error handeling.

Timing - Include speed matching & Sequencing

Three layered:

etwork
ccess
Layer

It is concerned with a exchange of data. Provides destination Address, priority, Invoke, transmission mode pe dependent.

Switching.

Circuited — In circuit switching a dedicated communication path is established b/w 2 station through Nodes of Network. We can see here physical links. Matlab Koi delay Nahi jaise data aata hai Vaise hi jaata hai

packet — data → divide (Smaller chunks) Each chunk has capability to Individually reach its destination through multiple nodes. Each packet has address of the destination.

Frame Relay

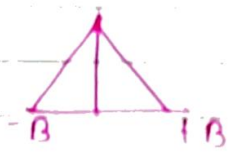
KYa hai packet switching mein overhead bits jaada lagate they Kyonki error Bohot tha but jaise jaise tech improve hua. Error ↓ Toh hamne overhead bits hataye aur variable size packets banaye → speed → 2 Mbps

Asynchronous Transfer Mode.

fixed size packets send Karte tha thode se overhead bits error correction Ke liye (fixed size) → overhead bits ↓↓ speed → 100 Mbps

PCM based Numericals

Signal K, Bandwidth B Hz



Sampling Rate : 2B sample/sec

Data rate 2B sample/sec
Transmitting Rate - 2nB Bits/sec

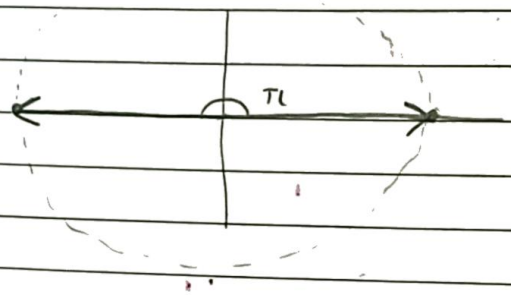
SNR = 1.76 + 6n , dB

Audio Signal freq f 4 KHz

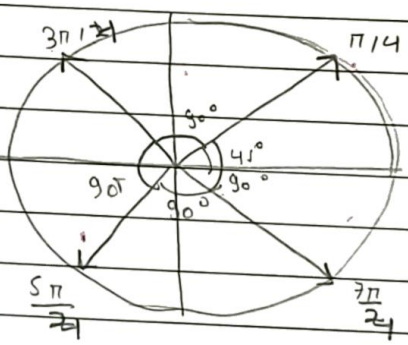
PCM Bandwidth nB

Constellation Diagram:

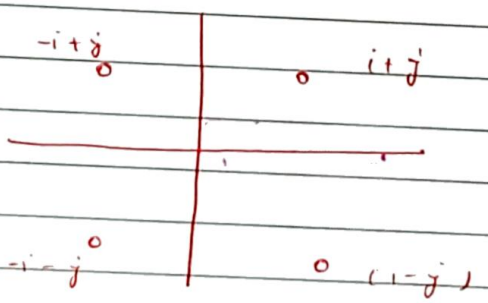
- BPSK

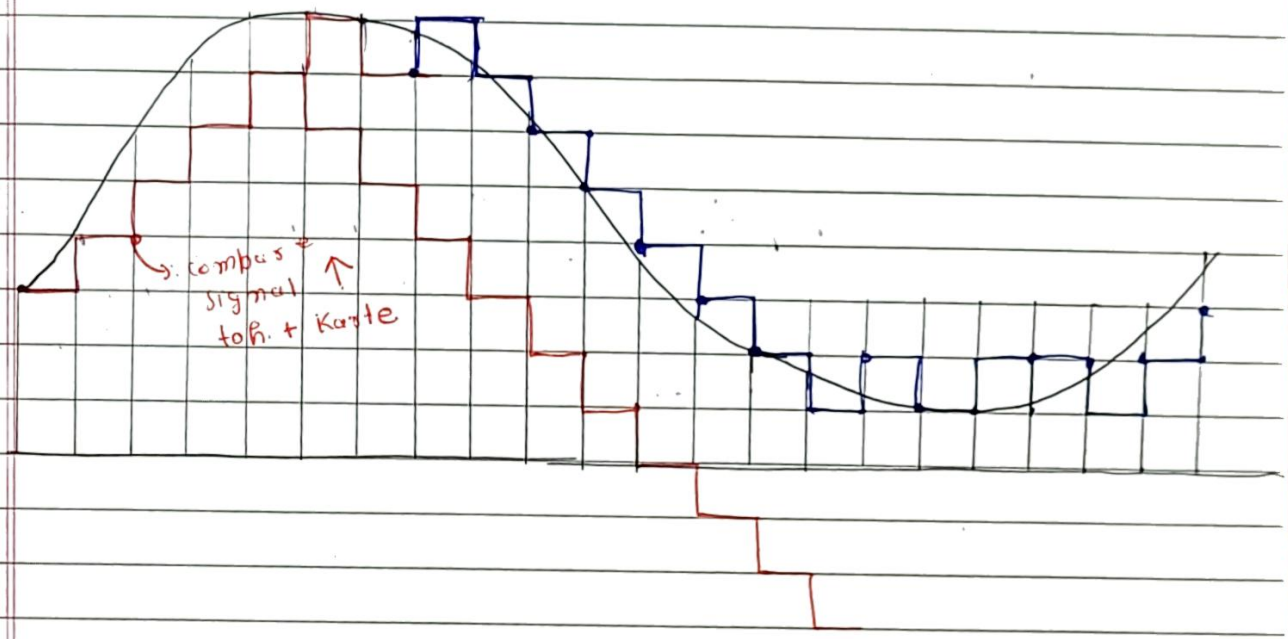


- QPSK



- QAM-4





You understand it Nicely.

Agar + δ = 1

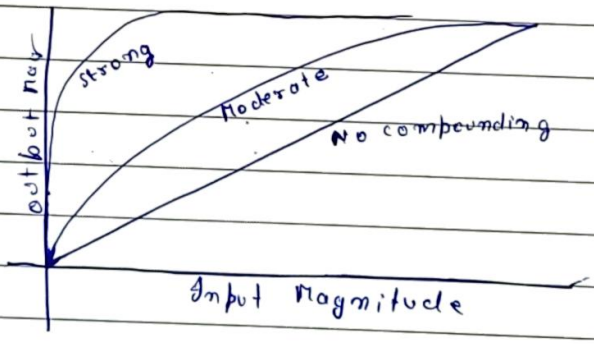
- δ = 0

* In PCM 8000 sample/sec (Advisable) → voice signal
* Quantization levels : 128
* Data rate = 56 Kbps
* Bandwidth = 28 KHz
* Normally Voice 4 KHz

Another Way

Companding — Lower Amplitude Ko higher amplitude mein convert Karo by multiplying with a function. Aur higher Amplitude Ko mat alter Karo

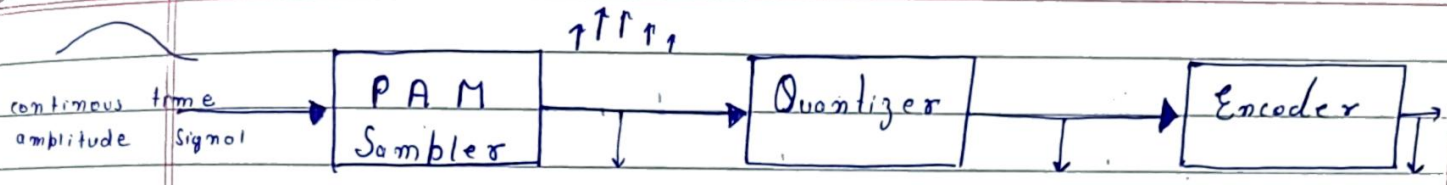
Companding function:



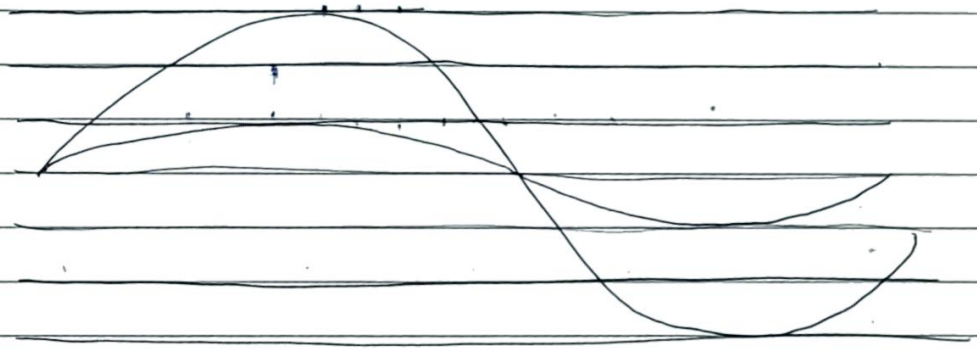
Delta Modulation

ek state bhejo aur phir signal agar jyada hai toh ek δ (step size upper) hum pechli state se compare karte hai

(Stair case Approach)

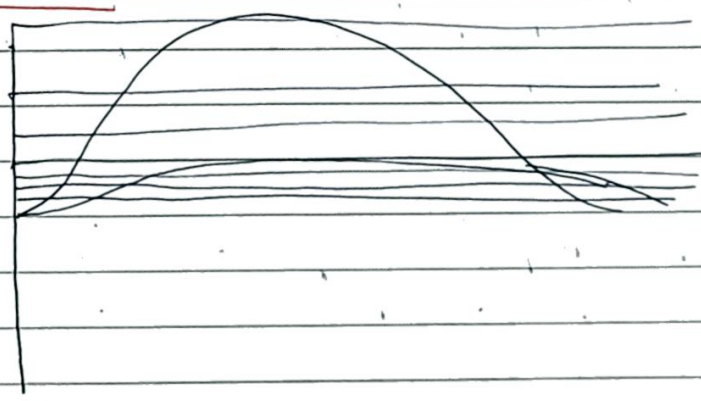


Linear Coding

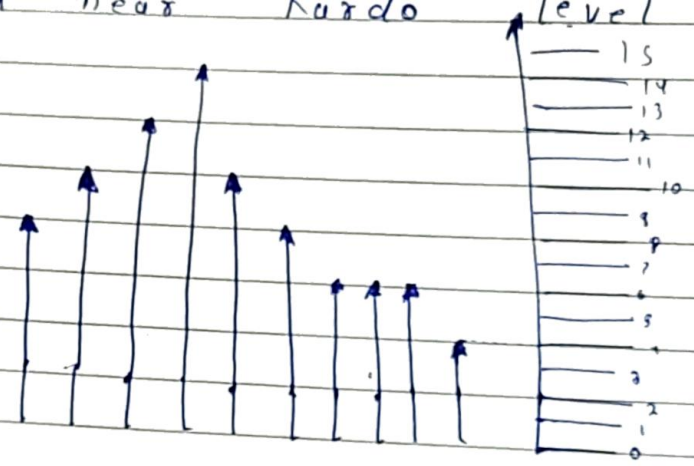


higher Amplitude mein toh koi dikkat nahi hai
but lower Amplitude mein error jaada hai
Kyunki

Non Linear



Quantization: Min se Max Amplitude ke beech kuch levels banalo 16 levels. phir har ek discrete Amplitude ko Round near kardo level ke.



Isey hame har ek voltage ka ek quantized no. milega.

Amplitude = 5.8 ⟶ 6
.2 error

⟶ Quantization Error.

PCM technique mein Zaroori nahi hai ki levels equally divided ho. Kuch levels ki beech mein Gap kam Zyada ho sakta hai.

Encoder: Har ek Amplitude pulse ko bit code assign kardia hai & we are good to go.

QAM

Ab isme hum ASK or PSK ko combine kar dete hai.

2 bits ke liye samjo.

Isme bhi I(t) Q(t) ka chakkar hai.

pehle bit divide karo Serial to II transfer se.

phir Carrier freq ko do parti mein divide karo ek doosre main $\pi/2$ ka gap.

phir iss Carrier freq par har ek bit I(t) or Q(t) ke liye Amplitude Modulation laga do.

Amplitude bhi depend

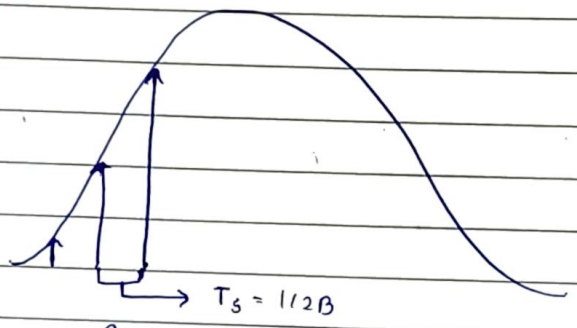
$$S(t) = d_1(t) \cos 2\pi f_c t + d_2(t) \sin 2\pi f_c t$$

phase change.

Analog & Digital Signals

Codec — Ek aisa device jo analog data ko digital data aur vice versa karta hai

Pulse Code Modulation



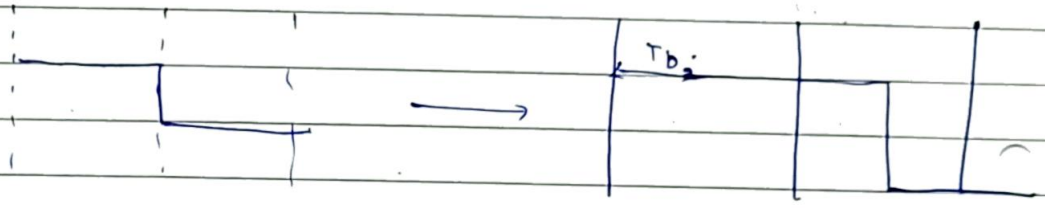
Ab ye ek continous time mein variable Amplitude hai

1st Step — discrete samay par Amplitude ki value lo

$$T_s = \frac{1}{2B} \qquad B = \text{Bandwidth}$$

$$f_s > 2 f_{max} \quad (f_{max} \text{ max freq Signal})$$

OQPSK Offset Quadrature phase shift keying jahan pe Q(t) mein hum ek delay laga dete hai @ Tb Ka jissey signal shift ho jata hai:



Issey fayda ye hota hai ki Tb samay pe dono mein se koi ek bit hee phase change karegi Toh Max to Max 90° phase change possible hai Nice thing for Modulator.

Performance

Here I am only specifying formulas.

ASK $B_T = (1 + \gamma) R$

MPSK $B_T = \frac{(1 + \gamma) R}{L}$

MFSK $B_T = \frac{(1 + \gamma) M}{\log_2 M} R$

1 pehli bit Ke liye $0 \rightarrow \frac{\pi}{2}$

2 sri bit Ke liye $\frac{\pi}{2} \rightarrow \pi$

Ab Samjo diagram

hum Kya Karege stream bits Ko divide Karenge I and Q aur agar

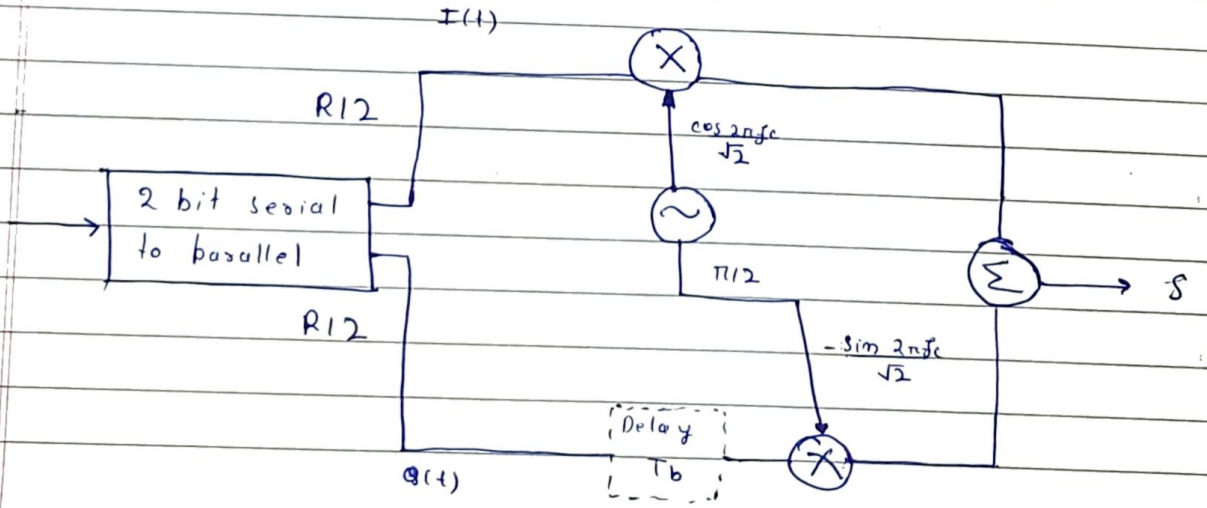
I (1) toh $\frac{\pi}{4}$ Ka phase change

Q (1) toh $\frac{3\pi}{4}$ $(\frac{\pi}{2} + \frac{\pi}{4})$ Ka phase change

Then Karde combine

$$s(t) = \frac{1}{\sqrt{2}} I(t) \cos 2\pi f_c t - \frac{1}{\sqrt{2}} I(t) \sin 2\pi f_c t$$

Cir Dig



PSK — Phase shift keying

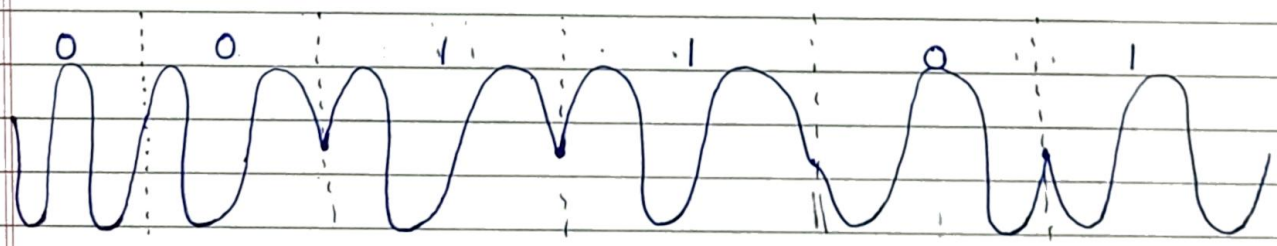
Two level PSK — The simplest scheme use two phases to represent two binary digits.

BPSK — $BPSK = s(t) = \begin{cases} A\cos(2\pi f_c t) & \} 1 \\ A\cos(2\pi f_c t + \pi) & \} 0 \end{cases}$

* Max phase shift hum π tak ka hi kar sakte hai

DPSK — Differential phase shift keying

Isme kya hota hai ki signal agar 0 hai toh same phase carry forward hota hai agar 1 encounter hota hai toh phase change hota hai



phase shift tabhi ho raha hai jab 1 aaye.

QPSK Ab isme bhi agar bandwidth efficient bana hai toh ek baar mein 2 bits bhejo za Zyada bhi bhej sakte hai

Max phase shift hai π

2 bits $\longrightarrow$ 4 combination $= \frac{\pi}{4}$ each.

QPSK $s(t) =$

$$\begin{cases} A\cos(2\pi f_c t + \frac{\pi}{4}) & 11 \\ A\cos(2\pi f_c t + 3\pi/4) & 01 \\ A\cos(2\pi f_c t) + 3\pi/4) & 00 \\ A\cos(2\pi f_c t) - \pi/4) & 10 \end{cases}$$

Ab Ye samjo Ki agar Kisi Cos wave mein $\frac{\pi}{4}$ ka phase change hai toh wave main Yeh $\frac{1}{\sqrt{2}}$ in case of cos toh Bol sakta hoo

$$\frac{1}{\sqrt{2}} \cos \omega t$$

Ab jo 2 bits AA rahi hai unhe Kaise divide.

Quadrature phase.

↓

Inphase

FSK Frequency Shift Keying

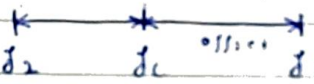
Different frequency different bits ko represent karti hai

BFSK Binary Frequency Shift Keying.

2 frequencies ka use karke sirf 2 bits 0 & 1

$$s(t) = \begin{cases} A\cos(2\pi f_1 t) & 1 \\ A\cos(2\pi f_2 t) & 0 \end{cases}$$

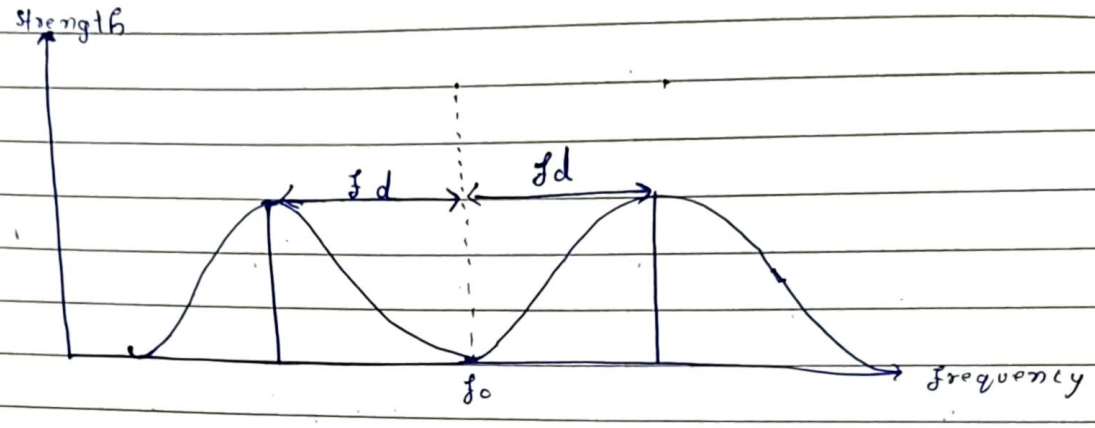
where f_1 & f_2 are offset from carrier frequency f_c in abb direction.



MFSK Multiple Frequency shift Keying

Ab maanlo bandwidth hai kam data bhej na hai jaada toh ek baar mein 2 bit bhejo

BFSK

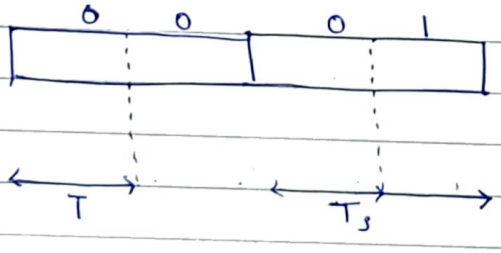


Bandwidth = 4 fd

MFSK

M = No. of different Signal Element
L = no. of bits per signal
fd = difference blw the frequencies

Band Width = 2 M fd ; T_s = LT ;



Eh bit fd doosri bit fd

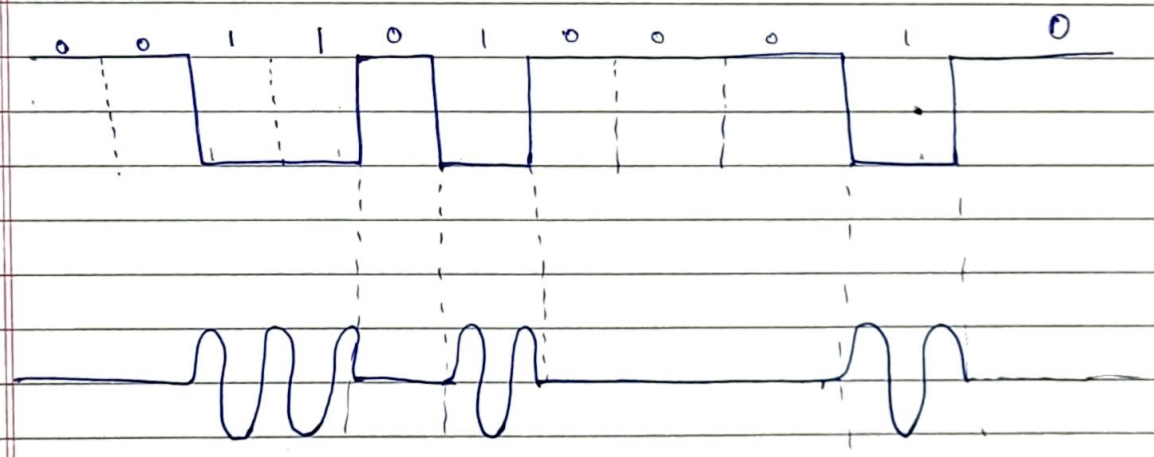
2 fd = 1 / T_s

Digital Data to Analog.

ASK Amplitude Shift Keying.

Do Different Amplitudes of carrier wave different values represent

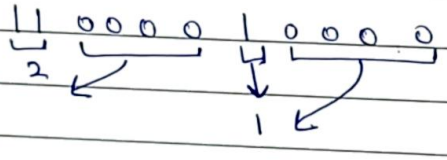
$$\text{Ask} \quad s(t) = \begin{cases} A \cos 2\pi f_c t & 1 \\ 0 & 0 \end{cases}$$

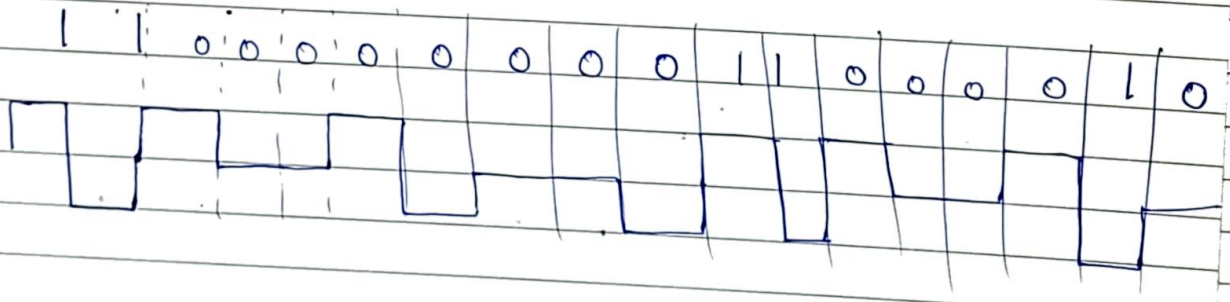


★ Zyada tar optical fibre transmission mein use hoti hai

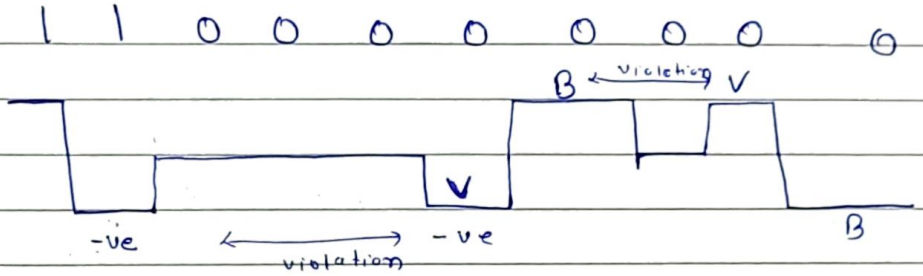
preceding polarity.	odd	Even
+	0 0 0 −	+ 0 0 +
	0 0 0 +	− 0 0 −

Ham check karte hai Ki Kitne 1's hai peeche





Agar pichla bhi -ve hai Aur upcomming bhi -ve hai toh vo Bipolar Ki violation Kar raha hai usse kehte hai V (Bit) or B (Bit).



Acc 000 - + 0 + -

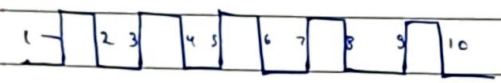
V (Violation bit)
B (Bipolar Bit)

000 V B 0 V B = (Seq)

HDB-3 High density bipolar 3 zero's.

- 4 zero's Ko replace Karta hai
- 4th zero hamesha code violation mein aayega. (V) (★)
- (V ⟶ violation succesive allernate bolarity Ke honge)

Matlab samjo transition Ka.



$= 10\ T_b$ (total time)

Total no of Transition = 10

Scrambling Techniques. Kya hua ki hamne AMI mein dekha hi 1 ko +ve or -ve se represent kara but continous zero ka hum kya karein toh hum kuch code assign kar dete hai jisse jo reciever vo ache se samaj paaye aur consecutive 0 ko phir unscramble karde.

B8ZS = Bipolar with 8 zero substitution

toh hoga kya 8 consecutive pehle last pulse dekhi jaayegi ki vo -ve hai ya +ve acc to that code Generate hoga

+ve 0 0 0 + - 0 - +

-ve 0 0 0 - + 0 + -

→ Remember

Block Coding

Jaise hame continous zero ya 1se problem thi na vo yahan pe hum resolve kar lete hai kya hai ki hum issey kehate hai

mB/nB coding.

Jisme hum code ko m bits mein arrange karte hai then unko n bits ke code se replace karte hai

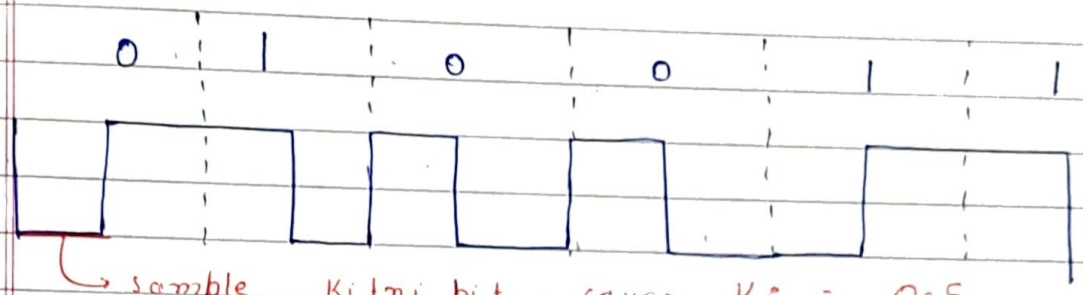
- division (Bits separate)
- Substitution (Replace)
- Combine (Join the bits)

$n > m$ → always.

4B/5B

0000 = 11110
0001 = 01001

→ Ex

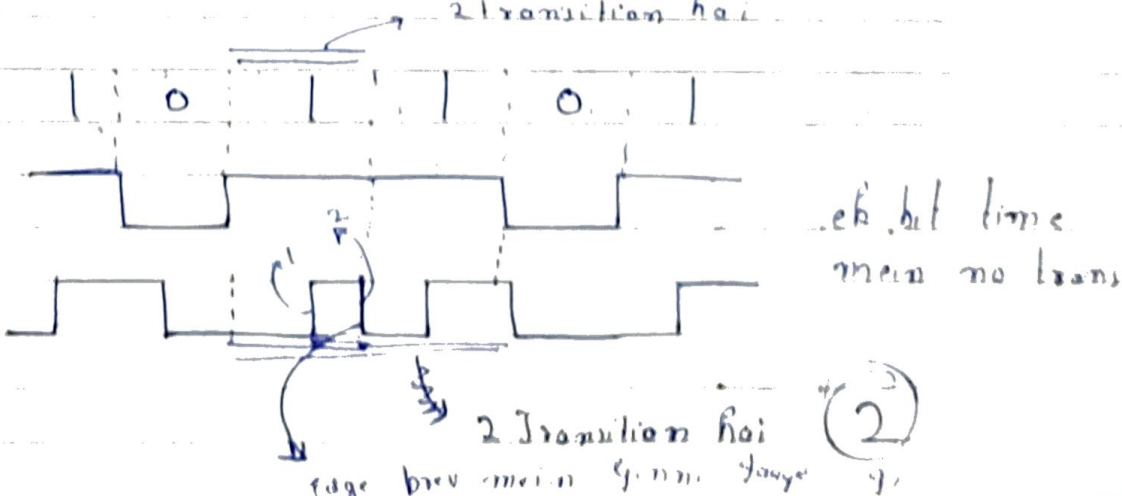


↳ sample Kitni bit cover Kr = 0.5

$$D = \frac{R}{L} = \frac{R}{0.5} = \underline{2R} \;//\; \underline{Easy}$$

Matlab agar starting mein transition hai vo represent karega 0 ko Nahi hai represent karega 1 ko

Modulation Rate = baud mein naapa jaata hai ki kitni baar eik T_b mein transition hota hai Ya toh 0 to 1 Ya 1 to 0. (different from bit Rate) = ham issey ase bhi samey sakte hai ki Transmitter kam se kam kitni der mein 0 to 1 Ya V V karna chahiye

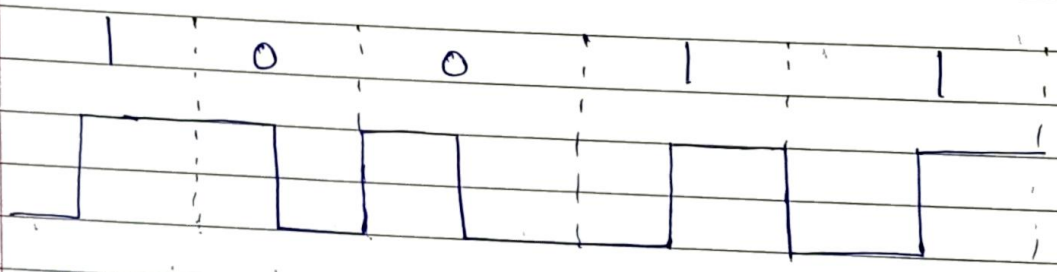


(2)

Biphase Another set of coding techniques

Manchester code
There is a transition at a middle of each bit period.
low to high = 1
high to low = 0

Midbit transition it can serve as a clock + sends data



Transition sirf middle mein Ya To be hota hai (beware).

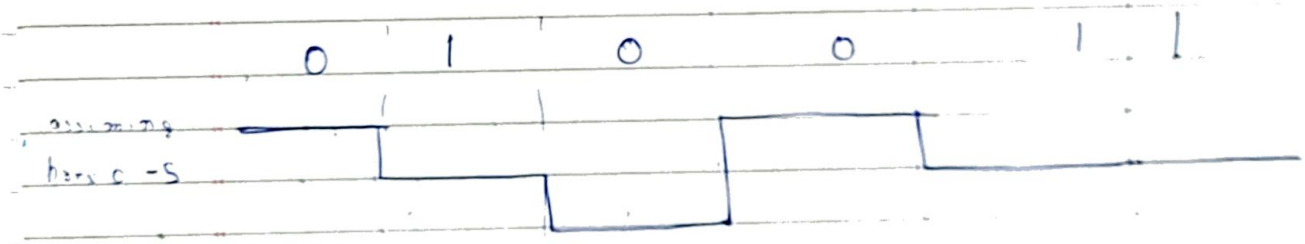
differential Manchester
Middle mein jo transition vo to hoga hamesha clocking Ke liye or starting Ke sumay jo transition hoga vo hoga bit Ke liye. agar hai toh 0 varna = 1

Faayda Ye hai Ke continuous ones mein easily differentiate ho sakta hai

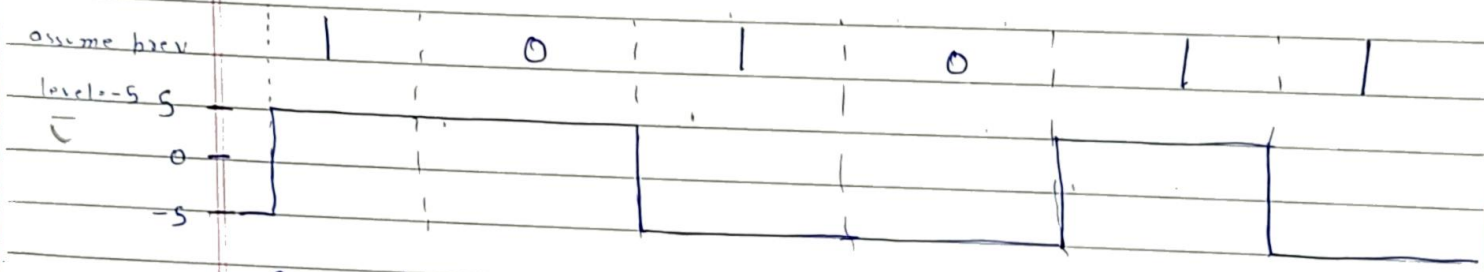
3 levels aap bhej rahe ho aur bits ho 2 toh ek tarike efficency kam hai

* Iske vajah se 3dB more power required hoti hai

Pseudo Jaisa pichla 1 Ke saath tha vaisa iska Ternary zero Ke saath hai 0 → 5 1-5 V
1 → 0 V



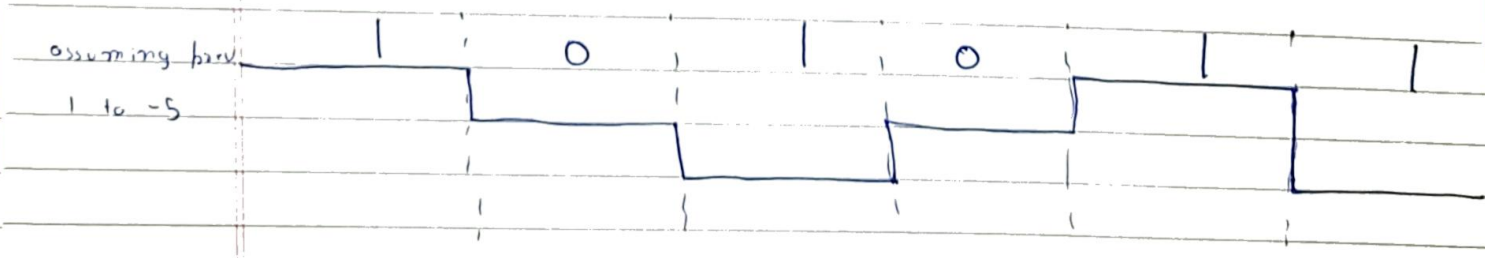
NRZ-I Ab isme kya hoga ki aapka jab 1 aayega toh voh apni prev level se change hoga or zero ka matlab change Nahi hoga.



Every time 1 pe level change.

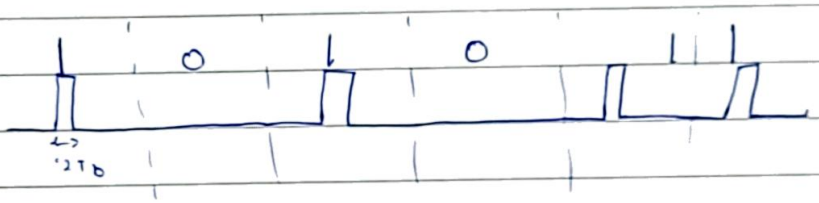
Bipolar 2 level se 1 ya 0 ko represent karte hai or usha jo opposite hota hai usko No line se represent karte hai. har ek 1 ya 0 (depend) on technique vo apne prev 1 ya 0 ka opp ho jaata hai.

Bipolar AMI
1 ⟶ +5 / -5 (Har ek apne prev 1 se opp hai).
0 ⟶ 0



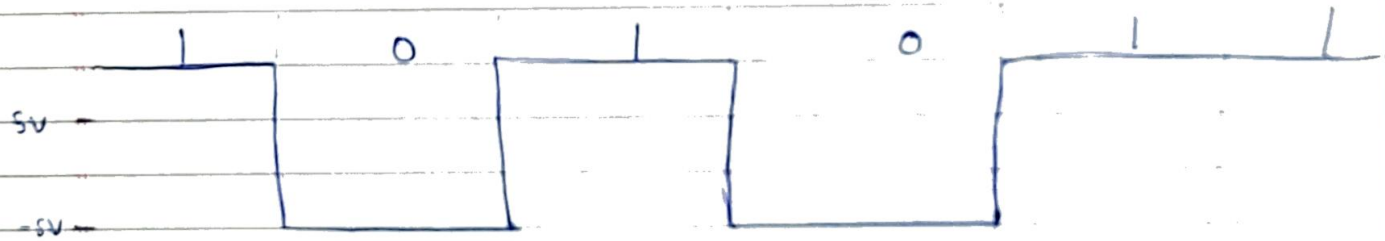
RZ — Tb Ke beech mein he agar High hua toh 1 maana jayega ; Power Save hoti hai Tb Tak 1 Kon rakhe.

* Reciever or transmitter sync mein hone chahiye varna pata kaise chalega K: Kab reciever sense Kare. Clocking is Necessary.



Polar — Two levels used hote hai 0 aur 1 Ke liye +5, -5V // +5V -3V (Jo bh.)

NRZ-L — Same as previous NRZ (+5) 1 -5 (0)



Chapter - 5

Signal Encoding - Converting a data (analog or digital) in a way so that it can be transmitted into a (digital or analog form)

→ Door Kitni hai, Noise, Kitni Voltages Rakhni hai. etc.

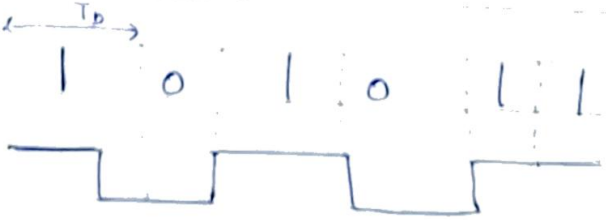
Techniques → unipolar, polar, bipolar } digital to digital

Line Coding → Conversion of digital data to digital signal

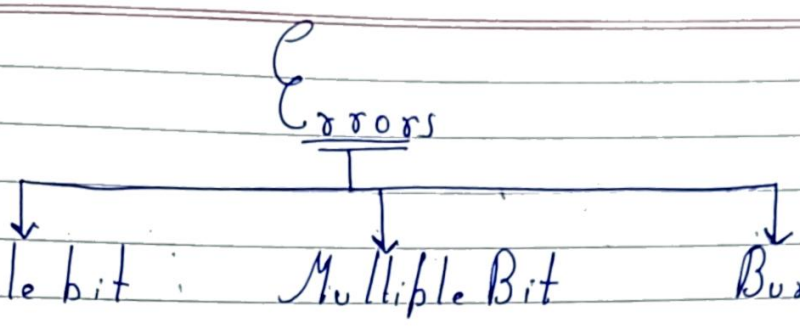
Unipolar → ek polarity ka - used to represent 1

→ NRZ (Non Return to Zero)
RZ (Return to Zero)

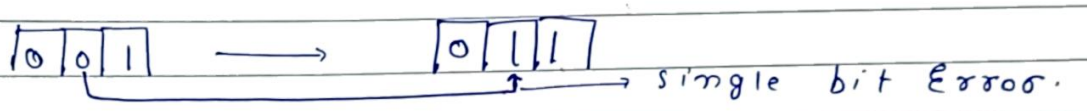
NRZ
1 pe high Volt
0 pe 0 Volt



T_b - bit duration (Kitne time tak active)

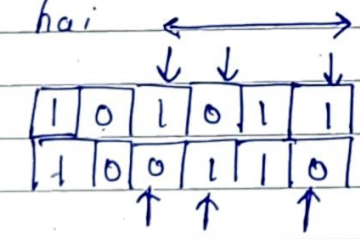


Single bit Yaani sirf ek bit ka error ho har ek sample mein.



Burst Error The Beam burst Error means that two or more bits in data unit have changed from 1 to 0 or from 0 to 1

Error Consecutive bits mein aaye zaroori nahi hai

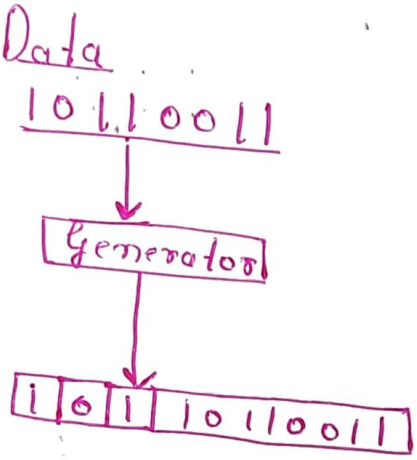


Burst Error length
first bit Error se last bit Error tak

Rebundancy bits.

Hamming Code jo sample hai maano 4 bits ka hai but hum usme Detection (Error) ke liye kuch Extra bit bhej sakte hai

Extra bits uses => Rebundancy bits.



Parity Check → Ab ye ek aisi bit hai jo ki 2 tarah se use hoti hai Even or Odd yaani

agar aap Sample meim odd parity hai toh Ye 1 ho jaati hai Agar even no° of 1 hai toh 0 ho jaati hai

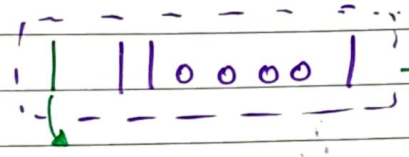
→ Even parity generator is ka vice versa odd parity generator

Data

1100001 (Eg VRC)

↓

Evenparity Generator

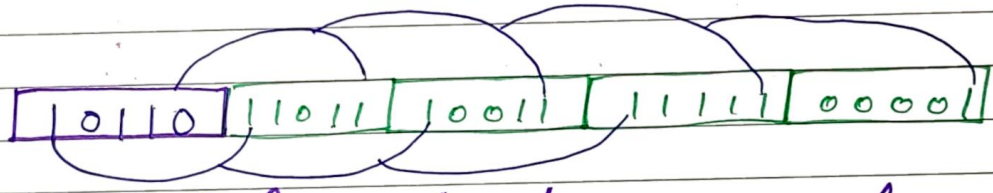


→ ab Signal ki parity Even hai

toh reciever par parity check O hee aana chahiye kyonki Signal meim always even no. of 1 hone chahiye.

★ Agar 2 bits change hui toh → ✗

LRC



parity check code banayega har ek block ka individual bit position ki

CRC

Cyclic Redundancy Check

K bit Ka message Generate hua ab hum Kya karte hai .ek n bit ka sequence hota hai known as frame check Sequence

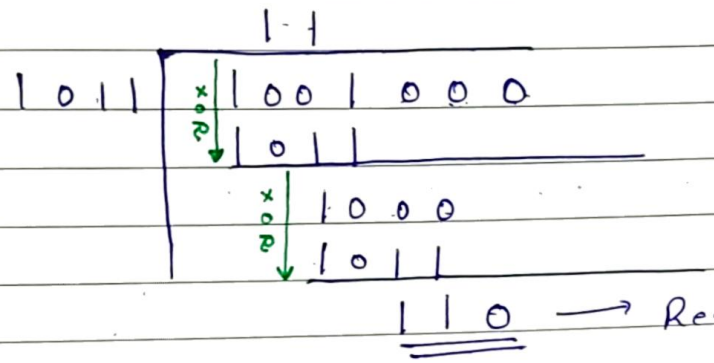
→ ab Ye jo Generate hua hai hum isko reciever pe karte hai check karte hai ki Kya vo FCS pre defined no se completely divisible hai If hai then No Error.

★ Isme hamara Jo Code word Banta hai vo aisa banta hai ki usko agar rotate kare toh vo hum ko meaningful Data word Show Karta hai

CRC Encoder

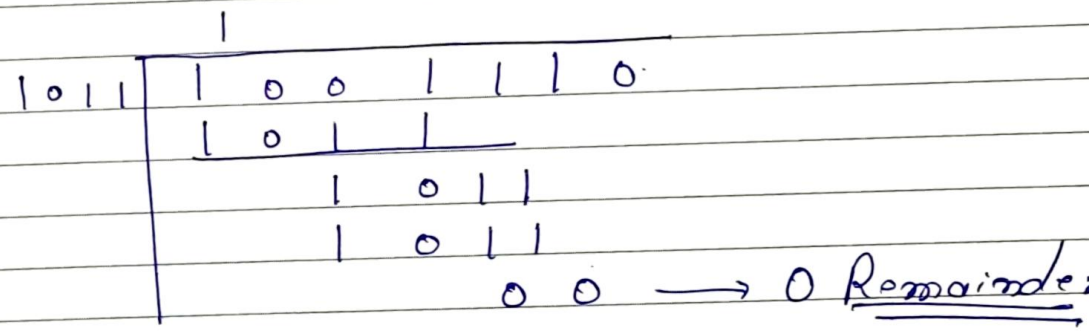
Dataword = 1001
Divisor = 1011 } Fixed Both Know back.
Redundancy = 3 →

{1001 0 0 0} by default 0
→ Data Ka Code word.



Codeword → 1001110

Decoder At Recievor



No Error

* Rebundancy bit 3 ha, toh divisor 4 bit ka hoga aur MSB 0 Nahi hogi 001 → 1bit consider hoga.

Agar Divisor polynomial ke form mein given hai

$$x^7 + x^5 + x^2 + x + 1$$

Jo x ki power hai vahan 1 baaki jagah 0

1	0	1	0	0	1	1	1
x^7	x^6	x^5	x^4	x^3	x^2	x^1	x^0

Check Sum

Sample divide karo k bection each of N bits.

Unka addition together through 1's compliment them.

Check Sum sent with data.

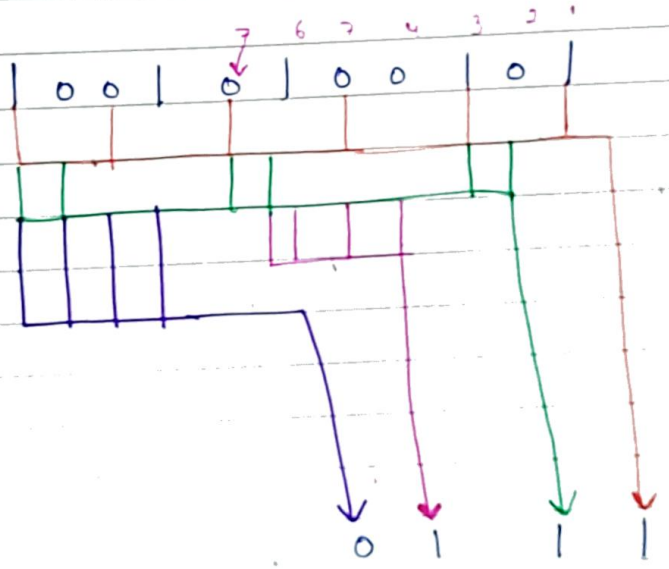
Reciever

Repeat the same process & Jo Sum 0 aaya yaani error free message hai.

1 0 0 1 0 0 1 1 1 1

Redundancy bits

Detection ki Check Ka Alag Scene hai



7 position bit Error

Flow Control

Ab kya hai Ye kuch aise protocols hai jo reciever aur sender ke beech main hote hai such that ki sender kab thoda wait kare message send karne se pehle. Kab vo repeat kare transmission agar galat recieve hua hai

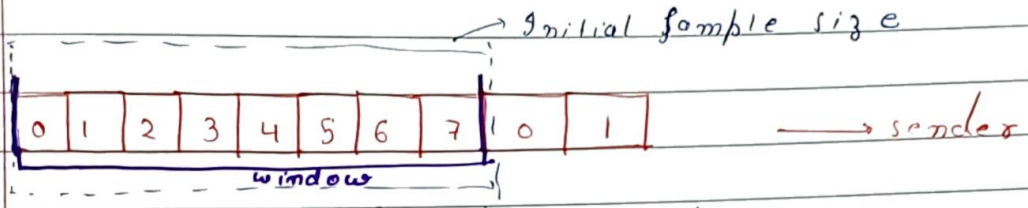
Flow Control refers to a set of procedures used to restrict amt of data the sender can send before waiting for acknowledgement

Jo data recieve hota hai uski processing bhi hoti hai toh processing slow hai transmission rate se toh reciever ke paas ek memory hai jo vo data ko store karta hai. → Buffer

Stop & Wait

har ek frame ke baad reciever Acknowledge karta hai ki sahi hai Ya Nahi then Sender Next Frame bhejta hai.

Sliding Window



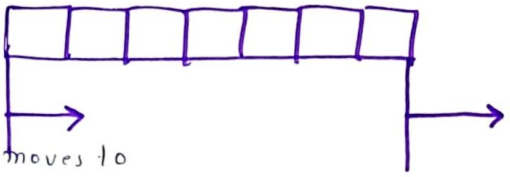
Ab isme kya hai ki sender n-1 samples bhej sakta hai ACK ke bina jaise jaise signal sent hote jaale hai Left side window ki taraf aati jaati hai suppose 3 sample bhejdiye yaani 0 1 2

0 1 2 3 4 5 6 7 0 1

Ab reciever jo acknowledgement bhejta hai vo bhejta hai agle sample ka seq jo vo recieve karna chaha raha hai iss case mein maano aaya 2 (Yaani 0, 1) Successfully Pohach Gaye toh Ab window ki right boundary 2 aage shift ho jayegi

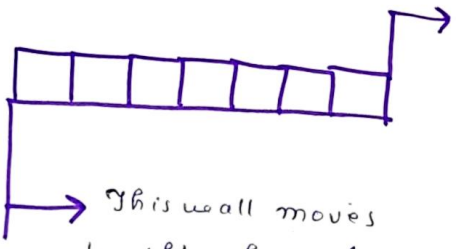
0 1 2 3 4 5 6 7 0 1

Conceptually the Sliding Window of Sender shrinks from left when frames of data are sent. The Sliding Window expands to right when acknowledgements are received.



Reciever

Reciever mein jo window hoti hai vo depict kaati hai No° of free slots jismein frame recieve ho raha hai.
Ab jaise hee reciever acknowledgement bhejta hai toh slot free ho jaate hai ek tarike se.



prior ACK = 2 ⟶ 0, 1, ⟶ recieve

window = 2 badgayi

ACK = 5 ⟶ 0, 1, 2, 3, 4 ⟶ recieve

window = 3 badegi°

Now ACK − prior ACK → Agar ye result -ve AAYe toh add kardo Yaani ☺

toh jo window ka size hai + 1

ARQ

Error Control in data link layer is based on Automatic Repeat Request which means retransmission of data in 3 Cases

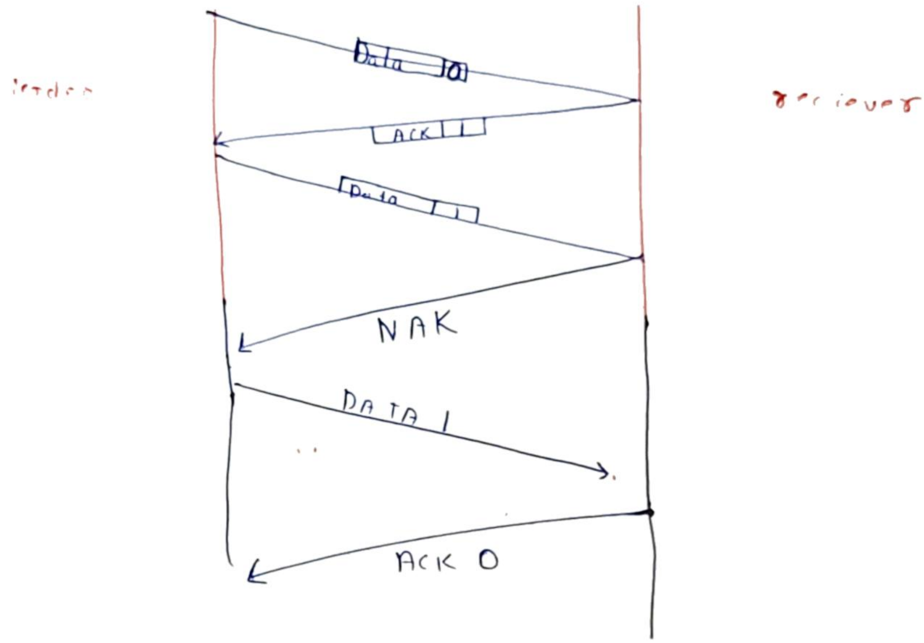
→ damage frame
→ lost frame
→ lost acknowledgement

Stop & Wait ARQ

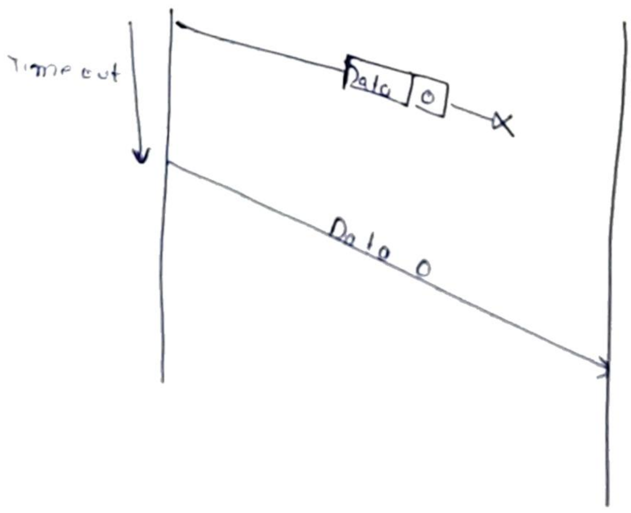
Sender transmitted signal ki copy rakhta hai last transmitted ki

Confusion No ho paaye isliye Data frame Sent & ACK recieve hota hai vo Alternate 0 & 1 ke hote hai. we will see Agar NAK → negative Acknowledgement ya.

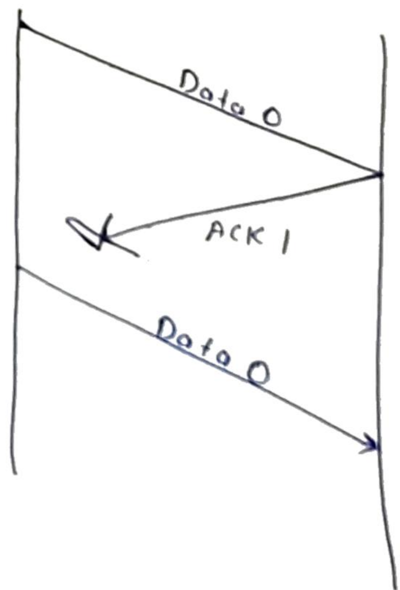
Eh time out hota hai sender ke paas. agar usey pehle ACK Nahi aaya toh sender same sample again send karta hai



Time Out



or



→ Data ka code

Sliding Window (ARQ)

Ab isme bhi sender transmitted frame ki copy rakhta hai jaise hee ACK AAYA maano 3 0, 1, 2 ki copy hat jaati hai.

But Hame NAK Har frame ke liye individually bhe

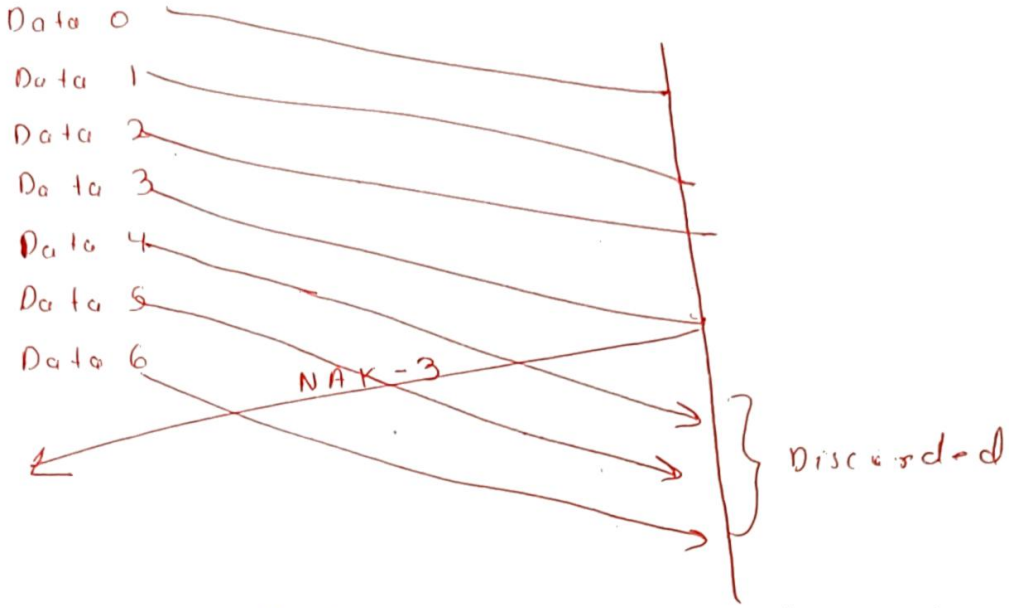
Goback n ARQ

Maanlo sender ne send kiya 0, 1, 2, 3, 4 ab NAK 2 recieve hua on Sender side toh Kya hoga reciever 2 Ke baad ke frames bhi recieve Nahi Karega Yaani 3, 4 Nahi recieve Karega bhale hee vo Intact Ho

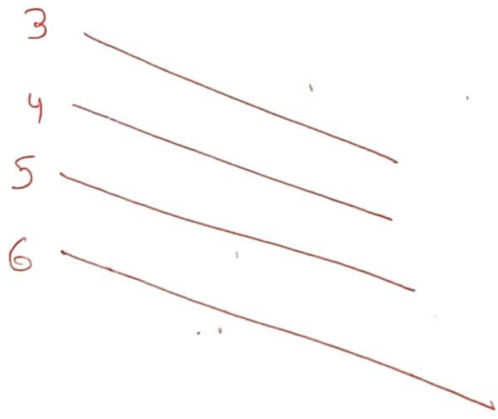
NAK 2 ka Matlab 0, 1 sahi recieve hue hai

toh Sender 2 ke baad jo bhi frame usne transmit kiya hai vo do bara transmit Karega.

2, 3, 4.



NAK 3 ko pohoch ne mein sender tak sender ne toh 4, 5, 6 bhej diye jo discard hogaye toh NAK-3 matlab 0, 1, 2 ⟶ sahi
toh ab 3, 4, 5, 6 ⟶ repeat honge



Selective Reject ARQ.

Ab isme kya hai ki aap jo frame galat hai usi ko retransmit karle hai. reciever automatic usko uski sahi jagah pe arrange kar dela hai.

reciever pe apna ek Sorting algorithm hota hai.

Searching bhi hoti hai

Aur jab tak Error frame Apni sahi jagah pe Nahi aa jata baaki upcoming frames buffer mein jate hai

$x^7 + x^3 + x^2 + x + 1$

10100111

PCM

Signal = B Hz

Sampling = 2B sampel 1sec

1001

Sampe = N bits.

= 2NB Bits 1sec.

PCM band = NB

SNR = 1.76 + 6N

Check Sum

1001 0011 → sample

1001 →
0011 →
1100 → comple = 0011 →

1001
0011
0011
1111 → com = 0000 → Error free.

CLASSMATE
Date :
Page :

NAP Network Access protocols

→ Source computer Address
→ Dest " "
→ Network facilities such as priority

SDU packets recieved by a layer are called Service data Unit.

OSI (Model)
(open system Interconnection)

Application — Allows access to network resource
Presentation — Translates Encrypts & compress data
Sessions — Establishes & manages Session
Transport — Reliable process for Error and message delivery.
Network — Move packets from Src to destination
Datalink — Organizes bit into frame provide hop to hop delievery.
Physical — Transmits over a medium provide Mechanical & electrical Specification.

Transport — Exchange Reliable, No Errors data same order mein recieve hona chahiye jaise bheja.

Application — Two level Address hota hai (Network Address) → sahi computer pe deliver ho

SAP (Service Access point) → Transport layer iss data Ko Konsi application Ko bheje.
(unique address for each Application in computer)

Har eh Application transport layer Ke facility use Karti hai

Terms

Encapsulation - The addition of control Information from transport layer is termed as encapsulation

PDU — Next higher layer control Information + Data

(Protocol data Unit) Transport PDU → Segments
Network PDU → packets

Transport PDU → Src port, Dest port, Error det, Frame check Seq, Seq Number

Baseband — Original Signal

Modulated Signal — Original Signal shifted to higher freq.

- Amplitude Modulation
- Phase Modulation
- Frequency Modulation. → ★.

Why Modulation.

$$\frac{\lambda}{4} = l$$

Normal Voice = 300 H_z — 3400 H_z

$$c = f\lambda$$

$$\frac{3 \times 10^8}{300} = \lambda = \frac{10^6}{} \lambda$$

$$l = \frac{\lambda}{4} = 25 \times 10^4 \text{ m}$$

$$= 250 \text{ Km} \rightarrow \times$$

high freq.

Increase distance
signal attenuated Nahi hota.
Multiplexing.

Camlin Page

Communication

★ Transfer of information from one place to another, should be efficient, reliable, secured.

★ System — Components / subsystem act together to accomplish information transfer / exchange.

Rate of Information — 2G, 3G, 4G, 5G → ☆

Source → Transmitter (→ modulator, Amplifier) → channel → Transducer

channel → medium

reciever → output transducer.

Source Transducer → microphone, Keyboard

medium → Twisted pair, cable, Fiber optics, wireless

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Terms to Remember

Attenuation $20 \log_{10} \frac{A_r}{A_t}$ or $10 \log_{10} \frac{P_r}{P_t}$ $K = 1.38 \times 10^{-23}$

Noise kT, kTB, $dB = -228.6 + 10 \log T + 10 \log B$

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

Nyquist $B = 2NB$

→ step Index, graded Index, single mode

→ IR - LOS, Microwaves - Satellite, Radio - System radio, paging System.

B8ZS + → 000 + - 0 - + , - 000 - + 0 + -

HDB3

	odd	Even
-	000 -	+ 00 +
+	000 +	- 00 -

PCM Numericals.

nB, 2^n, $2nB$; $1.76 + 6n$; $4\ kHz$

Datarate ↗

TCP/IP

A Application, T.P., Transport, Datalink, Physical

OSI

Application, present, session Transport Network Datalink, P

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In ALOHA (pure)

$G = ?$ $\quad S = G \times e^{-2G}$

Slotted

$G \times e^{-G}$

$K = k$, $\quad T = 2^K - 1$

$R = k \cdot T_b$

* The check Sum detects all error involving odd no. of bits.
* Agar har sample ki 3 bit damage ho jaaye toh check bit fail kar jaaye ga.

1 0 1 1 0 0 1 1

4 bits ke 2 Section.

```
1 0 1 1
0 0 1 1
1 1 1 0  ⟶ Sum + Complement
```

⟶ 0 0 0 1 ⟶ check Sum

Reciever

0 0 0 1 , 1 0 1 1 , 0 0 1 1

```
  0 0 0 1
  1 0 1 1
  0 0 1 1
  1 1 1 1  ⟶ complement
```

0 0 0 0 ⟶ No Error

Single Bit (Error) Correction

Let Data bits = m

Redundancy = r

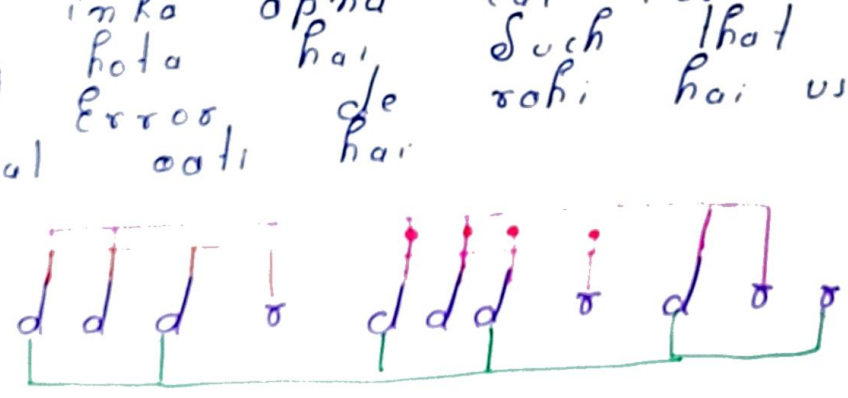
Total Message = $m + r$

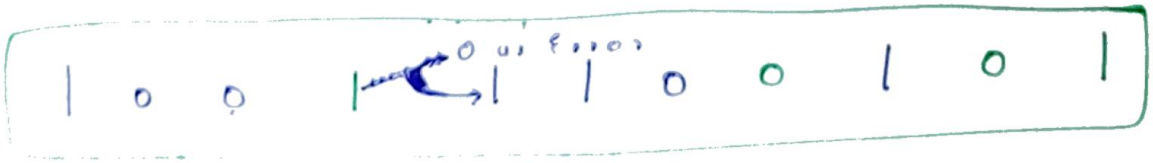
$$2^r \geq m + r + 1$$

Hamming Code

Redundancy bit beech main hoti hai aur inka apna alag hota bit Error Nikal aati hai

cal Karne ka tarika hai Such that ki do se rahi hai usi position

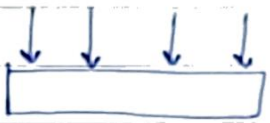




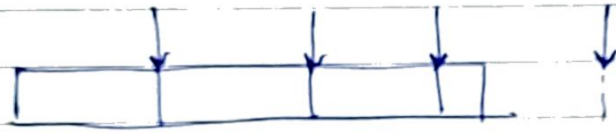
Sent

CSMA

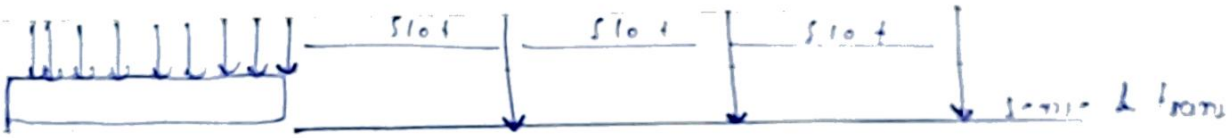
1> persistent

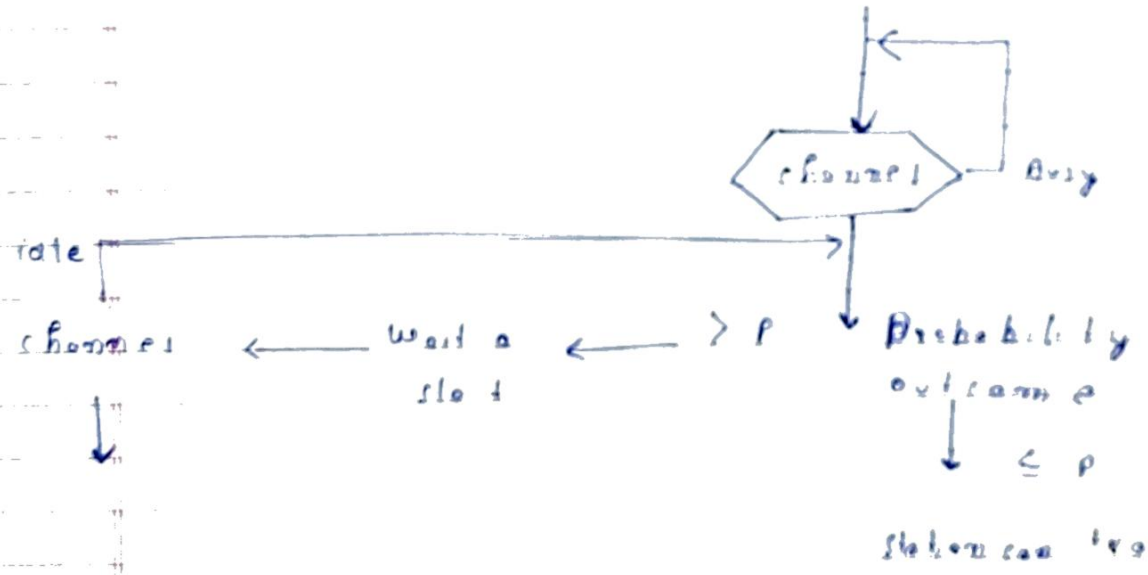


2> Sense at particular Interval



3> Probability outcome be depend both on fi:





Camlin Page

Through put → S → no. of successful transmission / total no. of transmission

G = load → Frames Generating / Sec / Total frames it can handle on medium

Medium = 1000 frames / sec
Nodes → All together = 500 frames / sec

$G = \frac{1}{2}$ ★

PURE ALOHA

$S = G \times e^{-2G}$

$G = \frac{1}{2}$, Max $S = .184$

Slotted ALOHA

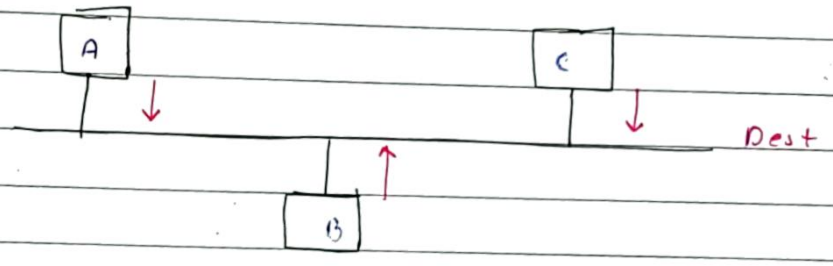
Vulnerable time = T_{fr}

$S = G \times e^{-G}$

$G = 1$ $S_{max} = .368$

MAC

Medium Access Control



Agar A, B, C saath mein Data trans mit Karenge Toh Data lost ho jaata hai ⟶ collision hogaya

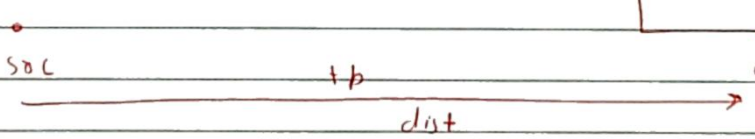
Access Control ⟶ vo batayega ki Kaun Kab Kab data transmit Karega.

Important Terms

K ⟶ no. of attempt for Successfull transmi
T_p ⟶ propagation time
T_{fr} ⟶ frame time
T_B ⟶ Back Off time

1 propagation time

$$t_p = \frac{dist}{c}$$



Camlin Page

Src ⟶ 20 kbps

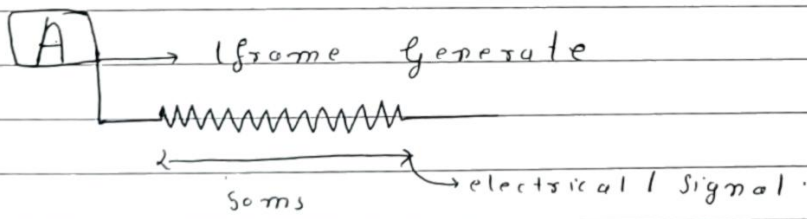
Frame length = 1000 bits

→ 20 frames / sec

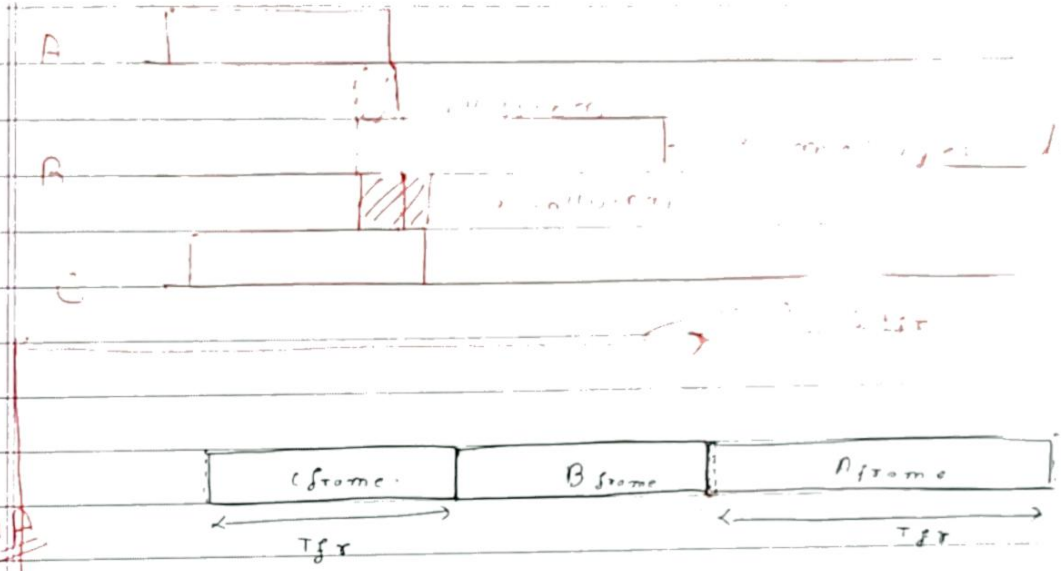
This means 20 frames take 1 sec so 1 frame will take

$$\frac{1}{20}\ \text{sec} = \frac{1000}{20} = 50\ \text{ms}$$

1 frame = 50 ms.



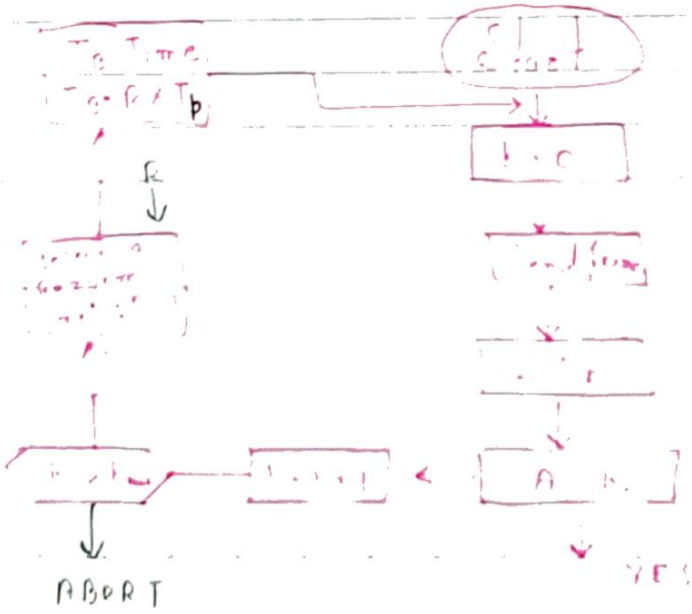
Collision



Agar main frame ko 2 Tfr ka gap de doon to collission nahi hoga.

Imp Pure ALOHA Vulnerable time = 2 Tfr

ALOHA



T_b = back off time . Ek Node Kitni dair wait Karega retransmission ke liye

~~R = k~~

$$T_b = R \times T_p$$

Ques

$K = 1 \quad = \{0, 1\} \quad R = 2^K - 1$

$T_b = 0 \times T_p = 0$ (Immediate transmission)

$T_b = 1 \times T_p = T_p$ (Wait Karega)

Range of Random no° = $2^K - 1$

Ques

PURE ALOHA → Frame Collision free chahiye toh main issey vulnerable time

$= 2 T_{fr}$