21 sep

data → Information

Data Communications

→ "Telecommunication" means communication at a distance.

→ "Data" refers to "information presented" in whatever form is agreed upon by the parties creating and using the data.

→ "Data Communications" are the exchange of data between two devices via some form of transmission medium such as a wire cable.

Components

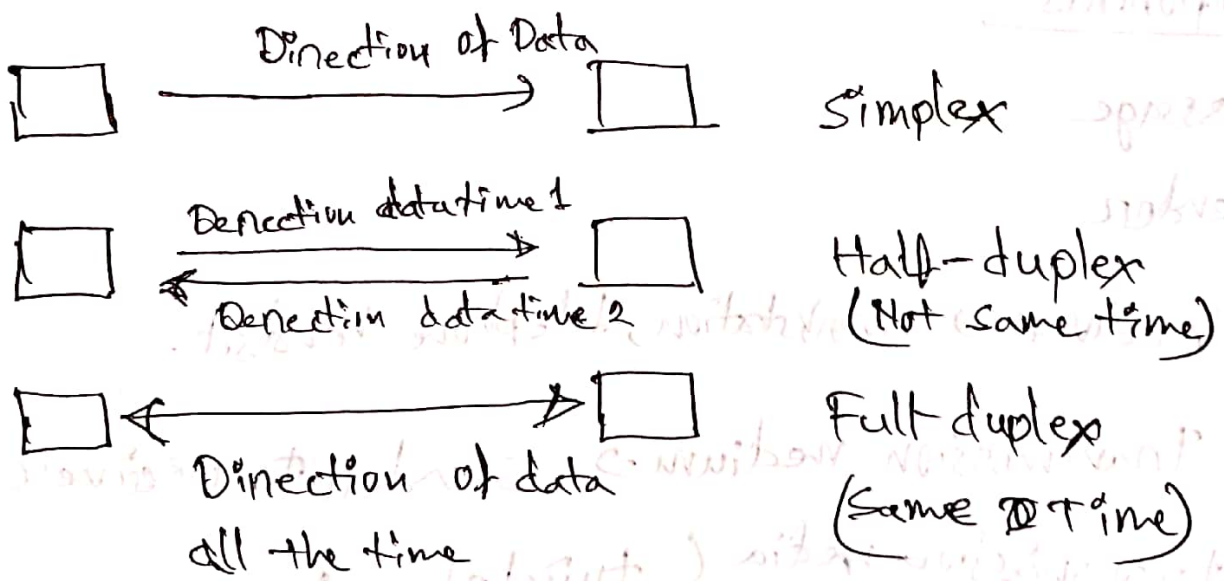
- Message
- Sender
- Receiver → workstation, telephone handset.
- Transmission medium → sender to receiver. Example of transmission media (twisted-pair wire, coaxial cable, fiber-optic cable, and radio waves.

[wire

Protocol: Set of rules that govern data communication. It represents an agreement between the communicating devices.

Data Representation

Direction of Data flow



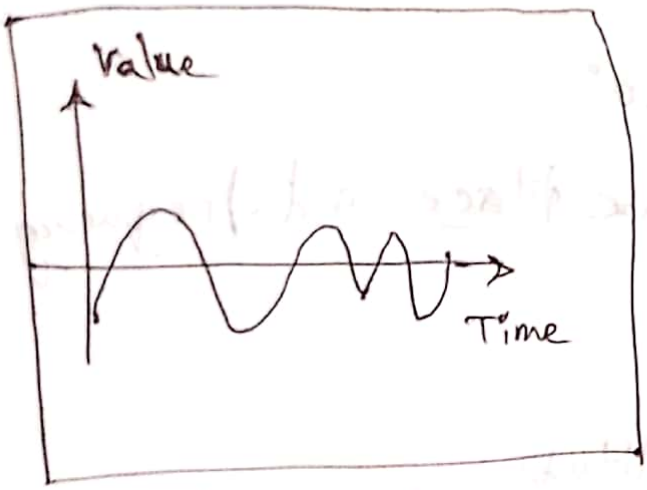
Analog and Digital

Data can be analog or digital.

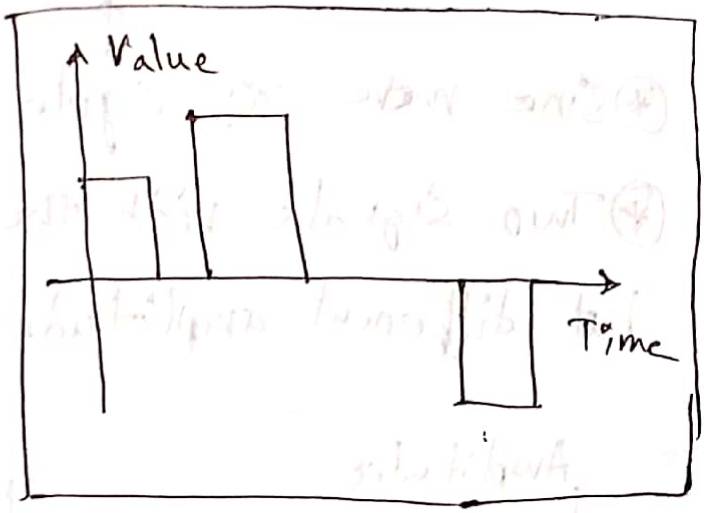
→ The term analog data refers to information that is continous; Digital data refers to information that has discrete states.

Signals can be analog or digital.

→ Analog signals can have an infinite number of values in a range; digital signals can have only a limited number of values.



Analog signal



Digital signal

We commonly use periodic analog signals and non-periodic digital signals.

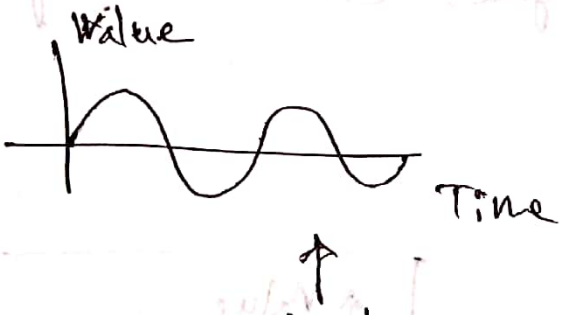
Periodic Analog Signals

Periodic Analog signals can be classified as 'simple' or 'composite'.

A simple periodic analog signals, a sine wave, cannot be decomposited into simpler signals.

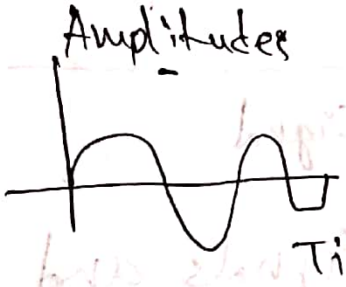
A composite periodic analog signals is composed of multiple sine waves.

Sine wave



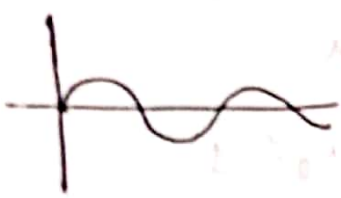
↑

* Sine wave 00 . cycle = 360°
* Two signals with the same phase and frequency but different amplitudes.



(a) Two signals with the same amplitude and phase, but different frequencies.

$f = \frac{1}{T}$ and $T = \frac{1}{f}$



Frequency concerns:

(1) Frequency is the rate of change with respect of time

(2)

28 Sep

Sin Wave

$y = \sin x$

+1 to -1

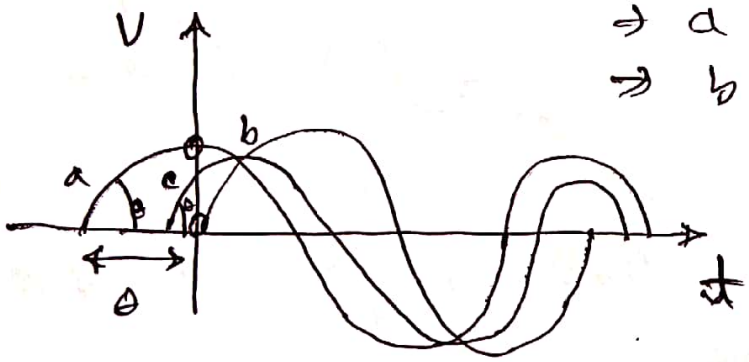
* $V = A \sin(\omega t + \theta)$

A → Amplitude

ω → angular frequency

* $\omega = 2\pi f$

Here,



→ a sin wave

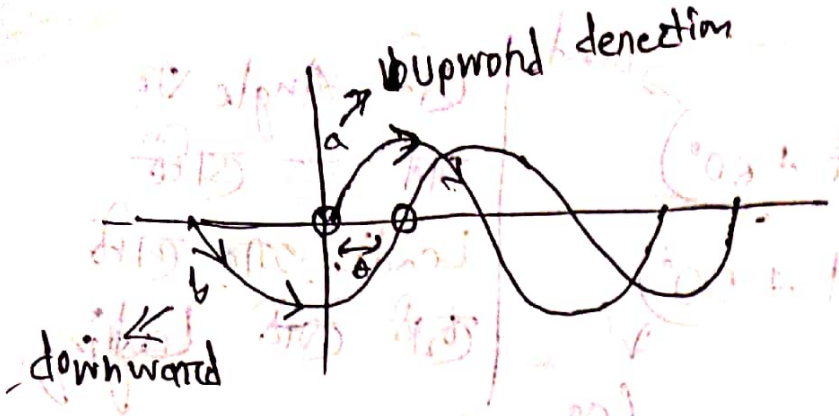
⇒ b cos wave

a > c > b = θ अंश

sin & cos wave में difference,

$\sin\theta = \cos(90° + \theta)$

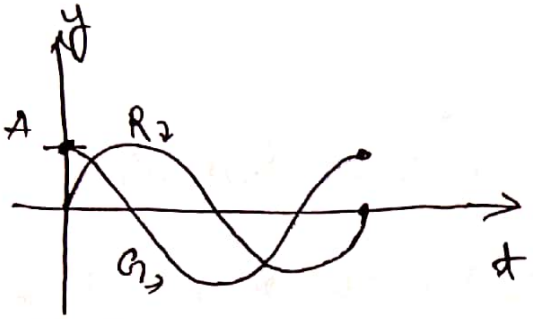
$\cos\theta = \sin(90° - \theta)$



সবসময় তোরা wave এর θ 360°.

Angle difference

#



$y_R = A\sin(\omega t + \theta_R)$ 0

$y_G = A\sin(\omega t + \theta_G)$ → 90°

Green wave (cos)

$y = A\sin(\omega t + \theta)$

$\Rightarrow A = A\sin(0 + \theta)$

$\Rightarrow 1 = \sin\theta$

$\Rightarrow \theta = 90°$

} Phases.

Red wave

$y = A\sin(\omega t + \theta)$

$\Rightarrow 0 = A\sin\theta$

$\Rightarrow \sin\theta = 0$

$\Rightarrow \theta = 0$

$\therefore y_G$ is leading y_R.

Exam Imp

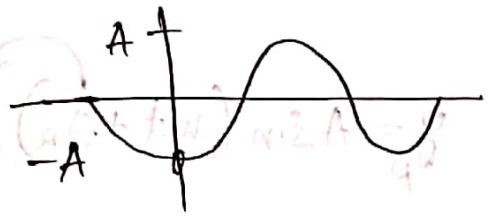
Exam এ যেভাবে দাও

$y = A \sin(\omega t + 60^\circ)$ → Lead

$y = A \sin(\omega t + 30^\circ)$ → Lag

যেটি Angle এর মান বড় হবে সেটি Leading. আর যেটি ছোট সেটি Lagging.

#



$y_B = A \sin(\omega t + \theta_B)$

$\Rightarrow -A = A \sin(\theta_B)$

$\Rightarrow \sin\theta_B = -1$

$\Rightarrow \theta_B = 270^\circ = -90^\circ$

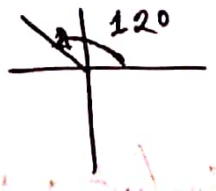
$\therefore y_B = A \sin(\omega t - 90^\circ)$ → Lag

$\therefore y = A \sin(\omega t)$ → Lead

$\theta = 180^\circ$ এর ক্ষেত্রে হবে না,

Example

$y = A\sin(\omega t + 120^\circ)$



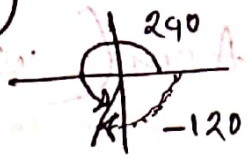
$y_1 = A\sin(\omega t + 240^\circ)$

$= A\sin(\omega t + 360^\circ - 120^\circ)$

$= A\sin(\omega t - 120^\circ)$

$\sin(360 + \theta^\circ) = \sin\theta$

-360
$+240$
-120



Ex 2

$y = A\sin(\omega t - 240^\circ)$

$= A\sin(\omega t + 360^\circ - 240^\circ)$

$= A\sin(\omega t + 120^\circ)$

$\sin\theta = \sin(360 + \theta^\circ)$

~~অথবা বিয়োগে~~

আছে,

$y = A\sin\alpha$

$= A\sin(\omega t - 240^\circ)$

$= A\sin(360^\circ + \alpha)$

Example-3

$y_1 = A \sin(\omega t + 130^\circ)$

$y_2 = A \sin(\omega t + 260^\circ) = A \sin(\omega t - 100^\circ)$

$y_3 = A \sin(\omega t - 300^\circ) = A \sin(\omega t + 60^\circ)$

$y_4 = A \sin(\omega t - 30^\circ)$

Sol

$y_1 > y_3 > y_4 > y_2$

(Ans)

3 Oct

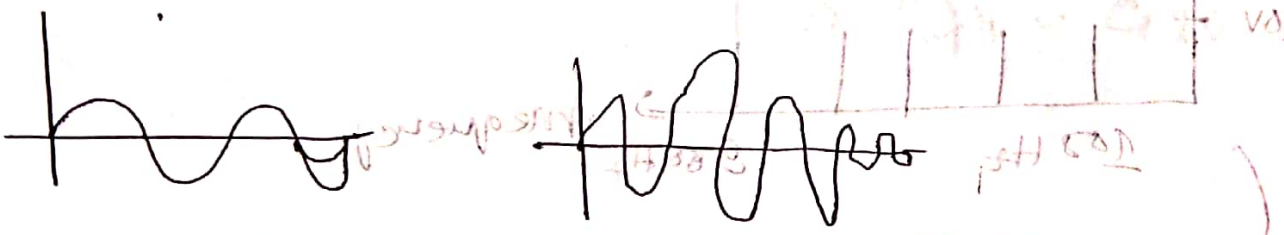
Signal → Signal is a representation of data. Signal is represented in electronic format.

Composite signal: Many simple sine wave.

* Fourier analysis, any composite signal sine waves, amplitudes and phases.

Composite signal and periodicity

* periodic → discrete frequencies.
* Non-periodic → Continuous frequencies.



periodic

Non-periodic

Bandwidth → A composite signal is the difference between the highest and lowest frequencies.

50 MHz

Example: GP → 1800 MHz to 1850 MHz

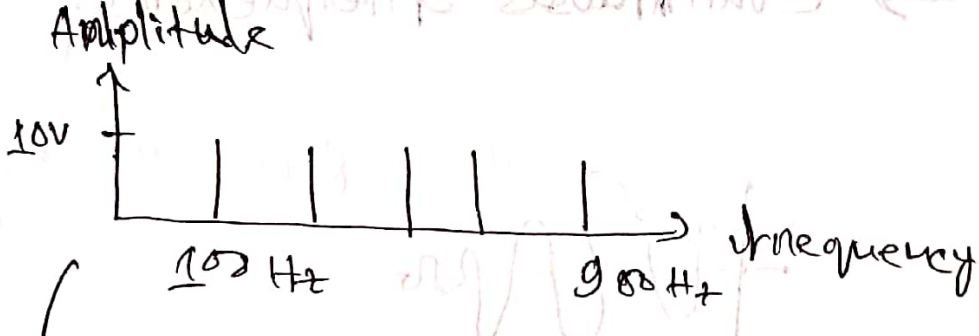
Robi → 1860 MHz to 1890 MHz

∴ High → GP, Low → Robi

30 MHz

P1: 800 Hz [Bandwidth problem]

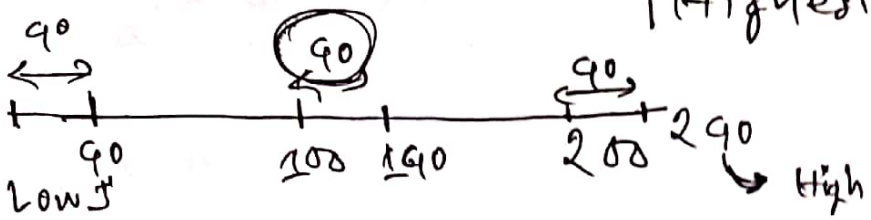
$B = f_h - f_l = 900 - 100 = 800$ Hz

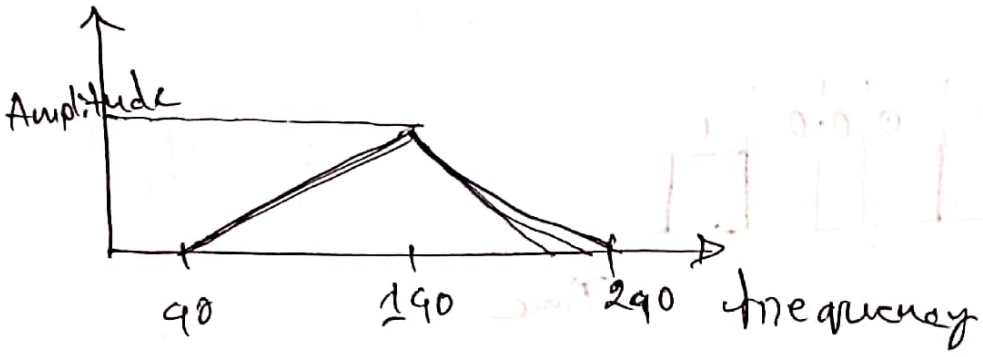


Spectrum Draw

Bandwidth = $f_{high} - f_{low}$

Q2/ Bandwidth = 200KHz { Low = 90 KHz, Highest = 290 KHz.





(12) Mark

Explain:

$f_h - f_l = 200$

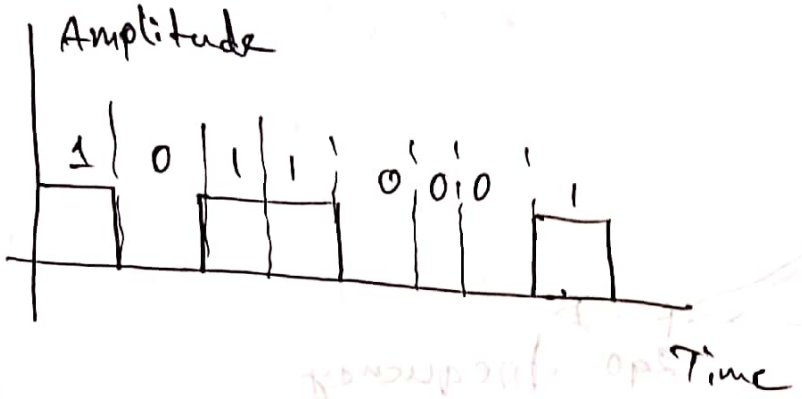
$\Rightarrow (f_h + f_l)/2 = 190$

$f_h - f_l = 200$

$\Rightarrow f_h + f_l = 280$

$\Rightarrow 2f_h = 480$

Digital Signal



Octal = 3 bit

Hexadecimal = 4 bit

∴ If we need n bit then get 2^n bits.

* We can work with 2, 4, 8, 16, 32 levels.

Math Problem

$\log_b a$ → argument

↓ base

Sol: (a) no

Given, Levels = 8

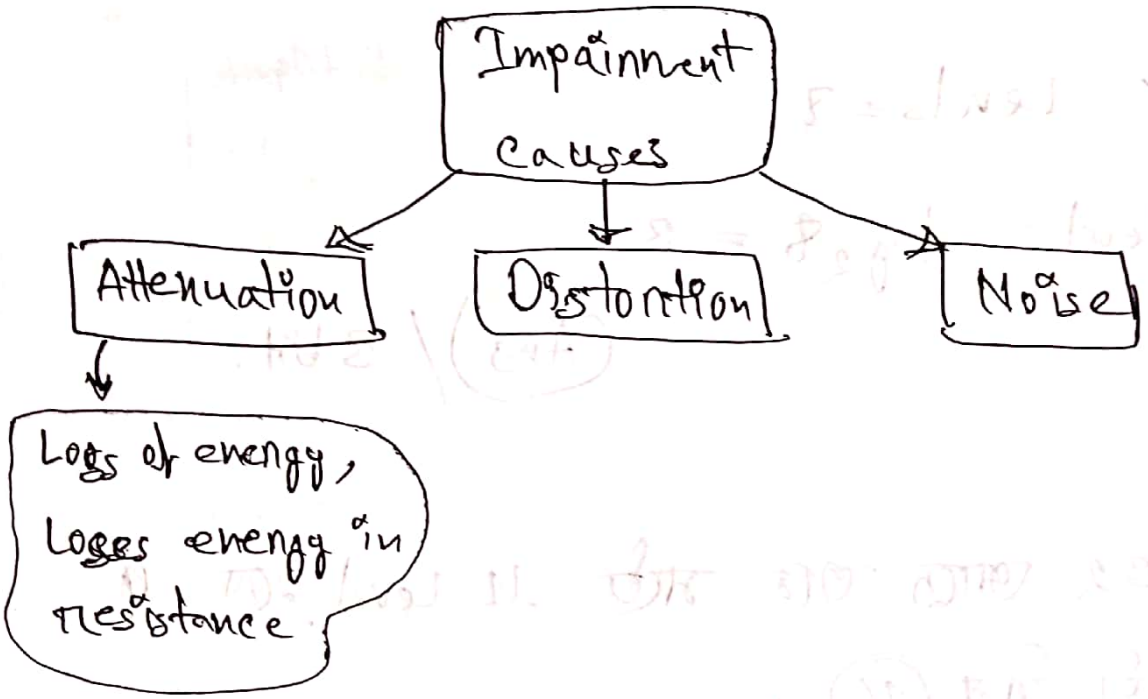
∴ bits per level = $\log_2 8 = 3$

(Ans) / 3 bit.

(#) 2, 4, 8, 16, 32 আকে তার মধ্যে 11 Level যদি upper limit দেয় (16),

Transmission Impairment

Signal travel through media which is not perfect. Three causes of impairement.



Measurement of Attenuation

Loses or gain energy units 'decibel',

$$dB = 10 \log_{10} P_2/P_1$$

Where,

P_1 = Input Signal Power.

P_2 = Output " ".

Math

(-) ঋণাত্মক Loss
(+) " Gain

(*) Given, $P_2 = \left(\frac{1}{2}\right) P_1$

Here,

$$10 \log_{10} \frac{P_2}{P_1}$$

$$= 10 \log_{10} \left(\frac{0.5 P_1}{P_1}\right)$$

$$= 10 \log_{10}(0.5)$$

$$= 10 \times (-0.3)$$

$$= -3 \text{ dB}$$

∴ Loss of 3 dB.

(#) Given,

power increase 10 times.

$P_2 = 10 P_1$

Here,

$$10 \log_{10} \frac{P_2}{P_1} = 10 \log_{10} \left(\frac{10 P_1}{P_1}\right)$$

$$= 10 \log(10^{10})$$

$$= 10 \times (1) = 10 \text{ dB}$$

∴ Gain 10 dB.

(Ans)

(*) Given,

milliwatts → power এ milli এ convert করা,

Here,

$dBm = 10 \log_{10} P_m$

$\Rightarrow -30 = 10 \log_{10} P_m$

$\Rightarrow P_m = 10^{-3}$ mW

Ans

(#) Given,

per kilometer loss = −0.3 dB/km

Input, P_i = 2 mW

So, loss = 5 × (−0.3)

= −1.5 dB

watt ⇒ dB
milliwatt ⇒ dB_m

Here,

$$dB = 10 \log_{10} \frac{P_2}{P_1}$$

$$\Rightarrow -1.5 = 10 \log_{10} \frac{P_2}{P_1}$$

$$\Rightarrow \frac{P_2}{P_1} = 10^{-0.15}$$

$$\Rightarrow P_2 = 0.71 \times P_1$$

$P_1 = 2$ → $\Rightarrow P_2 = 0.7 \times P_1$

$= 0.7 \times 2$

$= 1.4 \text{ mW}$

Last moment have to set

(Ans)

$\log_{10} x = y$

$\Rightarrow x = 10^y$

$$dB = 10 \log_{10} \frac{P_2}{P_1}$$

$$\Rightarrow \frac{-1.5}{10} = \log_{10} \frac{P_2}{P_1}$$

$$\Rightarrow -0.15 = \log_{10} \frac{P_2}{P_1}$$

$$\Rightarrow 10^{-0.15} = \frac{P_2}{P_1}$$

$$\Rightarrow 0.71 = \frac{P_2}{P_1}$$

Distortion

→ composite signal.

delay হলে
এর shape change
আসলে এটি
Distortion.

Noise

different types of noise →

Thermal → noise of electrons in the wire creates an extra signal.

Induced →

10 Oct

Signal to Noise Ratio (SNR)

$$\uparrow SNR = \frac{S}{N} \uparrow$$

∴ N এর তুলনায় বড় হলে, তাকে Noise বলা যাবে,

(*) SNR = 1.4

∴ Signal is greater.

(*) SNR = 0.8

∴ Noise is greater.

(*) $\log_2\left(\frac{S}{N}\right)$

∴ (+) হলে Gain, (−) হলে Lose.

Note: digital এ না দিলে log এর Base '10' use করব, এবং digital এর জন্য '2' use করব,

Math SNR

(*)

$$SNR = \frac{10{,}000\ \mu W}{1\ W} = 10000$$

$$SNR_{dB} = 10 \log_{10}(10000)$$

$$= 10 \log_{10}(10^4)$$

$$= 40$$

Ideal Condition

SNR and SNR_{dB},

$$SNR = \frac{\text{Signal power}}{0} = \infty \quad [\text{Real life এ হয় না}]$$

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

We can never achive this ratio. It is an ideal condition

(#) আমরা Signal এ সবসময় noise যোগ হবেই,

Material ③

Data Rate Limits

⇒ Explain:

$L = 2^n$ [n number of bits]

Level

$\therefore L = 2^3 = 8$

⇒ 000, 001, 010, 011, 100, 101, 110, 112

Logic →

0V → 0

5V → 1

$\therefore$ 4.5V হলেও '1'. Totally '5V' যাচ্ছে না, কিছু Lose হয়,

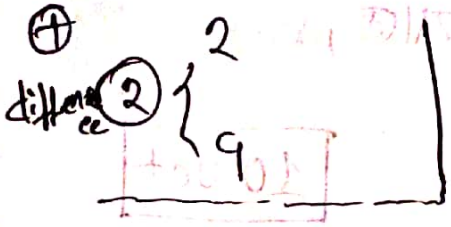
(2)
(4)

Value = 2.7 → (2)

⇒ কোনো নয়েজ noise add হয়ে 2.9 হলে = (2) ই হবে,

⇒ noise এসে 3.1 হলে (4) হবে,

Case 1

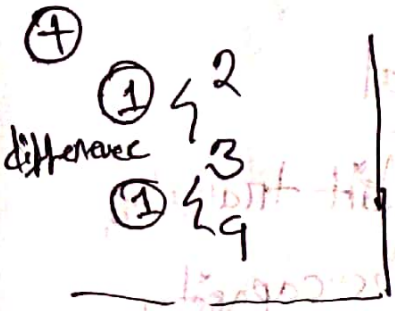


value = 2.3, 2.8, 3.1, 3

2 2 9 9

→ middle এর ~~বড় টাই~~

Case 2



2.3 2.8 3.1

2 3 3

(*) case 1 & case 2 এর মধ্যে Ennon কোনটি কম?

⇒ Case 2.

Example:

0
1

00
01
10
11

10 → 00 → 50%

01 → 100%

11 → 50%

(*) আমি 110 এর bit পাঠিয়েছি, কিন্তু 100 আসছে 1 টি bit হারিয়ে গেছে।

110
100

∴ Ennon = 33%

Note: Bit বাড়লে Error বেড়ে যায়,

— x —

10 Oct

Bandwidth

→ bandwidth in hertz, composite signal

→

Bit transmit, is capacity

Capacity of a System

→ When we increase one level on bit our capacity will increase.

Ex:

$C \propto B$

$C \propto n$

$C \propto nB$ → constant

$\therefore C = 2nB$

$= 2B \log_2 L$

$L = 2^n$

Uplink ↓

Downlink ↑

Nyquist Theorem

(It is applicable noiseless)

It states that a noiseless channel,

$$C = 2B \log_2 2^n$$

where,

C = Capacity in bps

B = bandwidth in Hz

Example – 3.36

Given,

$$265000 = 2 \times 20000 \times \log_2 L$$

$$\Rightarrow \log_2 L = 6.625$$

$$\Rightarrow L = 2^{6.625}$$

$$\Rightarrow L = 98.7 \text{ Levels}$$

(A:)

$C = 2B \log_2 L$

$$= 2B \log_2 2^n$$

$$= 2Bn \log_2 2$$

$$= 2Bn$$

— × —

$$\boxed{C = 2Bn}$$

$$\Rightarrow 265000 = 2 \times 20000 \times n$$

$$\Rightarrow n = 6.625 \approx 7$$

Note: 'n' এর অভিন্ন মানের '7' নিতে হবে।

Shannon's Theorem

This theorem gives the capacity of a system in the presence of noise.

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

— x —

Explanation:

$$SNR = \frac{S}{N}$$

① When the SNR is '0'. Then the capacity will be '0'

$$C = B \log_2 (1+0)$$

$$\Rightarrow C = 0$$

Exam

Example : 3.39

Given, (a) $SNR_{dB} = 36$

Here,

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

$$\Rightarrow 36 = 10 \log_{10}(SNR)$$

$$\Rightarrow \log_{10}(SNR) = 3.6$$

$$\Rightarrow SNR = 10^{3.6}$$

$$= 3981$$

$x_{(dB)} = 10 \log_{10} x$

$\log_{10} a = b$ $\Rightarrow a = 10^b$

And,

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

$$= 2 \times 10^6 \times \log_2 3982$$

~~$= 29$ Mbps~~

$= 29 \times 10^6$ bps [important line]

$= 29$ Mbps

base unit
(a) bps
(b) Gram (ওজন)

(Ans)

Example 3.91 (**)

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

$$= 10^6 \log_2(1+63)$$

$$= 6 \text{ Mbps}$$

and,

$$C = 2B \log_2 L$$

$$\Rightarrow \log_2 L = \frac{C}{2B} = \frac{6\times10^6}{2\times10^6}$$

$$\Rightarrow L = 4 \text{ (signal level)}$$

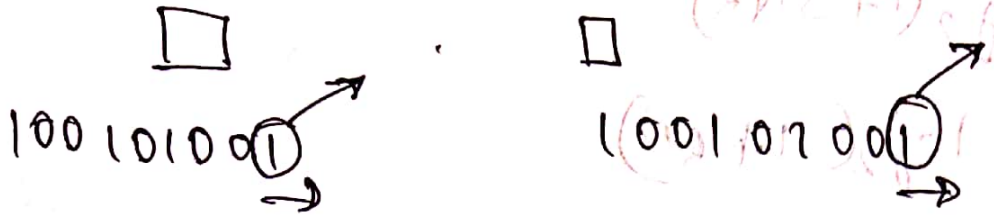
where,

$$\log_2 L = 3$$

$\therefore n = 3, \; L = 2^3 = 8$.

(Ans)

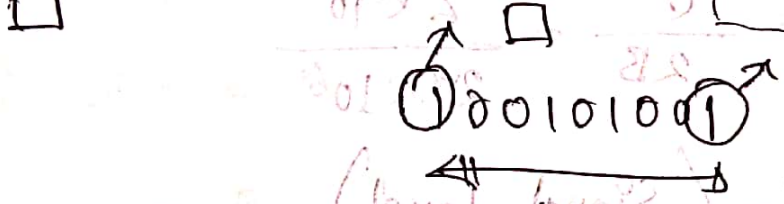
Propagation Delay



অর্থ

⊕ First bit টি সামনে অগ্রসর হতে যে সময় লাগে তাকে Propagation delay বলে।

⊕ distance এর উপর নির্ভর করে, ⊕ Single bit নিয়ে কাজ করে,



⊕ last bit টি শেষ হতে First bit টি যে সময়ে সময় হল Transmission delay.

⊕ সমস্ত Bit একত্রে এর উপর নির্ভর করে,

④ Propagation Delay = $\frac{\text{Distance}}{\text{Propagation Speed}}$

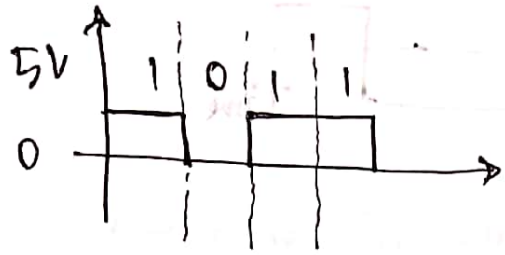
⊛ Transmission = $\frac{\text{Massage Size}}{\text{Bandwidth bps}}$

⊛ Latency = Propagation delay + Transmission delay + Queueing time + Processing time.

"instruction time" wait

4th Material

Digital to Digital Conversion



data element = 1
signal " = 1

④ n = Number of bits.

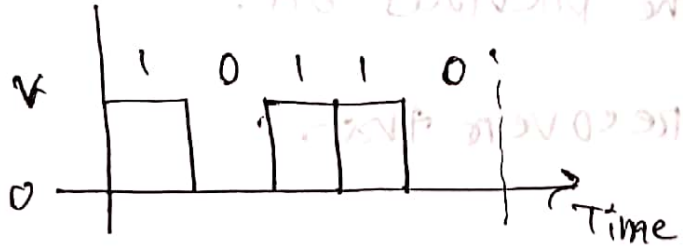
Data Rate vs Signal Rate

Data Rate → bits per second (bps)

Signal Rate → baud.

Line Coding

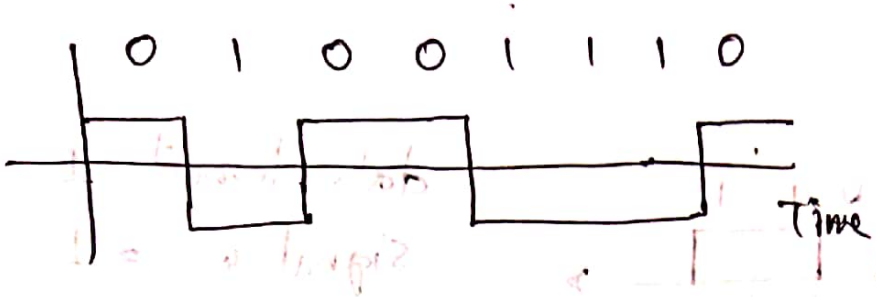
Unipolar NRZ scheme



① No negative value.

NRZ-L: (Polar)

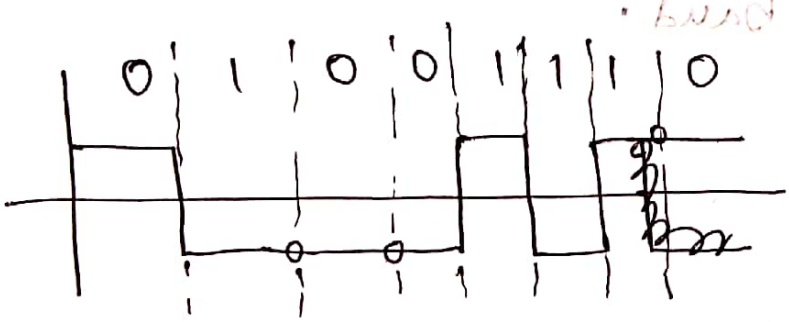
Polar → negative
নিচে নাও, থাকো।



NRZ-I: (Polar)

0 = No Change

1 = Change

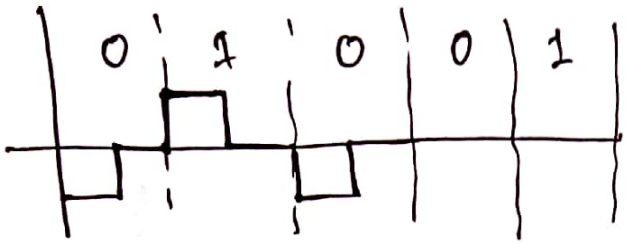


① It dependence on the previous bit.

② Bit missing can recovere that.

Polar RZ scheme

NRZ-L এর চেয়ে
Power consumption
কম।



④ Energy consumption is low.

∴ RZ means Return to Zero.

① Power Fluctuation – Voltage up/down / on/off

② Power Consumption – Current loss.

③ Charge Accommodation – charge store (bit dependent)

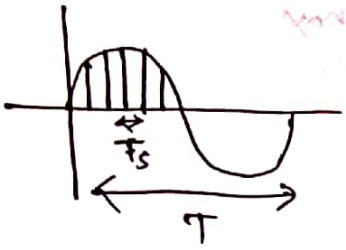
④ Error Collection = NRZ-I and Differential Manchester.

Final | Material - 5 | 24 04

Analog to Digital Conversion

(PCM)

Sampling



T_s = Sampling period

T = Time

f_s = Sampling frequency

$T_s < T$

$\frac{1}{T_s} > \frac{1}{T}$

$f_s > f$

Natural sampling:

(*) Memory elements. (*) Further calculation.

Flat top sampling:

(*) Average ~~হার~~ নির্ণয়,

(PCM) [Pulse Code Modulation]

~~Sampling etc~~ ৩ ~~3~~ টি Method:

① Sampling → Discrete Formate → Signal without Distortion

② Quantization → Signal discrete Amplitude → minimum number of bits limited distortion

③ Encoding → - compresses digital Data. - Doesn't cause distortion.

⇒ এখানে যে Process হয় তাকে Pulse amplitude modulation (PAM).

Nyquist Theorem:

$f_s = 2f$ / Nyquist rate $= 2 \times f_{max}$

Problem (3) Math

Sampling rate = 400 kHz

bandwidth = 200 kHz

low pass signal.

P-2:

$f_s = 2 \times f_m$

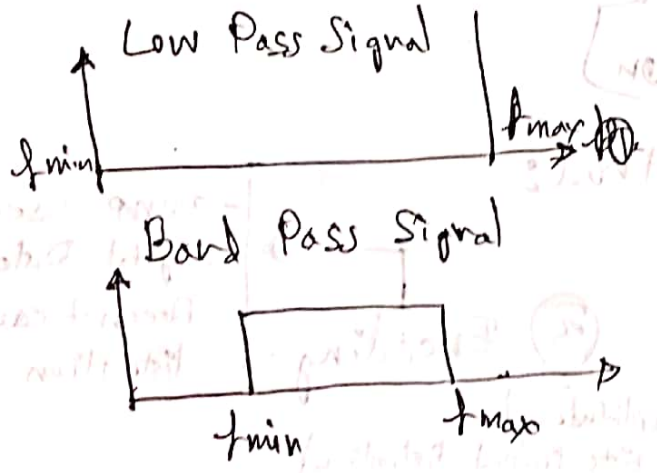
$= 200$ Hz

$f_1 = 20$ Hz

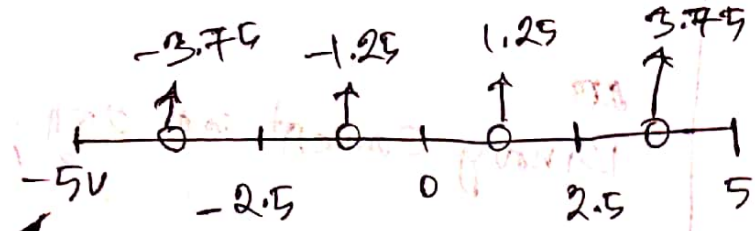
$f_2 = 50$ Hz

$f_3 = 100$ Hz

$f_{max} = 100$ Hz



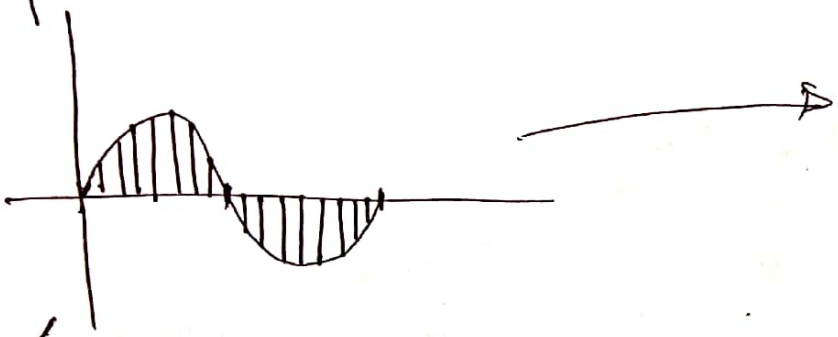
Quantization



← 2 bit

$$\Delta = \frac{V_{max} - V_{min}}{L}$$

$$= 2.5$$



0V	-3 V
2V	-4 V
3.5V	-5 V
5 V	-3.2 V
3.2 V	-11.1 V
1.8V	
0V	

* Bit সংখ্যা বাড়লে Quantization error কমে,

(1.25, 1.25, 3.75, 3.75, 3.75, 1.25, 1.25, -3.75, -3.75, -3.75, -3.75, 1.25)

3.4 ≠ 0.5

$\frac{\Delta}{2}$ = error

Example :-

-4.37 → 000
-3.12 → 001
-1.87 → 010
-0.63 → 011
0.63 → 100

Binary convert করা হয়েছে।

Analog Transmission

Course Material-6

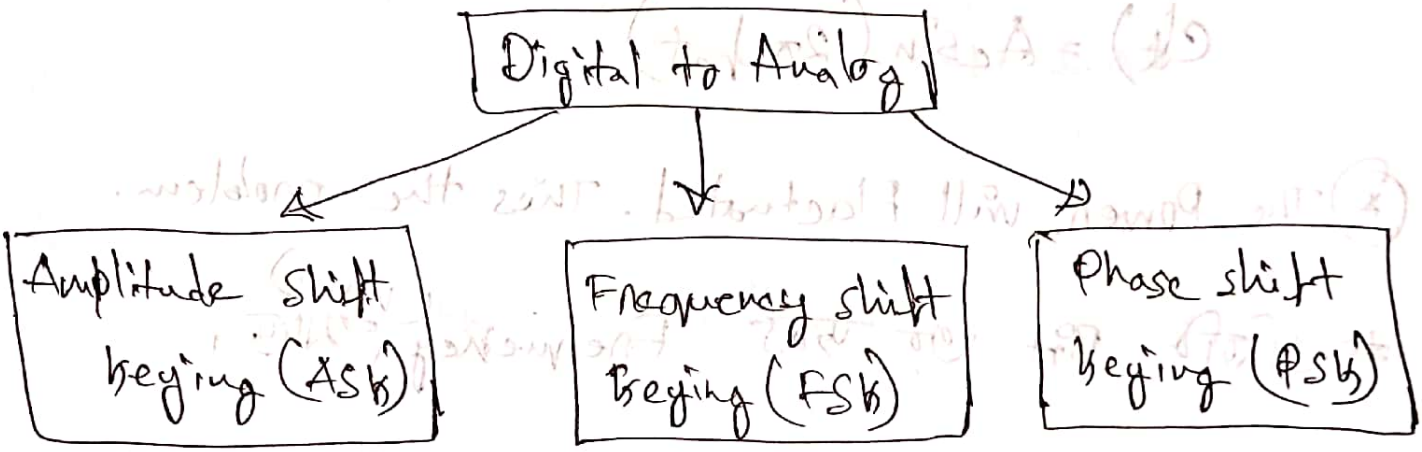
7 Nov

Digital Data → Analog signal

Digital Modulation

* Cannier will be high freque -ncy

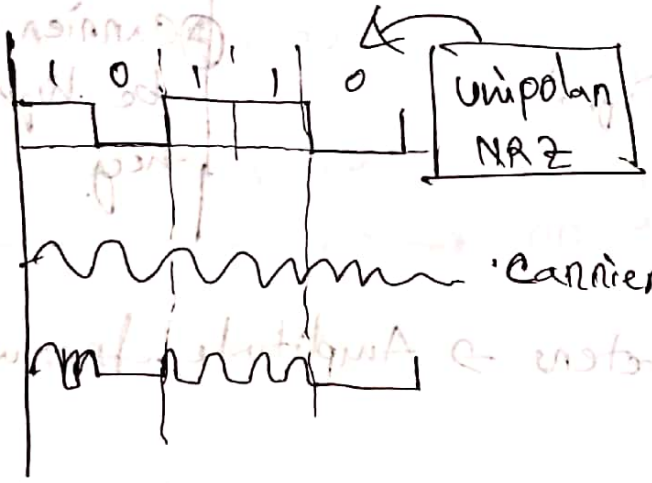
* Diff wave by, 3 ff Parameters → Amplitude, frequency, phase.



Amplitude Shift keying (ASK)

1 = Frequency

0 = No Frequency

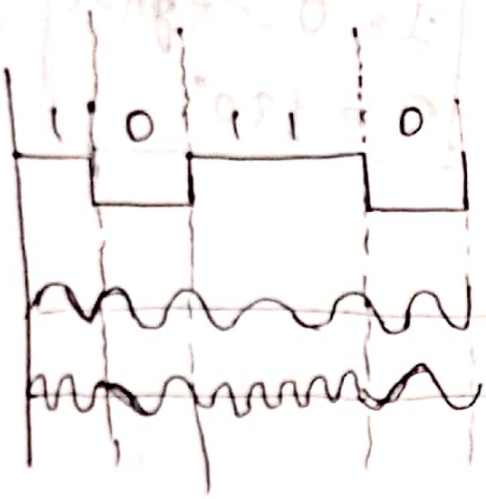


$$c(t) = A_c \sin(2\pi f_c t)$$

(*) The Power will Flactuated. This the problem

~~প্রতিটি~~ Bit ~~এর~~ ~~জন্য~~ Frequency (wave) আছে।

BFSK Implementation



(1) When 1 the frequency is increasing.

(2) When 0 " " is remains the same.

Problem

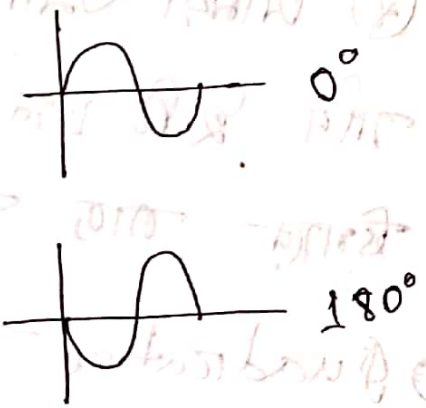
(*) It will increase the bandwidth.

35:00

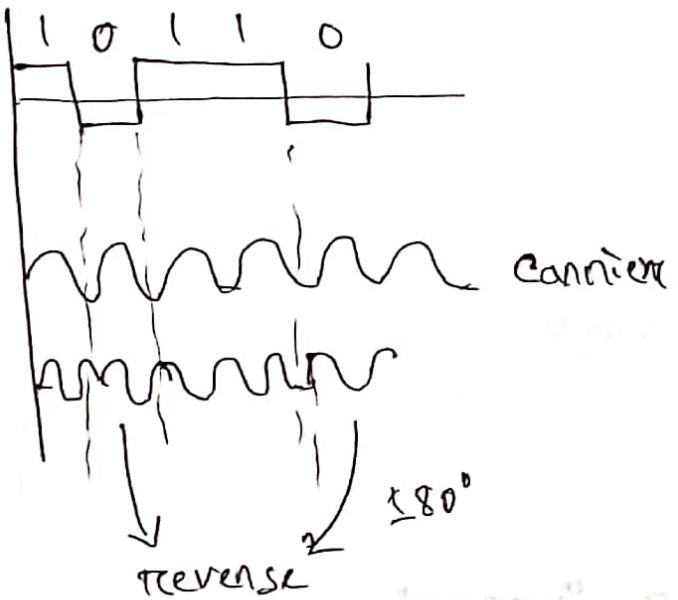
Note: In real world we want to

Phase Shift key (PSK)

Phase is an angle.



BPSK



1 = 0° degree
0 = 180°

Here,

$$c(t) = A_c \sin(2\pi f_c t)$$

$$1 \Longrightarrow A_c \sin(2\pi f_c t)$$

$$0 \longrightarrow A_c \sin(2\pi f_c t + 180^\circ)$$

$$= -A_c \sin(2\pi f_c t)$$

(*) আমরা এখন '1' bit নিয়ে কাজ করি, '1' bit = 0,1
যদি 2 টি Bit নিয়ে কাজ করি তাহলে 01, 10, 11, 00
ভিন্নভাবে কাজ করতে পারি।

⇒ Quadrature হলো 2 Bit নিয়ে কাজ করে।

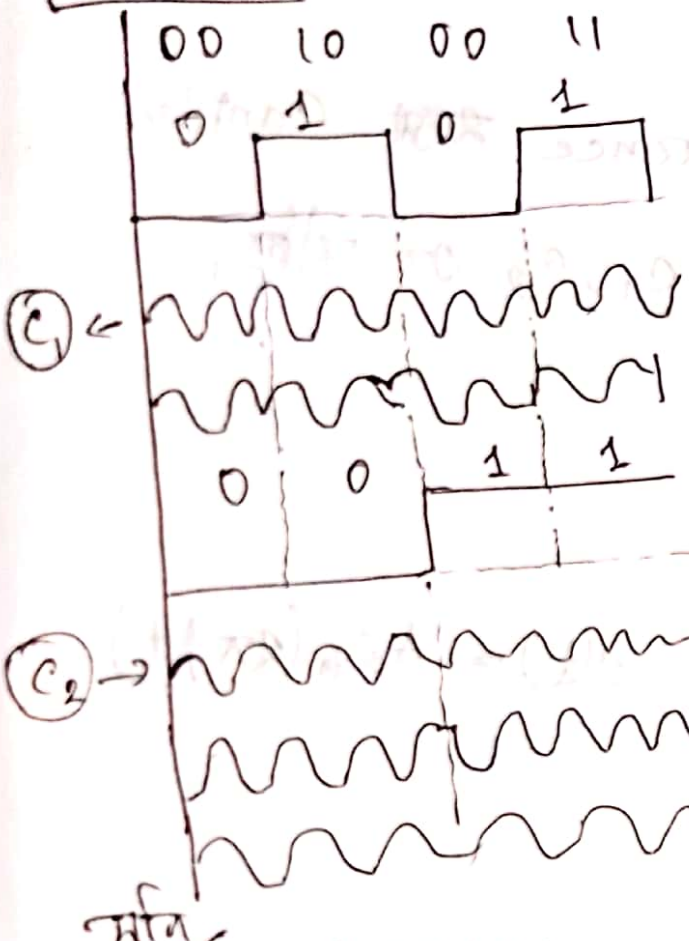
→ BPSK '1' Bit নিয়ে কাজ করে, আর, QPSK '2' Bit নিয়ে।

Degree ক 4 ভাগ করলে 90° করে পাব,

অর্থাৎ আমরা → 0°, 90°, 180°, 270°

→ দুইটি bit আমাদের
আমাদের করে নিচ্ছি,
00 হলে 0 এবং
1 আকারে নিব।

QPSK



→ (90°) phase shift key

Σ এর মধ্যে wave দুটি বিদ্যমান।

যদি,

100101

odd → 1, 1, 1
even → 0, 0, 0

[2 bit করে আছি]

odd → 1, 0, 0
even → 0, 1, 1

Then,

$$c_1(t) = A_c \sin(2\pi f_c t)$$

$$c_2(t) = A_c \sin(2\pi f_c t + 90^\circ)$$

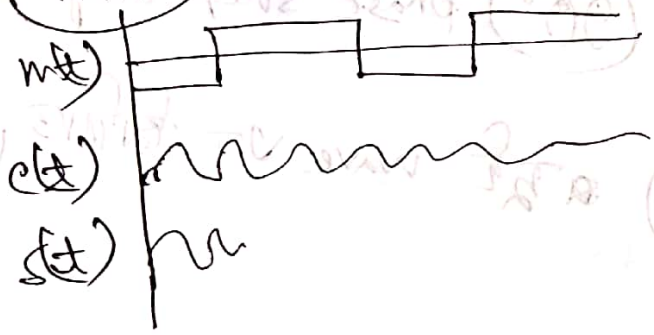
$$= A_c \cos(2\pi f_c t)$$

(#) $\sin(90^\circ + \theta) = \cos\theta$

(*) QPSK में difference Carrier में Difference में c_1, c_2 में होते,

Hence, (Again) QPSK

Part 1



$$c(t) = A\sin(2\pi f t)$$

If, $m(t) = 1$,

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

$m(t) = 0$,

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

$$= A\sin(2\pi f t + 180^\circ)$$

Analog to Analog Conversion

Material - 7

(#) Analog তে বিদ্যুৎ তরঙ্গ Frequency আকারে থাকে তাকে Cannier use করে দূরে তাকে Modulation.

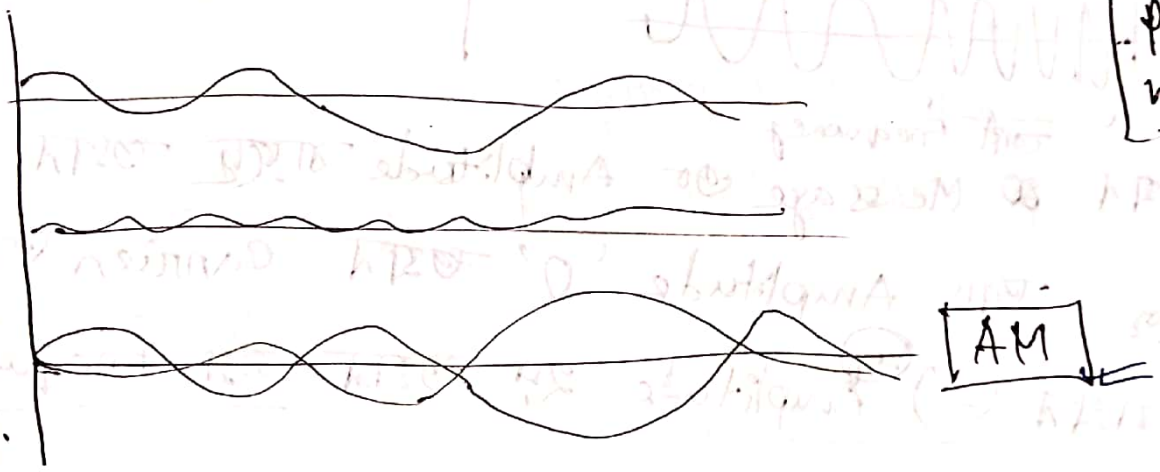
আমরা 20 - 20,000 Hz পর্যন্ত frequency শুনি তরঙ্গ আকারে

(*) Cannier wave এর তোমো কিছু তরঙ্গ না, সুতরাং Information canning তরঙ্গ,

(*) Continous wave.

(*) Band Pass Filter. (নির্দিষ্ট Frequency তে তাকে তরঙ্গ)

AM, FM, PM wava dnaw → Binary



(*) Amplitude change হয়, Message Signal এর wave ~~change~~ করলে Cannien wave change হয়,

(*) Classification of continous wave modulation:

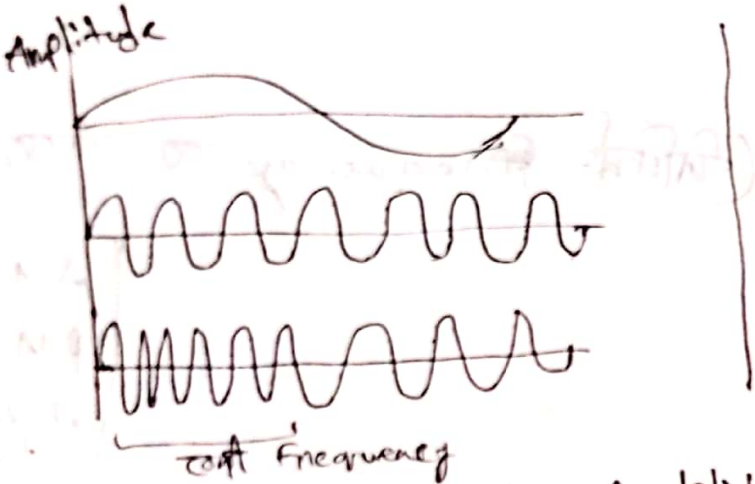
(1) Amplitude Modulation. (AM)
(2) Freawency " (FM)
(3) Phase " (PM)

AM (Amplitude Modulation)

(*) Amplitude change using the Message signal.

(*) Problem is Amplitude fluctuating.

FM (Frequency Modulation) → Change



(*) যখন Message এর Amplitude যাচ্ছে তখন Frequency বাড়ছে, আর Amplitude '0' তখন Carrier এর মত, আর যখন (-) neg Amplitude হয় তখন কম Frequency ছিড়ী হয়।

(*) VCO এর মাধ্যমে Voltage এর মধ্যে আনিবো আমরা।

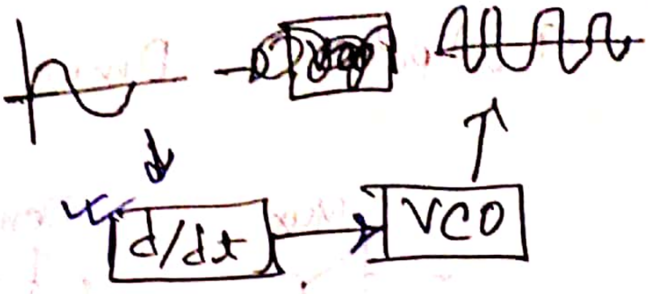
(*) Amplitude Fixed থাকে, তাই Noise থাকলে ফিল্টার করে নিতে পারি।

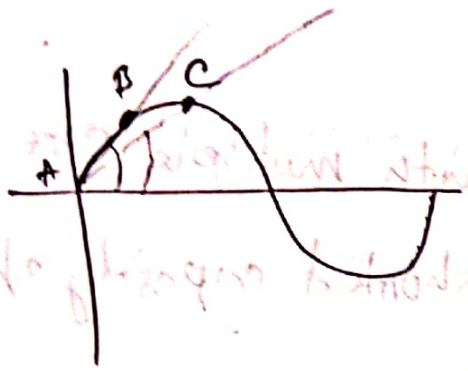
(*) Bandwidth বেশী হবে,

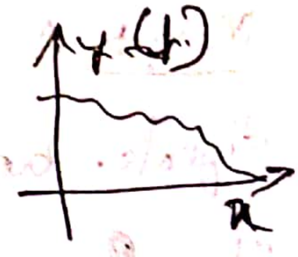
(*) AM এর তুলনায় FM ভালো।

Phase Modulation (PM)

(*) d/dt এর মাধ্যমে rate of change জানি।







→ AB এর slop বেশি, AC এর কম, কারণ কোণ (∠) দেখে।

(*) AB slop বেশি হলে Higher value হবে, তাহলে VCO সার্কিটে voltage এর পরিবর্তন করবে।

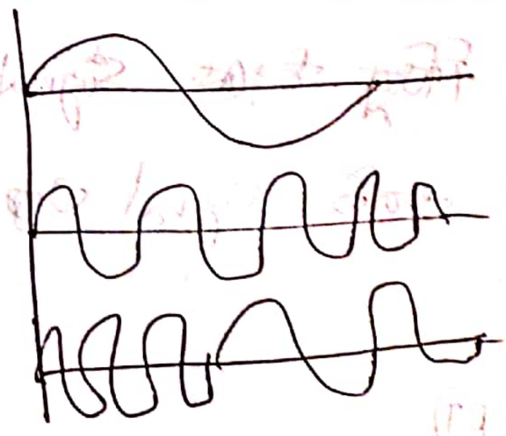
slop

যেখানে Differentiate নিয়ে যাবে সেখানে range.

(*) It is depend on the differentiate value of the amplitude.

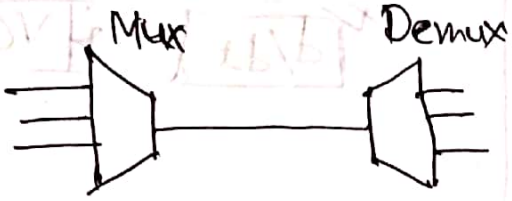
(*) y থেকে Differentiate value নিয়ে more efficient হয়।

(*) PM better than FM.



Material-8 | 21 Nov

একটা output এর Dmux এ 2টি switch থাকবে,



Mux ⇒ A channel being shared with multiple signals. but its have Neg. point is shorted capasity of it.

⇒ Bandwith are utilized.

Mutiplixing catagory

- ① Freqeuency division] Analog
- ② Wavelength division]
- ③ Time divisision] digital

FDM (Freqeuency division Multiplexing)

বিভিন্ন ধরনের signal কে একসাথে করে একটি signal এর মধ্যে পাঠানো হয়,

FDM এর মধ্যে AM use করা হয়েছে

PPT

Math

Ex-6.1

20 — 32 KHz

Combine three bandwidth 12 KHz

bandwidth = 4 KHz

∴ 1st person = 20 – 24 KHz

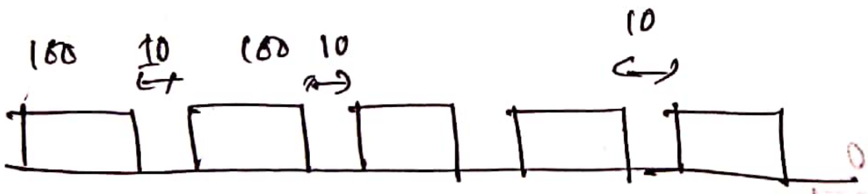
∴ 2nd = 24 – 28 KHz

∴ 3rd = 28 – 32 KHz

ppt → ছবি দেখা,

Ex-6.2

total amount of bandwidth = 540 KHz



guard band হলো মাঝখানে ফাঁকা জায়গা,

Ex-6.3

Divide into four channels $= \frac{1M}{4} = 250\,KHz$

Nyquest এর মাধ্যমে Data rate বের করা যাবে

বাকিটা সহজ [illegible],

~~C = 4 Mbps~~

~~= 2 × 250 × $\log_2 L$~~

C = 1 Mbps

$\Rightarrow 2 \times 250 \times \log_2 L = 1$ Mbps

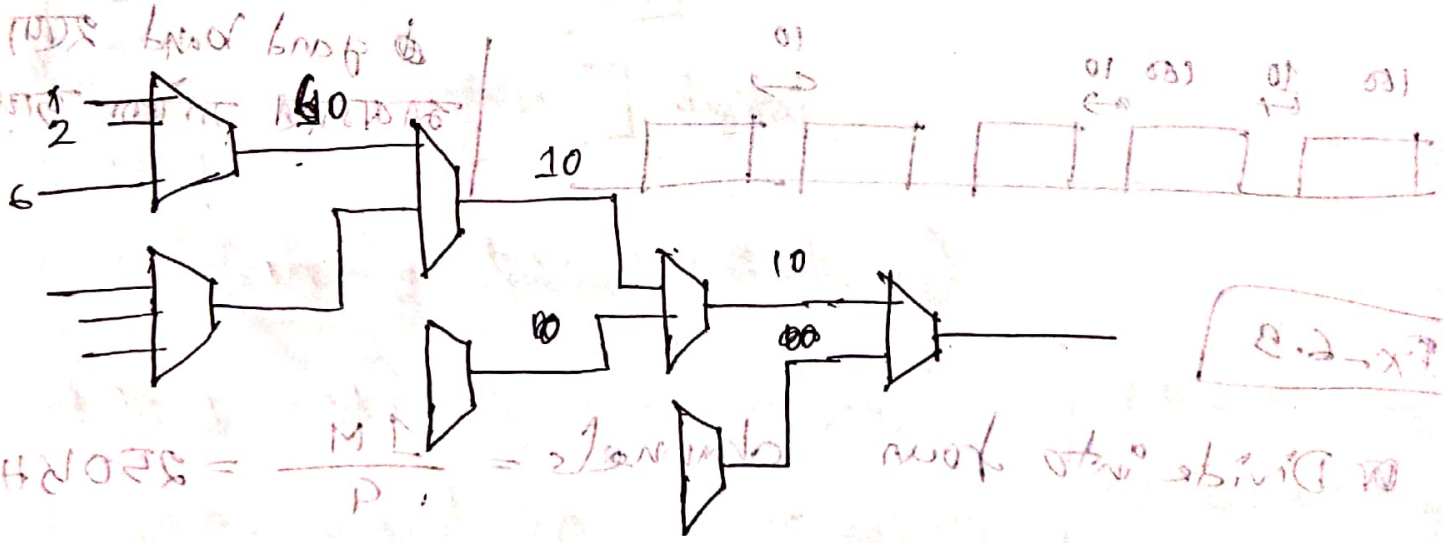
$\Rightarrow \log_2 L = 4$

$\Rightarrow n = 2$ bits / signal element

∴ solution is QPSK.

(because QPSK 2bit তিন্ন করে, ASK, FSK, PSK, এ 1bit করে তিন্ন করে থাকে)

Analog Hierarchy



Wi-Fi network এর জন্য connection:

Ex-6.4

→ Upload bandwidth and download bandwidth?

(*) Total bandwidth = 70

Guard band = 20

upload = 25 , Download = 25

∴ Each band is 25 MHz. Each users used 30 kHz

So, Total person we can send = $\frac{25 \text{ MHz}}{30 \text{ kHz}}$

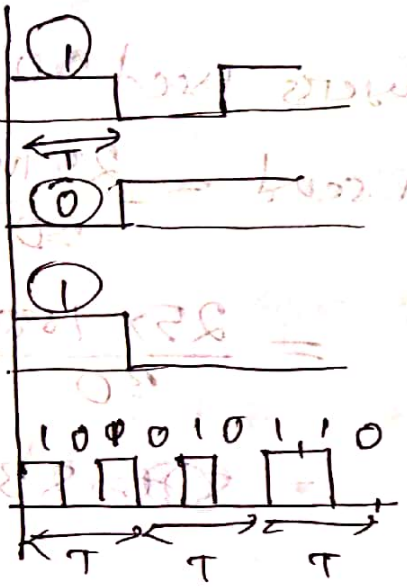
$= \frac{25 \times 1000}{30}$ kHz

$= 833.33$

∴ So the total users is 833.

Time Division Multiplexing (TDM)

আমরা খুব কম সময় যেমন 0.1 সেকেন্ডে ছোট সময়ে যে wave হয় তা ঠিকই নেয়া



আছে 1টি Bit সেন্ড T সময়ে

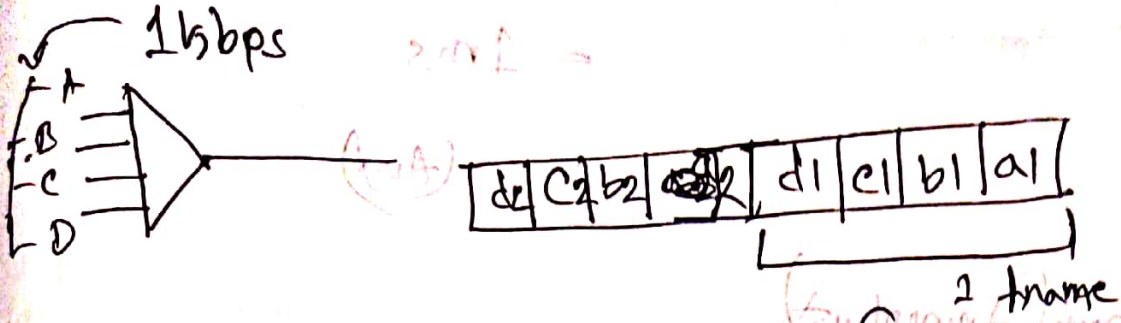
1 টি Bit এর সময় T/3

This process is TDM.

Frame - It is the range when every user has transmitted at least one element/bit. (একবার করে Contribut করবে প্রতি সেট তিনটি ইউজ)

(Mita → 6.5, 6.6), 6.8

Math-6.7



Ⓐ before multiplixing A তে যাবে।

ⓐ

Here,

1000 bits take 1 second

1 bit take $\frac{1}{1000}$ second

= 1 ms

ⓑ Transmission rate = 1 kbps × 4

= 4 kbps

ⓒ The duration of time slot এটা কি পরিমাণ সময় থাকবে।

4000 bits take 1 sec

∴ 1 bit takes $\frac{1}{4000}$ sec

= 250 μs

= 0.25 ms

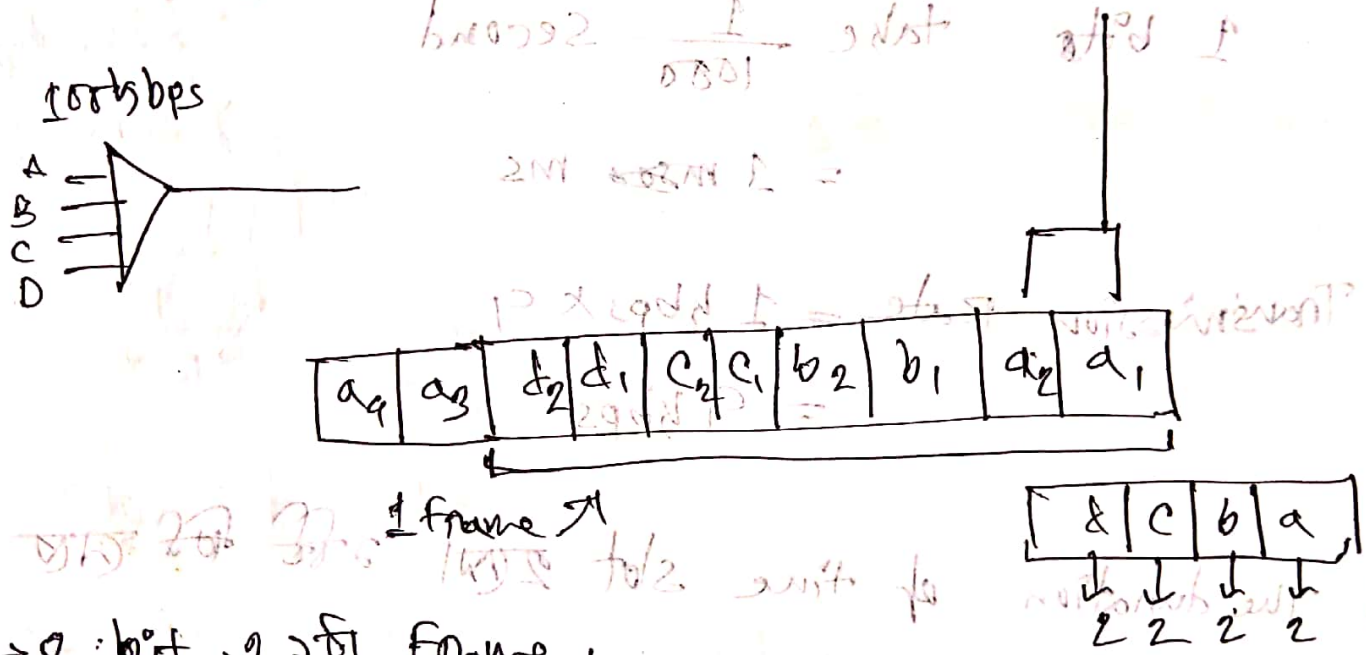
(d) The duration of a frame = 0.25×4

$= 1ms$ (Ans)

(#) 6.9 Math Exam (Important)

6.9

সমস্যা হচ্ছে Data সংযুক্ত হবে কত বাইট।



→ 8 bit এ একটি frame।

(+) Frame Rate:

Input data rate = 100 kbps

output " " = 400 kbps

$$\text{Frame Rate} = \frac{400 \text{ kbps}}{8 \text{ bit}} = 50 \text{ frames/sec}$$

$= 50,000$ frame/sec

Explain: 1 sec → 900 kbps

8 bit এ 1 টি Frame আছে।

∴ 1 sec এ Frame আছে 50000।

⊕ Here,

50000 frames take 1 sec

1 frame takes $\frac{1}{50k}$ sec

$= 0.02$ ms

$= 20\mu s$ (এটা নিয়ে আসবে)

⊕ What is the bit duration.

900 × 1000 bits take 1 sec

∴ 1 bit takes $\frac{\quad}{900 \times 1000}$

$= 2.5 \times 10^{-6}$ s

$= 2.5\ \mu s$

Data rate Matching (Imp)

28 Nov ⭐⭐⭐

5 marks in Exam — আগের Slide

Data Rate Management

Three ways ~~we can~~ input different.

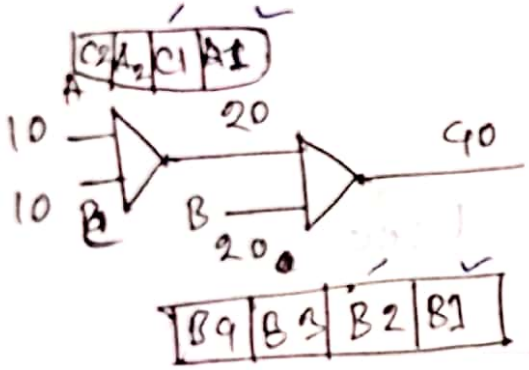
① Multilevel ②

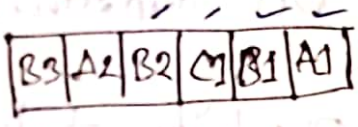
Multiplexing ও Input ও Bit rate সবার ই Same হবে।

Exam → Situation দেওয়া থাকবে, আমাকে Design করতে হবে। (Multiplixing system)

Multilevel :

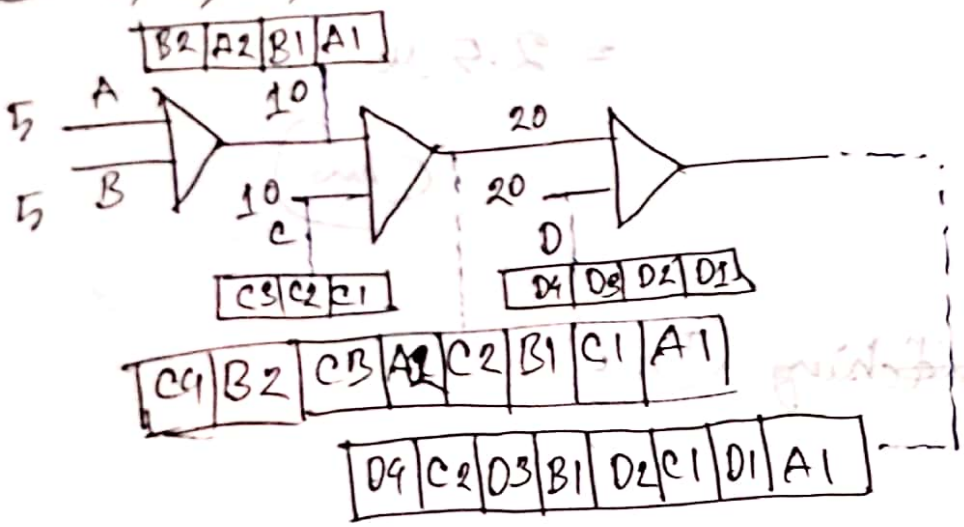
(#) 10, 20, 10 → 5 bps





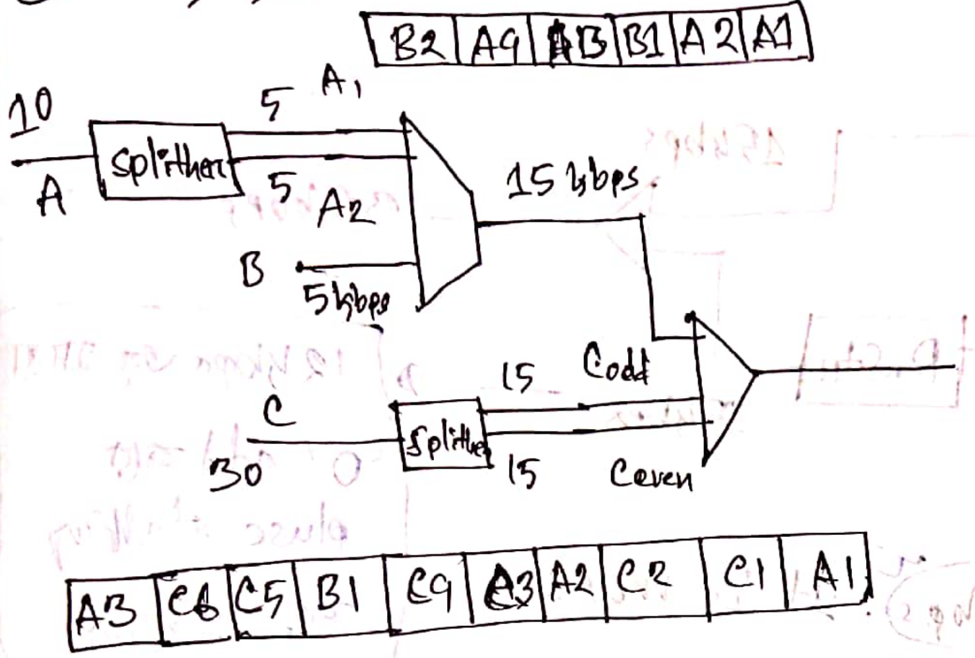
1 bit করে থাকবে।

(#) 5, 5, 10, 20 → 4 bps



Multiplixing have same data Rate.

5, 10, 30



→ common multiple

→ Splitter can divided.

→ common multiple,

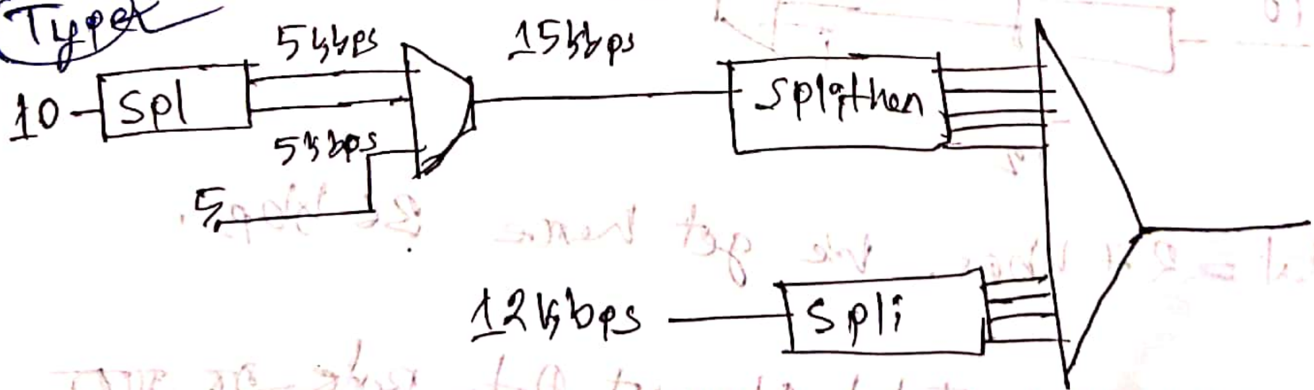
5, 10, 12

pulse stuffing (001 = 001 / 0001 / 01)

পাশাপাশি '0' add করা।

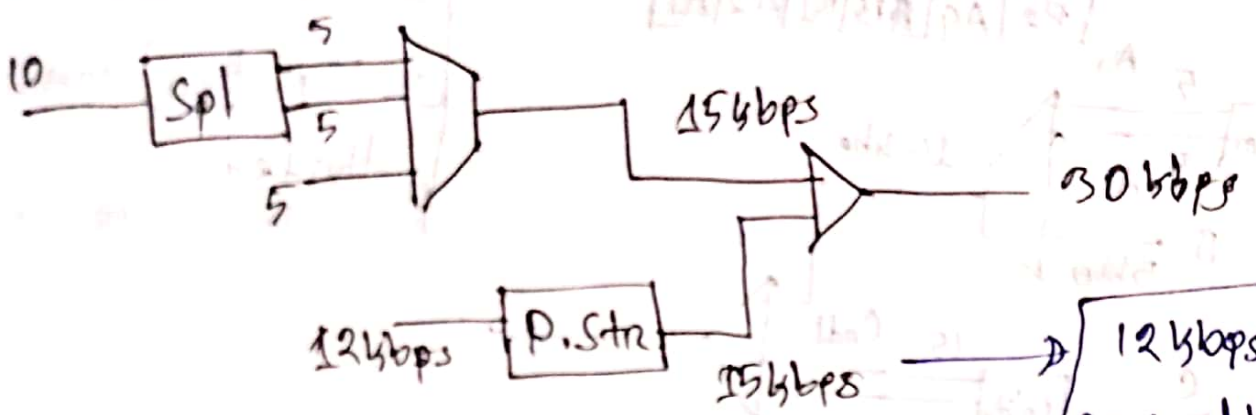
Zero padding
↓
001 = 1
098 = 98

Type



∴ A এই Type এ একাধিক কোন IC প্রয়োজন, তাই এটি ব্যবহার করা হয়।

Step-2

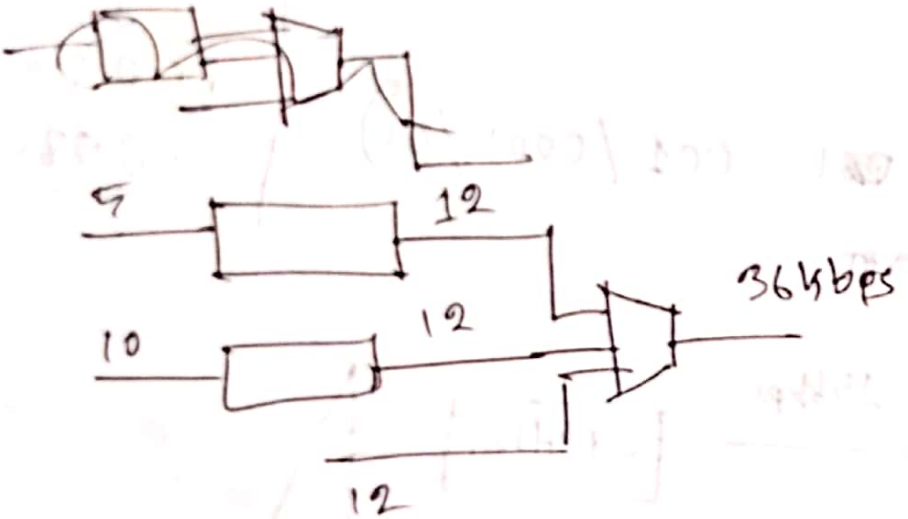


12kbps এর সাথে '0' add করে pluse stalling করে 15kbps বানানো হয়েছে।

Total = 27kbps

∴ but we get 30kbps. It is more effeciant than others.

Step-3



Total = 27kbps. We get here 36kbps.

Note: আমাদের total Abooust Data rate এর সাথে multiplex data rate এর Difference আসছে, IC তৈরী ~~করার~~ ~~এর~~ সময় 3 Problem হয়, তাই এত IC ~~ব্যবহার~~ হয়েছে।

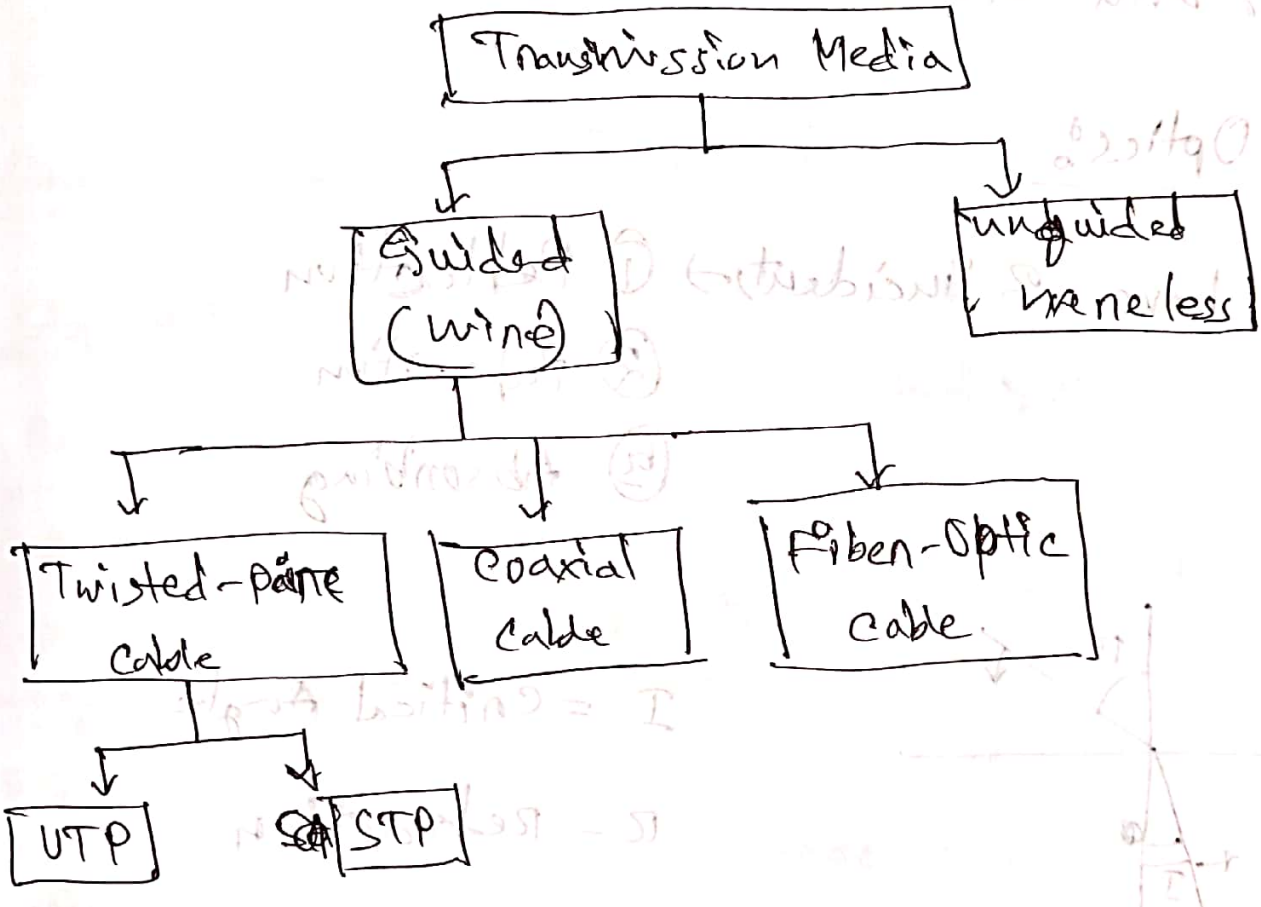
PPT - 9

25 Nov

Transmission Medium

Transmission medium হলো wire.

→ Transmission medium (cable) এর মাধ্যমে Data কে modify করা যায়।



Coaxial cable →

→ Capasiton এর মত structure আছে।

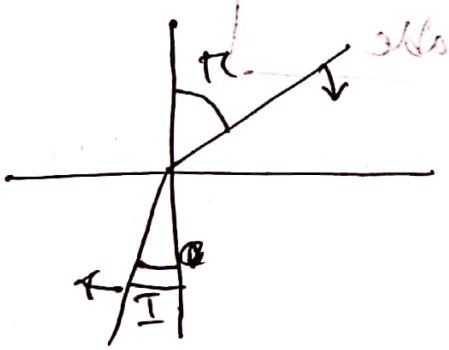
PPT 9 For B Art. (আগে দেখতে হবে, আসা আছে)

BNC Connector: Connector হিসেবে use হয়।

—এরল: Dish আর Connect করার জন্য।

Fiber Optics:

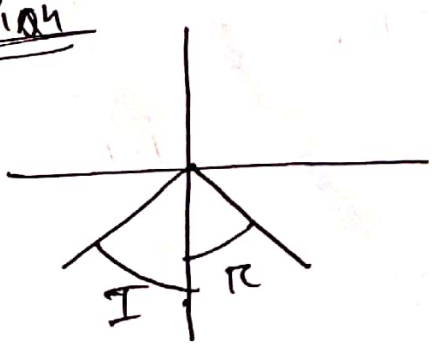
Light have 3 incident → ① Reflection
② Refraction
③ Absorbing



I = Critical Angle

R = Refraction

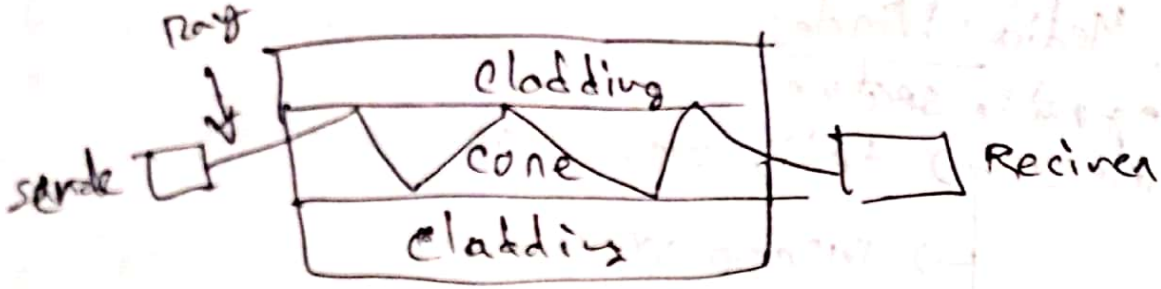
reflection



reflection হলে,

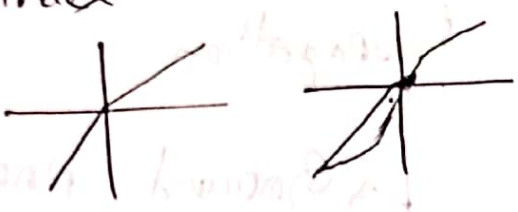
I = R

30 Nov



Propagation Modes

- Multimode
  - Graded index
  - Step index
- Single mode



Single: Core অত্যন্ত চিকন হয়।

Step index: Constant reflective index (Fixed), ফলে মান Direct change হয়।

Graded index: → অনেক Band (ভাগ) হয়ে যায়।

→ ঢালাম হবে।

→ n এর মান Gradally যাবে। (0.1, 0.2, 0.3)

Example:- Moved wave on reflect.

Fiber Construction

Fiber robust (সহজেই যা তাকে ভাঙা) হবে।

- ST connecton
- MT-RJ " (Joint এ use হয়)

Unguided Media : Wireless

Electromagnetic spectrum

Wireless → Radio wave
→ Micro wave
→ Infrate
→ Light wave ← (Most suitable)

Propagation

→ Ground propagation
→ Sky " (reflect on ionosphere)
→ Line-of sight " (Direct ray)

Most suitable

Exam

Broadcast ⇒ Example (Netflix)

Multicast ⇒ Example - Youtube

Exam (**)

(*) **Radio wave** are used for multicast. They can **Penetrate** through walls. Highly **regulated** (তোমার মাছে রেডিও খুঁজে পাওয়া যায়).

→ Use **Omni directional** antennas.

(*) **Micro wave** ⇒ Unicast communication.

→ Higher frequency ranges can't penetrate walls.

→

(*) **Infrared** ⇒ Used for short rang communication.