OCT - 8 - 2020

SANKET AGARWAL

ECEN 602

MIDSEM

Q:1 (a) frequency = 4 KHz.

SNR = 99 dB (Assuming it is given in dB).

Using Shannon capacity theorm we have.

$$\text{Capacity} = W \log(1+SNR)$$

Converting it to non

$$SNR_{dB} = 10 \log(SNR)$$

$$99 = 10 \log_{10}\left(\frac{S}{N}\right)$$

$$\frac{S}{N} = 10^{9.9}$$

$$\therefore \text{max Capacity} = W \{ \log_2 (1 + 10^{9.9})$$

$$= 4 \times 10^3 \cdot \log_2 (1 + 10^{9.9})$$

$$= 4 \times 10^3 \cancel{\log_{10}}$$

$$= 4 \times 10^3 \times 32.88$$

$$= 131.54 \text{ KHz}.$$

~~(b) To ensure we can transmit a 5KHz signal~~
~~→ make sure sampling rate is 2×5KHz.~~

(a) assuming SNR is the actual value not in dB.

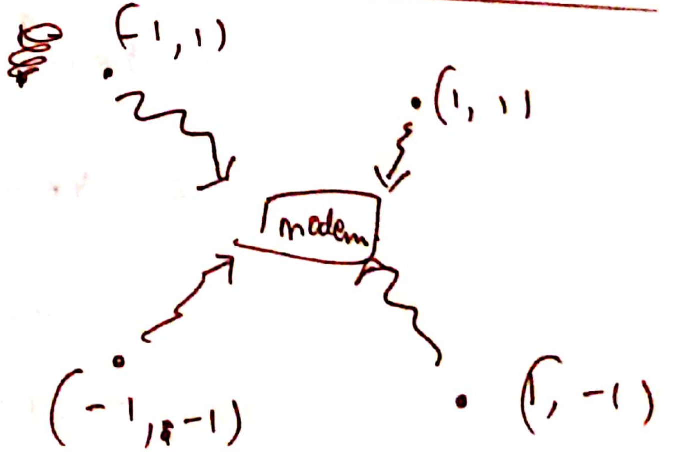
$$C = 4KHz \cdot \log(1+99)$$
$$= 26.57 KHz.$$

To ensure 5 KHz is digitially transmitted

(1) Sampling rate should be at least ~~to~~ 2×5
$= 10KHz$
(Nyquist theorem)

(2) Since max capacity in both cases is more than 5KHz we can transmit it if Nyquist theorem is satisfied.

Q:1(b)



→ Assuming the modem can receive data from all 4 constellations we ~~&~~ can have 2 bits/pulse. ③

i.e. 2w bits per second.

∴ the modem can receive 2400 x 2

= 4800 bps.

Q:1 C. Digital transmission is preffered over analog transmission because of following reasons:-

ⓐ Distortion, ⓑ noise, & ⓒ power requirements

↳ ⓐ Distortion:- ① As signals move across the channel their shapes get distorted. i.e.

a signal  may become 

② ~~with~~ ~~&~~ If the signal is a digital signal it is easy to recreate as compared to analog signal based on power levels of 0's & 1's

ⓑ noise:- ① In case ~~of~~ the nois gets added to the signal, It is difficult to seperate noise from analog signal. ~~Simply~~ Simple

④

~~amplifier~~ amplification would increase the noise level & thus make signal weaker with Digital signals it is easy to separate noise & data

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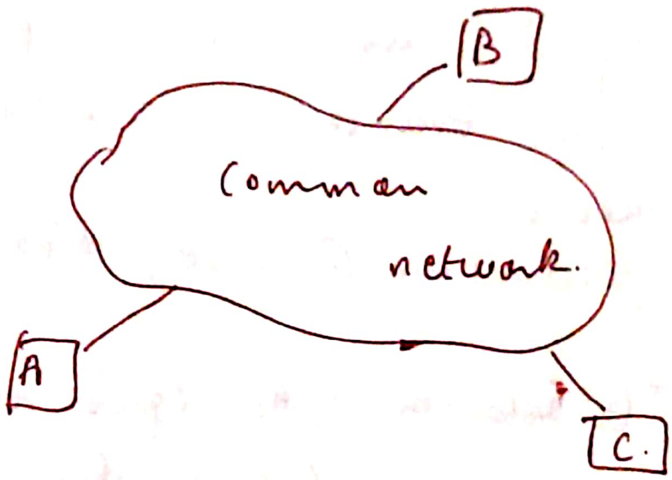
Q:1 d



* To transmit any signal between two nodes there should be a channel between them.
* In case of multiple users, a common chanel is shared amongst a small ~~user~~ no. of users. it could be in Time, B.W. or wavelength.
* They ~~could~~ could share the network in
    - ⓐ static ~~channel~~ channelization way.
    - ⓑ Dynamic ~~way~~ way
        - ~~the~~ scheduling
        - Random access.

Scanned with CamScanner

(a) Static channelization:- The common channel is predecided i.e. how it will be shared amongst users. for eg:- in FM radio the frequency bands are divided ~~the~~ no other ~~ser~~ user can access someone's slot. (It does not depend on flow of traffic)

(b) Dynamic way:- → In Dynamic way the channel is shared according to the flow of traffic.

Scheduling	Random access
The channel is shared after some central controller or the network nodes give control for the node to Tx. eg:- Token ring. where the token acts as control mecahanisim.	The channel is shared (i.e. users can send packets as & when they require with control protocols in case of collision eg:- ALOHA.)

(i) FM radio :- It is statically scheduled & slots are predetermined so behavior of C doesn't impact.

(ii) Ethernet :- It uses CSMA/CD for control access. As the traffic of C ↑ more collision would occur & throughput would ↓ preferred when network traffic is low. & vice versa.

(iii) Telephone network :- Again slots are divided. So traffic of C does not affect the performance. Slots may be wasted if 'C' is not ~~Tx~~ transmitting

iv) Wifi network :- ~~& T~~ As traffic from C ↑ RTS signals would increase from C & thus it would cause others to wait. Thus as traffic from C ↑ performance ↓ & vice versa.

Q: 3 (a) Since qs & qe are start & end of frames, ~~as~~ The data ~~containing~~ starting with 'q' must be protected. Thus whenever we encounter 'q' we will add a character 'x' post that.

So the final transmitted data would be.

"qs The qxueen stood in the qxueue with a qxill in her qxuiver qe."

at receiver this 'x' would be removed

(b) info = 1 0 10 0 111

$$x^7 + x^5 + x^2 + x^1 + x^3$$

gen = $x^3 + 1$

info x gen power = $(x^7 + x^5 + x^2 + x + x^3)\, x^3$

$$= x^{10} + x^8 + x^5 + x^4.$$

dividing by the generator pollynomial

$$
\begin{array}{r|l}
 & x^7 + x^5 + x^4 \quad 1 \\
\hline
x^3+1 & x^{10} + x^8 + x^5 + x^4 + x^3 \\
 & +x^7 \\
\hline
 & x^8 + x^7 + x^5 + x^4 \\
 & x^8 \quad\quad x^5 \\
\hline
 & x^7 \quad + x^4 \\
 & x^7 \quad\quad x^4 \\
\hline
 & 0 \quad + x^3 \\
 & \cancel{x^3 \quad 1}
\end{array}
$$

∴ adding x^0 we get

1010011100101

Q: 3C generator polynomial = $x^3 + - - -$

what we send is.

(info). $g(x) + r(x)$.

i.e. $i(x) \cdot x^{(n-k)}$ puts $(n-k)$ low order position.

now $x^{(n-k)} \cdot i(x) = g(x) \cdot q(x) + r(x)$

quotient, remainder

So $g(x)$ has degree $(n-k)$.

let error pattern be $d(x)$

~~g(x) cannot divide~~

$g(x)$ cannot divide $d(x)$ if

$\deg(g(x)) > \deg d(x)$.

Since the division will not be possible with degrees $> n-k$,

(1) $n-k$ or less degree errors will be detected.

Q:4

Info @ node.

(a)

	A	B	C	D	E	F
A	0	∞	3	8	∞	∞
B	∞	0	∞	∞	2	∞
C	3	∞	0	∞	1	6
D	8	∞	∞	0	2	∞
E	∞	2	1	2	0	∞
F	∞	∞	6	∞	∞	0

(b)

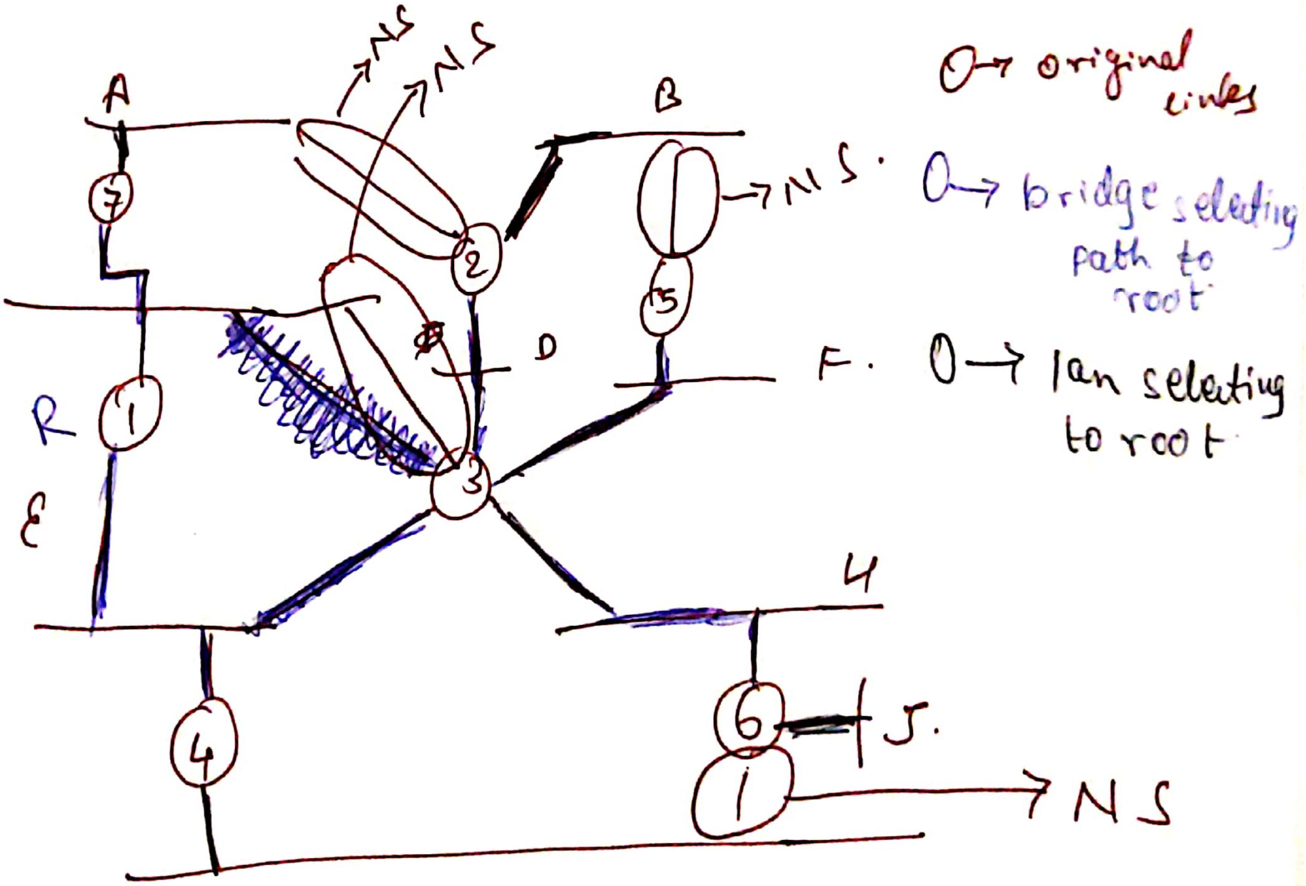
	A	B	C	D	E	F
A	0	∞	3	8	4(C)	9(C)
B	∞	0	3(E)	4(E)	2	∞
C	3	3	0	3(E)	1	6
D	8	4(E)	3(E)	0	2	∞
E	4(C)	2	1	2	0	7(C)
f	9(C)	∞ not heared updated	6	∞	7(E)	0

Assuming all nodes hear intial node in step (a) in alphabetical order A ⟶ F.

(c)

	A	B	C	D	E	F
A	0	6(E)	3	6(CE)	4	9(C)
B	6(EC)	0	3(E)	4(E)	2	9(EC[illegible])
C	3	3(E)	0	3(E)	1	6
D	6(EC)	4(E)	3(E)	0	2	9(EC)
E	4(C)	2	1	2	0	7(C)
F	9(C)	9(EB)	6	9(CE)	7(C)	0

Q:4 selecting root node as 1 & each bride's connection to root as below. & lower order incase of same hops.



1. first selected Bridges to root node 1
2. then ~~create~~ created actual network with lans.

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Q.2 frame = 1000 bits.

seq no :- 3 bit.

1mbps → up link.

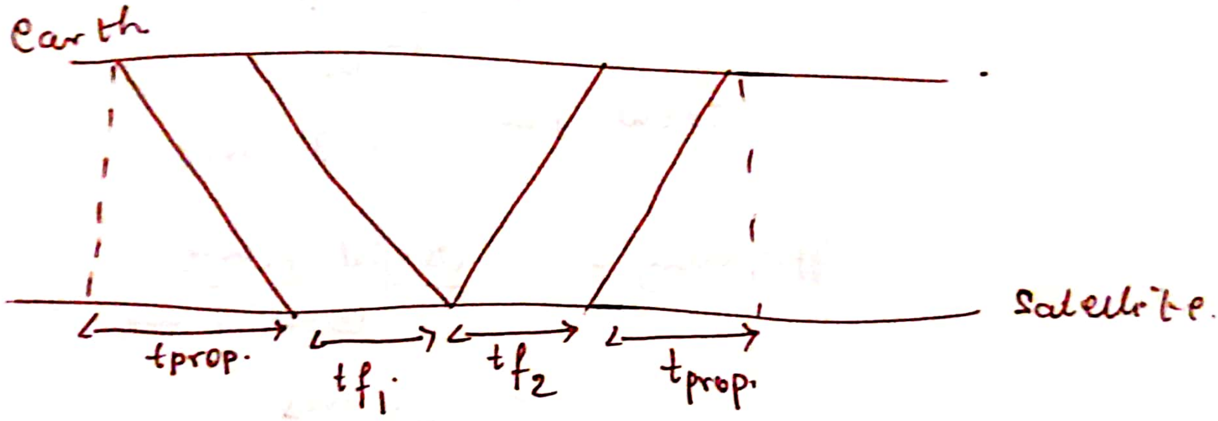
100 kbps → down link.

max O-W : → ?

sequence no :- 3bits

One way delay = 10ms.

① ~~Max b...~~



(assuming zero processing time)

$$\text{total time} = t_{prop} + t_{f_1} + t_{f_2} + t_{prop}$$

$$\text{total time} = 10 \times 10^{-3} + \frac{1000}{1 \times 10^{6}} + \frac{1000}{100 \times 10^{3}} + 10 \times 10^{-3}$$

$$\cancel{= 2 \times 10 \times 10^{-3} + 10^{-3} + 10^{-2}}$$

= ~~31 ms~~. 31 ms

(a) stop & wait.

↳ frame loss probability = 1%.

∴ total time would be $\frac{Total}{1-\left(\frac{1}{100}\right)}$

$$= \frac{31\ ms}{1-\frac{1}{100}}.$$

Total time = 31.31 ms.

∴ Efficiency = $\frac{\text{useful time}}{\text{total time}}$

$$= \frac{1\ ms}{31.31\ ms}$$

$$= 0.031$$

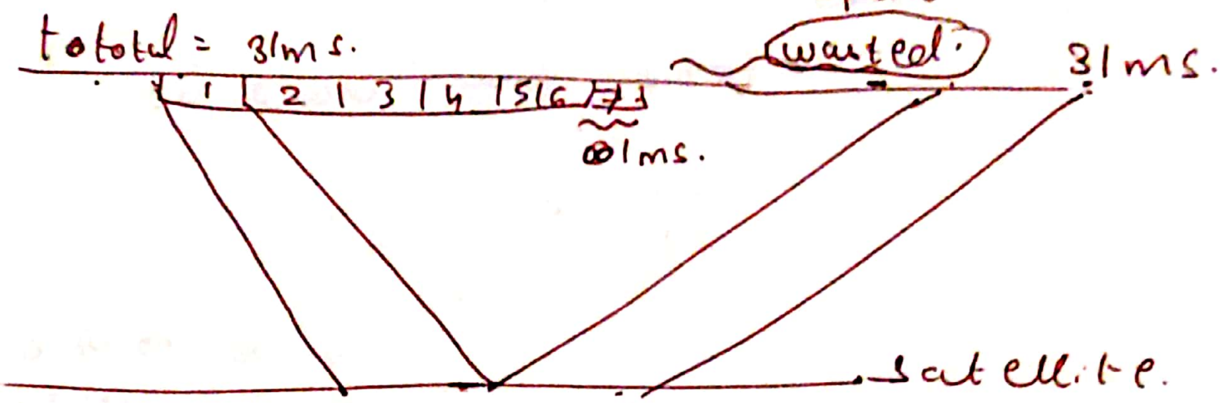
∴ max B.W. on the uplink = 31.938 Kbps

max B.W. on the downlink = 310 kbps

(b) Go-back N with no losses.

sequence bits = 3.

∴ max window = 7 on uplink.



∴ wasted ~~useful~~ time = 31ms − 7 × 1ms

= ~~30.3ms~~ 24ms

i.e. we cannot send more packets until we get ack for first one.

∴ Efficiency = $\dfrac{7\times 1}{0.1 + 30.3}$

$= \dfrac{7\times 1}{\cancel{30.7}\ 24}$

$= \cancel{0.02}\ 0.29.$

∴ BW:- uplink = 290 KHz

downlink = 29 KHz.

for selective reject

for selective reject the total time would be.

$$\frac{t_f + \text{wasted time}}{(1 - p_f)}$$

$$= \frac{1ms + (31-4)}{1 - \frac{1}{100}}$$

as no of bits are only 3
max = 4 frames from 1 side.

$= 27.27ms.$

$\therefore$ efficiency $= \frac{1}{27.27}$

$= 0.036$

max BW on uplink = 36.66 KHz

max BW on downlink = 3.6 KHz.

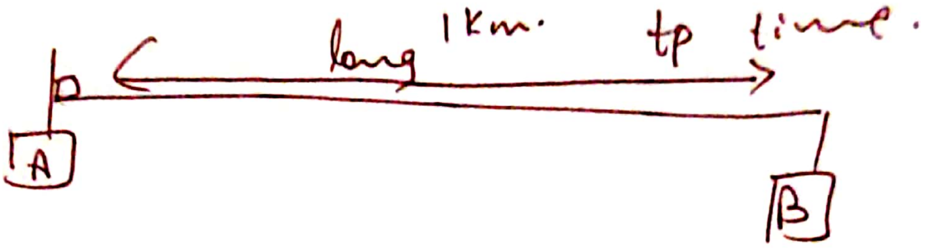
$\hookrightarrow (0.036 \times 10^{5})$

Q: 5 $\quad d = 1\ Km.$

$BW = 10\ mbps.$

$10^6 \times 200\ m/s\ sec = v$

$fram = 256\ bits$



$t_f = 0.0256\ \cancel{sec}\ ms.$

$t_p = .5ms.$

① Since the transmission time is very small compared to the propagation time. it is possible that the packets from A & B could collide ~~first~~ at any point. i.e.

② ∴ effective ~~BW~~ throughput would be.

$$10 \times 10^6 \times \frac{1}{255} \times 0.184$$

$= 7215$ frames/sec.