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Course: CS5403 Computer Networks   Wed, Sep 29

Class Test

Solution 1: Bandwidth of signal = 4KHZ.

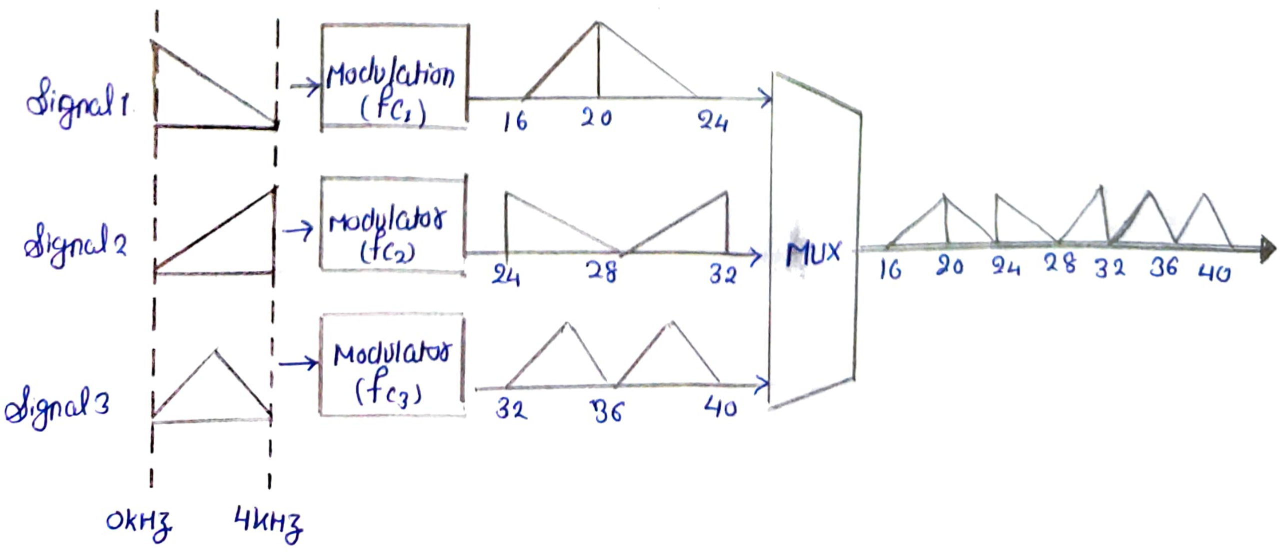
So according to the details provided in the question, Using modulation we can choose carrier frequencies to the space signals in a desired 24KHZ range.

∴ Assigning voice signals 1 to 16 - 24 KHZ bandwidth
→ Modulated if f_{c_1} (say) = 20 KHZ

Assign voice signal 2 24-32 KHZ bandwidth
→ Modulated it with f_{c_2} = 28 KHZ

Assign voice signal 3 32-40 KHZ bandwidth
→ modulated with f_{c_3} = 36 kHz

- Finally after combining these three modulated signals and send it via a common channel. In case of radio transmission, we can achieve the multiplexing effect with a single transmitter sending the combined signal or three different transmitters, transmitting each of their respective modulated signals. since they will combine together in free space.



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Solution 2: We can use the band-pass filters to remove half of the modulated signals before transmitting. We can do this because the lower sideband is just a mirror image of uppersideband and so we donot need to transmit both of them to communicate the required information.

- Dividing the bandwith channel into three separate frequencies range and then assign range to a signal and shift the original signal to assigned ranges.. This is done with modulation with carrier frequency.

  - Assign voice signal 1 to 20-24 KHz bandwidth → modulated with $f_{c_1} = 20KHz$
  - Assign voice signal 2 to 24-28 KHz bandwidth → modulated with $f_{c_2} = 24KHz$
  - Assign voice signal 3 to 28-32 KHz bandwidth → modulated with $f_{c_3} = 28KHz$

- The using a band-pass filter to remove the lower bandside. For example BPF singnal 1 would have a lower cutoff frequency of 20KHz and upper cutoff frequency of 24 KHz.

- Finally we combine these three modulated signals and send via a common channel.

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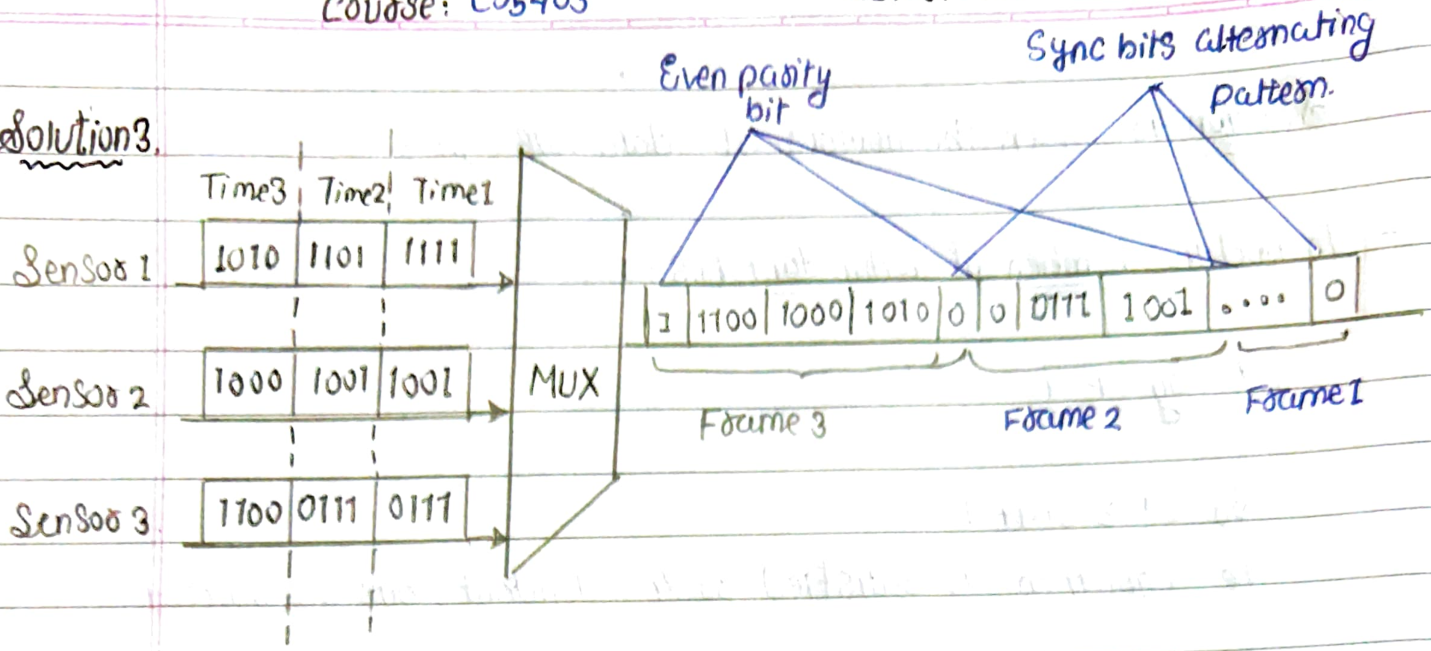
Solution3.



$$\text{frame rate} = \frac{100 \times 10^3}{14}$$

$$= \frac{10^5}{14}$$

$\therefore$ $\boxed{\text{Frame rate} = 7142.86 \text{ or } 7142 \text{ fps}}$ (Frames per sec)

bit rate = 7142 x 4 (∵ 4 bits per frame)

$\therefore$ $\boxed{\text{bit rate} = 28568 \text{ bps}}$ (bits per sec)

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Solution 4: Given the number of data bits, n=5

- To find the number of redundant bits:

Let say p=4.

So $2^4 \geq 5+4+1$

The equation is satisfied so 4 redundant bits are selected.

So, total code bit = 9.

Redundand bits are placed at bit positions 1, 2, 4 and 8.

- ~~Co~~ Constructing the bit location table:

Bit location	9	8	7	6	5	4	3	2	1
Bit designation	D_5	P_4	D_4	D_3	D_2	P_3	D_1	P_2	P_1
Bit representation	1001	1000	0111	0110	0101	0100	0011	0010	0001
Informal bits	1		1	0	0		1		
Parity bits.		1				1		0	1

- To determine the parity bits:

For P_1: Bit locations 3, 5, 7, 9 have three 1's, P_1 must be '1'.

For P_2: Bit locations 3, 6, 7 have two 1's, P_2 must be '0'.

For P_3: Bit locations 5, 6, 7 have one 1's, P_3 must be '1'.

For P_4: Bit locations 8, 9 have one 1's, P_2 must be 1,

Ans: Thus encoded 9-bit hamming code is 111001101

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Solution 5: To detect the error, from bit location table.

Bit location	9	8	7	6	5	4	3	2	1
Bit designation	D_5	P_4	D_4	D_3	D_2	P_3	D_1	P_2	P_1
Binary Representation	1001	1000	0111	0110	0101	0100	0011	0010	0001
Received Code	1	1	0	0	0	1	1	0	1

Checking the parity bits:

For P_1 : locations 1,3,5,7,9 , three '1's in grouph , hence bit value P_1 is 1.

for P_2 : locations 2,3,6,7, one '1' in group, hence P_2 is 1.

For P_3 : Check location 3,5,6,7, one 1 in the group , Hence P_3 is 1.

For P_4 : Check locations 8,9 , two '1's in the group, hence P_4 is 0.

Resultant binary word is 0111. It corresponds to bit location '7' in above table. The error is detected in data bit D_4. The error is 0 , should be changed to 1.

Hence corrected Code is. 111001101.

Solution 6:

probability of error = 0.2. = P(E) say

protocol used: Stop-and-wait protocol

average transmission attempts required to transfer 100 packets ?

probability of success = 1 - P(E)
P(S) say = 0.8

now for transmitting packets

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Say $E = P(S)\times 1 + P(S)\times 1 + \dots n \text{ times} = 100$ [for 100 packets]

$\therefore \quad 0.8 \times 1 \times n = 100$

$[\therefore n = 125]$

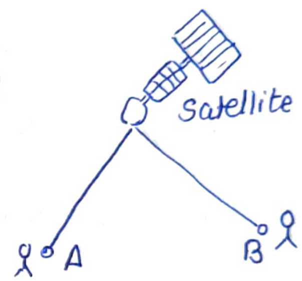
$\therefore$ To receive 100 packets we have to transmit 125 packets

—x—

Solution 7:

Bandwidth = 50 Kbps $= 50\times 10^3$ bps.

from $\boxed{40 \quad 13960}$



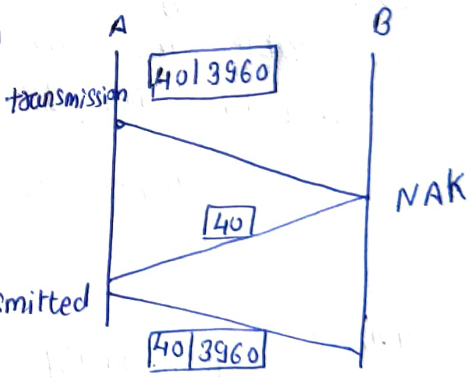
we have propagation time $T_p = 270\times 10^{-3}$ sec

NAK = 40 bits.

Error rate = 1%

we transmit say 100 frames (100<128)

then error rate = 1% (for data frames)



$\Rightarrow$ 1 frame will be corrupted

$\Rightarrow$ 1 frame will be retransmitted after receiving NAK.

So total data transmitted $= 100\times 4000 + 40 + 4000$ bits

Overhead $= (100\times 40) + 40 + 4000$

$$\text{Ratio} = \frac{8040}{101\times 4000 + 40} \qquad \left(\frac{\text{overhead}}{\text{total data transmitted}}\right)$$

$[\text{Ratio} = 0.0198]$

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Solution 8:

given $L = 65535 * 8$ bits

Band Width $= 1\times10^9$,

Round Trip Time = 20 milisec

So band width delay product = Band width x Round Trip Time

$= 1\times10^9 \times 20\times10^{-3}$

$\left[\text{Band with delay product} = 20\times10^6\right]$

But we have a limitation of only 65535×8 bits

So Efficiency is $= \dfrac{65535\times8}{20\times10^6}$

$\left[\text{Efficiency} = \dfrac{26\%}{10} = 2.6\%\right]$ 2.6

Throughput = Efficiency × Band width

$= \cancel{2.6} \times \cancel{100} \times \cancel{20\times10^6}\ \dfrac{2.62}{100} \times 1\times10^9$

$\left[\text{Throughput} = \cancel{52\times10^6}\ 2.62\times10^9\right]$

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Solution 9:

given data is 101011 0010

Coding schemes are given below.

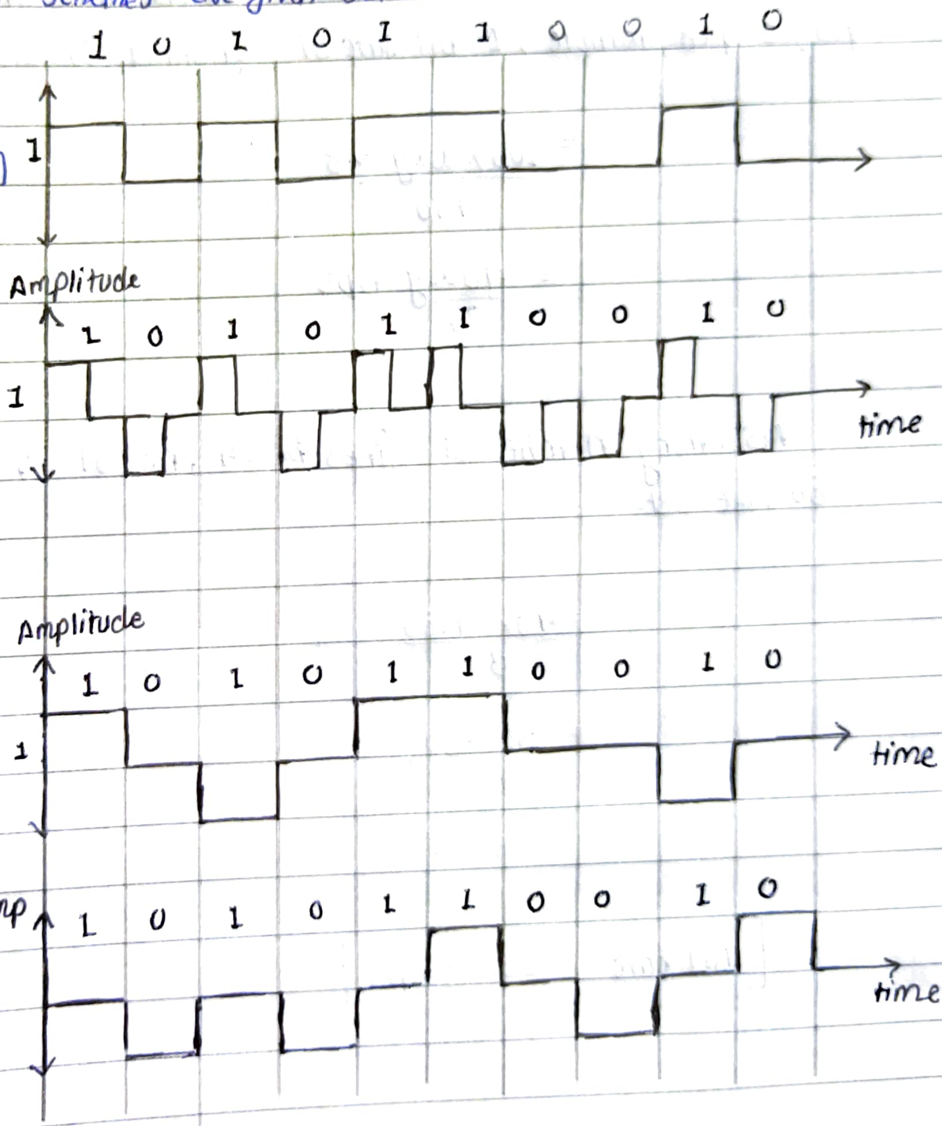
a) NRZ (Unipolar)

b) RZ

c) Bipolar

Ami

psuedo ternary



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—x—

Solution 10) Lets suppose no. of lines in pass be x and no. of characters be y.

Also each character is of 8 bits.

For download test document of the rate of 100 pages per minute, 1 bit rate of Channel should be

$$= \frac{100 \times x \times y \times 8}{60}$$

$$= \frac{40xy}{3} \text{ bps}$$

Assuming number of lines be 24, no. of characters be 80, we get.

$$= \frac{40 \times 24 \times 80}{3}$$

$$= 320 \times 80$$

$$= 25600$$

[Bit rate = 25.6 kbps]