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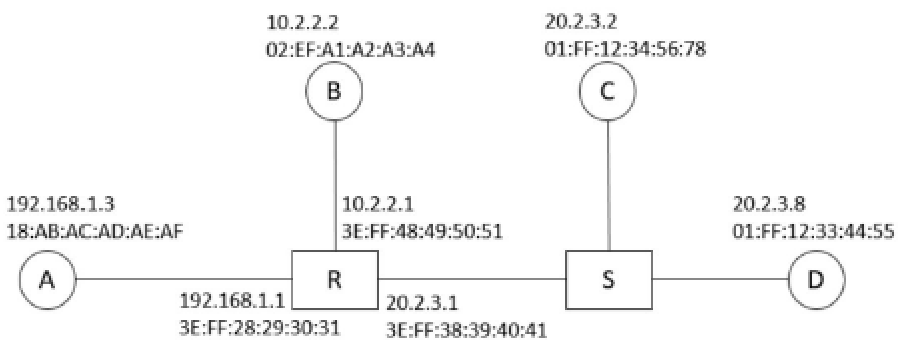
TE Comps
2019230069 (52)

CE51, Monsoon 2020
ISE Assignment #1
Due date 20th Sept. 20@17hrs (IST)

Instructions:

- This Assignment is to be completed individually be each student.
- No partial credit for showing only final result, hence must show all necessary computational steps to gain credits

Q.1	Consider a channel with bandwidth W=1 MHz and SNR =20 dB, and we want to allocate this channel among M=10 users.	
a	What bit rate is available to each user if we divide the entire channel into M channels of equal bandwidth	1
b	What bit rate is available to each user if the entire frequency band is used as a single channel and TDM (time division multiplexing) is applied?	1
c	How does the comparison of (a) and (b) change if the FDM (frequency division multiplexing) scheme in (a) requires a guard band between adjacent channels? Assume the guard band is 10% of the channel bandwidth	1
Q,2	Consider the IP network is shown below, where R is a router and S is a switch. A, B, C, and D are hosts. IP addresses and MAC addresses of hosts and router interfaces are listed as follows	



a	In this question, we assume R has a complete routing table and S has a complete forwarding table. However, R's ARP cache is empty right now. R received a packet with the following header	1

Ethernet Src	Ethernet Dst	IP Src	IP Dest	Payload
18:AB:AC:AD:AE:AF	3E:FF:28:29:30:31	192.168.1.3	20.2.3.2	

<table>
<tr><td></td><td>Since R does not have anything in its ARP cache yet, it will not be able to fill in the
Ethernet Dst field before it tries to send it to next hop. Thus, R will send out an ARP request first. Which host(s) will receive this ARP request sent by R? After the device(s) received the ARP request from R, which will respond?</td><td></td></tr>
<tr><td>b</td><td>After the above operation was successfully completed, what would the new header of the packet that R sending out?

<table><tr><td>Ethernet Src</td><td>Ethernet Dst</td><td>IP Src</td><td>IP Dest</td><td>Payload</td></tr><tr><td></td><td></td><td></td><td></td><td></td></tr></table></td><td>1</td></tr>
<tr><td>c</td><td>After the above operation was successfully completed, would R send out ARP requests again for this incoming packet? (2 pts)

<table><tr><td>Ethernet Src</td><td>Ethernet Dst</td><td>IP Src</td><td>IP Dest</td><td>Payload</td></tr><tr><td>18:AB:AC:AD:AE:AF</td><td>3E:FF:28:29:30:31</td><td>192.168.1.3</td><td>20.2.3.8</td><td></td></tr></table></td><td>1</td></tr>
<tr><td>Q.3</td><td>Consider a code on six-bit strings that contains (only) the following four codewords:
000000, 000011, 001111, 111111</td><td></td></tr>
<tr><td>a</td><td>What is the hamming distance of this code?</td><td>1</td></tr>
<tr><td>b</td><td>What is the rate of this code if we use it to encode two-bit strings? Is it efficient? If it is not efficient, please explain</td><td>1</td></tr>
<tr><td>c</td><td>How many bit flips can be using this code detected? How many bit flips can be corrected?</td><td>1</td></tr>
<tr><td>d</td><td>What is the max burst error that can be detected with generator $x4 + x3 + 1$?</td><td>1</td></tr>
</table>

<table>
<tr><td colspan="3">Name: Salvi Vishal</td></tr>
<tr><td colspan="3">SID: 2019230069 (52)</td></tr>
<tr><td>Q.No</td><td>Marks</td><td>Score</td></tr>
<tr><td>1</td><td>3</td><td></td></tr>
<tr><td>2</td><td>3</td><td></td></tr>
<tr><td>3</td><td>4</td><td></td></tr>
<tr><td>Total</td><td>10</td><td></td></tr>
</table>

Answers:

Qe 1

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UID : 52 DCCN

Q.1)

→ $W = 1\ MHZ$, $SNR = 20dB$, $M = 10$ users – Given

a) $SNR = 10\log_{10} SNR$

$20 = 10 \log_{10} SNR$

$\therefore SNR = 10^2$

$\boxed{\therefore SNR = 100}$ —— (I)

$\therefore$ Bit Rate by shannon's Formula $= \frac{W}{M} * \log_2 (1+SNR)$

$= \frac{1}{10} * \log_2 (1+100)$

$= 0.1 * \log_2 (1+100)$

$\therefore$ Bit Rate $= 0.66$ Mbps

Therefore, We divide the Bandwidth among m i.e 10 users.

Bit rate with division of Bandwidth among 10 users = 0.66 Mbps

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b)

The total bit rate afforded by the W hz is divided equally among all users:

$$\therefore \text{ bit rate} = [W * \log_2 (1+SNR)] / M$$

$$= [1 * \log_2 (1+100)] / 10$$

$$\therefore \text{ bit rate} = 0.66 \text{ mbps}$$

$$\boxed{\therefore \text{ Bit Rate} = 0.66 \text{ mbps}}$$

c)

Because of the guard band we expect that the scheme in (b) will be better since the bit rate in (a) will be reduced.

In (a), the bandwidth usable by each channel is 0.9 W/M.

Thus we have :-

$$\text{bit rate} = 0.9 * (W/M) * \log_2 (1+SNR)$$

$$= 0.9 * 0.66$$

$$= 0.59 \text{ mbps}$$

Therefore, new bit rate for (a) is 0.59 mbps

Qe 2

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Q.2)

a) Host C, D will receive the ARP request Sent by R.

After Receiving the ARP request host C will Respond.

b) After the above operation was Successfully completed, the new header of the Packet that R sending out is

Ethernet Src	Ethernet Dest	IP Src	IP Dst	Payload
8E:FF:38:39:40:41	01:FF:12:34:56:78	198.168.1.3	20.2.3.2	...

c) When R receives a new header, R needs to be directed to IP Dest → 20.2.3.2 But, Since there is still no cache for 20.2.3.8

Hence, R Send out ARP request again to fill in the cache

Yes, R Send out ARP request.

Qe 3

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Q.3)

The following four codewords:

000000, 000011, 001111, 111111 – Given

a) Hamming distance of this code :
2

Since, I observe that the minimum no of different bit among each codewords is at least 2.

Thus, hamming distance of this codewords is 2.

b)

This code uses 6 bits codewords to represent information that can be represented by 2 bits.

$$\text{Rate} = \frac{\cancel{2}}{\cancel{6}\,3} \times \cancel{100}\,33$$

∴ Rate = 33 %.

No, It is not efficient.
An efficient scheme should have a uniform distance among neighbour codewords.
111111 has neighbour codeword as 000000, 001111

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111111 and 000000 have distance of 6
i.e hamming distance 6.

001111 and 111111 have distance of 2
i.e. hamming distance 2.

c)

Since, the hamming distance in the above code is 2.

$$2d + 1 = 2$$
$$2d = 2 - 1$$
$$2d = 1 \qquad \boxed{\therefore 2d = 1}$$

So, we can detect upto 2d bit flips, which is 1 bit in this case.

We can correct upto d bit flips, which is 0 bit in this case.

i.e. $2d + 1 = 2$
$$2d = 2 - 1$$
$$2d = 1$$
$$\boxed{\therefore d = \frac{1}{2} < 1}$$

d) The max burst error that can be detected with generator $x^4 + x^3 + 1$ is "4 bits".