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Question 1 (a):

Bandwidth B = 600 Hz.

$SNR_{db} = 600$

We know that

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

Here SNR is given in db

So we know that

$SNR_{db} = 10 \log_{10} (SNR)$

Or

$SNR_{db}/10 = \log_{10} (SNR)$

$600/10 = \log_{10} (SNR)$

$60 = \log_{10} (SNR)$

Or

Antilog 60 = SNR

$SNR = 1 \times 10^{60}$

$C = 600 \log_2 (1+SNR)$

$C = 600 \log_2 (1x10^{60})$

$C = 600 \times 60$

$C = 3600$ Hz

Question 1 (b):

C = 4800

$Log_2 M = 8$

We know that

$C = 2B \log_2 M$

4800 =2B x 8

4800/16 = B

B = 300 Hz

Question 2 (a):

The answer is No, there is no such protocol which can be used by the two blue armies to defeat the red army because there is no way of knowing what each blue army is thinking about the attack.

• If both the blue armies attack the red army which is present in the valley in that case only the red army can be defeated.

• No proper communication between the two blue armies, so by using the unreliable communication they cannot avoid the defeat.

• If the unreliable works properly, one of the blue army commander sends a message of attacking the red army and waits for the acknowledgment from the second blue army commander.

• Again if the unreliable communication works and this time If the commander of one blue army receives the acknowledgment from the commander of another blue army, then both blue armies attack the red army simultaneously from opposite sides then the attack can be successful.

• If the unreliable communication won't works i.e. If the order of attack from one blue army commander is missing, then the commander of another blue army commander fails to receive the acknowledgment. Hence the attack can be unsuccessful in defeating the red army because the red army can defeat either of the blue armies separately.

Question 2 (b):

Physical layer: It connect the adjacent devices.

Network layer: It provide the addressing communication through connection of internet.

Internet layer: It connects the different network together.

Transport layer: The data is checked by this layer either it is in correct form or not.

Application layer: It convert that complex data in to readable text.

First the data comes in physical layer and then shifted to network layer were different addressing provide after that data comes to inter layer where different network unit. Then transport layer check the data and sent to application layer where it is again converted into readable text.

Question 3 (a):

Pi = 0.0

f = 6 GHz

d = 35863

Isotropic free space (LdB)

Path to satellite from earth=35863km

$$\text{LdB} = -20 \log (\text{pi}) + 20 \log (\text{diameter})$$

$$= 20 \log (0.050) + 20 \log (35863 \times 10^3)$$

$$= 26.020599 + 151.09293232$$

$$= 177.11 \text{ dB}$$

Some cases we add 21.98 with dB

LdB = 199.09 dB

Question 3 (b):

Particular signal system = -155dbw

Link transmitting 2400bps

Temperature 1600k

We know that

Eb/ No = -155dbw – 10 log (2400) -10 log (1600) + 228.6

= -155dbw -10 (3.3) -10 (3.2) + 228.6

= -155dbw -33 -32 + 228.6

= -155 + 229.6

= 74.6

Question 4 (a):

Acronyms stand for:

GEO: Geostationary earth orbit

LEO: Low Earth orbit

MEO: Medium earth orbit

Differences between GEO, LEO, AND MEO satellites
GEO (Geostationary orbit)
They have the same velocity with the Earth while they orbit it at around 35000 kilometers.
They are the biggest and largest compared to LEO and MEO satellites hence they have the biggest footprint.
They are efficient for they use few satellites to have a full coverage of the earth hence they deployment is cheaper than in LEO and MEO.
They also have the greatest visibility among the others types of satellites MEO and LEO.
Have the greatest latency basic they are the furthest.
They also have a long life compared to LEO.
They are the least expensive to deploy.
Orbit period is about 24 hours.

LEO (Low earth orbit)
They orbit the Earth at about 500 to 1500 kilometers.
They have the lowest latency basing they are the closest to Earth.
They need a lot of satellites to cover the Earth compared to GEO and MEO.
They also have the least visibility among the others types of satellites GEO and LEO.
They are the smallest compared to GEO and LEO.
They are the most expensive to deploy.
Have a short satellite life.
MEO (Medium earth orbit)
They orbit the Earth at about 5000 to 12000 kilometers.
They orbit the earth at a duration of two to eight hours.
They have a low Handoffs.
Have a long life than LEO.
Deployment of these satellites is required between eight to twenty.
They have a medium latency compared to LEO and GEO.

Question 4 (b):

Let satellite altitude be S = 36786 km

Uplink delay is calculated as T = S/C where C is the speed of light

(36786 x 103) / (3 x 103) = 12262ms

Round Trip delay is calculated as T = 2S/C where C is the speed of light

(36786 x 103 x 2) / (3 x 103) = 24524ms

Question 4 (c):

There are two main type of subsystem

1) Space segment subsystem

2) Earth segment subsystem

1) **Space segment subsystem:**

   The subsystem would have AOC subsystem, TTCM subsystem, Transponders and Power and Antenna system.

2) **Earth segment subsystem:**

   The subsystem would be present in the ground segment which would have the ability for accessing the satellite repeater in a manner for providing the communication among the users. Here the earth segment is otherwise known as ground segment.
   This would mostly have 2 function where in such transmission of a signal for the satellite as well as reception of the signal from that the satellite.
   In the earth segment, the earth station would be major subsystem.