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### Question NO 3 (a)

Determine the isotropic free space loss in dB's at 6 GHz for the shortest path to a synchronous satellite from earth (35,863 km)  
At 6 GHz, the wave length is 0.050m

### Solution:

$$\lambda = 0.05$$

$$f = 6 \text{ GHz}$$

$$d = 35863 \text{ km}$$

⇒ isotropic free space (LdB)

$$L_{dB} = -20 \log(\lambda) + 20 \log(\text{diameter})$$

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

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$$= 26.020599 + 151.09298232$$

$$= 177.11 \text{ dB}$$

Some case we add 21.98

With LdB

$$\text{LdB} = 199.09 \text{ dB}$$

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## Question No 3 (b)

If the received signal level for a particular digital system is  $-155$  dBW and the receiver system effective temperature is  $1600$  K, what is  $E_b/N_0$  for a link transmitting  $2400$  bps?

**Solution:**

Particular signal system =  $-155$  dBW

link transmitting  $2400$  bps

Temperature  $1600$  K

$$E_b/N_0 = -155 \text{ dBW} - 10 \log(2400) - 10 \log(1600) + 228.6$$

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$$-155 \text{ dbw} - 10(3-3) - 10(3-2) + 228.6$$

$$-155 \text{ dbw} - 33 + 228.6$$

$$-155 + 229.6$$

$$74.6$$

Question NO 1 (a)

Find the channel capacity for a channel with a 600-Hz bandwidth and a signal-to-noise ratio of 600 dB?

**Solution:**

$$\text{Bandwidth } B = 600 \text{ Hz}$$

$$\text{SNR}_{\text{dB}} = 600$$

④

⑤

$$C = B \log_2 (1 + \text{SNR})$$

$$\text{SNR}_{\text{db}} = 10 \log_{10} (\text{SNR})$$

OR

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

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

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

OR

$$\text{Anti log } 60 = \text{SNR}$$

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

$$C = 600 \log_2 (1 + \text{SNR})$$

$$C = 600 \log_2 (1 \times 10^{60})$$

$$C = 600 \times 60$$

$$C = 3600 \text{ Hz}$$

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## Question No 1 (b)

A digitized system is required to operate at 4800 bps. If a signal element encodes an 8 bit word, what is the minimum required bandwidth of the channel?

## Solution No 1 (b)

$$C = 4800$$

$$\log_2 M = 8$$

$$C = 2B \log_2 M$$

$$4800 = 2B \times 8$$

$$\frac{4800}{16} = B$$

$$B = 300 \text{ Hz}$$

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## Question No 4 (a)

Explain what GEO, LEO and MEO Satellites are (including what the acronyms stand for) Compare the three types with respect to factors such as size and shape of orbits, signal power, frequency reuse, propagation delay, number of satellites for global coverage, and handoff frequency.

### Solution:

Difference b/w 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

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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 ~~life~~ compared ~~are~~ 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 needed a lot of satellites to cover the earth compared to GEO and MEO.

They also have the least visibility among the others type of



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Satellites 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 low handoffs.

Have a long life than LEO

Deployment of these satellites is required b/w eight to twenty.

They have a medium latency compared to LEO and GEO.

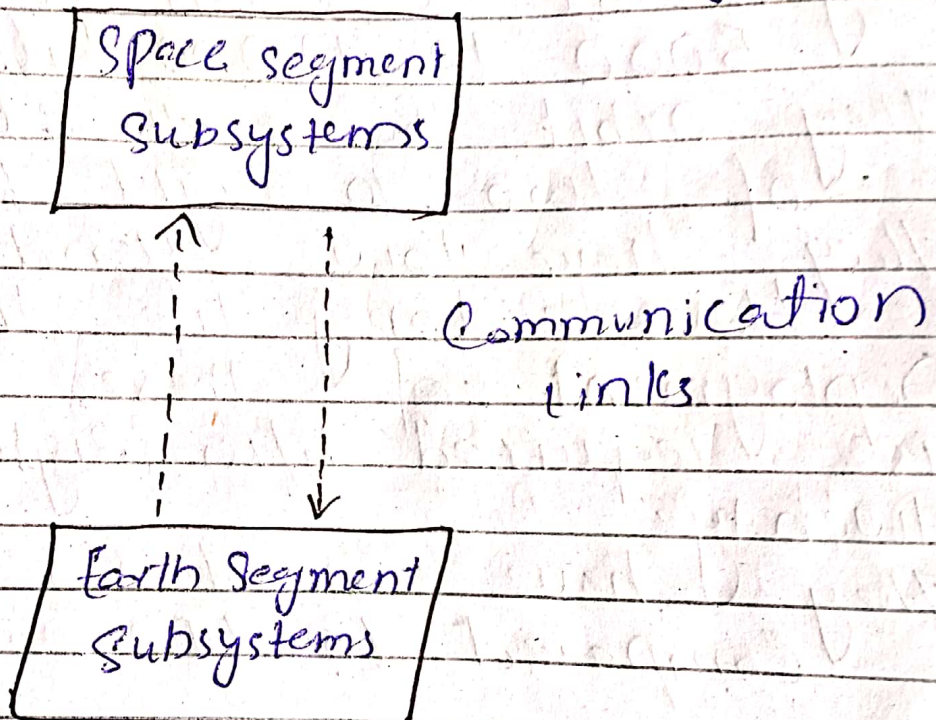
Question no 4 (b)

What are the different satellite subsystems? Briefly explain each of them.

**Solution:**

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A satellite communication consist of mainly two segments. Those are space segment and earth segments so accordingly there will be two types of subsystems namely space segment subsystems and earth segment subsystems.



### Space Segment Subsystem:

The subsystems present in space segment are called as space segment subsystems. Following are the space segment subsystem.

- AOC Subsystem.

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- TTCCM Subsystem
- Power and Antenna Subsystems
- Transponders.

- AOA:-

Attitude Control Subsystem takes care of the orientation of satellite in its respective orbit.

- TTCCM Subsystem:-

Telemetry subsystem present in the satellite send this data to earth station.

Power and Antenna Subsystems:-

is a vital subsystem, which provides the power required for working satellite.

Transponder:-

Transponder perform the functions of both transmitter and receiver in a satellite.

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→ Earth Segment Subsystems:-

The subsystems present in the ground segment have the ability to access the satellite repeater in order to provide the communication b/w the users. Earth segment is also called as ground segment.

Question NO 4(b)

Find an uplink and Round Trip Delay of GEO satellite having an altitude of 36,786 km?

Solution:

Let satellite altitude  $s = 36,786 \text{ km}$

Uplink delay is calculated as  $T = S/c$   
where  $c$  is the speed of light  
 $(36,786 \times 10^3) / (3 \times 10^8) = 12262 \text{ ms}$

Round Trip delay is calculated as  $T = 2S/c$  where  $c$  is the speed of light  
 $(36,786 \times 10^3 \times 2) / (3 \times 10^8) = 24524 \text{ ms}$

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## Question NO 2(a)

Solution:

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

- No proper communication b/w the two blue armies, so by using the unreliable communication they can't avoid the defeat.

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

- If the unreliable works properly, one of the blue army commander send a message of attacking the red army and waits for the acknowledgement from the second blue army commander.

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- 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 side then the attack can be successful.

- If the unreliable communication won't work i.e. if the order of attack from one blue army commander is missing, then the commander of another blue army commander fail 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.

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## Question NO 2(b)

Briefly explain the steps performed by the Receiver with the help of diagram of the TCP/IP protocol Suite?

Solution:

### TCP/IP PROTOCOL SUITE:

Communication b/w computer on a network is done through protocol suits. The most widely used and most widely available suite is TCP/IP protocol suite. TCP/IP is normally considered to be a 4 layer system. The 4 layers are as follows:

- 1 - Application layer
- 2 - Transport layer
- 3 - Network layer
- 4 - Data link layer.

#### 1 Application layer

This is the top layer of TCP/IP protocol suite. This layer includes

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application or processes that use transport layer protocol to deliver the data to destination computers.

- HTTP
- FTP
- SMTP
- SNMP

## 2 - Transport layer

This layer provide backbone to data flow b/w two hosts.

This layer receives data from the application layer above it. There are many protocols that work at this layer but the two most commonly used protocols at transport layer are TCP and UDP.

## 3) Network layer:-

There is also know as Internet layer. The main purpose of this layer is to organize or handle the movement of data on



network. By movement of data, we generally mean routing of data over the network. The main protocol used at this layer is IP. While ICMP and IGMP are also used at this layer.

#### 4) Data link layer:-

This layer is also known as network interface layer. This layer normally consists of device drivers in the OS and the network interface card attached to the system. Both the device drivers and the network interface card take care of the communication details with the media being used to transfer the data over the network.

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# Diagram:-

