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Subject: Wireless Networks

Q.1.a:

Ans: As give in the question the Bandwidth is 600 Hz

SNR_{dB} 600

Explanation:

We will use the Shannon Capacity formula:

$C=B * Log_2(1+SNR)$

We have to convert SNR_{db} to SNR

SNR dB = 10Log(SNR)

IF SNR dB is 40 then for 10Log (SNR) to be 40, SNR will be 10000 (As 10Log(10000) =40)

Therefore, SNR will be 10000

We have calculated SNR and we already have the Bandwidth. we will put these values in the Shannon capacity formula

C= 600 * Log(base2) (1+SNR)

C= 600 * Log2(10001)

C= 600 * 13.28

C= 7968 Hz or approx 8kHz

Q.1.b:

Ans: Using Nyquist's equation: $C = 2B \log_2 M$

We have C= 4800 bps and $\log_2 M = 8$ because a signal element encodes a 8-bit word

Therefore, C= 4800 = 2B * 8, and B= 300 Hz

The minimum required bandwidth of the channel = 300 Hz

Q.2.a:

Ans: 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 acknowledgment. Hence the attack can be unsuccessful in defeating the red army because the red army can defeat either of the blue armies separately.

Q.2.b:

Ans:
Application Layer
A TCP/IP application is any network process that occurs above the Transport Layer. This includes all of the processes that users directly interact with as well as other processes at this level that users are not necessarily aware of.

Presentation Layer
The Presentation Layer provides standard data presentation routines. This function is frequently handled within the applications in TCP/IP.

Session Layer
In TCP/IP, this function largely occurs in the Transport Layer, and the term "session" is not used; instead, the terms "socket" and "port" are used to describe the path over which cooperating applications communicate.

Transport Layer
Much of our discussion of TCP/IP is directed to the protocols that occur in the Transport Layer. The Transport Layer guarantees that the receiver gets the data exactly as it was sent.

Network Layer
The Network Layer manages connections across the network and isolates the upper layer protocols from the details of the underlying network.

Data Link Layer
The reliable delivery of data across the underlying physical network is handled by the Data Link Layer. TCP/IP rarely creates protocols in the Data Link Layer.

Physical Layer
The Physical Layer defines the characteristics of the hardware needed to carry the data transmission signal. Features such as voltage levels and the number and location of interface pins are defined in this layer.

Q.3.a

Ans: Explanation:

Given: λ= 0.050 m

f= 6 GHz

d= 35,863 km

isotropic free space loss (LdB)

LdB= -20 log (λ) + 20 log (d)

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

$= 177.11$ dB

Some case we add 21.98 with LdB

LdB= 199.09 dB

Q.3.b:

Ans: Given,

Ratio of Signal energy per bit to Noise Power Density per Hertz = E_b / N_o

Received signal power (S_{dBW}) = -155 dBW

Receiver system effective noise temperature (T) = 1600K

Link transmitting rate(R) = 2400 bps

Boltzmann's constant (k) = 1.38×10^{-23} J/K

Now we Calculate the Ratio of Signal energy per bit to Noise Power Density per Hertz in decibel notation.

$(E_b / N_o)_{dB} = S_{dBW} - 10\log R - 10\log k - 10\log T$

$= -156 - 10\log 2400 - 10\log (1.38 \times 10^{-23}) - 10\log 1600$

$= -156 - 10(3.38) - 10(-22.86) - 10(3.20)$

$= -156 - 33.8 + 228.6 - 32$

$= 6.8$

$(E_b / N_o)_{dB} = 6.8$ dB

Q.4.a:

Ans: GEO stands for geostationary earth orbit; LEO stands for low earth orbit and MEO stands for medium earth orbit.

Differences between GEO, LEO and MEO:

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.

Q.4.b:

Ans: These delays can be found with a quick calculation.

Explanation:
GEO satellites have a rotational period of 24h around the Earth, so their footprint (covered area) is always de same. From a Physics expression, time can be found by dividing Distance/Speed. In this case, the signal's speed is the speed of light (300 000 km/s) and the distance to travel by the signal is 36,786 km (GEO satellite altitude). An uplink trip is the one made by the signal from an Earth station to satellite. A round trip is the entire path: transmitting Earth station - GEO satellite - receiving Earth station and back. These are the results:

Uplink delay: t = d / s ---> t = 36,786,000 / 300 000 = 0,12262 sec.

Round Trip Delay is 4 times uplink or downlink delay, so: t = 0,12262 * 4 = 0,49048 sec.

Q.4.c:

Ans: Below are common Satellite Subsystems:

Propulsion
The propulsion system is part of the components that get the satellite into orbit. Other chemical or electrical motors are also used to move the satellite back into the correct orbit when either atmospheric drag, magnetic fields or the solar winds deflect the satellite out of its correct trajectory.

Power

Solar panels are used in combination with batteries to provide a constant source of electrical power on the satellite.

Communications

The communications subsystem uses transmitters, receivers or transponders (transmitter and receiver in one component). The communications subsystem handles all transmit and receive communications functions.

Superstructure

The satellite must survive the violent forces of the rocket ride into space. The superstructure of the satellite not only supports it in space, but reduces the shock and vibration the internal components might suffer during the launch.

Thermal

The whole point of the thermal system is to regulate the temperature of the satellite's components. Too hot or too cold, or too great a swing in temperature will prematurely end the useful life of a satellite.

Attitude & Orbital Control

The attitude & Orbital control system allows the satellite to remain pointed correctly. These are often very small motors compared to the propulsion system.

Telemetry Tracking & Command

The satellite must inform the satellite operations center what its current state is, and where it is located in orbit. Often a simple 'beacon' system is used to allow the ground station to track the satellite in orbit.