WIRELESS NETWORKS MID SEMESTER ASSIGNMENT

Id: 13002

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

Given data: (signal-to-noise ratio) SNR_{dB} = 600dB

(Bandwidth) B = 600Hz

(Channel Capacity) C = ?

Formula: $SNR_{dB} = 10 \log_{10} (SNR)$

$C = B*10 \log_2 (1+SNR)$

Solution: as we have SNR in dB, so we have to extract SNR from SNR_{dB} equation .

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

$SNR=10^{SNRdB/10}$

$SNR=10^{600/10}$

$SNR=10_{60}$

Now we have to find channel capacity.

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

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

$C=600*\log 11^{60}/\log 2$

$C=600*207.56$

$C=124,539.54$

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

Ans: C = 4800bps

Formula: $C = 2B \log_2 M$

Put the values in the formula

$4800 = 2B * 8$

$2B = 4800/8$

$2B = 600$

$B = 300Hz$

3. Two blue armies are each poised on opposite hill preparing to attack a single red army in the valley. The red army can defeat either of the blue armies separately but will fail to defeat both blue armies if they attack simultaneously. The blue armies communicate via an unreliable communication system (a foot solider). The commander with one of the blue armies would like to attack at noon. His problem is this: if he sends a message to the other blue armies, ordering the attack, he cannot be sure it will get through. He could ask for acknowledgment, but that might not get through. Is there a protocol that the two blue armies can use to avoid defeat?

Ans: The problem may be solved by using the approach taken by TCP when setting up a connection. TCP uses a Three-Way Handshake to establish a connection as follows:

SYN: The active open is performed by the client sending a SYN to the server. The client sets the segment's sequence number to a random value A.

SYN-ACK: The server replies with a SYN-ACK. The acknowledgment number is set to one more than the received sequence number (i.e., A+1) and the sequence number that the server chooses for the packet is another random number B.

ACK: The client sends an ACK back to the server. The sequence number is set to the received acknowledgement value (i.e., A+1), and the acknowledgement number is set to one more than the received sequence number (i.e., B+1).

At this point, both the client and server have received an acknowledgment that the connection has been established. Steps 1 and 2 establish the sequence number as a connection parameter in one direction and allow its acknowledgement. Steps 2 and 3 establish the sequence number as a connection parameter in the other direction and allow its acknowledgement. Both steps allow the establishment of a full-duplex communication.

4. Briefly explain the steps performed by the receiver with the help of diagram of the TCP/IP protocol suite?

Ans: The name TCP/IP refers to an entire suite of data communications protocols. The suite gets its name from two of the protocols that belong to it, The Transmission Control Protocol (TCP) and the Internet Protocol (IP). TCP/IP is the traditional name for this protocol suite the TCP/IP protocol suite is also called the Internet Protocol Suite (IPS). Both names are acceptable.

LAYER
APPLICATION
TRANSPORT
NETWORK
NETWORK ACCESS
PHYSICAL

I. Application layer: This is the top layer of TCP/IP protocol suite. This layer includes applications or processes that use transport layer protocols to deliver the data to destination computers. applications use to communicate with the second layer, the transport layer. Some of the popular application layer protocols are:

- HTTP (Hypertext transfer protocol)
- FTP (File transfer protocol)
- SMTP (Simple mail transfer protocol)
- SNMP (Simple network management protocol)

II. Transport layer: This layer provides backbone to data flow between 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.TCP is used where a reliable connection is required while UDP is used in case of unreliable connections

III. Network layer: This layer is also known 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 (used by popular 'ping' command) and IGMP are also used at this layer.

IV. Network access layer: It is used to exchange the data from user work station to the internet. It organizes the data packet for transmission between local area network and internet. It is also called as data link layer that handle the transmission across the medium.

V. Physical layer: It is the bottom layer that transmit the data through the physical wire or the radio signals. it is concerned with how raw data bits are transmitted from one system to another over physical communication line.

5. Determine the isotropic free space loss in dBs at 6 GHz for the shortest path to a synchronous satellite from earth (35,863 km). At 6 GHz, the wavelength is 0.050 m. Ans: Friss equation:

$$P_{rec} = P_{tr} * G_{rec} * G_{tr} * (\lambda/4\pi r)^2$$

Taking log on both sides

$$10\log P_{rec} = 10\log [P_{tr} * G_{rec} * G_{tr} * (\lambda/4\pi r)^2]$$

$$10\log P_{rec} = 10\log [P_{tr} * G_{rec} * G_{tr}] + 10\log (\lambda/4\pi r)^2]$$

Received power = Transmitted power + Gain-losses

Free space path loss = $P_L = -10 \log (\lambda /4\pi r)^2$

According to log rules

$P_L = -20 \log (\lambda / 4\pi r)$

The radius r is changed to distance d

$P_L = -(20 \log \lambda - 20 \log 4\pi d)$

The λ is changed to speed of light / frequency

$P_L = -(20\log c/f - 20 \log 4\pi d)$

$P_L = -(20\log c - 20\log f - 20 \log 4\pi - 20\log d)$

$P_L = -(20\log (299792458) - 20\log f - 20 \log 4\pi - 20\log d)$

$P_L = -(-20\log f - 20 \log 4\pi + 20\log (299792458) - 20\log d)$

$P_L = +20\log f + 20\log d \underline{-20\log (299792458) + 20 \log 4\pi}$

Addition

$\underline{P_L} = +\underline{20\log f} + \underline{20\log d} - 147.55222$ (Now put the Given values)

[dB] [Hz] [m]

$P_L = +20\log (6*10^9) + 20\log (35.863*10^6) - 147.55222$

$P_L = 195.563025 + 151.0929323 - 147.55222$

$P_L = 199.203737$

6. If the received signal level for a particular digital system is -155 dBW and the receiver system effective temperature is 1600 K, what is EB/ No for a link transmitting 2400bps? Sol: Eb/No = (signal power / noise power) * (B/R)

Noise power = kT X B

Hence Eb/No = (signal power) / (kT R)

$= 10^{-151/10} / (1.38X10^{-23}X1500X2400)$

$= 15.99$

$= 12$ dB

Or (Eb/N0) dB = Signalpower_dBW – 10logk – 10logT – 10logR

$= -151 - 10\log (1.3810^{-23}) - 10\log 1500 - 10\log 2400$

$= 12$ dB

7. Explain what GEO, LEO and MEO satellite is (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. Ans:

Geo stationary Orbit (GEO):

It is the highest earth orbit from the earth rotated same as the earth rotation. It located in 35800 kilometers from the earth's equator. It is the highest located satellite hence it provide great visibility and signaling.

Medium Earth Orbit (MEO):

It is located between the range of hundreds to thousand of kilo meter from the earth's orbit. Intermediate cellular applications use MEO for its communications.

Lower Earth Orbit (LEO):

It is the lowest orbit which is located very nearest to the earth, typically the distance in hundreds to thousand kilo meters. It is used for small data communication purposes like video calling and chatting etc.

	GEO (Geostationary or Geosynchronous Earth Orbit)	LEO (Low Earth Orbit)	MEO (Medium Earth Orbit)
Size	Large footprint	Small footprint	Small footprint
Shape of orbit	Circle Earth above the west to specific paths around Earth in orbit	Does not need to take specific paths around Earth in orbit	Does not need to take equator from east following Earth's rotation
Signal power	High	High	Low
Frequency reuse	Low	Hight	Low
Propagation delay	High	Low	High
Global coverage	Only 3 satellites are required	500 to 200 satellites are required	10 to 50 satellite are required.
Handoff frequency	None	high	Low

8. Find an Uplink and Round-Trip Delay of GEO satellite having an altitude of 36,786 km?

Ans: The round-trip delay of GEO satellite at the altitude of 36786 is 480millisecond. and the Uplink delay of GEO satellite having an altitude of 36786 is 119.3 millisecond.

9. What are the different satellite Sub System? Briefly explain each of them.

Ans: A communication satellite is an artificial satellite that relays and amplifies radio tele communication signals via a transponder: it is creating a communication channel between a source transmitter and a receiver of different location on earth.

Russia launched the first satellite name sputniks in 1957, this was the oldest communication satellite revolving around the earth with 1100 another active communication satellite and first communication Telstar that was launched in 1962 at the height of 32000m. A complete satellite consists of several sub-system. most important of them are as follow: I. Power supply system.

II. Altitude and orbit control system.
III. Tracking, telemetry and command system.
IV. Communication system.

Telemetry, tracking, and command system:

Data received from the satellite about status of attitude, orbit and other involve parameters Is processed at the ground station. Telemetry, tracking and command subsystem is a part of satellite management task and it is involving on earth station. The main functions of TT and C subsystem are as follow:

I. Measuring of angle and range for the location of the satellite. II. Transmission of housekeeping information.

III. Status of a satellite to the ground control station.

IV. Receiving command signals for the station keeping operations of the on board equipment's.

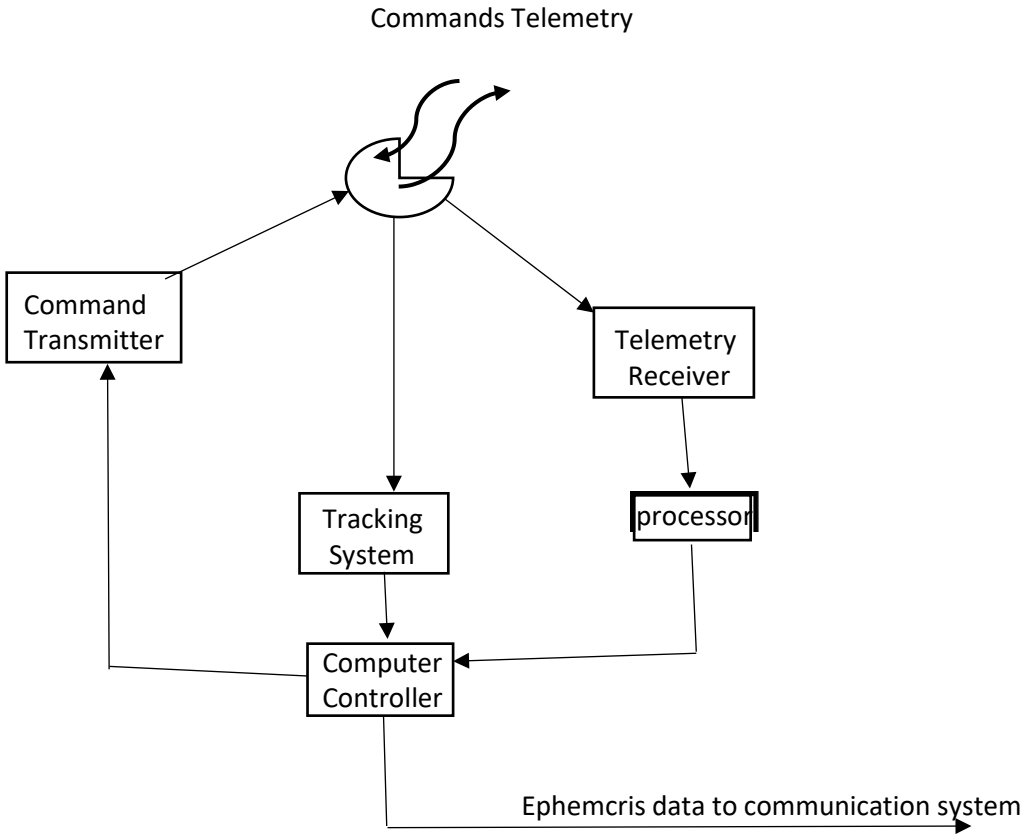

Diagram: Arrangement of telemetry, tracking and command system.