**SQ**

1. Differentiate between the different types of transmission impairments.
2. What is the difference between processing delay and queuing time? Explain with an example.

**Math:**

1. Banglalink has a bandwidth of 3.5 kHz (0.3 to 3.8 kHz) assigned for voice calls. If the signal-to-noise is 5021. What is the theoretical highest bit rate of Banglalink? How many levels are required?

C = B \* log2 (1+SNR) = 3500 \* log2 (5021+1) = 43029 bps

BitRate = 2\*B\*log2(L)

43029 = 2 \* 3500 \* log2(L)

L = 2^6.147 = 70.86 levels

1. What are the propagation time and the transmission time for a 4 kbyte message if the bandwidth of the network is 1.5 Gbps? Assume that the distance between the sender and the receiver is 14,000 km and that light travels at 2.4 ×10^8 m/s.

Propagation time = (14000\*1000)/(2.4\*10^8) = 58.33 ms

Transmission time = (4000 \* 8)/(1.5 \* 10^9) = 0.021 ms

SQ

1. What factors do we need to consider while calculating the channel’s bit rate? Explain each of them.
2. Write the difference between bandwidth and throughput. If the distance between the sender and receiver is higher then the transmission delay becomes higher as well. Yes or No? Explain your answer.

Math

a) We have a channel with 5 KHz bandwidth. If we want to send data at 1000 Kbps, what is the minimum SNRdB? What is SNR? [5]

b) We need to send 900 kbps over a noiseless channel with a bandwidth of 64000 Hz. How many signal levels do we need? (the answer is not accepted as a decimal number. It should be an integer value, so propose a solution accordingly) [5]

**SQ**

1. Differentiate between the digital and analog signals.
2. Differentiate between Distortion and Noise.

**Math:**

1. The power of a signal is 100 μW and the power of the noise is 1 nW; what are the values of SNR and SNRdB?

SNR = (100\*10-6 W) / (1\*10-9 W) = 100000

SNRdB = 10 log10 (100000) = 50 dB

1. What is the total delay (latency) for a frame of size 9 million bits that is being sent on a link with 7 routers each having a queuing time of 5 μs, 2 μs, 3 μs, 5 μs, 4 μs, 3 μs, and 3 μs, respectively. And the processing times of the router are 2 μs, 3 μs, 3 μs, 2 μs, 4 μs, 6 μs and 5 μs, respectively. The length of the link is 9500 Km. The speed of light inside the link is 2 × 10^8 m/s. The link has a bandwidth of 12 Mbps.

Propagation time = 9500000/(2 × 10^8) = 0.0475 s

Transmission Time = (9 x 106)/(12 x 106) = 0.75 s

Queuing Time = (5+2+3+5+4+3+3) x 10-6 = 25 x 10-6  s

Processing Time = (2+3+3+2+4+6+5) x 10-6 = 25 x 10-6  s

Delay = 0.0475 s + 0.75 s + 25 x 10-6  s + 25 x 10-6  s =0.79755 s

**Math**1. Suppose we have a 5 GHz bandwidth channel. If the upper limit of the bit rate is about 33 Gbps, what is the signal to noise ratio?

Ans:

33 = 5log2(1+SNR)

=> 33/5 = log2(1+SNR)

=> 6.6 = log2(1+SNR)

=> 1 + SNR = 2^6.6

=> SNR = 97 - 1

=> SNR = 96

2. Suppose you want a channel with a maximum theoretical speed of 72 Mbps. If you want the channel to have 64 signal levels, how much bandwidth should be allocated to the channel?

Ans:

72 = 2 x B x log2(64)

B = 6 Mhz

**SQ**

1. What are the causes of three transmission impairments? Describe how to solve at least one of these impairments.
2. Differentiate composite periodic and non-periodic signals in terms of frequency and explain. Decompose a composite periodic signal in the time and frequency domains.(Draw figures and explain)

**Math**

1. Consider a telephone line with a frequency range 500 Hz to 4500Hz assigned for data communications. Assume that SNRdb=35. Calculate the capacity of this noisy channel?

Answer: Bandwidth= 4500-500=4000Hz

SNRdb=10log10SNR

SNR=1035/10=3162.28

C=Blog2(1+SNR)=4000log2(1+3162.28)=46508.82219 bps=46.5kbps

1. A signal travels from BRAC University to your home. At BRAC University, the signal power is 1.2kW. At your home, the power is 106mW. What is the loss or gain in decibels?

Answer:

10log10(P2/P1)= 10log10(1000W/1200W)=-.79dB(Loss)

**SQ:**

1. What are Simple Signals and Composite Signals? What is Peak Amplitude?

**Simple signal and Composite signal:** if there is one single sine wave that is simple signal; Composite signal is made of many simple sine waves

**Peak amplitude:** The peak amplitude of a signal is the absolute value of its highest intensity, proportional to the energy it carries.

1. There are two cases of SNR. Which one can be considered better and why?

Answer: High SNR because High SNR means less noise.

**Math:**

1. A line has a signal-to-noise ratio of 1000 and a bandwidth of 4000 KHz. What is the maximum data rate supported by this line?

**Answer:**

**C= B\*log2\*(1+SNR)**

**= 39868905.04 bps**

**= 39868.905 kbps**

1. A network with bandwidth of 10 Mbps can pass only an average of 15,000 frames per minute with each frame carrying an average of 8,000 bits. What is the throughput of this network?

**Answer:**

Throughput = (15000\*8000)/60 = **2 Mbps**