Computer Networks and Distributed Systems

Questionnaire about Basic Performance and Line and Channel Encoding

Context

- Brief intro to Communication and Information Theory: Nyquist, Shannon-Hartley
- Links, wavelength
- Datalink protocols
- Basic Ethernet

1. Which Internet Architecture layer is this chapter focused on? Briefly list the functions of this layer and the name and the structure of its PDU (Protocol Data Unit) in the case of the Ethernet technology.

2. Observe the network diagram of slide no. 6 of presentation http://paloalto.unileon.es/cn/lect/CN-Ch1-2018-Section4.pdf, then, respond to the following questions related to it:

    a. Is the physical layer implemented in all the network elements? Explain why it is

    b. Switches have no IP, try to justify this on the basis of the board discussions we held in the labs as we were evolving the lab practicals

    c. Why do routers have IP?

    d. Try to justify the great variety of link layer protocols that appear on the net diagram

3. We can digitize the variables that represent a real-world process like the surrounding sound by turning time, which is considered continuous, into a discrete variable, then, at each discrete-time value we must quantize the sound which consists of assigning the correct discrete value to its sound power (Air pressure). Nyquist established an important result known as the Nyquist rate or criterion:

    a. We want to find out whether Nyquist rate applies to the discretization process (continuous time to discrete time) or the quantization process (Continuous air-pressure to discrete air-pressure)

    b. Is the Nyquist rate a sufficient condition or a necessary condition for obtaining the original signal from the digitized samples?

    c. We are digitizing music at a 8Ksamples/sec, then, when converting the samples back into real sound, what will that sound bandwidth be?

4. Over a communication channel, can we transmit at a speed as high as we wish? Carefully discuss this question according to Shannon-Hartley theorem.

5. Compute the Shannon capacity of a channel with a 2MHz bandwidth whose SNR=500. In order to increase

the channel capacity in this case, you can choose to double either the bandwidth or the SNR: which one would you choose? Explain why.

6. In the presentations mentioned above, you can observe that the different transmission media offer different bandwidths. Why is it good to have transmission media with high bandwidth? Does a higher bandwidth mean a higher propagation speed?

7. The following URL gives us a listing of the frequency bands used by European LTE mobile operators, among them, Movistar uses these frequencies: 800 MHz, 1800MHz and 2600MHz:

   https://en.wikipedia.org/wiki/List_of_LTE_networks_in_Europe

   a. Calculate the electromagnetic signals' resulting wavelengths and briefly discuss the advantage to using the highest frequency (Recall the lectures when I explained the efficiency of an antenna).

   b. Calculate the wavelength resulting when transmitting at 2600MHz