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Computer Networks and Distributed Systems

Questionnaire on the Conceptual Basis chapter of CN

Context

- Lecture of 22th/March/2018
- paloalto.unileon.es/cn under the heading "*Chapter 1: Conceptual Basis*"
- paloalto.unileon.es/cn under the heading *"Chapter 1: Brief notes on basic network performance and solved exercises*" which points to http://paloalto.unileon.es/cn/ComplNotesCN.Ch1.pdf

1. *(Already published in Q2, reproduced here for convenience)* Did you already study ch.1 ex. 4.a and 4.b? If so, now we request you to calculate the throughput attained in each case. Throughput means the effective performance attained, that is, considering only real user data transferred from end to end (From host to host).

2. *(Already published in Q2, reproduced here for convenience)* Check the pdf document mentioned above about **Network Performance** (http://paloalto.unileon.es/cn/ComplNotesCN.Ch1.pdf) and *study all the exercises solved in it*. In 2018, we will work exercises 4.a and 4.b in the review class (*Monday 26th/March/2018 17:30 (G3 and G4) and 18:45 (G1 and G2)*). In the case of ex. 4.b, please, note that the explanation I provided you in the lab is easier to grasp than that included in the pdf document mentioned above.

3. Briefly list the functions of the Physical and Datalink layers. Depict the fields of a Physical Layer Ethernet frame and a Datalink Layer Ethernet frame.

4. Study the network diagram included in slide entitled "Datalink protocols in an Internetwork" in the "Conceptual Basis, section 4" presentation, then, respond to the following questions related to it:

    a. Is the physical layer implemented in all the network nodes? 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 practices

    c. Why do routers have IP?

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

5. In the presentation mentioned above, the slide titled "IF link bandwidth is limited" 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? (Skim the Complementary Notes document mentioned above in the Context section).

6. 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 (Apply the formula that yields the wavelength of an electromagnetic wave given its frequency at slide titled "Links" in section 4 of the Conceptual Basis presentation)

7. There exist a number of PCM line encoding techniques, among them, we note the importance of NRZ, which you used in the Digital Electronics lab, however, in this course on Computer Networks, we are only interested in PCM signals such as NRZ-i and Manchester. Provide a brief explanation about why we don't use NRZ in Computer Networks.

8. Briefly explain the voltage levels used at the output of a CMOS NOT gate for representing a 0 and a 1. Observe that all CMOS NOT gates must follow these specifications, in particular, we want to note that each binary value is represented by a continuous range of voltages and that in between them, there exists a region in which no signal should remain for a long time.

9. By contrast to logic gates, line encoders (NRZi, Manchester, etc.) don't have such a stringent specification but the receiver keeps the average value of the input signals it has seen so far and decodes a 1 when the input signal's value is greater than the average voltage and 0 otherwise. What adverse effect is derived when a signal stays on the same level for a long number of bit times? What's the name of this effect?

10. Assume a 4B/5B + NRZ-I encoder for this exercise. We want to transmit the following sequence of 20 binary symbols: 0100 0000 0000 0000 0001

    a. What's the length of the longest string of bits 0 present in the sequence?

    b. What's the length of the longest string of bits 0 present in the output of the 4B/5B encoder? Is this result consistent with the 4B/5B encoder's mission?

    c. What's the length of the longest string of bits 1 present in the output of the 4B/5B encoder? Now, carry out the NRZ-I line encoding, then, count the longest string of bit times in which the signal stays on the high level and also count the longest string of bit times in which the signal stays on the low level. Contrast each of the results obtained with the results obtained in a) and in b).

    d. Assume the encoder is using a bit time $\tau = 0.1\mu s$. Calculate the transmitting clock frequency corresponding to this value of τ.

    e. Estimate the sampling clock derived by the receiver by calculating the average distance between signal level changes.

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11. Assume, now a Manchester encoder:
    a. Encode the same bit sequence used in the preceding exercise

    b. Assume the encoder is using a bit time τ=0.1μs. Calculate the transmitting clock frequency corresponding to this value of τ.

    c. Estimate the sampling clock derived by the receiver by calculating the average distance between signal level changes.

12. Practice line and channel encoding by solving exercises 1 and 3 of chapter 2 in the textbook by Professor Peterson and Bruce Davie (Computer Networks: A Systems Approach).