Physical layer homework - week of Sept. 20-22

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September 22, 2016

Instructions

This homework is optional, but recommended. Please feel free to contact me if you have questions or if you need hints. Resources for the homework and lectures are available from the URL containing this homework description. Please make sure you show how you obtained your answwers.

Questions

Question 1: An audio CD is designed to reproduce sound frequencies accuratelty up to 22 kHz.

    a) What is the sampling rate for the audio tracks?

    b) Given that a track on an audio CD records digitized sound containing 12 bits per sample, at what rate (in bits per second) does a CD player read data from the CD?

    c) Given that a telephone channel has a bandwidth of 4 kHz and it uses 8 bits per sample, how many telephone channels could be recorded, in parallel, on a CD audio track?

Question 2: Use the suggested resource to discover the bandwidth of a WiFi channel. Use any online resources to clarify terminology that you may find unfamiliar. Then answer the following questions.

    a) Use the Shannon formula to estimate the theoretical upper bound on the data transmission capacity, measured in bits per second, that a WiFi channel can support, given a signal to noise ratio of 10. Find the upper bound on the capacity of the channel that is advertised by the standard. If you discover a difference between the values, what is your opinion on the possible cause(s) for this difference?

    b) CRAWDAD is a database of real network measurements. A particular dataset called *pdx/metrofi* contains many measurements for an urban WiFi network that was deployed in the Portland Oregon, area. The data contains, among other parameters, measurements for both upstream and downstream throughput (or actual capacity of the communication channels). A description of the data set is available from `http://www.crawdad.org/pdx/metrofi/20111024/2007/` The actual data is available to download from the URL containing this homework. Try to extract a few actual throughput values for both upstream and downstream connections from this data. How do these values compare with both the theoretical and the advertised limits?

Resources

– WiFi characteristics (easy to read paper): `https://www.nostarch.com/download/wifi_01.pdf` You do not need everything from this paper to answer Question 2 (you just need the bandwidth of a channel), but you may find the content interesting.