ECE/CS 438: Fall '18: HW 1: Basics and Application Layer

Your Name and Net ID:

1) Assorted questions:
State True/False with one-sentence explanations:
(a) Data rate is both a function of the bandwidth as well as the center frequency of the transmitted signal.

(b) Applications requiring low latency (but equal bandwidth) would benefit more from FDM than TDM.

(c) A remote space telescope transmits from 5000 km away, at a data rate of 100Kbps. The total time for packet delivery to the earth station is dominated by the transmit time and not the propagation delay.

(d) When average La/R is less than 1, packets will obviously not have to wait in a queue (where 'a' is the packet arrival rate, L is the number of bits per packet, and r is the router's service rate).

(e) A network administrator tells you that 500 users can be accommodated by statistical multiplexing, given that each user needs 1Mbps and has a 25% chance of being active. With FDM, 125 such users can be accommodated. https://math.stackexchange.com/questions/918861/probability-problem-in-networking

2) Bandwidth, data rate, and SNR:
Shannon's ground breaking equation says that: C = B log (1 + SNR) where, C is the data rate in bits/s achievable on the communication link (also called capacity), B is the bandwidth in Hz, SNR is the ratio of received signal power to the receiver?s noise power.

(a) Now, a laptop intends to transmit to its WiFi base station located R=5m away. What data rate can a WiFi laptop achieve, when transmitting at a bandwidth of 20MHz, at a power P=10 milliWatt. Assume that received signal power (Q) = P / R^2, and that noise power at the receiver is N=0.01 milliWatt.

(b) If the laptop intends to double its data rate, how close should it move to the WiFi base station.

(c) If moving close is not an option, how much should it increase its bandwidth to double its data rate.

3) Web Caching:
(a) We understand that web caching reduces access latency because the content a client is looking for is already in the cache (hence, the client does not need to fetch the content from the server). This suggests that the latency reduction is proportional to the cache hit rate. However, it turns out that the latency reduction is actually much higher. Can you explain why?

(b) If UIUC has excellent web-caching performance, do you think that Parkland college users could benefit? Note that UIUC and Parkland college do not share web caches.

4) Packet Tracing:
Run `traceroute iitkgp.ac.in` on a computer, print the output, and answer the following questions:
(a) Label every field in the rows of the output.

(b) Can you track which locations are the packet flowing through.

(c) What is the average latency to reach the US coast (i.e., before going across the Atlantic Ocean).

(d) Why are there * * * in some of the rows.

(e) Make an interesting observation by looking at the screenshot, and doing some research on your own.

(f) What is reverse DNS. Research yourself and explain in one sentence.