INFSCI 1072/TELCOM 2700: Wireless Networks
Fall 2016

Midterm Exam: October 17th, 2016

This test is to be taken individually. You are free to consult class notes and the reading material and the instructor - **absolutely no one and nothing else**! In particular, you CANNOT use anything except a scientific calculator for calculations and you CANNOT access the Internet.

The exam is due within 24 hours from the time it is picked up or October 18th, Tuesday, by 10.00 a.m. whichever is earlier. The exam question sheet is to be returned along with all material you wish graded. Sign the honor pledge below after completing the exam.

Pledge:
On my honor, I pledge that I have not given or received aid on this exam. I have not violated the policies stated above. I have also not spent more than 24 hours on the exam after picking it up.

Signature: _____

Name: _____

General Instructions:
Answer all questions. Read the questions carefully to understand what is being asked. Avoid writing unnecessary things in the answers but write all the essential steps in solving any problem. Explain the steps.

If you are not able to do any numerical calculation explain clearly what you would do to solve the problem.

THERE WILL BE NO PARTIAL CREDIT FOR VAGUE ANSWERS OR UNCLEAR STEPS. I SHOULD BE ABLE TO UNDERSTAND WHAT YOU WERE TRYING TO DO WITHOUT YOUR VERBAL EXPLANATION LATER.

1. Answer the following questions in not more than six lines each ($6 \times 5 = 30$)
    a. Explain the difference between the units of antenna gain dBi and dBd. What does EIRP mean?
    b. What are the basic mechanisms of radio propagation at frequencies larger than 500 MHz? Explain one of these mechanisms.
    c. What are the situations where the Okumura-Hata model is applicable? Can this model be directly applied for analyzing WiFi transmissions and why?
    d. How is GPRS different from GSM (a) in terms of allocation of air-interface resources and (b) in terms of the core (wired) network architecture?
    e. Compare 1G, 2G, 3G and 4G networks in terms of the "channels" and "bandwidth" allocation to specific mobile devices. Use AMPS, GSM, UMTS, and LTE as the examples.
2. One path-loss model recommended for use with IEEE 802.11 (WiFi) devices is given as:

$$L_p = L_0 + \begin{cases} 10\alpha_1 \log d, & d < d_{bp} \\ 10\alpha_1 \log d_{bp} + 10\alpha_2 \log\left(\dfrac{d}{d_{bp}}\right), & d > d_{bp} \end{cases}$$

where the distance between the transmitter and the receiver is divided into two segments separated at a break-point distance d_{bp}. The distance-power gradients in the two segments

are $\alpha_1 = 2$ and $\alpha_2 = 3.5$, respectively. The first meter loss L_0 is calculated from the free-space model. Assume the carrier frequency is 2.45 GHz.

   a. If $d_{bp} = 30$m, compute the path-loss at a distance of 25m and at a distance of 50m. (15)

   b. If the transmit power is 150 mW, what will be the received power at 25m and at 50m in dBm? How would you calculate the received power at 250m and 500m? Explain. (15)

   c. If the standard deviation of shadow fading for this model is 10 dB, what fade margin should be used for 90% coverage at the cell-edge? (5)

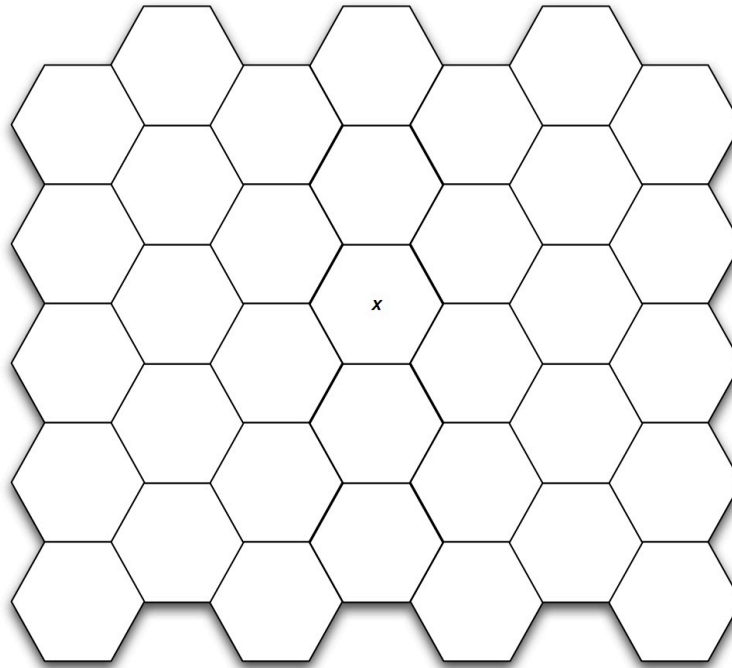3. Answer the following questions:

Figure 1

   a. In Figure 1, show all cell that acre co-channel cells with cell x if the technology that is used is (i) GSM with a reuse factor of 4 and (ii) UMTS Explain how you would find the co-channel cells. (10)

   b. Assume that a demand increases around an area that is in between two cells that you have labeled x. Explain how cell splitting can be used to address the problem. (10)

   c. Differentiate between strict and soft fractional frequency reuse in LTE like cellular networks. (10)

   d. How is fractional frequency reuse similar to and different from reuse partitioning? Explain. (5)