ELEX 7860 : Wireless System Design
Term 201310

MID-TERM EXAMINATION
11:30 AM – 12:20 PM
March 27, 2013

This exam has four (4) questions. The marks for each question are as indicated. There are a total of 15 marks. Answer all questions. Write your answers in the exam book provided. Show your work. You may answer the questions in any order. Books, notes and calculators are allowed. You may keep this exam paper.
Show your work.

Question 1 (4 marks)

A point-to-point microwave relay link across English Bay operates at a frequency of 9 GHz. The transmit and receive antennas both have an effective aperture of 0.1 m^2 and are separated by 8 km. The receiver has a (noise) bandwidth of 1 MHz and a noise figure of 8 dB. What transmit power is required to achieve an SNR of 8 dB at the receiver?

Hint: For this problem you may assume tha the antenna gain G and directivity D are the same if you wish.

Question 2 (5 marks)

The Vancouver emergency services radio system operates at 150 MHz. They would like to improve their coverage and have two choices: increase the effective transmitter antenna height from 30 m to 60 m or increase the transmit power from 200 W to 800 W.

(a) How much would you expect each of these to improve the signal strength for a receiver 10km away from the transmitter?

(b) Assuming a path loss exponent of 2.4, by how much would the *best* of these two improvements increase the range? The coverage area?

Hints: Assume Vancouver is a typical urban area. You don't have to compute the actual path loss.

Question 3 (2 marks)

A start-up is trying to recruit you. Their business plan is to provide computer backup services via satellite. For the business to work they need to achieve data rates of at least 1 Mb/s. The FCC has allocated them channels that are 100 kHz wide and from preliminary link budgets it looks like they will be able to achieve an SNR of 12dB.

The company would pay you a very low salary but they are also offering stock options that will make you lots of money if their business plan succeeds. Should you take the job? Justify your answer with a technical argument.

Question 4 (4 marks)

An electric utility is installing wireless meters in residences. The meter reading system relies on links between the meters. Although in any given neighbourhood the distance between each meter is approximately the same, it is found that the path loss between meters varies due to many factors such as the placement of the meter, the orientation of the buildings, construction materials, etc.

(a) What might be a reasonable model for the path loss distribution if the path loss is measured in dB?

(b) In one neighbourhood the mean path loss is found to be 60 dB with a variance of 25 dB. The system is designed so that a link will work with a path loss of up to 70dB.

What is the probability that any one link in this neighbourhood will work?

(c) Assuming the probabilities of each link working are statistically independent, what is the probability that a given set of 20 of these links will all work?

Hint: the probability that a N independent events will happen if each has a probability p is p^N.