$P_r = \dfrac{A_e \, P_t \cdot G_t}{4\pi d^2}$ $\qquad G_r = \dfrac{4\pi A_e}{\lambda^2} \Rightarrow P_r = \dfrac{P_t \, G_t \, G_r}{\left(\frac{4\pi d}{\lambda}\right)^2}$ $\qquad D^2 = \sqrt{3N}\, R^2$

「無線通訊行動網路」 期中考

[10%] 1. Suppose a transmitter produces 100W of power. If the transmitter's power is applied to a unity gain antenna with a 3-GHZ carrier frequency, what is the received power in dBm at a free space distance of 100m? Assume the antenna gain for the transmitter and receiver is 1 and the effective area for the receiver, $A_e = G_r * \lambda^2 / 4\pi$.

[20%] 2. Assume each user of a single base station mobile radio system makes one call on average every 20 minutes, and each call lasts an average of 5 minutes. Assume the system is a LCC system. (Solve this problem without looking up the Erlang B Table! 公式忘了的話，趕快自己導一下囉!)

(a). What is the traffic intensity (offered load) for each user? (10 %)

(b). Find the number of users that could use the system with 1 % blocking if two channels are available. (Namely, only two servers in the system.) (10 %).

[20%] 3. Pretend your company won a license to build a Taiwan cellular system (Congratulations!). Your license is to cover 160 square km. Assume a base station costs US $50,000 and a core-network infrastructure costs US $1,500,000. An extra US $500,000 is needed to advertise and start the business. You have convinced the bank to loan you US $6 million, with the idea that in four years you will have earned US $9 million in gross billing revenues, and will have paid off the loan (It means totally you make US $15 million.).

(a). How many base stations (i.e. cell sites) will you be able to install for US $6 million?

(b). Assuming the earth is flat and subscribers are uniformly distributed on the ground, what assumption can you make about the coverage area of each of your cell sites? What is the major radius of each of your cells, assuming a hexagonal mosaic?

(c). Assume that the average customer will pay US $50 per month over a four year period. Assume that on the first day you turn your system on, you have a certain number of customers which remains fixed throughout the year. On the first day of each new year, the number of customers using your system doubles and then remains fixed for the rest of that year. What is the minimum number of customers you must have on the first day of service in order to have earned US $ 9 million in gross billing revenues by the end of the 4th year of operation?

(d). For your answer in (c), how many users per square km are needed on the first day of service in order to reach the US $ 9 million mark after the 4th year?

[15%] 4. Consider a (7,4) code system with the generator polynomial $P(x) = x^3+x+1$. For the following data blocks, please calculate the complete codeword in the air.

(a) 0100. (b) 1010. (c) 1111.

[15%] 5. Consider a cellular system in which there are a total of 1001 radio channels available for handling traffic. Suppose the area of a cell is 6 square km and the area of the entire system is 2100 square km.

(a) Calculate the system capacity if the cluster size is 7.

(b) How many times would the cluster of size 4 have to be replicated in order to approximately cover the entire cellular area?

(c) Does decreasing the cluster size increase the system capacity? Explain.

[20%] 6. Explain the following terms in details. (Please describe detailed enough to let me believe you understand these terms. You may draw pictures to make your explanation better.) (a) Doppler Effect, (b) Delay Spread, (c) Co-channel Interference, (d) Cell Sectoring.