Department of Electrical & Computer Engineering
The University of Calgary
ENEL 529 – Wireless Communications Systems
Fall 2014

Assignment #1 - Due Date: Friday, October 10, 2014 @ 12:00 pm

Problem 1

a) Consider a mobile communications system whose propagation channel is characterized by a path loss exponent γ of 3.8. Suppose the received power by a mobile unit at a distance of 2 km from its base station is equal to 2 microWatts. Find the received power in dBm units at distance d = 3 km, 6 km, and 15 km.
b) A mobile unit receives a power of -105 dBm from its base station. If the predicted loss is 115 dB, what was the transmitted power in milliWatts?
c) For the predicted path loss in b), what is the maximum distance (in kilometers) between the base station and the mobile unit for the following path loss models: i) free space, ii) γ = 3, and iii) γ = 4. Assume operating frequency f_c = 900 MHz, $G_t = G_r = L_t = L_r$ = 1 and d_{ref} = 1 meter.

Problem 2

The power amplifier (PA) output power of a base station transmitter, P_t, is 10 Watts. The output power is fed into a feeder cable with a loss, $L_{t,dB}$, of 10 dB. The transmit antenna has a gain $G_{t,dB}$ of 12 dB radiating in the direction of the mobile receiver antenna with a gain $G_{r,dB}$ of 0 dB and feeder loss $L_{r,dB}$ of 2 dB. The mobile receiver has a sensitivity $P_{r,min,dBm}$ of –104 dBm. See Fig. P2 below.

a) Determine the effective radiated power in dBW and Watt units
b) Calculate the maximum acceptable propagation path loss in dB
c) For the maximum acceptable path loss calculated in b) and assuming two-ray propagation model, what is the maximum communication range in kilometers? For the 2-ray model, assume a mobile station antenna height of 1.5 m, a base station antenna height of 30 m and operating frequency of 900 MHz.
d) What will be the communication range in kilometers if the base station antenna height is doubled? How does this compare with the range calculated in c)?

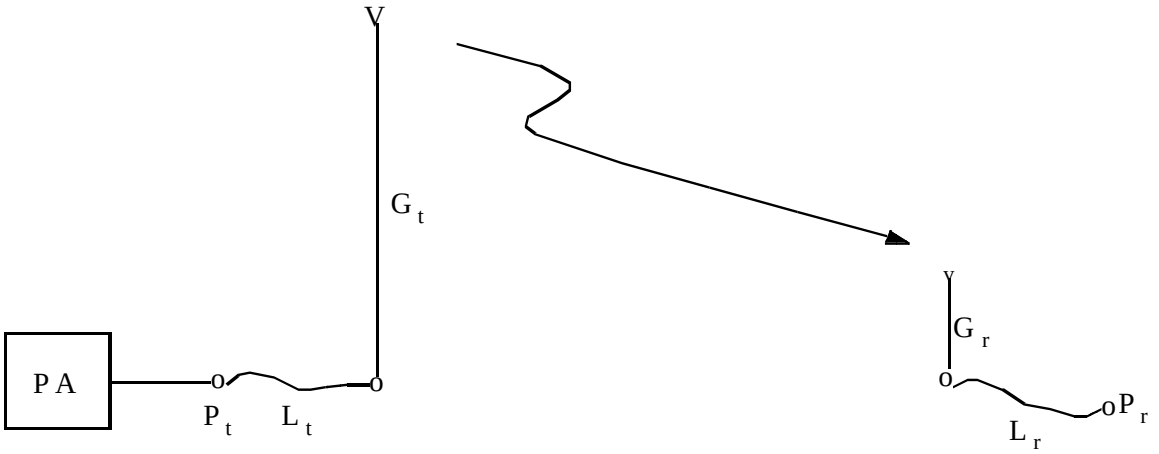

Fig. P2. Transmission by Base station to mobile station

Problem 3

To keep an acceptable level of performance and therefore have many happy wireless subscribers, a wireless service provider is planning to maintain an outage probability of 3%. In this problem, outage is defined as the probability that the received signal power falls below a specified threshold power P_{min}. Assuming that the received signal power (in dBm unit) is Gaussian with mean P_{av} (in dBm) and standard deviation σ_{dB} dB, what should be the threshold power P_{min} (in dBm unit) if σ_{dB} = 8 dB and the average received power P_{av} is –95 dBm?