EEEN 474 Wireless Communication, Spring 2019, Week 6

Example 1

Suppose a total of 18 MHz is allocated to a particular FDD cellular telephone system that uses 30 kHz duplex channels and 12–cell reuse. The current capacity of the overall system is known to be 12600 channels.

a) Compute the total number of channels available in the cellular system.
b) Compute the number of channels available per cell.
c) Compute the number of clusters.
d) Compute co-channel reuse ratio.
e) Compute the signal-to-interference ratio (dB) assuming a path loss exponent of 4 and that there are 6 co-channels in the first tier, all of them being at the same distance from the mobile.
f) Suggest a new cluster size for this system to increase the capacity. Compute the new capacity. Compute the corresponding co-channel reuse ratio and SIR (dB).
g) Comment on the trade-off between the capacity and SIR.

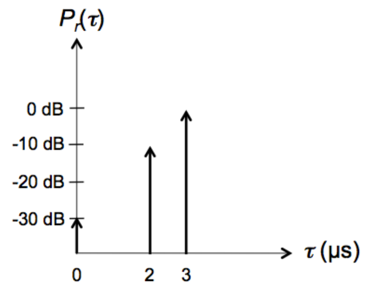
Example 2

Assume that a transmitting antenna with maximum dimension of 2 m and an operating frequency of 900 MHz is transmitting a power of 40 watts. Assume that the transmitting and receiving antennas have unity gains, and L=1.

a) Calculate the far field distance of the transmitting antenna.
b) Compute the received power and the associated path loss at a free space distance of 50 m.
c) Using your results in (b), find the received power and the associated path loss at a free space distance of 5 km.
d) If the environment is not free space but shadowed urban area, select a suitable path loss exponent and by using log-distance path loss model, calculate the average path loss and the average received power at a distance of 5 km (use the reference values found in (b)). Comment on the differences between the results of (c) and (d).
e) By using log-normal shadowing model, estimate the probability that the received power exceeds -140 dB at a distance of 5 km from the transmitter if the standard deviation of the normal distribution is 10 dB. (Take the same path loss exponent as in (d)).
f) Determine the area coverage of this transmitting antenna for the radius and the received power threshold in (e) using the same model as in (e).
g) Suppose you are asked to use Okumura's model to obtain an estimate of the received power at the distance of 5 km. Given the additional information that the heights of the transmitting and receiving antennas are 200 m and 2 m, respectively, find the received power according to the model. Comment on the result.

Example 3

For the channel with the power delay profile shown below, estimate the 50% coherence bandwidth. Would this channel be suitable for GSM service (B_S = 200 kHz) without needing an equalizer?



Example 4

If a baseband binary message with a bit rate R_b=100 kbps is modulated by an RF carrier using BPSK:

a) Find the range of values required for the rms delay spread of the channel such that the received signal is a flat fading signal.
b) If the communication channel had the same power delay profile as in Example 3, would it work without needing an equalizer?
c) If the modulation carrier frequency is 900 MHz, what is the coherence time of the channel assuming a vehicle speed of 100 km/hour?
d) For your answer in (b), is the channel fast or slow fading?