

ECE 257B: Principles of Wireless Networks

Class Exam — March 3, 1998

1. The signal transmitted by a Base Station has a power of 1 mW at a distance of 1 m from the transmitter. Measurements have shown that the propagation exponent for the path loss is $n = 3$ up to a distance of 1 km and $n = 4$ beyond that. For adequate signal quality, a signal to noise ratio of at least 15 dB is required. Find the maximum cell radius if an AMPS receiver with bandwidth 30 kHz and total noise figure (including the antenna) $F = 6$ dB is used and (a) there is no shadowing, and (b) quality objective is to be met with probability 99% in the presence of log-normal shadowing with $\sigma = 6$ dB.
2. You want to download a 5 Mbit file over a 10-Mbps Rayleigh fading channel in the 1800 MHz frequency band. You are traveling at 6 km/h and use 1000-bit packets. The fading margin of the channel is 20 dB. If any packet is received in error during the transfer, the operation is aborted. (a) What is the probability that you successfully transfer the file? Solve this by using both the Markov packet error model (use the table on the back of this sheet for r) and the level crossing rates (assume an exponential distribution for fading and non-fading durations). (b) If after a failure you wait a long time and then retry, what is the average number of attempts you will need to finally succeed? (c) Do you think doubling the packet size would help?
3. You have a bandwidth of 10 MHz (per direction) in a single-cell system and want to deploy a wireless telephone system. You have the following options: analog 30-kHz channels (as in AMPS), digital 30-kHz channels (each supporting 3 users as in IS-54), digital 200-kHz channels (each supporting 8 users as in GSM), or CDMA with 10-kbps user signals requiring an E_b/N_0 of 6 dB. (a) Compute the achievable capacity (in number of simultaneously active users per cell) for each case. (b) How do the results in (a) change if you use 120° sectorization? (c) How do the results in (b) change if instead of a single cell you have many? (Ignore voice activity factor in all of the above.) (d) For the above case of AMPS-like channelization with 7-cell reuse and 3 sectors per cell, suppose that you need to serve 900 users per cell. If the average duration of a call is 2 minutes, what is the maximum calling rate which guarantees a GOS of 2%?