

ECE 257B: Principles of Wireless Networks

Homework assignment # 2

(due on Tuesday, February 17)

Assigned Reading:

- Rappaport, Chapter 2
- Section 2 of the paper: M. Zorzi, “Fast computation of outage probability for cellular mobile radio systems,” *European Transactions on Telecommunications*, vol. 6, pp. 107–113, Jan.–Feb. 1995.
- M. Zorzi, R.R. Rao, L.B. Milstein, “On the accuracy of a first-order Markov model for data block transmission on fading channels,” in *Proc. IEEE ICUPC’95*, pp. 211–215, Nov. 1995 (you may want to skip III.A).

(papers are available on line at <http://www-cwc.ucsd.edu/~zorzi>)

Suggested (optional) Reading:

- M. Zorzi, “On the analytical computation of the interference statistics with applications to the performance evaluation of mobile radio systems,” *IEEE Trans. Comm.*, vol. 45, pp. 103–109, Jan. 1997.
- V.M. Jovanovic, J. Gazzola, “Capacity of present narrowband cellular systems: interference-limited or blocking-limited,” *IEEE Personal Communications Magazine*, vol. 4, pp. 42–51, Dec. 1997.

Problems to hand in:

1. Rappaport, Problem 2.3
2. Rappaport, Problem 2.4
3. Rappaport, Problem 2.8
4. Rappaport, Problem 2.9
5. Rappaport, Problem 2.18
6. Rappaport, Problem 2.19
7. Consider a hexagonal grid system with omnidirectional antennas and frequency reuse with cluster size $N = 9$. Assume that the propagation path-loss exponent is equal to 5. Suppose that new receiver technology is contemplated which will reduce the required S/I ratio by 4 dB. Does this improvement justify the use of $N = 7$?
8. Consider a communication scheme with two protocol layers. The lower layer recovers packet errors by immediate retransmission (assume instantaneous and error-free feedback). The upper layer resets a connection if it does not receive correct packets for τ seconds. The idea is to counteract physical channel impairments (consider only Rayleigh fading here) through immediate retransmission, and to release a connection if something more persistent happens (e.g., congestion in the network). We want to avoid that the protocol resets a connection due to Rayleigh fading attenuation. Find an appropriate value of the timeout, τ , as a function of the fading margin F (consider the range 5 to 25 dB) in the following cases: pedestrian environment (3 km/h mobile velocity and 1 Mbps channel speed) and vehicular environment (60 km/h mobile velocity and 200 kbps channel speed). Packet length is 1000 bits and carrier frequency is 900 MHz. Your design should be such that connection reset happens due to Rayleigh fading with small probability (consider 1% and 5% in your results).