Habib University
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EE 422 – Wireless & Mobile Communication
Assignment # 03
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Problem 04 – Consider a cellular system operating at 900 MHz where propagation follows free space path loss with variations from log normal shadowing with σ =6dB. Suppose that for acceptable voice quality a signal-to-noise power ratio of 15 dB is required at the mobile. Assume the base station transmits at 1 W and its antenna has a 3 dB gain. There is no antenna gain at the mobile and the receiver noise in the bandwidth of interest is -10 dBm. Find the maximum cell size so that a mobile on the cell boundary will have acceptable voice quality 90% of the time.

Assuming free space path loss parameters;

- *fc = 900MHz*
- *lambda = 1/3m; lambda=c/f*
- *SNRreceived = 15dB*
- *Ptx = 1W*
- *Gtx = 3dB*
- *Pnoise = -40 dB ; Preceived = -35 dB*
- *Cell radius = d*
- $\sigma_{\psi dB} = 6$

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Problem 05 – In this problem we will explore the impact of different log-normal shadowing parameters on outage probability. Consider a cellular system where the received signal power is distributed according to a log-normal distribution with mean μ dBm and standard deviation σ_ψ dBm. Assume the received signal power must be above 10 dBm for acceptable performance.

(a) What is the outage probability when the log-normal distribution has μ_ψ = 15dBm and σ_ψ = 8dBm?

Outage probability = Probability $[\text{received } power_{dB} \leqslant Tp_{dB}]$
Tp = 10dB

(b) For σ_ψ =4dBm, what value of μ_ψ is required such that the outage probability is less than 1%, a typical value for high-quality PCS systems?

σ_ψ = 4 dBm & Outage probability = 0.01

(c) Repeat (b) for σ_ψ = 12dBm.

σ_ψ = 12 dBm & Outage probability = 0.01

(d) One proposed technique to reduce outage probability is to use macro diversity, where a mobile unit's signal is received by multiple base stations and then combined. This can only be done if multiple base stations are able to receive a given mobile's signal, which is typically the case for CDMA systems. Explain why this might reduce outage probability.

For the migrating of the effect of shadowing, we may use the macroscopic diversity. Diversity is a powerful communication receiver technique that provides wireless link improvement at relatively low cost. Diversity exploits the random nature of radio propagation by finding independent (or at least highly uncorrelated) signal paths for communication. By receiving more than one copy of the transmitted received signal and then selecting one (or multiple) of them intelligently, both the instantaneous and average SNRs at the receiver may be improved, often by as much as 20 dB to 30 dB. Macroscopic diversity is to send the message from different base stations to achieve uncorrelated shadowing. In this way the probability of power outage will be less because both base stations are unlikely to experience an outage at the same time, if they are uncorrelated.