KFUPM - COMPUTER ENGINEERING DEPARTMENT

COE-543 – Mobile Computing and Wireless Networks

Student Name:
Student Number:

---

1) (20 points) on the path loss models

a) State the free-space path loss model – write the formula

b) In practice, the actual signal level is not always equal to the signal level computed by the path loss model. In fact the actual signal is 50% higher or 50% lower than the computed local mean following a normal distribution. What controls the local signal level? i.e. what controls how far does it swing around the local mean.

2) (20 points) On the subject of Small-scale fading and multipath channels

a) For small-scale fading or Rayleigh fading channels, the signal level typically follows a Rayleigh distribution. However, under some circumstances, the envelope distribution may follow the Rician distribution. State these circumstances and sketch typical plots for the Rician distribution.

b) Small-scale fading manifest itself in two mechanisms with respect to the transmitted signal. What are these mechanisms and briefly describe each of them.

c) What is a frequency selective channel and how is this related to the coherence bandwidth?

Solution:

1.a) The free-space path loss model is given by $\frac{P_r}{P_t} = G_t G_r \times \left(\frac{\lambda}{4\pi d} \right)^2$

1.b) The swing is controlled by the shadowing standard deviation: the larger the standard deviation the larger the swing around the mean. The shadowing process is a function of the large signal obstacles.

2.a) When there is a dominant nonfading signal component (Line of Sight or LOS), the signal envelope is said to follow a Rician distribution. A plot for the Rician distribution is as shown below.

2.b) The two mechanisms are:

1) Spreading of the signal (or pulse): multipath intensity profile – RMS delay – coherence bandwidth

2) Time variation of the channel due to motion – spaced-time correlation function – doppler spectrum – coherence time

2.c) A frequency selective channel is a channel that is fading (has low gain) in some parts of the spectrum and non fading (has high gain) in other parts of the spectrum – The band of frequencies that fade or not fade together are not greater than the coherence bandwidth of the channel. Therefore, any transmission that occupies spectrum less than the coherence bandwidth will experience non-selective (or flat) fading and vice versa.