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قديم

Mansoura University	Communications Systems
Faculty of Engineering	January 2013
Department of Electronics and Comm. Eng.	Fourth year قديم
Time: 3 hours	Final grade: 110

Answer the following questions (Assume any missing data)

1) Discuss the different types of fading according to the reasons of occurrence, mathematical models, and effects on the wireless signal. (20 points)

2) The following table lists empirical pathloss measurements for two mobile cells where the operating frequency is 1 GHz, and d_o=10m. (30 points)

Distance from basestation	P_r/P_t for cell 1	P_r/P_t for cell 2
25m	-67 dB	-65 dB
100m	-85 dB	-80 dB
200m	-98 dB	-80 dB
400m	-105 dB	-85 dB
800m	-115 dB	-103 dB
1600m	-123 dB	-110 dB
3200m	-140 dB	-117 dB

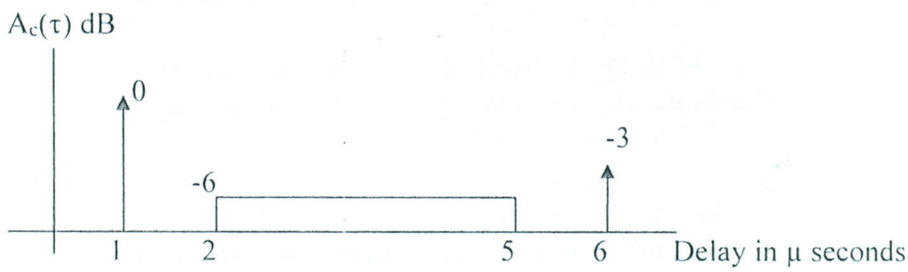
a) Find the path loss exponent γ that minimizes the MSE between the simplified pathloss model and the empirical dB power measurements for the two cells.

b) Find the standard deviation of the log-normal shadowing for both of the two cells.

c) Assume the receiver noise power in the bandwidth of interest is -105 dBm, and the minimum acceptable SNR at the receiver side is 8 dB for both cells. What are the base stations transmitted power, in Watts, to achieve a cell radius of 3 Km for both cells with acceptable voice quality 90% of the time.

d) Using the data and the results from (c) find the coverage area for both cells.

3) Consider a channel having the following power delay profile. *(30 points)*



a- Compute the channel's mean delay spread, and rms delay spread.

b- What is the maximum symbol rate such that a linearly modulated signal transmitted through this channel does not experience ISI.

c- What is the channel 50% coherence bandwidth.

d- If a mobile is traveling at a speed of 60 Km/hour, what is the channel coherence time when the operating frequency is 900MHz.

4) Assume a mobile traveling at a velocity of 60 Km/hr receives two multipath components at a carrier frequency of 900 MHz. The first component is assumed to arrive at $\tau=0$ with an initial phase of 0^o and a power of -60dBm, and the second component which is 2 dB weaker than the first component is assumed to arrive at $\tau=1$ μs, also with an initial phase 0^o. If the mobile moves directly towards the direction of arrival of the first component and directly away from the direction of arrival of the second component, compute the narrowband instantaneous power at time intervals of 0.1 seconds from 0 to 0.5 seconds. Compute the average narrowband power received over this observation interval. Compare average narrowband and wideband received power ovr the interval. (20 points)

5) For a mobile receiver operating at a frequency of 900 MHz and moving at 90 Km/hr. (20 points)

a) Sketch the Doppler spectrum if a continuous wave signal is transmitted and indicate the maximum and minimum frequencies

b) Calculate the level crossing rate and average fade duration if ρ= -15dB.

Good Luck
S.K.

Useful relations and tables

Tabulation of the Q-function

z	$Q(z)$	z	$Q(z)$
0.0	0.50000	2.0	0.02275
0.1	0.46017	2.1	0.01786
0.2	0.42074	2.2	0.01390
0.3	0.38209	2.3	0.01072
0.4	0.34458	2.4	0.00820
0.5	0.30854	2.5	0.00621
0.6	0.27425	2.6	0.00466
0.7	0.24196	2.7	0.00347
0.8	0.21186	2.8	0.00256
0.9	0.18406	2.9	0.00187
1.0	0.15866	3.0	0.00135
1.1	0.13567	3.1	0.00097
1.2	0.11507	3.2	0.00069
1.3	0.09680	3.3	0.00048
1.4	0.08076	3.4	0.00034
1.5	0.06681	3.5	0.00023
1.6	0.05480	3.6	0.00016
1.7	0.04457	3.7	0.00011
1.8	0.03593	3.8	0.00007
1.9	0.02872	3.9	0.00005

The definition of Q function is:

$$Q(z) = \int_z^\infty \frac{1}{\sqrt{2\pi}} e^{-y^2/2} dy$$

Two important properties of $Q(z)$ are

$$Q(-z) = 1 - Q(z)$$

Assume the symbol error rate for QPSK $\approx 2Q\left(\sqrt{\gamma_s}\right)$

$$\sum_{n=0}^{\infty} (a)^n = \frac{1}{1-a}$$ for a<1