ECE 2305: Introduction to Communications and Networks

Quiz #2

3:00-3:30 PM, 03 April 2014

Name: Solutions

Box #: _____

Instructions:

- Do not open this quiz until you are instructed to do so.
- This quiz is closed book, but you are permitted to bring one two-sided 8.5" by 11" sheet of notes.
- Calculators are permitted.
- Laptops or other electronic devices with wireless capability are *not* permitted.
- No collaboration is permitted; the WPI academic honesty policy is in effect.
- There is no penalty for guessing, but you must show all your work to get full credit.
- You have 25 minutes to complete the quiz.
- Please submit your sheet of notes when you turn in your quiz.

Problem	Points	Score
1	10	
2	10	
3	15	

Good luck!

1. **Cellphone "Deathgrip" Experiment (10 pts total)** A student performs the following experiment with a cellphone. First, the student puts the phone on a pedestal and, using field test mode, observes a received signal power

$$P_A = -110 \text{ dBm}$$

The student then removes the pedestal, holds the phone tightly in the same location as the first test, and observes

$$P_B = -119 \text{ dBm}$$

(a) 5 pts. What is the attenuation (in dB) caused by tightly holding the phone?

9 dB

(b) 5 pts. Compute

$$\frac{\text{power received when tightly holding phone}}{\text{power received when phone is on pedestal}}.$$

Your answer should *not* be in decibels. What percentage reduction in (absolute) power occurred once the phone was tightly held? (Hint: If the price of pack of gum is normally \$1, but it goes on sale for a price of \$0.75, we would say that this is a 25% reduction in price).

Since $\text{Power(mW)} = 10^{\text{Power(dBm)}/10}$

$$\Rightarrow \frac{\text{power when holding phone}}{\text{power on pedestal}} = \frac{10^{-119/10}}{10^{-110/10}}$$

$$= 10^{-9/10} \cong 0.125$$

So there is a 87.5% reduction in power

2. **Domain Name Service (10 pts)** Describe the function of the "time-to-live" field in a DNS resource record.

The purpose of the time-to-live field is to specify the time interval that the resource record(RR) may be cached before the source of the information should be consulted again.

3. **Propagation models and SNR (15 pts total)** Consider the wireless propagation model

$$\text{attenuation(dB)} = 10\log_{10}\left(\frac{(4\pi d)^2}{\lambda_c^2 G_t G_r}\right)$$

where d is the distance between the transmit and receive antennas, $\lambda_c = \frac{c}{f_c}$ is the carrier wavelength, and G_t and G_r are the transmit and receive antenna gains, respectively.

(a) 5 pts. What are the implicit assumptions in this wireless propagation model?

This is a line-of-sight free space propagation model, where reflections are negligible and carrier frequency is at least 30 MHz.

(b) 10 points. Consider a GPS satellite link from a GPS transmitter to a GPS receiver on the ground with the following parameters

Transmit power	25 Watts
Transmit antenna gain	13 dBi
Receive antenna gain	0 dBi
Link distance	20000 meters
Carrier frequency	1575 Mhz

Use the wireless propagation model to compute the received power in dBm.

$P_{in} = 25\,W = 10\log_{10}\left(\frac{25\,W}{1\,mW}\right) = 43.98\,dBm$

$\text{attenuation(dB)} = 10\log_{10}\left(\frac{(4\pi d)^2}{\lambda_c^2}\right) - G_t(dBi) - G_r(dBi)$

$= 122.4 - 13 = 109.4\,dB$

So $P_{out}(dBm) = P_{in}(dBm) - \text{attenuation(dB)}$

$= 43.98 - 109.4 = -65.42\,dBm$