UNIVERSITY OF CALIFORNIA, LOS ANGELES

CS M117

CS M117 Student name ____________________ DIS:

1A	*1B*	*1C*	*1D*	*1E*	*1F*

Pre-laboratory Homework #1 (Due **04/11** or **04/12**)
(HW must be typed)

Data Transmission over 802.11b Wireless LAN
(Lecture 1 + Reading 1)

Section A
Wireless MAC, TCP

1. (1) Are RTS and CTS used with short packets, even if there is a hidden terminal situation?

No, they are not used for short packets. Because, if the data packet is even shorter than the "probe", it would be a waste to use RTS and CTS. In fact, just sending out the data packet is more efficient.

2. (2) Should we still use the Contention Window and Binary Backoff with short packets? Explain?

Yes, because even with short packets, data collision might still happen. Therefore, we still use the Contention Window and Binary Backoff for efficient data retransmission.

3. (2) Why can a new packet that senses the medium idle go off without using the Contention Window ("direct access if medium is free") ?

The contention window is the time a device waits before resending out a signal, therefore to avoid signal collision as much as possible. If no contention window is detected, it means the medium is idle and no other signals are floating in the air. Therefore, it is guaranteed that no signal collision would happen. Thus, a new packet can go off without using contention window.

4. (2) To deal with this problem 802.11, when many users are located in the same area, and use the same wireless LAN at the same time, what access methods are defined to supports two modes of operations?

DCF - Distributed Coordination Function
PCF – Point Coordination Function

5. (2) Consider the effect of using slow start on a line with a 10-msec round-trip time and no congestion. The receive window is 24 KB and the maximum segment size is 2 KB. How long does it take before the first full window can be sent?

In slow start, the number of segments doubles after each RTT. Starting from 2KB, after each RTT, the size of sent data becomes 4KB, 8KB, 16KB, 32KB, respectively. In this way, it has gone through 4 round trips before reaching first full window.
Thus, 4 * 10msec = 40 msec

6. (1) Given a cannel with an intended capacity of 20 Mbps. The bandwidth of the channel is 3 MHz. What signal-to-noise ratio is required in order to achieve this capacity?

According to Shannon's Capacity Thereom,
C = B + log (1 + S/N) (base 2)
20 = 3 * log (1 + S/N)
S/N = 100.6
S: signal, N: noise
Therefore, the signal to noise ratio is 100.6

Section B

Data Transmission over 802.11b Wireless LAN

1) (a) (1) List the three different modes of multipath signal propagation (besides direct signal) and the cause for each of these modes.

(b) (1) What kind of signal reception problems these different modes cause?

(a)
1. Reflection: occurs when surface is larger than wavelength
2. Diffraction: occurs when waves are obstructed by sharp-edge surfaces
3. Scattering: occurs when objects are smaller than wavelength
(b)
1. Reflection: caused by large scale fading
2. Diffraction: caused by small scale fading
3. Scattering: caused by small scale fading
other problems: weakening, dispersion of signale, etc.

2) (a) (1) How do multipath signals effect signal reception? This effect limits the transmission rate of wireless channel.

(b) (1) Give relation between transmission rate and this "effect" in part (a).

(a)
If multipath signals are time delayed, they arrive at the receiver at different times. This causes inter-symbol interference and distortion, which leads to a compromise of transmission rate of the wireless channel.
(b)
The relation is an inverse relation. More specifically,
$\mathbf{R = 1/(2\tau_d)}$

3) (a) (2) How much power you expect to receive if your receiver is at distance *d* away from the transmitter and the transmitter transmits at frequency f_c. Assume isotropic receiver/transmitter antennas and isotropic free *space* loss. Give path loss in dB.

(b) (1) Assume your WLAN system has transmission power of 15 dBm and the received power must be at least –72 dBm. WLAN radio frequency is 2.4 GHz. Assuming isotropic antennas and no obstructions (i.e. isotropic free space loss), what is the maximum distance you can communicate over.

a)

Isotropic free *space* loss = 20 * $\log(\frac{4\pi f d}{c})$

According to the course reader:

$P_{received} = P_{transmitted} * (\frac{c}{4\pi f d})^2$

Note: in this particular case, $f = f_c$

b)

f_c = 2.4GHZ

$P_{received}$ = -72dBm

P_{trans} = 15dBm

$P_{received} = P_{trans}$ - Isotropic free *space* loss

$-72 = 15 - 20 * \log(\frac{4\pi * 3 * d}{3 * 10^{\wedge}8})$

so we get [d = 222.69m]

4) (1) What is frequency range of 802.11b Wireless Channel?

2.4 GHz ~ 2.4835 GHz

5). (2) Multipath fading is maximized when the two beams arrive 180 degrees out of phase. How much of a path difference is required to maximize the fading for a 50-km-long 1-GHz microwave link?

c: speed of light, f: frequency

λ= c/f = (3*10^8)/(10^9) = 0.3m

path difference = λ/2 = 0.15m