UNIVERSITY OF CALIFORNIA, LOS ANGELES

*CS M117*

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**Data Transmission over 802.11b Wireless LAN**

**Pre-laboratory Homework #2** (Due 04/13)

(HW must be typed)

Section A

Wireless MAC, TCP

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

No. RTS/CTS packet size threshold is 0-2347 octets. Sending RTS/CTS frames does not occur unless the packet size exceeds threshold. A short packet would likely be below the threshold. So it is more efficient to send the packet and expect some collisions.

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

Yes, collision can still happen with short packets. Scheduled retransmission with binary backoff can still help avoid traffic and improve efficiency.

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”) ?

If a new packet senses the medium idle, it gets direct access to the receiver. Therefore using contention window is unnecessary and takes up more time.

4. (2) Suppose that an 11 Mbps 802.11b LAN is transmitting 64-byte frames back-to-back over a radio channel with a bit error rate of 10-7. How many frames per second will be damaged on average?

64 bytes = 64\*8 =512 bits

All success rate for each frame= 0.9999488

At least one damaged for each frame= 1-0.9999488=

11\*106 bits per second= 21484 frames per second

damaged frame per second = 1.1

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?

With the slow start, the first RTT sends out 1 segment (2KB); the second sends out 2 segments (4KB); the third sends out 4 segments (8KB); the fourth sends out 8 segments (16KB). After the fourth RTT, there is a full window. So the time is 4\*10=40msec

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?

**Section B**

According to Shannon’s law

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?

1. Reflection happens when wave reflected by object larger than wavelength.

Scattering happens when wave hits loose objects smaller than wavelength.

Diffraction happens when wave obstructed by surface with shape, irregular edges.

1. Reflection causes large-scale fading. Scattering causes small-scale fading. Diffraction causes loss in signal strength and signal dispersion.

**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).

1. Signals that went over different paths will arrive at different time and have a phase difference. We they are received, their waveforms interpose with each other and combine to form a totally different signal that might resemble neither of the original signals. In the worst case, if two signals are received with same strength and their phase difference is 180, they cancel each other out.

**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 *fc*. 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)

The free space isotropic loss is simply the inverse of the power received

b)

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

2.4000GHz to 2.4835GHz

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?

. Out of phase is half of the wavelength apart. So the path difference required to maximize the fading is 0.15m.