CS 438 Communication Networks Spring 2014
Homework 2 Due Date: February 19

1. Questions to ponder

a) What's the tradeoffs between copper and optical?
b) Introduce two multiple access methods / protocols that weren't covered in class. Discuss their advantages and disadvantages.
c) In a token ring network, describe a situation where delayed release is preferred to early release, and another situation where early release is preferred.

2. Noisy Channel Data Rates

The decibel is a measure of the ratio between two signal levels: $N_{db} = 10 \log_{10} (P_2/P_1)$, where N_{db} = the number of decibels, P_1 = the input power level and P_2 = the output power level.
a. A telephone line is known to have a loss of 20db. The input signal power is measured as 0.50 watt and the output noise is measured as 8 μwatt. Using this information, calculate the output signal-to-noise ratio in dB.
b. What is the capacity of this phone line with a frequency range of 100 Hz – 1000 Hz?
c. If the attenuation rate of this phone line is 2db/km, and the minimum output signal is 0.00025 watt, given the input signal from part a), how long can the phone line be before requiring a repeater?

3. 4B/5B Encoding

a) Show the 4B/5B encoding, and the resulting NRZI signal, for the following bit sequence: 1110 0101 0000 0011
b) Show the 4B/5B encoding, and the resulting NRZI signal, for the following bit sequence: 1101 1110 1010 1101 1011 1110 1110 1111

4.Two-Dimensional Parity Error Detection

a) Show (give an example) that two-dimensional parity checks can correct and detect a single bit error.
b) Show (give an example) that a double-bit error that can be detected but not corrected.

5. CRC Error Detection

In CRC approach, consider the 5-bit generator, G=10011, and suppose that D has the value
a.1010101010.
b.1001000101.
c.1010001111.
d.0101010101.

What is the value of R(remainder)?

6. Multiple Access

Suppose nodes A and B are ready to send a packet at the same time a third node ends transmission on a 10 Mbps Ethernet. In the ith round after i − 1 collisions have already occurred, the two nodes wait 0, 1, . . . , $2^{i-1} - 1$ slots until the next attempt, all 2^{i-1} choices having equal probability.

(a) Find the probability q_i of a collision in the ith round, given that there are collisions in the previous i−1rounds(i.e. $q_1 = 1, q_2 = 1/2$),for all $i \geq 1$.

(b) Find the probability p_i that exactly i rounds are needed for the first success, and compute $p_1, p_2, ..., p_4$.

(c) Now assume that after the first collision, node A "wins" the backoff and transmits successfully. After it is finished, both nodes try to transmit again (A has an infinite amount of traffic to send), causing a collision. After this collision, the A's collision counter is at 1 and B's is at 2. Compute the probability that A wins again.

(d) Given that A "won" the first round, compute the probability that A captures the network for the next 5 frames.

7. Token Ring Networks

In a token ring network, a station is allowed to hold the token for some period of time, the token holding time, THT. Let RingLatency denote the time it takes the token to make one complete rotation around the network when none of the stations have any data to send.

(a) In terms of THT and RingLatency, express the efficiency of the network when only one station is active. Assume early release for the next few questions.

(b) What setting of THT would be optimal for a network that only had one station active (with data to send) at a time?

(c) In the case where N stations are active, give an upper bound on the token rotation time, TRT, for the network.

(d) Let N = 100, THT = 1000 μs, and RingLatency = 200μs. Compute the efficiency of this network if all N nodes are active and are using early release.

(e) Compute the efficiency of the above network if delayed release is used.