University of California, Riverside

CS 164 Midterm Test –Fall 1996

50 Minutes, Aids Allowd: Textbook and Notes.

1. [15 points total] Your company has three remote locations, each with its own server and an independent copy of an important corporate database. You are trying to decide which of the remote servers to use as a backup site in case the local server fails:

- Remote #1 is a small branch office in San Bernardino. It has a direct connection to your site using a point-to-point 9,600 bps leased line that is 20 miles long.
- Remote #2 is a large manufacturing plant in Asia. It has a direct connection to your site using a private 56,000 bps link through a geosynchronous satellite.
- Remote #3 is in Northern California, which is 10 hops away over the Internet. Assume each Internet link is a T1 line running at 1.544 Mbps, and the average length of each link is 60 miles.

a) Estimate the minimum Round-Trip Time (RTT) in each case. Note: cut-through switching is *not* used.
b) Assume that your application sends a 100 byte query to the database, and then the database sends back a 100 byte response. Also assume that the processing time at the database is very small. How long would it take to get a response from each of the 3 remote sites, assuming there is no other traffic on any of the links?
c) Repeat part a) assuming the response from the database is a 1000 byte packet.
d) What would happen to the minimum RTT to Remote #3 if the Internet started using a connection-oriented virtual circuit protocol with hop-by-hop acknowledgements instead of the current connectionless style of operation? Justify your answer.

2. [10 points] Suppose we use the Sliding Window Algorithm that is described in section 3.5.2 on the satellite link to Remote #2 described in the previous question.
a) What is the minimum size of the transmitter's window needed to get a throughput of at least 30,000 bps for a very large file transfer using 1,000 byte packets and 100 byte acknowledgements? You may ignore errors for this part of the question.
b) Suppose <u>7 bit errors</u> occur on the channel during the file transfer. What is the *minimum* and *maximum* number of *bits* that might need to be retransmitted because of these bit errors? Does your answer depend on the transmitter's window size?

3. [10 points] Suppose we replace the 16-bit ARPANET Checksum with a 16-bit parity word scheme, in which the *i*-th bit of the parity word is zero if and only if an even number of 16-bit data words in the frame contain a one bit in the *i*-th position.
a) Briefly explain (in words, or using pseudocode) how the sender could efficiently generate the parity word, and how the receiver would check it.
b) What is the <u>maximum</u> length of a burst error that this scheme is <u>guaranteed</u> to detect?
c) Suppose one of the packet switches in the network contains a bug that outputs *three copies* of the eighth 16-bit word in each passing frame. Will this new parity word scheme detect the error?

4. [10 points] The textbook (in Chapter 4, problem 11) says that in ATM the AAL3/4 protocol data unit only contains up to 3 bytes of padding, whereas the AAL5 PDU may contain up to 47 bytes of padding.
a) Since ATM uses only fixed-length cells to carry the data, briefly explain how is it possible to send messages of <u>any</u> length using AAL3/4.
b) How does the padding in the AAL3/4 PDU make it easier to process?
c) Since the AAL3/4 PDU ends with the <u>length field</u>, which could be anything, rather a specific sentinal value reserved for this purpose, why doesn't the receiver have trouble deciding where the frame ends?

5. [5 points] Consider an *N* node, fully connected network running the Link State algorithm with <u>synchronized update times</u>. Exactly at time *T*, every node sends a link-state packet to each of its neighbors, and thereafter the neighboring nodes immediately forward a copy of each new packet to all of their neighbors except the one that sent the packet. How many copies of each link-state packet would each node receive?

6. [5 points] Briefly explain why every Ethernet adapter has: a) a unique 48 bit address; and b) a different seed for the random number generator it uses for calculating the backoff delays.