ECE 358: Problem Set 3

Problem 1

Suppose that you are transmitting blocks of data over a link having a known bit error rate BER. What is the probability that a received block of size L has error(s) but goes undetected? What is this probability if you can detect all single errors? Explain your assumptions. Draw the curves giving these 2 probabilities as a function of L for a given BER and as a function of BER for a given L. Comment the curves.

Note: Stop-and-go protocol = Alternate bit protocol = Stop-and-wait protocol

Problem 3.

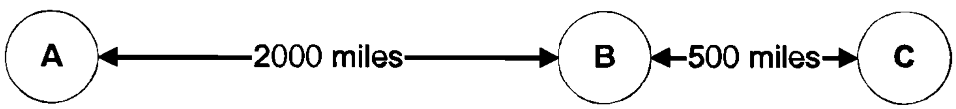

Figure 1

(a) In Figure 1, frames generated by node A are sent to node C through node B. Determine the minimum transmission rate required between node B and C so that the buffers of node B are not flooded, based on the following data:
- The data rate between A and B is 300 kbps.
- The propagation delay is 12μsec/mile for both lines.
- There are full duplex lines between the nodes.
- All data frames are 1500 bits long; ACK frames are separate frames of negligible length.
- Between A and B, a sliding-window protocol with window size of 5 is used.
- Between B and C, the stop-and-wait protocol is used.
- There are no errors.

(b) Now, imagine a scenario similar to the one in question (a) except for the fact that link AB operates with a stop and wait protocol and link BC operates with a sliding window protocol of window size 5. Find the transmission rate required for link BC so that the buffers of node B are not flooded.

Problem 5.

A link is such that the ideal window size for a maximum pipeline effect is 30 packets of 1500 bytes each (not worrying at all about the overhead).

a) If the propagation speed is 10^8 m/s, what is the length of the link if its rate is 1 Mb/s? Explain your assumptions.

b) If the length of the link is 8 km, what is the link rate? Explain your assumptions.

Problem 7:

Host A is sending an enormous file to Host B over a TCP connection. Over this connection there is never any packet loss and the timers never expire. Denote the transmission rate of the link connecting Host A to the Internet by R bps. Suppose that the process in Host A is capable of sending data into its TCP socket at a rate S bps, where S = 10R. Further suppose that the TCP receive buffer is large enough to hold the entire file, and the send buffer can hold only one percent of the file. What would prevent the process in Host A from continuously passing data to its TCP socket at rate S bps? TCP flow control? TCP congestion control? Or something else? Elaborate.

Problem 8:
Consider sending a large file from a host to another over a TCP connection that has no loss.
a) Suppose TCP uses AIMD for its congestion control without slow start. Assuming CongWin increases by 1 MSS every time a batch of ACKs is received and assuming approximately constant round-trip times, how long does it take for CongWin to increase from 1 MSS to 6 MSS (assuming no loss events)?
b) What is the average throughout (in terms of MSS and RTT) for this connection up through time = 5 RTT?