Department of ICT, MIT, Manipal
Principles of Data Communication [ICT 2156]
Tutorial 8

1. In Figure frames are generated at node A and sent to node C through node B. Determine the minimum data rate required between nodes B and C so that the buffers of node B are not flooded, based on the following:
   a. The data rate between A and B is 100 kbps.
   b. The propagation delay is 5 µS/km for both lines.
   c. There are full duplex lines between the nodes.
   d. All data frames are 1000 bits long; ACK frames are separate frames of negligible length.
   e. Between A and B, a sliding-window protocol with a window size of 3 is used.
   f. Between B and C, stop-and-wait is used.
   g. There are no errors.

   Hint: In order not to flood the buffers of B, the average number of frames entering and leaving B must be the same over a long interval.

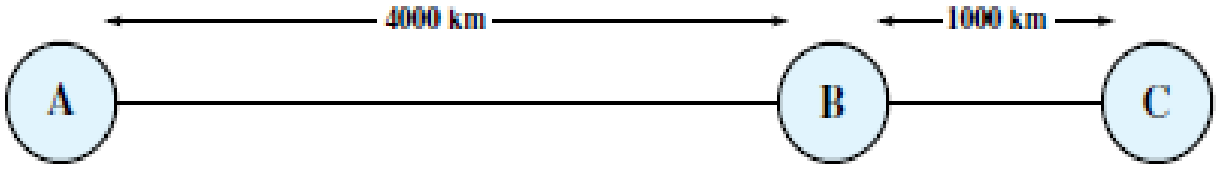

Figure 7.10 Configuration for Problem 7.4

2. Two neighboring nodes (A and B) use a sliding-window protocol with a 3-bit sequence number. As the ARQ mechanism, go-back-N is used with a window size of 4. Assuming A is transmitting and B is receiving, show the window positions for the following succession of events:
   a. Before A sends any frames
   b. After A sends frames 0, 1, 2 and receives acknowledgment from B for 0 and 1
   c. After A sends frames 3, 4, and 5 and B acknowledges 4 and the ACK is received by A

3. Two stations communicate via a 1-Mbps satellite link with a propagation delay of 270 ms. The satellite serves merely to retransmit data received from one station to another, with negligible switching delay. Using HDLC frames of 1024 bits with 3-bit sequence numbers, what is the maximum possible data throughput; that is, what is the throughput of data bits carried in HDLC frames?

4. Assume that the primary HDLC station in NRM has sent six I-frames to a secondary. The primary's N(S) count was three (011 binary) prior to sending the six frames. If the poll bit is on in the sixth frame, what will be the N(R) count back from the secondary after the last frame? Assume error-free operation.

5. A system uses Stop and Wait protocol. Consider each frame consists of 1kbits, which is to be transmitted over a 5000km link with a capacity of 60kbits/minute and a propagation speed of $2x10^8$ m/sec.

   a. Calculate the total time required for the transmission of 1 million bits of data, assuming error free transmission and negligible processing time and ACK frame size.
   b. On an average if it is observed that two out of hundred packets need to be retransmitted, calculate the maximum link utilization.