Computer Networks
Homework #2

Answer the following questions from your book:

1. R4, page 502
2. R11, page 503
3. P18, page 506
4. Consider a point-to-point link between nodes A and B with the following measured values:

a) Link length = 2000 kilometers
b) Signal propagation speed = 5 meters/nanosecond
c) Link speed = 1 Mbps
d) ACK processing time at node A = 10 milliseconds
e) Packet processing time at node B = 20 milliseconds
f) Packet size = 1500 bytes
g) ACK size = 64 bytes

Assume the node A is sending to node B and permits (acks) are granted after each packet is received. Compute the network utilization for the following cases:

a) Stop-and-Wait with no channel errors.
b) Sliding Window with no channel errors and W=10 (W is the window size)
c) Stop-and-Wait with Prob[bit in error] = 0.0001

Answers

1. There will be a collision in the sense that while a node is transmitting it will start to receive a packet from the other node.

2. An ARP query is sent in a broadcast frame because the querying host does not know which adapter address corresponds to the IP address in question. For the response, the sending node knows the adapter address to which the response should be sent, so there is no need to send a broadcast frame (which would have to be processed by all the other nodes on the LAN).

3. At $t = 0$ A transmits. At $t = 576$, A would finish transmitting. In the worst case, B begins transmitting at time t=324, which is the time right before the first bit of A's frame arrives at B. At time t=324+325=649 B's first bit arrives at A. Because 649> 576, A finishes transmitting before it detects that B has transmitted. So A incorrectly thinks that its frame was successfully transmitted without a collision.

4. a) minimum required frame length is given by $2*d_{prop}* BW=2*(500+700)/(2 \cdot 10^8) * 10 *10^6=120$ bits. There is no maximum required packet length.

   b) Efficiency is given by
   $1/(1+5* d_{prop}/ d_{trans}) =1/(1+5*120/2/1500)=0.83$

5. If all the 11=9+2 nodes send out data at the maximum possible rate of 100 Mbps, a total aggregate throughput of 11*100 = 1100 Mbps is possible.

6. Consider a point-to-point link between nodes A and B …

   Assume the node A is sending to node B and permits (acks) are granted after each packet is received. Compute the network utilization for the following cases:

   a) Stop-and-Wait with no channel errors.

   Tfr = (1500*8)/10^6 = 12 milliseconds
   Tack=(64*8)/10^6 = .512 milliseconds
   Tack = (64*8)/10^6 = 0.512 milliseconds
   Tprop = (2000000*10^-9/5) = 0.4 milliseconds

   U=Tfr/(Tprop+Tprop+Tfr+Tack+TprocA+TprocB) = 27.7%

   b) Sliding Window with no channel errors and W=10 (W is the window size)

   W*Tfr > (Tprop+Tprop+Tfr+Tack+TprocA+TprocB), therefore U=100%

   c) Stop-and-Wait with Prob[bit in error] = 0.0001

   Prob[frame in error] = 1 – (1-0.0001)^(1500*8) = 0.6988

   So, U = (1 – Prob[frame in error]) * Tfr /
   (Tprop+Tprop+Tfr+Tack+TprocA+TprocB) = 8.3%