EE 450 Homework 4
Spring 2013 Nazarian

Score:___/200

Student ID: _____ Name: _____

Assigned: Thursday 3/14/2013 Perfect Score: 200, Maximum: 210

Due: Thursday 3/28/2013, at 5pm (EE450 HW locker, on the 3rd floor of EE Building.) Late submissions are accepted for only day with a maximum penalty of 15%. Submissions between 5pm-6pm: 2%, 6-7pm: 4%, 7-8pm: 8%. After 8pm: 15%. Solutions will be posted Friday night (3/29).

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1) (20 pts) 12 frames are transmitted using the Stop&Wait Automatic Repeat Request protocol. The 3rd, 5th, and 7th frames are received with no errors detected, however the first frame is dropped and the rest are lost. The retransmitted 4th and 6th frames are received with no errors detected. However for the rest, the second attempt is delivered with error and finally the third attempt is successful.

- **a)** Draw a timing diagram to illustrate the frame transmission between the sender and receiver nodes.
- **b)** Calculate the throughput assuming the time required for each frame transmission and receiving its ACK is RTT. Also the timer is set to timeout after 3RTT.

2) (70 pts) Repeat the previous problem:

- **a)** Using Go-Back-N error/flow control and assuming 3 sequence bits.
- **b)** Also repeat that problem using Selective-Repeat error/flow control and assuming 3 sequence bits. Assume NAK policy is also implemented.

NOTE: For both parts draw both the send and receive windows for each transmission.

3) (20 pts + 10 extra credit pts) Given the dataword 110011010010 and the generator 10101.

- **a)** Show the generation of the codeword at the sender site (using binary division)
- **b)** Assume the channel is reliable and the receiver obtains the codeword with no error. Show the checking of the codeword at the receiver site.
- **c)** Extra credit: Show an example of a dataword which is delivered with error, however the receiver fails to detect that!

4) (20 pts) Repeat parts (a) and (b) of the previous question using polynomials.

5) (70 pts) Assume the data rate of A and C is 15Mbps and that of B and D is 25Mbps. The propagation speed is $2.3*10^8$m/s.

- **a)** Calculate the minimum frame length (in bits) for each of the four nodes, assuming the worst case scenario discussed in lecture.
- **b)** Assume D starts sending its frame at t=40ns. A collision occurrs between that frame and another sent by A right at the point where B is placed. Calculate the time A started sending its frame.
- **c)** Calculate the time C would sense the collision in part (b).
- **d)** How many bits has station A sent before detecting the collision in part (b)?
- **e)** How many bits has station D sent before detecting the collision in part (b)?
- **f)** When should B start sending its frame such that the first bit of its frame collides with the first bit of the frame sent by D at t=40ns? Please give us the collision time range.
- **g)** When should B start sending its frame such that the 30th bit of its frame collides with the first bit of the frame sent by D at t=40ns? Is it possible? If possible, please give us the collision time. Otherwise, please state the reason.
- **h)** Is it possible that all nodes get involved in a collision, meaning they could not sense other activities early enough and sent their frame? If so, give an example.
- **i)** C starts sending a frame to D at t=200ns. When is the earliest B could send its frame such that no collision occurs between the two frames.