KING FAHD UNIVERSITY OF PETROLEUM & MINERALS
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COMPUTER ENGINEERING DEPARTMENT

COE 540 – Computer Networks
Assignment 2 – Due Date April 4th, 2011 - Solution Key

Problem 1 (30 points): On the Error Detection

1) Consider a data string of length K bits where we add L bits as parity check. In this context answer the following questions.
   a) Define a parity check code. Define a code word
   b) What is the number of all possible code words
   c) Define the following terms: minimum distance of the code and burst-detecting capability.
2) For CRC code with g(D) that is a product of a primitive polynomial of degree L-1 time (D+1), answer the following questions:
   a) Define the primitive polynomial and its role in the error detection capability of the CRC code
   b) What is the minimum distance of the code defined in (2)? Why?
   c) What is the burst detection capability and the probability of a completely error-free string will be accepted as error-free?

Problem 2 (20 points): On Framing

1) Consider the bit stuffing roles of section 2.5.2. Remember the flag is 01^60, and the stuffing role is to insert a 0 after the occurrence of 5 consecutive 1s.
   a) Apply bit stuffing to the following frame:

   011011111001111110101111 1111101111010

   b) Suppose the following string of bits is received

   01111110111110110011111001111101111011000111111010111110

   Remove the stuffed bits and show where the actual flags are.
2) Explain what is meant by the DLC sensitivity problem
3) Framing is one important function that is performed by the data link layer. What are the arguments against moving this function to the upper layer?

Problem 3 (20 points): On Frame Size

1) List all the arguments for a large frame size and those that are for a small frame size at the data link layer. Refer to the textbook material pages 94, 95, and 96.

2) Define and write an expression for the total delay figure for streaming service where the stream packet of size K bits is generated at rate R b/s and have to traverse N back-to-back links. Assume the ith link transmission rate is denoted by Ci b/s.

Problem 4 (30 points): On ARQ Protocols

1) Assume the frame header has k bits for sequence numbers. What is the maximum window size that can be supported for Go-Back-N protocol? What is the maximum window size that can be supported for Selective-Reject ARQ protocol? Why?

2) Consider a link where node A connected to node B using a link whose physical distance is 8,000 km. The link is operating a sliding window protocol with W = 7. Let the data frames be of length 1024 Bytes, while the ACK frames be of length 64 Bytes. Let the processing time for each data or ACK frame be equal to 1 msec.

a) Compute the link speed R_star where the link utilization is 100% for all R_AB less than R_star. What is the corresponding Tf_star (i.e. the frame time) at link rate equal to R_star?

b) Draw the utilization function of the link AB as the link AB varies from 0 to infinity.

c) Draw the throughput function of the link AB (in data frames per second) as the link AB rate, R_AB, varies from 0 to infinity.

d) Compute the maximum possible (useful) throughput on link AB in frames per second and also in bits per second.

You are **not** to ignore the Tack and Tproc. Use the values specified in the problem statement. In each of the required curves ALL critical points (values) must be specified. Label your axes properly. For the graphs in (b) and (c) you need to show R_star on the curve and the corresponding utilization/throughput.