SIMON FRASER UNIVERSITY
SCHOOL OF ENGINEERING SCIENCE

Spring 2017
ENSC 427: COMMUNICATION NETWORKS
ENSC 894 SPECIAL TOPICS II: COMMUNICATION NETWORKS

Midterm No. 2
Wednesday, March 29, 2017

Duration: 50 minutes. Attempt all problems. Questions are not equally weighted.

Closed book and closed notes. Simple calculators (with no graphing/programming functions) are permitted. PDAs, laptops, and wireless phones are not permitted. Please provide brief and concise answers and include diagrams, graphs, and tables, as needed. Expand all acronyms. Please write legibly. Illegible text will not be graded. Please use a pen (no pencils please).

1. **Circuit Switching Networks (35 points)**:

   (a) Consider a Clos switch with N inputs and N outputs, where the N inputs are grouped into N/n groups of n input lines. Draw the general architecture of the three-stage Clos non-blocking switching fabric.

   (b) Calculate the number of cross points required in the three-stage switch. Include all switch components.

   (c) Find the smallest number of intermediate stages k for a non-blocking switch.

   (d) Calculate the number of cross points required to make the switch non-blocking.

   (e) Find an approximate value of n that minimizes the number of cross points for a non-blocking switch architecture. Calculate this minimum number of cross points.

2. **Peer-to-Peer Protocols and Data Link Layer (25 points)**:

   (a) Describe the Go-Back-N ARQ protocol using the flowing sequence of events diagram for $N = 5$. Include the case when one frame is lost. Clearly identify frame numbers and ACK numbers.

   (b) What is the maximum allowable size of the send window W_s for the $M = 2^m$ numbering sequence?

   (c) Provide an example that clearly justifies your answer.

   (d) Calculate the efficiency η_{GBN} of the protocol if the probability of frame loss is P_f.

   (e) What is the effective information transmission rate in the absence of errors?

3. **Medium Access Control Protocols and Local Area Networks (25 points)**:
   (a) Describe the Carrier Sensing Multiple Access (CSMA) scheme.
   (b) List and describe the three CSMA options.
   (c) Describe the ”truncated binary exponential backoff”.
4. **Riverbed Modeler Tutorial (M/M/1 Queue) (15 points)**:
   (a) Describe the M/M/1 queue, show the system diagram, and describe its components.
   (b) Describe the main model parameters.
   (c) Describe the process model attributes for the processor module.