SIMON FRASER UNIVERSITY
SCHOOL OF ENGINEERING SCIENCE

Spring 2011
ENSC 427: COMMUNICATION NETWORKS

Final Examination
Wednesday, April 20, 2011

Duration: 180 minutes. Attempt all problems. Questions are equally weighted.

Closed book and closed notes. PDAs, laptops, and wireless phones are not permitted. Simple calculators (with no graphing/programming functions) are permitted.

Please provide precise and detailed answers and include diagrams, graphs, and tables, as needed. Expand all acronyms. Please write legibly. Illegible text will not be graded.

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

   (a) What are ARQ protocols? Briefly describe their major functions.

   (b) Describe the following ARQ protocols:

   i. Stop-and-Wait
   ii. Go-Back-N
   iii. Selective Repeat

   Use *the flowing sequence of events diagrams* and clearly identify both the frame and ACK numbers.

   (c) What is the maximum window size in each case?

2. **Packet-Switching Networks (25 points)**

   (a) Show the network layers and protocol stacks and identify the end-to-end and the node-to-node layer operations.

   (b) Briefly describe packet routing. Identify the layer responsible for its implementation. What are routing tables and where are they stored?

   (c) Use a simple graph of your choice to describe details of the two main shortest-path routing algorithms:

   i. Bellman-Ford algorithm
   ii. Dijkstra's algorithm.

3. **TCP/IP (25 points)**:

   (a) Show the digram of the TCP/IP protocol suite.

   (b) Show the format of the TCP segment. Indicate its size and list the header fields.

   (c) Describe the TCP connection establishment and termination.

   (d) List main phases of the TPC congestion control algorithm. Indicate each phase on a plot of *TPC window size* vs. *time*. Describe the TCP feedback mechanism in case of packet loss. How is the packet loss detected by TCP? How does TCP react to each type of packet loss?

   (e) What is "round-trip time" and how is it estimated? What is "timeout" and how is its value set in TCP?

4. **OPNET CSMA/CD and ns-2 Tutorials (25 points)**:

   (a) List two channel access protocols that were modeled in the CSMA/CD tutorial and show the diagram of the modeling hierarchy.

   (b) Show the elements of:

     i. Aloha transmitter and receiver process models

    ii. Aloha generic transmitter and receiver node models.

(c) Provide a graph showing simulated *channel throughput* as a function of *channel traffic*. What is the expected theoretical result for a pure Aloha system? How did the simulation results compare to the theoretical analysis?

(d) List two main internal components of ns-2? What do they control? How do you run an ns-2 simulation? What do you need to specify in order to run ns-2? What is the result from an ns-2 simulation run?