Electrical, Computer, and Systems Engineering

ECSE 4760: Computer Communication Networks

**Homework set 1: Due Friday, September 14**
**(Wednesday, September 19 for tape delayed students)**

## Notes:

1. Be brief.
2. **SUBMIT THIS HOMEWORK USING WEBCT DROP BOX.**
3. 4000 level students need to answer only Reading Assignment questions 1 and 2 and Homework Problems 1, 2 and 3.
4. 6000 level students need to answer all questions.
5. All papers for the reading assignment are available from the course web page.

## Reading Assignment

**1.** Read Chapter 1. Summarise key concepts and issues **NOT** covered in class. The summary should not be more than 10-15 lines. (10pts)

**2.** Reading: P. Baran, "On Distributed Communication Networks," IEEE Transactions on Communication Systems, Mar. 1964. Also as Rand Corporation Technical report with the same title (Memorandum RM-3420-PR, 1964). Available from http://www.rand.org/publications/RM/RM3420/

Submit a one page summary of the paper. (15pts)

# Homework Problems

**1.** Concepts: **(Multiplexing)** What is multiplexing and how does it improve system design? Why is statistical multiplexing not good for systems whose load characteristics have no variation? Why is packet switching more efficient than circuit switching? (20pts)

**2.** Suppose users share a 5 Mbps link and each user requires 500 Kbps when it is active. Also, each user is inactive 75% of the time and transmits only 25% of the time.

(a) With circuit switching, how many users can be supported? (5pts)

(b) Now consider packet switching with 50 users. What is the probability that **exactly** 10 users are active? (7.5pts)

(c) What is the probability that **at least** 10 users are active? (7.5pts)

(d) What is the maximum number of users that can be supported on the link with packet switching assuming we do not want the probability that 10 or more users are active to be greater than 0.05? (10pts)

**3.** Concepts: **(Layering)**

(a) Can direct, peer to peer communication take place in a layered environment (i.e. can any layer communicate directly to its couterpart in another machine without going through other layers)? Augment your answer with examples of layers which can have direct peer to peer communication and which cannot, if any. (12.5pts)

(b) What is the role of the service interface in the layered network system? How does each layer ensure that its functions are implemented on the packets that it receives from upper layers before passing it onto the lower layers? (12.5pts)

# Additional questions for 600 level students

**1.** Consider a queue at a router with a output link rate (i.e. service rate) of $R$ bits/sec. If $N$ packets arrive at the router every $LN/R$ seconds and each packet is $L$ bits long, find the average queueing delay for any arbitrary packet. Give a closed form solution. (25pts)

**2.** Reading: D. Clark, "The Design Philosophy of the DARPA Internet Protocols," *Computer Communication Review,* vol. 18, no. 4, pp. 106-114, August 1988. (Available from http://www.ecse.rpi.edu/Homepages/shivkuma /teaching/sp2001/readings/ccr-9501-clark.pdf) Submit a one page summary of the paper. (15pts)