EECS 563

Homework #6

1. Packets arrive at arrival rate of λ =100 packets/sec. What is the expected number of packets arrivals in 10, 100, and 1000 sec.

2. Video Multiplexer Analysis: A packet digital video service statistically multiplexes 100 video channels onto one fiber with a capacity of 1 Gb/s. That is, all 100 video sources share one buffer with one transmission facility, the system includes the buffer and transmission facility(i.e., a statistical multiplexer). Assume on average the HD video channel uses 5 Mb/s/channel and video packets are 5000 bits long and exponentially distributed.

a. What is the total bit rate into the statistical multiplexer ?

b. What is the probability the statistical multiplexer has no packet to send, i.e., the system is empty?

c. Find the average number of video packets in the statistical multiplexer.

d. Find the variance of the number of video packets in the statistical multiplexer.

e. What is the utilization of system statistical multiplexer?

f. What is the average delay for the video packets in μs?

3. Assume a link rate of R=100 Mb/s and a packet length of L=100 Kbits. The customer QoS requirement that the expected delay be 2.0 ms, i.e., E[D]=2.0ms. To maintain this QoS the packet arrival rate λ must be less than some maximum; find the maximum packet arrival rate λ (packets/sec) and the corresponding input rate, r_{in} (Mb/s).

4. Design a statistical multiplexer with a finite system, i.e., specify the output line rate in b/s and system size so the average delay is less than 0.2 ms and the probability of a blocked packet is less than 0.01. Assume the average arrival rate to the multiplexer is 10,000 packets/second with an average size of 1000 bits. Assume the interarrival times and message length p.d.f.'s are exponential. (Determine the link capacity using an infinite buffer assumption first, and then using that capacity, find the system size).

5. A DWDM system with 50 wavelengths operating at 400 Gb/s/wavelength connects a file server to a compute server. The compute server requests files at a rate of 10 files/sec with an exponential interarrival times; the file size is exponentially distributed with an average of 200 GByte.

a. What is the average service (holding) time in seconds?

b. What is the load in Erlangs on the DWDM system?

c. What is the probability that a file request is blocked, i.e., the probability that all the 50 wavelengths are busy with other file transfers?