CS/EE 145A Networking

Homework Set # 5
Due: Wednesday, 28 November 07

1. Packets arrive at a rate of k per unit time and are queued for transmission on a link. Each packet requires a constant processing time of p and a transmission time that is uniformly distributed over the range $[t, 2t]$. What is the average number of packets in the system (i.e., in the queue or undergoing transmission)?

2. Consider a slotted random access protocol for a multiple access link. Suppose at the beginning of some time slot there are n nodes with data to send, and each of them transmits in that slot with probability p. What is the probability that there is a successful transmission in the slot, and what value of p maximizes this success probability?

3. Consider a discrete time stationary and ergodic arrival process $\{B_k, k \geq 0\}$, where B_k is the amount of data that arrives in timeslot k. Let $\Gamma(\theta)$ be the log moment generating function for this process.

   (a) Show that if $\{B_k\}$ is scaled by n (i.e., for every bit arriving in $\{B_k\}$, n bits arrive in the scaled process) then the log moment generating function for the scaled process, $\Gamma_n(\theta)$, is given by $\Gamma(n\theta)$.

   (b) **(extra credit)** The scaled and unscaled sources are each fed into separate multiplexers with infinite buffers. Show that the effective bandwidth for the scaled source, $e_n(\theta)$, is related to that for the unscaled source, $e(\theta)$, by $e_n(\theta/n) = ne(\theta)$.

   (c) **(extra credit)** Explain why there is no contradiction between the observation in (b) and the additive property of effective bandwidth.