ECE - Computer Networks II
Winter 2007

Problem Set #2

To be discussed: February 1, 2007.

1. Textbook Problem #4.4
2. Textbook Problem KMK #4.9
3. Consider N_1 dual leaky bucket (R_1, σ_1, ρ_1) flows multiplexed with N_2 leaky bucket (σ_2, ρ_2) flows at a link with capacity C. Derive an expression for the maximum delay $d_{\max}$ in a FCFS server.
4. Consider a non-work-conserving FCFS server that takes vacations every other T seconds, i.e., for T seconds, the server services traffic in FCFS order at rate C, and for the next T seconds, the server services no traffic, even if traffic is queued.
   (a) What is the lower service curve of this server.
   (b) Derive an expression for the maximum delay $d_{\max}$ for N (σ, ρ) flows multiplexed at this server. Justify your answer with a graphical illustration.
5. Consider time to be slotted to one second and consider a fluid source that transmits a sequence $\{2, 5, 1, 3, 2, 5, 1, 3, \cdots\}$. This means that, for example, the source transmits fluid at rate 2 (bits per second) in the intervals $\{[0, 1], [4, 5], \cdots\}$.
   (a) Sketch the empirical envelope $\mathcal{E}(t)$ for this source as well as the cumulative arrivals $A(t)$ of the original stream.
   (b) Determine a valid set of (R, σ, ρ) traffic parameters with a value of σ greater than 0. Sketch the resulting envelope $E(t)$ along with the empirical envelope $\mathcal{E}(t)$. Make sure your parameters are tight, i.e., $(10^6, 10^6, 10^6)$ will not be given credit.
   (c) For a link capacity $C = 3$ and the above (R, σ, ρ) flow, compute the maximum queueing delay.