Network Calculus
Exercise Series

Lecture 11

2005

Exercise 1 *For a CBR connection, here are some values from an ATM operator:*

peak cell rate	(cells/s)	100	1000	10000	100000
CDVT	(microseconds)	2900	1200	400	135

1. *What are the (P, B) parameters in b/s and bits for each case ? How does T compare to τ ?*
2. *If a connection requires a peak cell rate of 1000 cells per second and a cell delay variation of 1400 microseconds, what can be done ?*
3. *Assume the operator allocates the peak rate to every connection at one buffer. What is the amount of buffer required to assure absence of loss ? Numerical Application for each of the following cases, where a number N of identical connections with peak cell rate P is multiplexed.*

case	1	2	3	4
nb of connnections	3000	300	30	3
peak cell rate (c/s)	100	1000	10000	100000

Exercise 2 *Is it true that offering a service curve β implies that, during any busy period of length t, the amount of service received rate is at least $\beta(t)$?*

Exercise 3 *We consider a buffer of size X cells, served at a constant rate of c cells per second. We put N identical connections into the buffer; each of the N connections is constrained both by GCRA(T_1, τ_1) and GCRA(T_2, τ_2). What is the maximum value of N which is possible if we want to guarantee that there is no cell loss at all ?*

Give the numerical application for $T_1 = 0.5$ ms, $\tau_1 = 4.5$ ms, $T_2 = 5$ ms, $\tau_2 = 495$ ms, $c = 10^6$ cells/second, $X = 10^4$ cells

Exercise 4 *We consider a flow defined by its function $R(t)$, with $R(t) =$ the number of bits observed since time $t = 0$.*

1. *The flow is fed into a buffer, served at a rate r. Call $q(t)$ the buffer content at time t. We do the same assumptions as in the lecture, namely, the buffer is large enough, and is initially empty. What is the expression of $q(t)$ assuming we know $R(t)$?*
   We assume now that, unlike what we saw in the lecture, the initial buffer content (at time $t = 0$) is not 0, *but some value $q_0 \geq 0$. What is now the expression for $q(t)$?*
2. *The flow is put into a leaky bucket policer, with rate r and bucket size b. This is a policer, not a shaper, so nonconformant bits are discarded. We assume that the bucket is large enough, and is initially empty. What is the condition on R which ensures that no bit is discarded by the policer (in other words, that the flow is*

We assume now that, unlike what we saw in the lecture, the initial bucket *content (at time $t = 0$) is* not 0*, but some value $b_0 \geq 0$. What is now the condition on R which ensures that no bit is discarded by the policer (in other words, that the flow is conformant) ?*