

Real-Time Systems (CSE 40463/60463) — Fall 2007

Homework Assignment 3

Due date: October 30th, 2007 (in class)

MY NAME IS: -----

Question 1: At time 0, a 200-byte and a 400-byte packet arrive from connection 1 and 2 respectively to an empty WFQ scheduler. The WFQ scheduling weights are $w_1=2$ and $w_2=5$, respectively. The line rate is 200 Bps (bytes per second). Assuming an idealized byte-by-byte WFQ scheduler (i.e., the ideal scheduler serves a byte from each stream in every round), answer the following questions:

- a) At what *real times* do the two packets complete service?
- b) What are the corresponding round numbers (virtual time) when the packets complete service?
- c) If a 20-byte packet arrives on connection 1 at real-time 1.5 seconds, what would be the finish time (round number)?

Question 2: Consider a network with three switches and a packet stream that has been admitted with the following parameters: $(4,1,D)$ (period, number of packets per period, end-to-end deadline) and the negotiated relative deadline for all three switches is 3. The first switch receives 5 packets at times 0, 4, 5, 10, 15. Assume that the effective arrival time for the first packet at the first switch is 0. The experienced delays at each switch for these packets are 2, 2, 2, 3, 1 (assume that the propagation delays are 0).

a) Compute the effective arrival times and deadlines at the first switch and the arrival times, effective arrival times, and deadlines for the second switch, assuming Delay-EDD.

b) Compute the ready times and deadlines for the first switch, the arrival times, effective arrival times, ahead times, ready times, and deadlines for the second switch, and the arrival times for the third switch, assuming Jitter-EDD.

Question 3: Consider a switch that uses HRR (hierarchical round robin) to schedule flows of packets. The switch supports 600Kbps and uses three levels. The (n_i, b_i) values for all three levels are: (4, 2), (6, 1), and (4, 0) (levels 2 and 3 split n_i equally among the higher-level slots). The following flows request service from this switch:

Flow A: 100Kbps

Flow B: 50Kbps

Flow C: 25Kbps

Flow D: 25Kbps

Flow E: 150Kbps

Flow F: 45Kbps

Flow G: 140Kbps

Flow H: 15Kbps

Flow I: 20Kbps

Indicate the level and number of slots used by each flow, compute the frame time for each level, and draw the schedule for 24 slots.