PRINCE OF SONGKLA UNIVERSITY

FACULTY OF ENGINEERING

Midterm Examination Semester I : Academic Year : 2005

Date : 4 August 2005 Time : 9.00 – 12.00 Room : A400

Subject : 240 – 575 Special Topics in Information Network Engineering II

(Differentiated Services in the Internet)

Instruction:

- Make sure that there are 6 problems (95 points) in your exam paper.
- This exam is closed book and you have 3 hours to complete your exam.
- All of your answers can be written in either Thai or English.
- Dictionary and Calculator are allowed.
- No palm pilots or other hand held computers are allowed.

Problem 1 Philosophy of the Internet (10 points)

1.1 Explain how the end-to-end principle has led to an opposite design of the Internet as compared to the telephone system. (5 points)

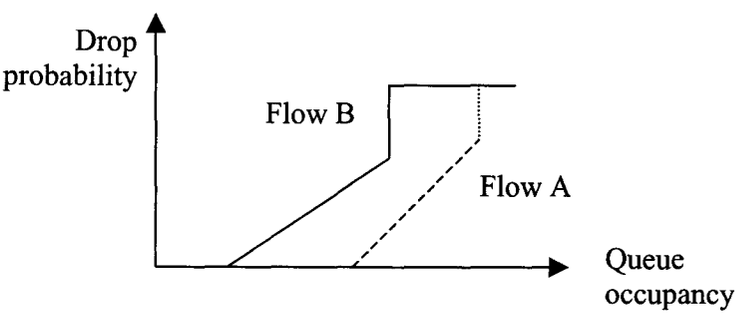
1.2 Routing is a fairly complex function placed inside the network and not in end-systems. Explain why it is still consistent with end-to-end principle. (5 points)

Problem 2 QoS and Congestion Control in the Internet (15 points)

2.1 TCP congestion control has two key pieces: slow start phase and congestion avoidance phase. Explain what is the role of each piece, and how they are complementary to each other in terms of functionality. (5 points)

2.2 How does the use of active queue management (AQM) schemes like random early detection/drop (RED) at routers help TCP congestion control over-and-above the congestion control functions at end-systems? (5 points)

2.3 In RED scheme, suppose that two flows share the same queue. Flow 'A' is given a higher drop preference than flow 'B', as indicated in the figure below. Can we claim that flow 'A' is protected from flow 'B'? Why or why not? *(5 points)*



Problem 3 Fair Queueing (10 points)

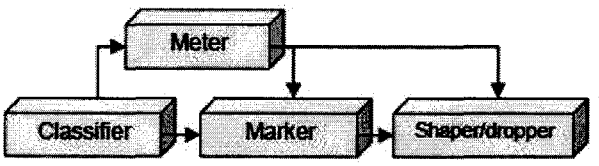
3.1 What is the main problem when emulating GPS (General Processor Sharing) with (unweighted) round-robin? (5 points)

3.2 Four sources wish to transmit data at rates R_1 = 4 Mb/s, R_2 = 13 Mb/s, R_3 = 2 Mb/s and R_4 = 2 Mb/s, where R_i is the desired rate of source i. All four flows share a link with data rate 10Mb/s. All four flows contain TCP traffic and we'll assume here that the congestion control mechanism of TCP adapts each flow so that its average rate is equal to the max-min fairness allocation. What average rate (in Mb/s) does each flow actually operate at? *(5 points)*

Problem 4 QoS Architecture (30 points)

4.1 Discuss the tradeoffs between stateful and stateless architectures (eg: Intserv, Diffserv, Edge-based Closed-loop architectures). (10 points)

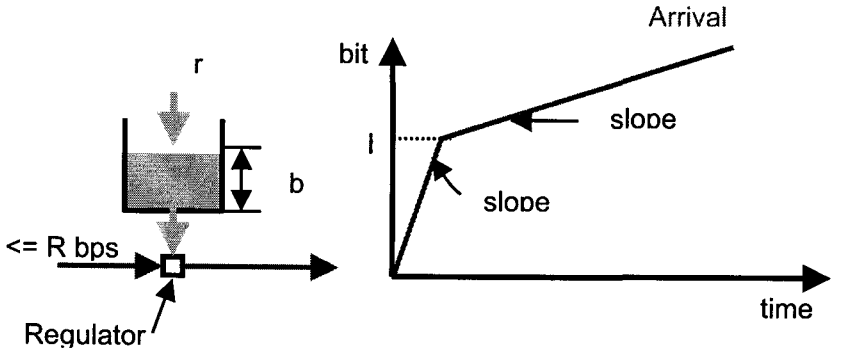
4.2 In DiffServ, there are four functions that characterize a router's functionality: The Classifier, the Meter, the Marker and the Shaper/dropper. Explain how they work together and what functionality they implement! Show how they can enforce that the traffic leaving the router complies with the service level agreement (SLA)? How can traffic that is "out of profile" be handled? (10 points)



Problem 5 (10 points)

(a) Describe a (r, b) curve of token bucket descriptors for a source, and how does it help in selecting a traffic descriptor? (5 points)

(b) If a source commits to send a leaky-bucket (r, b) constrained flow to a destination, and agrees on a bound of the end-to-end delay with the network. The path taken by the flow includes four links and three routers. At what minimum rate must the routers serve the flow in order to guarantee an end-to-end delay guarantee? (5 points)



Problem 6 (20 points)

As the variants of RED mechanism have been proposed in the research papers, give some weaknesses or problems of native RED mechanism that are mentioned in those papers and explain how they can be solved or handled.

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August 2005