

- h) ----- The effectiveness of congestion control in Random Exponential Marking (REM) routers does not rely on cooperation of users.
- i) ----- Random Exponential Marking (REM) mechanism in routers can be set to drop packets, instead of marking packets, during congestion.
- j) ----- Any forms of utility functions at users can drive the optimal flow control scheme to be converged to optimality after several iterations.

Problem 2 Internet Enhancement Models

2.1 Discuss the tradeoffs between stateful and stateless architectures (eg: Intserv, Diffserv, Edge-based Closed-loop architectures e.g. in TCP).

(10 points)

2.2 In Differentiated Service (DiffServ) architecture as shown in Figure 1, there are four functions that characterize a router’s functionality: The Classifier, the Meter, the Marker and the Shaper/dropper.

(a) What is the role of the “Shaper/Dropper”?

(b) What does “intra-class fairness” and “inter-class fairness” mean for DiffServ?

(15 points)

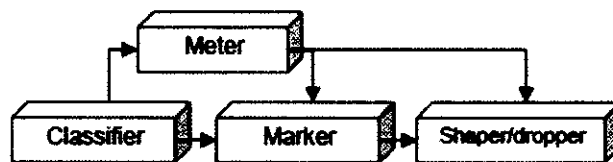


Figure 1

Problem 3 MPLS

3.1 What is a Label Switch Path used in Multi Protocol Label Switching (MPLS)?

(5 points)

3.2 Why MPLS is suitable to support Quality of Service (QoS) provisioning for adaptive real-time multimedia applications in the Internet?

(10 points)

Figure 2

Problem 4 Optimization Flow Control

4.1 Compare packet marking (or dropping) policy for congestion control used in Random Early Detection (RED) and Random Exponential Marking (REM) router mechanisms. (5 points)

4.2 Regarding the global optimization problem for solving the congestion control problem in the Internet as shown in Figure 2 below,

- Explain why this problem is not practicable to use in the real networks, (5 points)
- Explain how this problem is modified in such a way that the source and link models of Random Exponential Marking (REM) mechanism are developed. (5 points)
- Explain how the REM algorithms in both link (router) and users can work cooperatively towards achieving the optimal fair of bandwidth sharing among contending users after several iterations. (5 points)

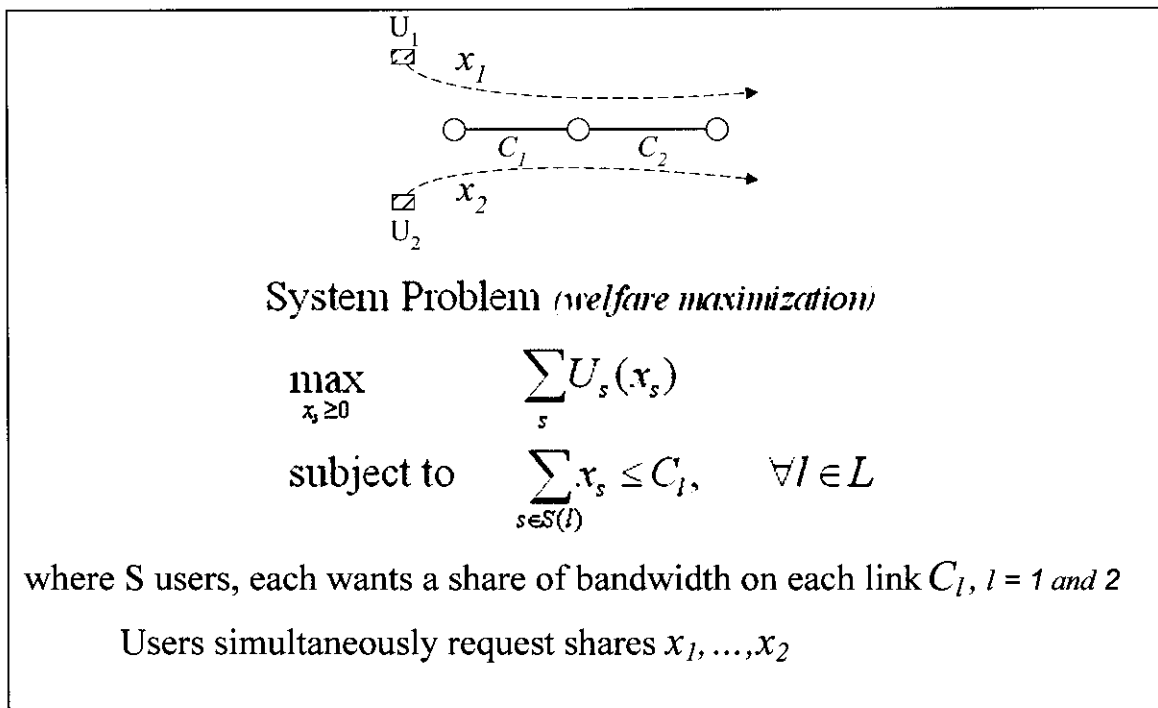


Figure 2

Problem 5 Issues related to QoS Provisioning Mechanisms

Based on the Figure 3, explain the approach that is proposed to use for alleviating the weakness of optimization flow control scheme in the research paper “Combinatorial Approach to Optimization-based Flow Control”
(10 points)

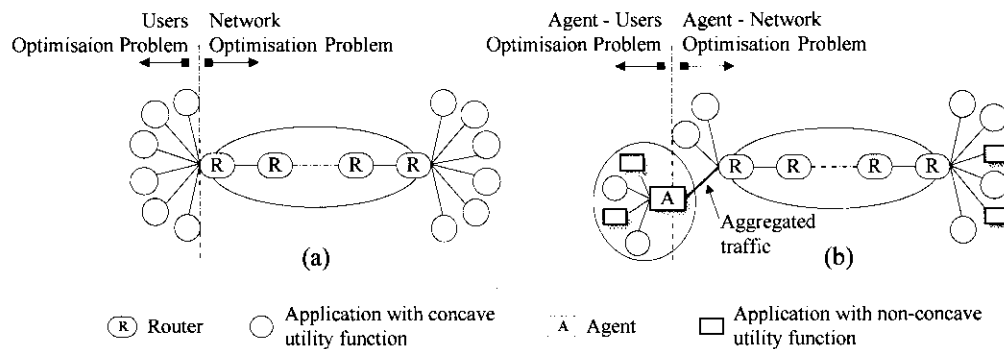


Figure 3

Problem 6 Issues related to QoS Provisioning Mechanisms

Pick up only TWO topics from the list given below and use the following guidelines for explanation.

- How and in what way QoS is related the selected issue?
- QoS-related problems needed to be solved or concerned, and their solutions if available.

- a) QoS Pricing and Billing
- b) Web Services and QoS
- c) QoS in Wireless Mesh Networks
- d) Performance Issues in Peer-Peer (P2P) Networks
- e) Internet Gaming and Network Performance issues
- f) QoS for Storage Systems

(20 points)