EE 384Y- Project Proposal

Demand Based Rate Allocation and Congestion Control for the Internet

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Present Scenario:

In the present Internet, rate allocation is determined by the TCP algorithm. Depending on the load at a buffer (at a router), which in turn is determined by the traffic of all active users, packets are dropped or marked. This feedback is used by each sender to modify its rate. Thus the rate achieved by a user depends on the aggregate traffic demand. This kind of scheme does not allow a rate allocation based on the amount a user is willing to pay. The average utilization of the network capacity may also be low as a result of the responses of users to congestion signals from the network.

Previous Work:

A case of a single resource being shared by several users is studied in [2]. A congestion control scheme was proposed by marking packets at the resource. Here the number of marks received by each user determines the amount it has to pay. The number of marks received by a user is proportional to its share in causing congestion. Depending on the amount a user is willing to spend, it sends at a higher or lower rate so that the number of marks it receives over a long time period equals that amount. This paper, however, does not consider a network scenario like the Internet. Nor does it consider congestion avoidance and thus prevention of packet losses due to congestion.

Congestion control protocols currently employed in the Internet have been analyzed in [1] using deterministic flow models. However, this work does not allow for a rate allocation based on user-demand.

Proposed Work

An interesting question is whether rate and congestion control can be achieved by means of a supply-demand kind of mechanism, based on the cost each user is willing to pay. We plan to investigate rate-control and congestion control in a packet-switched network where feedback is provided to the users through marks on the transmitted packets. With the inclusion of the ECN bit in the IP header, such a scheme could become possible in reality. In this context, the cost to each user is the number of marks it receives. This will lead to a rate allocation that is proportional to the amounts the users are willing to pay. This is because, by using appropriate algorithms for marking the packets, the number of marks received by each user could be made proportional to the rate at which it sends (if there is congestion). It also results in congestion control, since each user is forced to send at a rate that it can pay for; a single user could buy a very large share of the bandwidth provided it can pay for it. This would lead to the price for that link becoming prohibitively high for the other users, thereby forcing users who cannot pay that much to reduce their rates.

Thus we consider a framework wherein the network uses the ECN bit for feedback and charging. We plan to investigate various decentralized algorithms at the users for rate control. We also hope to derive the utility function corresponding to each user that is related to the equilibrium solution for the rate control algorithm, and find out how this relates to the aggregate utility maximization problem. We would also like to look at the dual formulation to relate the prices to the dual variables. We plan to use deterministic flow models for the analysis of these algorithms as used in [1]. We also plan to study various mechanisms to be used at each router in the network for packet marking. In particular, we will be analyzing the effect of marking packets instead of dropping them as is done in active queue management (AQM) schemes. This should result in congestion control with fewer losses. If possible, we would also like to extend our work to include the contract and balancing process as proposed in [3].

In summary, we plan to study demand based rate allocation and efficient congestion control schemes for the Internet through packet marking using the ECN bit, where the number of marks received determines the cost for each user.

References

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[3] E. Anderson, F. P. Kelly, R. Steinberg, "A contract and balancing mechanism for sharing capacity in a communication network", http://www.statslab.cam.ac.uk/ frank/aks.html, Aug 2002.