

A game theoretic view of efficiency loss in network resource allocation

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Abstract

The Internet has evolved into a heterogeneous system, comprised of many users who value their own performance, rather than the efficiency of the system as a whole; as a result, proposals for network resource allocation must be robust against self-interested behavior of the network users. With this motivation, we analyze a network congestion game in which the users of congested finite-capacity links anticipate the effect of their actions on the link prices. We show existence of a Nash equilibrium, discuss uniqueness, and establish that the efficiency of the system drops by no more than 25% relative to the social optimum. We also show that among a wide class of mechanisms satisfying certain desirable properties, the mechanism we consider minimizes efficiency loss. We conclude by discussing several extensions, including: Models where links have elastic capacity; models where capacity may be stochastic; and some implications of these results for current work on Internet congestion control.

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