Network Resource Allocation for Users With Multiple Connections: Fairness and Stability

Abstract:

This paper studies network resource allocation between users that manage multiple connections, possibly through different routes, where each connection is subject to congestion control. We formulate a user-centric Network Utility Maximization problem that takes into account the aggregate rate a user obtains from all connections, and we propose decentralized means to achieve this fairness objective. In a first proposal, cooperative users control their number of active connections based on congestion prices from the transport layer to emulate suitable primal-dual dynamics in the aggregate rate; we show this control achieves asymptotic convergence to the optimal user-centric allocation. For the case of non cooperative users, we show that network stability and user-centric fairness can be enforced by a utility-based admission control implemented at the network edge. We also study stability and fairness issues when routing of incoming connections is enabled at the edge router. We obtain in this case a characterization of the stability region of loads that can be served with routing alone and a generalization of our admission control policy to ensure user-centric fairness when the stability condition is not met. The proposed algorithms are implemented at the packet level in ns2 and demonstrated through simulation.