Bandwidth provisioning in contention-based access networks

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Abstract

We study the link congestion problem in contention-based access networks such as wireless LAN's. These networks are characterized by the use of a random access protocol for channel access. We assume adaptive users or applications in the sense that their traffic flows are elastic. We further assume that individuals' service requirements can be characterized by demand functions that are price-sensitive. A price-based rate control strategy, where the price indicates the current congestion state, is considered to control channel congestion.

The effectiveness of price-based rate control is studied in the context of the classic slotted ALOHA model with an infinite population. The price as the new state variable is dynamically updated based on control parameters and the ternary channel feedback. Our results show that under this model stabilization of the ALOHA channel can be achieved. In particular, by using drift analysis, we prove that the associated Markov chain is positive recurrent. The resulting steady state probability distribution thus characterizes an operating point for the model. Moreover, a desired operating point as such could be selected by proper choice of the control parameters. We also show that service differentiation is realized at the operating point. From a control perspective, where demand functions become predetermined system parameters, such a price-based scheme offers a simple

mechanism to provide service differentiation in a best-effort contention-based network.

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