

Cross-Layer Rate Optimization in Wired-cum-Wireless Networks*

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Abstract. In this paper, we address the end-to-end rate optimization problem in a wired-cum-wireless network, where CSMA/CA based wireless LANs extend a wired backbone and provide access to mobile users. The objective is to achieve proportional fairness amongst the end-to-end sessions in the network. Since the network contains wireless links whose capacities are not fixed quantities and depend on transmission rates of neighboring links, the problem requires joint optimization at both the transport layer and the link layer. A distributed algorithm is proposed in this paper to solve the rate optimization problem. It works at the link layer to adjust transmission rates for the wireless links in the wireless LANs, and at the transport layer to adjust session rates. It is proved rigorously that the algorithm converges to the globally optimum solutions. Simulation results are provided to support our conclusion.

1 Introduction

CSMA/CA based wireless LANs are being successfully used as the last-mile technology in present-day pervasive computing environments: they provide sufficient bandwidth for office applications with relatively limited mobility. Wireless LANs extend the wired network where it is impractical or overly expensive to use cabling. In a typical wired-cum-wireless network, mobile hosts (MHs), such as laptop computers, peripherals and storage devices can roam in the wireless networks, called basic service sets (BSSs), which are attached at the periphery of a wired backbone (infrastructure). The wired infrastructure can be an IEEE 802 style Ethernet LAN or some other IP based networks.

The wired and wireless networks are inter-connected via Access Points (APs), which are actually fixed base stations that provide interfaces between the wired and wireless parts of the network and control each BSS. The MHs can roam from one BSS to another. A MH within a BSS can only access the infrastructure through its AP, and it is assumed that, in each BSS, all the MHs are within the broadcast region of that particular AP.

* This work was supported in part by NSF grant ECS-0330203.

