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CONTROL AND ADAPTATION OF TDMA IN WIRELESS NETWORKS

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Abstract. Time-division multiple-access (TDMA) is a widely used technique for simultaneous utilization of a single channel by multiple users. In its traditional form, TDMA suffers from a lack of power-efficiency, which is particularly damaging in wireless communications. This paper develops two controlled versions of TDMA, which lead to considerable power-efficiency improvements without a loss in average throughput for all users. The first one provides at least 11 dB improvement in comparison with traditional TDMA but lacks location-fairness. The second, which is an adaptive version of the first, provides at least 5 dB improvement along with excellent location-fairness.

Keywords. TDMA, wireless networks, Ranking TDMA, Adaptive Ranking TDMA, transmission scheduling.

1 Introduction

Time-division multiple-access (TDMA), whereby each user is assigned a particular time slot to transmit its information packet, is often used in wireline and wireless networks as a means to utilize a single channel by multiple users [2]. Although quite simple in implementation, TDMA suffers from two problems. First, it is throughput-deficient, since the user, assigned to a particular slot, may have no packet to transmit. Second, it is power-deficient, since the user, selected for transmission, may have bad (randomly fluctuating) channel conditions and, thus, would have to expend substantial power to attain the necessary signal-to-noise ratio (SNR). The latter is particularly damaging in wireless networks where users often have limited local power supply.

Throughput-efficient versions of TDMA, based on control-theoretic approach, have been introduced in [5, 7]. In the current paper, we develop two controlled versions of TDMA, which are power-efficient. The first one, referred to as *Ranking TDMA* (R-TDMA), selects for transmission the user with the best current channel conditions. We show that R-TDMA is extremely power-efficient, reducing power consumption by at least 11 dB in