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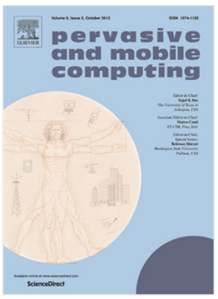

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Queue based Scheduling in Single and Multi Channel Dynamic Spectrum Access Networks

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Abstract

One of the ways to harness the radio bands that are not used by their primary owners, is to allow opportunistic use of the bands by secondary users (SUs) such that they do not interfere with the primary users. In a dynamic spectrum access (DSA) network, multiple SUs contend to acquire the bands that are available and proper scheduling techniques can resolve such contentions. However, all scheduling techniques have their own pros and cons. In this paper, we propose scheduling algorithms with different objectives for secondary users in a DSA network. Scheduling is performed at the beginning of each super-frame where appropriate channel(s) are assigned to the SUs based on the expected throughput for each channel on specific time slots. Throughput is computed considering: i) primary channel occupancy, ii) signal-to-interference-and-noise ratio, and iii) back-logged queue length of the SUs. We consider two DSA environments: single channel and multi-channel. We propose two scheduling algorithms– the first one focuses on maximizing the expected throughput and the second one focuses on fairness. We model the state of the channel for every user using a discrete-time Markov chain (DTMC) and compute their state transition probabilities. Multiple SUs are allocated the same channel on the same time slot as long as there is no interference between them. Such non-interfering sets of SUs are found by considering the expected throughput of each user on all candidate channels. In order to maximize spatial and temporal reuse of channels, the non-interfering sets are assigned as many channels as possible. Moreover, the channel is reused among the non-interfering sets in the same super-frame. Performances of the proposed scheduling schemes are validated using simulations where we measure metrics such as throughput, number of slots allocated, fairness, delay, and blocking probability. We also show the efficiency of the queue-aware scheduling by comparing with one that does not consider the SU queues.

Index Terms

Dynamic spectrum access, cognitive radio, SINR, scheduling, throughput, fairness.

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