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Dynamic Cooperative Secondary Access in Hierarchical Spectrum Sharing Networks

Abstract:

We address the challenge of energy efficiency in hierarchical spectrum sharing networks with dynamic traffic. We consider a primary and a cognitive secondary transmitterreceiver pair, where the secondary transmitter can utilize cooperative transmission to relay primary traffic while superimposing its own information. The secondary user meets a dilemma in this scenario. By choosing cooperation it can transmit a packet immediately, but it has to bear the additional cost of relaying. Otherwise, it can wait for the primary user to become idle, which increases the queuing delay secondary packets experience. To solve this dilemma, and trade off delay and energy consumption, we propose dynamic cooperative secondary access control that takes the state of the spectrum sharing network into account. We formulate the problem as a Markov Decision Process (MDP) and prove the existence of a stationary policy that is average cost optimal. We evaluate reinforcement learning to find optimal transmission strategy when the traffic and link statistics are not known. We demonstrate that dynamic cooperation is necessary for the secondary system to be able to adapt to changing network conditions, and show that optimal sequential decision can significantly improve the tradeoff of the energy consumption and the delay.