School of Electrical, Computer and Energy Engineering

PhD Final Oral Defense
Power Allocation and Scheduling of Real-Time Data for Cognitive Radios

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Abstract
In this dissertation, I propose potential techniques to improve the quality-of-service (QoS) of real-time applications in cognitive radio (CR) systems. Unlike best-effort applications, real-time applications, such as audio and video, have a QoS that need to be met. There are two different frameworks that are used to study the QoS in the literature, namely, the average-delay and the hard-deadline frameworks. In the former, the scheduling algorithm has to guarantee that the packet's average delay is below a prespecified threshold while the latter imposes a hard deadline on each packet in the system. In this dissertation, I present joint power allocation and scheduling algorithms for each framework and show their applications in CR systems which are known to have strict power limitations so as to protect the licensed users from interference.

A common aspect of the two frameworks is the packet service time. Thus, the effect of multiple channels on the service time is studied first. The problem is formulated as an optimal stopping rule problem where it is required to decide at which channel the SU should stop sensing and begin transmission. I provide a closed-form expression for this optimal stopping rule and the optimal transmission power of secondary user (SU).

The average-delay framework is then presented in a single CR channel system with a base station (BS) that schedules the SUs to minimize the average delay while protecting the primary users (PUs) from harmful interference. One of the contributions of the proposed algorithm is its suitability for heterogeneous-channels systems where users with statistically low channel quality suffer worse delay performances. The proposed algorithm guarantees the prespecified delay performance to each SU without violating the PU’s interference constraint.

Finally, in the hard-deadline framework, I propose three algorithms that maximize the system's throughput while guaranteeing the required percentage of packets to be transmitted by their deadlines. The proposed algorithms work in heterogeneous systems
where the BS is serving different types of users having real-time (RT) data and non-real-time (NRT) data. I show that two of the proposed algorithms have the low complexity where the power policies of both the RT and NRT users are in closed-form expressions and a low-complexity scheduler.