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Resource allocation in realistic wireless cognitive radios networks

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Abstract: Cognitive radio networks provide an effective solution for improving spectrum usage for wireless users . In particular, secondary users can now compete with each other to access idle, unused spectrum from licensed primary users in an opportunistic fashion. This is typically done by using cognitive radios to sense the presence of primary users and tuning to unused spectrum bands to boost efficiency . Expectedly, resource allocation is a very crucial concern in such settings, i.e., power and rate control, and various studies have looked at this problem area. However, the existing body of work has mostly considered the interactions between secondary users and has ignored the impact of primary user behaviors. Along these lines, this dissertation addresses this crucial concern and proposes a novel primary-secondary game-theoretic solution which rewards primary users for sharing their spectrum with secondary users. In particular, a key focus is on precisely modeling the performance of realistic channel models with fading. This is of key importance as simple additive white Gaussian noise channels are generally not very realistic and tend to yield overly optimistic results. Hence the proposed solution develops a realistic non-cooperative power control game to optimize transmit power in wireless cognitive radios networks running code division multiple access up-links. This model is then analyzed for fast and slow flat fading channels. Namely, the fading coefficients are modeled using Rayleigh and Rician distributions , and closed-form expressions are derived for the average utility functions. Furthermore, it is also shown that the strategy spaces of the users under realistic conditions must be modified to guarantee the existence of a unique Nash Equilibrium point. Finally, linear pricing is introduced into the average utility functions for both Rayleigh and Rician fast-flat fading channels, i.e., to further improve the proposed models and minimize transmission po