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Spectrum Bonding and Aggregation with Guard-Band Awareness in Cognitive Radio Networks

Abstract:

Spectrum access/sharing algorithms for dynamic spectrum access (DSA) networks are often designed without accounting for adjacent-channel interference. In practice, guard bands are needed to prevent such interference. Introducing guard bands naturally constrains the effective use of the spectrum. In this work, we investigate the problem of assigning channels/powers to opportunistic transmissions, while accounting for such a constraint. Specifically, we propose a novel guard-band-aware channel assignment scheme for DSA systems. Our scheme reduces the number of required guard channels for a given transmission by exploiting the benefit of utilizing adjacent channels and considering already reserved guard channels. We analytically formulate the channel access problem as a joint power control and channel assignment optimization problem, with the objective of minimizing the required spectrum resource for a given CR transmission. We show that the optimization problem is a binary linear program (BLP), which is, in general, NP-hard. Accordingly, we present a near-optimal solution based on sequential fixing, where the binary variables are determined iteratively by solving a sequence of linear programs. Based on the proposed channel assignment algorithm, we develop an operational MAC protocol that enables DSA users to dynamically utilize the spectrum. The proposed protocol realizes our channel assignment algorithm in a distributed manner while relying only on information provided by the two communicating users. Simulation results are provided, which verify the effectiveness of our protocol and demonstrate the significant gain achieved through guard-band-aware channel assignment.