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# *Modeling Heterogeneity of SUs in a Distributed Medium Access Control for Cognitive Radio Networks*

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The medium access control (MAC) of decentralized cognitive radio networks has been a topic of interest in the last years due to the lack of a central coordinator and the necessity of self-organizing procedures that effectively lead the nodes to act autonomously but efficiently.

This work addresses a scenario where multiple non-licensed cognitive radios communicate with an access point (or a base station) when licensed users do not use the spectrum. We consider a MAC protocol for the non-licensed users, which adopts channel reservation and considers that non-licensed users are randomly synchronized by the access point. Non-licensed users perform spectrum sensing in a synchronous way and the proposed MAC is opportunistically employed when the channel is sensed idle.

Adopting a traditional energy-based sensing, we characterize the performance of the considered protocol by capturing the influence of the sensing in the MAC's performance and assuming the same channel statistics for all non-licensed users (homogeneity). Based on that we present several results to evaluate the performance of the proposed scheme achieved in optimal conditions, which are compared to a cognitive "slotted-aloha"-like protocol.

In a second step we introduce a more realistic scenario, where the multiple non-licensed users can experience different spectrum occupancy's assessment in the same sensing period. This scenario, denominated as heterogeneous, accounts for practical scenarios when the spatial distribution of the primary users can be sensed differently by the multiple non-licensed users. We present the steps involved to model the behavior of the protocol, by proposing a formal model based on the synchronization of multiple Markov processes. A closed form for the throughput achieved by the non-licensed users is deduced, and its accuracy is evaluated through several results achieved by simulation. Finally, we present several results related with the impact of the heterogeneity in the protocols' throughput.

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