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Enhancing the Coexistence between LTE and Radar Systems in the Unlicensed Bands

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1. Extended Abstract

Despite the dense allocation of radio frequency (RF) spectrum to different services and systems and the ever-increasing need for more bandwidth, recent studies have shown that RF frequency bands are sparsely used [1]. That is the reason that the concept of spectrum sharing has gained lots of interest recently in order to help improving spectrum utilization. Spectrum sharing implies that two or more users (using different technologies) can share the spectrum and use it as needed and available without creating harmful interference to one another. On the other hand, the commercial success of Long-Term Evolution (LTE), along with its wide deployment, significantly contributed to the growth in data traffic. Because of the natural scarcity of the RF spectrum below 6 GHz, cellular network operators strove for new and innovative technologies to develop scalable solutions to keep pace with the steadily growing service demand. One promising solution is LTE-Unlicensed, which has been recently proposed to allow cellular network operators to use the unlicensed 5 GHz band to offload some of their data traffic to increase capacity [2]. The 5 GHz band is occupied by several radar systems, so there is an urgent need to develop effective spectrum sharing techniques that take into account maintaining the great performance of LTE technology without affecting the detection capability of the radar system. The current regulations mandate implementing the dynamic frequency selection (DFS) mechanism for operating in different 5 GHz sub-bands; DFS assumes that the LTE-Unlicensed transmitter either transmits with the maximum power or does not transmit, which leads to mandating a large protection distance between the radar and the LTE network.

In this paper, we develop a novel spectrum sharing technique based on chance-constrained stochastic optimization to allow the LTE-Unlicensed base station to share the spectrum efficiently with a radar system. The optimization problem is formulated to guarantee the minimum performance criteria for the radar operation, and at the same time allows the LTE-Unlicensed eNodeB to control its transmit power to maximize the performance for the serving LTE-Unlicensed device. The paper first analyzes the situation with a single LTE base station and a single radar system, then the analysis is extended for a single LTE base station in a multiple-cells scenario. In the two cases, a mathematical model is used to transform the stochastic optimization problem into a deterministic one, and an exhaustive search is used to solve the resulting optimization problem. Due to the power control mechanism resulting from the proposed algorithm, numerical results show a significant reduction in the protection distance required between the radar and the LTE-Unlicensed network for the two to coexist, as the proposed algorithm can allow the two systems to operate effectively with a protection distance of only 3.95% of the one imposed by the regulations.

2. References

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