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Coalitional Double Auction for Spatial Spectrum Allocation in Cognitive Radio Networks

Abstract:

Recently, many dynamic spectrum allocation schemes based on economics are proposed to improve spectrum utilization in cognitive radio networks (CRNs). However, existing mechanisms do not take into account the economic efficiency and the spatial reusability simultaneously, which leaves room to further enhance the spectrum efficiency. In this paper, we introduce the coalition double auction for efficient spectrum allocation in CRNs, where secondary users (SUs) are partitioned into several coalitions and the spectrum reusability can be executed within each coalition. The partition formation process is not only related to the interference condition between SUs, but also the expected economic goals. Therefore, we propose a fully-economic spatial spectrum allocation mechanism by incorporating the coalition formation approach with auction theory. With the proposed scheme, the primary operator acts as an auctioneer, who performs multiple virtual auctions to form a stable partition of SUs and conducts a final auction to decide the winning SUs. Moreover, we propose a possible operation rules for the primary operator to iteratively change the partition, and prove that the virtual auctions could converge in finite time. Comprehensive theoretical analysis and simulation results are presented to show that our scheme can satisfy the crucial economic robustness properties of double auction, and outperform existing mechanisms.