

Auction-based resource allocation in cognitive radio systems

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Cognitive radio has emerged as a promising technology to efficiently utilize the scarce radio resources by allowing the unlicensed users (i.e., secondary users) to opportunistically and dynamically access the spectrum owned by licensed users (i.e., primary users). By allowing the secondary users to access the licensed radio resources, the licensed users can gain monetary returns from the unlicensed users. In this context, models based on market- and microeconomic theory can be used to efficiently manage the radio resources to bring benefits to both the primary and secondary systems. Recently, auction theory, which provides rich economic tools and solutions, has been employed to model, analyze, and optimize the radio resource (e.g., subchannels, time slots, and transmit power) allocation and management in cognitive radio systems.

This article first provides an overview of the fundamentals of auction theory. Then it describes how the radio resource management problems in wireless networks can be modeled using auctions theory. Then the critical considerations and techniques of auction designs for cognitive radio systems are discussed, including the currency design for monetary transactions in auctions, the auction languages used in cognitive radio, and system-level descriptions. Also, the current literature adopting different auction mechanisms are surveyed. Finally, some possible future research issues are outlined, e.g., joint resource auction, payment and settlement security, and design of auction-based practical resource sharing methods and protocol framework.

In summary, this article provides a comprehensive survey on auction methods adopted for resource allocation in cognitive radio systems. Readers who are interested in recent developments and applications of auction theory as an economic approach to enable the emerging cognitive radio systems would find this article very useful. With the rapid proliferation of smart wireless devices and increasing demand for wireless data applications, dynamic spectrum access through cognitive radio will be a key technology for next generation wireless systems. In addition to technical considerations, economic considerations will also play a very important role in the design and implementation of cognitive radio technology. This article makes valuable contributions in this context.

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Author: Y. Zhang, D. Niyato, P. Wang, and E. Hossain

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