Chapter 5

AUCTIONS, BIDDING AND EXCHANGE DESIGN

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1. Introduction

Auctions have found widespread use in the last few years as a technique for supporting and automating negotiations on the Internet. For example, eBay now serves as a new selling channel for individuals, and small and big enterprises. Another use for auctions is for industrial procurement. In both these settings traditional auction mechanisms such as the English, Dutch, First (or Second) price Sealed-Bid auctions are now commonplace. These auctions types are useful for settings where there is a single unit of an item being bought/sold. However, since procurement problems are business-to-business they tend to be more complex and have led to the development and application of advanced auction types that allow for negotiations over multiple units of multiple items, and the configuration of the attributes of items. At the heart of auctions is the problem of decentralized resource allocation.

A general setting for decentralized allocation is one with multiple agents with utility functions for various resources. The allocation problem for the de-
cision maker, or intermediary, is to allocate these resources in an optimal way. A key difference from the classical optimization perspective is that the utility function of the agents is private information, and not explicitly known to the decision maker. In addition, standard methods in decentralized optimization fail because of the self-interest of participants. Therefore the design of decentralized allocation mechanisms must provide incentives for agents to reveal their true preferences in order to solve for the optimal allocation with respect to the true utility functions. Thus, the behavioral aspects of agents must be explicitly considered in the design. It is common in the economic mechanism design literature to assume rational, game-theoretic, agents. Another common assumption is that agents behave as myopic price-takers, that are rational in the current round of negotiation but not necessarily with respect to the final outcomes at the end of the negotiation.

In settings where the allocation problem itself is hard even if the decision maker knows the “true” utility function of each agent, the issues of incentive compatibility makes the design of an appropriate auction mechanism even more challenging.

The focus of this chapter is to provide an overview of the different auction mechanisms commonly encountered both in practice and in the literature. We will initially provide a framework for classifying auction mechanisms into different types. We will borrow a systems perspective (from the literature) to elucidate this framework.

1.1 A framework for auctions

We develop a framework for classifying auctions based on the requirements that need to be considered to set up an auction. We have identified these core components below:

**Resources** The first step is to identify the set of resources over which the negotiation is to be conducted. The resource could be a single item or multiple items, with a single or multiple units of each item. An additional consideration common in real settings is the type of the item, i.e. is this a standard commodity or multiattribute commodity. In the case of multiattribute items, the agents might need to specify the non-price attributes and some utility/scoring function to tradeoff across these attributes.

**Market Structure** An auction provides a mechanism for negotiation between buyers and sellers. In *forward auctions* a single seller is selling resources to multiple buyers. Alternately, in *reverse auctions*, a single buyer is sourcing resources from multiple suppliers, as is common in procurement. Auctions with multiple buyers and sellers are called *dou-