DFCA: A Flexible Refundable Auction for Limited Capacity Suppliers

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Abstract. This paper proposes a novel auction-based mechanisms named Decreasing Cancellation Fee Auction (DCFA) for task allocation in the environment where a service provider has finite capacities and consumers could withdraw their bids. We consider a new type of auction called the refundable auction, i.e. refund means that a consumer’s showing up is uncertain and he can get back partial of his payment if his cancellation or no-show occurs. This mechanism can boost seller revenue, satisfy incentive compatibility, individual rationality and still hold a high efficiency.

Keywords: Refundable auction, price matching, incentive compatibility, VCG mechanism, advance reservation.

1 Introduction

Due to the geographic distribution of resources that are often owned by different organizations with different usage policies and cost models, and varying loads and availability patterns, the task of resource management and scheduling in these environments is a complex undertaking. Distributed Computational Economy [3] has been recognized as an effective metaphor for the problem of such management. In particular, auction has been recognized as an effective method for the management of distributed resources [3,6], because it enables the regulation of supply and demand for resources, provides economic incentive for service providers, and motivates the service consumers to trade off among deadline, budget, and the required level of quality-of-service. Typical applications include task assignment, distributed scheduling, etc.

The distributed system has a highly dynamic environment [21] with servers coming on-line, going off-line, and with continuously varying demands from the clients. Therefore, the function of Advance Reservation has been strongly recommended into supporting the allocation and scheduling mechanisms, because the computing resources are usually not storable and the capacity available today cannot be put aside for future use [6]. It should be noted that the auction-based advance reservations are currently being added to some economic-based toolkits,
such as GridSim \cite{1} which has integrated First-Price Sealed-Bid, English, Dutch and Continuous Double auction protocols. However, there may exist many uncertainties of consumers’ requests (bids). The possibilities for breaks in actions include \cite{9}: an erroneous initial valuation or bid, unexpected events outside the winning bidder’s control, information obtained or events that occurred after the auction, etc. For instance, in Data Mining applications, users may cancel the visualization step when the result is not interesting enough or the mining procedure could not be fulfilled. Hence, an importance feature, as noted in GRAAP-WG\cite{1} the advance reservation protocol should allow consumers to cancel or alter their booked services.

In economics-based allocation methods, refund policies are used to control for the selection of potential customers who make reservations but differ with respect to their cancellation probabilities. Refund policy assumes that a consumer pays for the service during the reservation is made, but the consumer gets partial (or all and no) refund when his cancellation or no-show occurs. Refunds are widely observed in almost all privately-provided services and also to some degree in retail in industries. Most noticeably, refunds are heavily used by airline companies. Refundable bookings tend to attract consumers who are likely to cancel or not show up for the service, and deter consumers who are less likely to cancel and are therefore more price sensitive \cite{20}. However, the cancellation and refund issue in auctions has been discussed little in both economics and computer science literatures.

In this paper, we concentrate on the design of partially refundable auction mechanism of advance reservation systems in which consumers’ show-ups are uncertain and their personal information are unknown by the service providers. We demonstrate the nonexistence of any mechanism which satisfies seller’s profit-maximizing, individual rational and incentive compatibility simultaneously. We propose a flexible auction mechanism that can satisfy incentive compatibility, individual rationality, and still obtain a high efficiency. The remainder of this paper is organized as follows. In Section 2, we present the main related work in this area. In Section 3, the basic model of the refund auction is described. We point out that there does not exist any uniform pricing and cancellation fee allocation mechanism that could maximize seller’s profit and satisfy incentive compatible at the same time. In Section 4, we present Decreasing Cancellation Fee Auction mechanism. In Section 5, the experimental comparison of our mechanisms with an ideal optimal algorithm and other counterparts are evaluated. Finally, we conclude this paper and discuss future work in Section 6.

2 Related Work

Incentive mechanism design is an important issue not only in Economics but also recently in E-commerce and Distributed Artificial Intelligence, obviously