Incentive Compatibility on Multiple Internet Auctions based on Bidding Support Agents

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ABSTRACT

Agent-mediated electronic commerce has recently commanded much attention. We envision a future in which many people trade their goods by using a bidding support agent on Internet auctions. In this paper, we formalize a situation in which people are trading their goods on Internet auctions and employing bidding support agents. Then, we prove that in the above situation all participants need to submit true bids. This means that, as a whole, this situation can be viewed as an incentive compatible mechanism.

KEYWORDS

Software Agents, Bidding Support Agents, and Agent-mediated Electronic Commerce.

1 INTRODUCTION

Agent-mediated electronic commerce has recently commanded much attention. Software agents can act autonomously and cooperatively in a network environment on behalf of their users. There have been several agents proposed that can support users to attend, monitor, and make bids at multiple auctions simultaneously, e.g., *BiddingBot*[4] and Anthony's agent[1].

We envision a future in which many people trade their goods by using a bidding support agent on Internet auctions. In this paper, we formalize a situation in which goods are traded via Internet auctions and each user uses a bidding support agent in order to make reasonable contracts. Then, we prove that the above situation, as a whole, can be seen as an incentive compatible mechanism. In an incentive compatible mechanism, the best strategy for each agent is to submit a true bid, i.e., to tell the truth. This means that by employing bidding support agents, we can realize an incentive compatible mechanism.

An auction consists of an auctioneer and bidders. In an auction, the auctioneer wants to sell an item and get the highest possible payment for it, while each bidder wants to purchase the item at the lowest possible price. The certain value of the utility that a user receives from an item is called its value to him/her. The user's estimate of the item's value is called the user's valuation[5]. The English auction method has been adopted by many online auction sites. In the English auction, each bidder is free to revise their bid upwards. When no bidder wishes to revise their bid further, the highest bidder wins the item and pays the price that was bid[5].

In this paper, we focus on bidding support agents that can support users to monitor, attend, and make bids in **multiple** auction sites. Some auction sites offer users a simple proxy bid program. This proxy bid program resides on the auction site and bids on a user's behalf. Users enter the maximum price that they can pay into this program and it then automatically submits the lowest possible bid to the auction site. Such proxy bid programs cannot participate in multiple auction sites.

One of the most famous agents is ShopBot[2]. ShopBot helps users to find desired shops or goods from the Internet. The main function of ShopBot is to find a web site or a description of goods based on the user's preference. Greenwald[3] analyzed a future situation in which there were many ShopBots and consequently proposed PriceBot in order to enable sellers to price dynamically. However, ShopBot cannot make a bid in multiple auctions. ShopBot mainly retrieves information from shop sites. In contrast, we focus on bidding support agents that can make bids in multiple auctions. Furthermore, while Greenwald's[3] analysis is based on using a lot of information gathering agents, i.e., ShopBot, our analysis is based on using a lot of bidding support agents.

This paper consists of four sections. In Section 2, we formalize an electronic commerce model in which people trade their goods via multiple auction sites by using bidding support agents. In Section 3, we present incentive compatibility in terms of the situation described in Section 2. Finally, we make some concluding remarks.

2 AN E-COMMERCE MODEL BASED ON MULTIPLE AUCTIONS

In this section, we define several terms and notations.

- A set of buyers is represented by $B = \{b_1, \ldots, b_n\}$.
- Buyer b_i's reservation price is represented by P_{b_i}.
- Each buyer has a bidding support agent a_{b_i}.
- A bidding support agent a_{b_i} accurately finds the user's desired good and accurately submits a bid in the auction site whose price is the lowest among multiple auction sites. Further, a bidding support agent a_{b_i} does not make a bid higher than the user's reservation price.
- A set of auction sites is represented by $S = \{s_1, \ldots, s_m\}$.
- Each auction site employs English auction.
- We assume the starting time of all auction sites is the same time.
- We assume the increasing price for each auction site is a small number α.
- We assume that $|B| - |S| \geq 1$. Namely, the number of bidders is larger than the number of auction sites.

Figure 1 show four examples of multiple bidders in multiple auctions. Here, we assume three bidders, $B = \{b_1, b_2, b_3\}$, two auction sites, $S = \{s_1, s_2\}$, and $\alpha = 10$. Reservation prices are $P_{b_1} = 300$, $P_{b_2} = 200$, and $P_{b_3} = 100$. "Current price" means the bidder's current bid. "Current site" means the site in which the bidder has the highest bid. If a bidder does not have the highest bid in an auction site, "Current site" is "none". Example 1 shows an initial state. Example 2 shows an example of a state in a certain time. Example 3 shows an example where b_3 reached the reservation price. Example 4 shows an example of a final state in which b_3's bid was out-bid by b_1's bid price of 110. The main point of Example 4 is that both b_1 and b_2's final price is determined by b_3's final price.

3 INCENTIVE COMPATIBILITY AMONG BIDDERS

In this section, we demonstrate that for participants truth-telling is a dominant strategy in the situation described in Section 2.

Theorem 1 *Under the condition described in Section 2, the best strategy for each bidder is to submit a true value. Namely, a participant's dominant strategy is to tell truth. Thus, we can say the situation based on the condition described in Section 2 is* **incentive compatible**.

Bidder	b_1	b_2	b_3
Reservation price	300	200	100
Current price	0	0	0
Current site	none	none	none

Example 1

Bidder	b_1	b_2	b_3
Reservation price	300	200	100
Current price	40	50	50
Current site	none	s_1	s_2

Example 2

Bidder	b_1	b_2	b_3
Reservation price	300	200	100
Current price	90	110	100
Current site	none	s_1	s_2

Example 3

Bidder	b_1	b_2	b_3
Reservation price	300	200	100
Current price	110	110	100
Current site	s_2	s_1	none

Example 4

Figure 1: Examples of Multiple Bidders in Multiple Auctions

Proof 1 *(Outline) As we show in Figure 1 in Section 2, the awarding price is determined based on the price that is the highest among participants who failed to win a good. Concretely, in Figure 1 in Section 2, the price for* b_1 *and* b_2 *is determined based on the* b_3*'s price.* b_3 *failed to win a good. This is because all of the auction sites employ the English auction protocol. Namely, since winners' prices do not depend on their bids, the participants' dominant strategy is to submit true values. The details are almost the same as the proof for the Vickrey auction protocol[5].*

4 CONCLUSIONS

In this paper, we formalized a situation in which people are trading their goods on Internet auctions and employing bidding support agents. Then, we proved that in the above situation all participants need to submit true bids. This means that, as a whole, this situation can be seen as an incentive compatible mechanism.

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