Mobile Agent–Based Auction Services

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INTRODUCTION

Electronic Commerce, a Booming Industry

There is now a gradual shift of many of the traditional business models from the real world to the Internet platform; of these models, auction service is most successful. The existence and development of numerous auction Web sites, such as eBay and OnSale Inc., have demonstrated the survivability of electronic auctions in online transactions.

However, current Web-based systems suffer from shortcomings in the following aspects:

- **Fairness and Friendliness:** Due to the different conditions of Internet connections, users across different regions may suffer from the inadequacy of limited bandwidth, especially when participating bidders are distributed across the world. This global nature also makes online auctions difficult to adapt to the potential users across the world.
- **Security and Privacy:** Security concern is one of the important issues users consider when using electronic transactions. Many users also wish to be guaranteed of privacy when doing business.
- **Intelligence and Flexibility:** The vast majority of electronic auction customers are not Internet experts but ordinary people that do not know much about the technical details. Current Web-based auction systems require too much user intervention. It would be commercially profitable if intelligent assistance is provided.

Software Agents, a Paradigm for Mobile Computing

Mobile agents refer to self-contained and identifiable computer programs that can move within the network and act on behalf of the user (Pham & Karmouch, 1998). The mobile agent paradigm as reported in the literature has two general goals: reduction of network traffic and asynchronous interaction. The mobile agent paradigm proposes to treat the network as multiple agent-friendly environments and the agents as programmatic entities that move from location to location, performing tasks for users.

Research on agent-based e-commerce is still underway (Franklin & Reiter, 1996; Guan, Ngoo, & Zhu, 2002; Guan & Yang, 2004; Guan & Zhu, 2002; Maes, Guttman, & Moukas, 1999; Poh & Guan, 2000; Subramanian, 1998; Yi, Wang, Lam, Okamoto, & Hsu, 1998). Mobile agents have demonstrated tremendous potential in conducting transactional tasks in e-commerce. The architecture proposed here is based on mobile agents. The advantages of mobility, intelligence, and autonomy of the agents are taken, which are actually representatives of their respective owners to perform the auction process. By using this framework, we wish to get rid of the previously listed disadvantages in the current online auctions. Specifically, the features of the system will be as follows:

- **Fairness:** The deficiency of bandwidth and network traffic will be overcome by taking the advantages of the mobility of software agents.
- **Autonomy:** Based on the preferences of an owner, agents can be fully automated to participate in the auction with little or no intervention from the owner.
- **Security and Privacy:** Third-party involvement is introduced to enhance the security and privacy throughout the auction. Agents are protected from malicious attacks during transportation and bidding. Furthermore, with the assistance of the coordinator and the encryption mechanism, the real identity of each participating bidder is protected.
- **Flexibility:** The architecture proposed will serve as a unified framework for various auction types as long as the bidding strategies and competing rules are well defined.

Related Work

There has been much research in agent-based auction systems. The Michigan Internet AuctionBot (http://ecommerce.media.mt.edu) sees itself as an information service that collects the bids, determines the resulting price, and notifies the participating parties about the outcome. The Fishmarket Project (http://www.iiia.csic.es/Projects/fishmarket/) evaluates a very narrow field of electronic commerce. Its main focus lies in rebuilding a com-

merce structure that is found in real life on downward-bidding fish markets of Spain, and it supports Dutch auction style. CASBA (Guttman, Moukas, & Maes, 1998) offers flexibility and support for all common auctions types including auctioning of multiple units. It does not have sophisticated negotiation strategies and learning mechanism to improve agent performance on the market. It is not designed with mobile agent capability. The **KASBAH** project of the AmEC Initiative (http://ecommerce.media.mit.edu/) introduced agents that negotiate following three time-constrained rules. The system itself was designed to be one huge double auction system. It is not designed with mobile agents in mind.

## DESCRIPTION OF MOBILE AGENT–BASED AUCTION SYSTEMS

A complete auction service involves the following aspects: information shopping, auction process, payment, and shipping. In our architecture (Figure 1) however, we are only interested in the auction process and assume that auction-related information has been collected by the participants ahead of time.

Overview

In an English auction, the buyers gather together to bid for a certain product, according to the published rules and preferred strategies. In the proposed architecture, the following are typical:

- **Participants:** The auctioneer agent represents the seller of the products; the bidder agents represent potential buyers who wish to compete for the auction item; the coordinator agent is the coordinator of the auction, the receptionist agent collaborates with the coordinator and serves as the receptionist during the auction. The functions and particulars of each agent are listed in Table 1.

Figure 1. A typical auction scenario
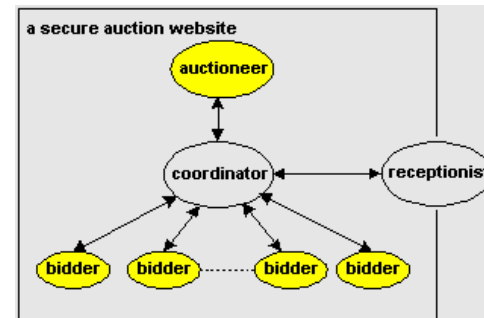
- **Place:** The auction Web host is a secure auction environment provided by a certified third party, widely trusted by the participants.

Admission

Admission is the preparation, namely the reception of agents and the build up of the auction relationship. The admission process will be further divided into two periods: SAFER transport and auction registration. SAFER (Guan & Yang, 1999; Yang & Guan, 2000; Zhu, Guan, Yang, & Ko, 2000), has been proposed as a framework for intelligent mobile agent mediated e-commerce. Our system adopts one of the three proposed transport protocols, the supervised agent transport protocol for the secure roaming of agents to prevent agents from malicious attacks during their transportation. The agent is built up with the bidding strategies customized by the owner and carries the owner's certificate for identification purpose and his or her public/private key for encryption and signing purpose. Figure 2 illustrates the supervised agent transport protocol.

After the agents have successfully roamed to the destination, all agents are welcome by the auction receptionist. The agents then communicate with the reception-

Table 1. Functions of the participating agents

Participating Agent	Owner	Function
Auctioneer	Seller	Decide the winner
Bidders	Customers	Bid
Coordinator	Third party	Coordinate auctions
Receptionist	Third party	Receive agents

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