BUILDING AN E-TENDERING SYSTEM IN A P2P SEMANTIC WEB

Timon C. Du, Department of Decision Sciences and Managerial Economics, The Chinese University of Hong Kong, Address: KKL, Shatin, Hong Kong, 852-26098569, timon@cuhk.edu.hk
Jacqueline Wong, Department of Decision Sciences and Managerial Economics, The Chinese University of Hong Kong, Hong Kong, KKL, Shatin, Hong Kong, 852-26098517, jacquelinewong@cuhk.edu.hk

ABSTRACT

This study proposes an e-tendering system that uses the Semantic Web to investigate the automatic negotiation process. The system is built in a P2P environment to simulate a two-player negotiation. It is found that the ontology of semantic information can be used to locate qualified suppliers and precede negotiation. The bargaining power of each party is then determined by the relative magnitude of the negotiators' respective costs of haggling and the utility that varies with the degree of risk preference.

Keywords: Semantic Web, negotiation, P2P, e-tendering

INTRODUCTION

In the past decade, the boom in Internet technology has built a platform for the accumulation and sharing of vast ranges of information among peoples, organizations, and enterprises. However, most of the information is written in HyperText Markup Language (HTML), which mainly follows a certain format for displaying the content. This information is normally written for human comprehension. As information volume has grown, the time that is needed to locate and digest the information has increased exponentially.

In this study we built an e-tendering system on a P2P Semantic Web and simulated the negotiation process of the e-tendering service: that is, a reverse auction. Note that the peer to peer (P2P) architecture offers a decentralized and distributed network to avoid co-ordination bottlenecks [1]. A pure P2P sharing network is basically an information directory in which explicit knowledge is maintained on local computers [2]. In the e-tendering system, the P2P environment is used to simulate a two-party negotiation. The e-tendering system allows the negotiation to be done in a one-to-one manner and the seller who gives the best offer is selected to win the tender. A utility function (representing the anticipated payoff for each party corresponding to their selected strategies) is used to determine the settlement. The bargaining power considering the relative magnitude of the negotiators' respective costs of haggling and risk preference is used to find the settlement. The utility function of negotiators and their bargaining power are modeled in the semantics of Web pages. A case study of the purchasing problems that arise when there is one buyer, 10 sellers, and multi-bargaining issues is used for this demonstration.

MODEL

This study applies P2P architecture in a semantic Web to the negotiation process for an e-tendering system, particularly in a two-party bargaining process, where two parties have a common interest in cooperating, but also have conflicting interests over exactly how to cooperate [3]. This study considers negotiation as a multiple-criteria decision-making (MCDM) problem, i.e. a multi-attribute decision making problem, where many criteria are taken into account as attributes for decision-making [4]. In the past decade, many studies have built negotiation systems. In general, they can be categorized into automated negotiation systems

(ANSs) and negotiation support systems (NSSs), where ANSs emphasize the building of automatic negotiation processes and NSSs provide more information and strategies to the negotiators. ANSs mainly use intelligent agents or mobile agents to travel between computers to simplify the negotiation process, using machine learning. Unlike ANSs, NSSs mainly suggest solutions or provide process support. However, current research into the building of negotiation systems focuses on either system development or machine intelligence, rather than on the negotiation process itself. Thus, our focus on the negotiation process is the major distinction of this study.

SYSTEM DEVELOPMENT

A system was developed to simulate the auto negotiation in an e-tendering system with P2P architecture using JXTA, developed by Sun Microsystems. Note that JXTA™ technology is a set of P2P open protocols that can connect various devices to a network ranging from cell phones and wireless PDAs to PC servers. JXTA peers create a virtual network where a node can interact with other peers or resources directly, even when they are behind a firewall or have different network transports.

In a P2P environment, each node on the network is known as a peer. They can communicate with each other through sending messages. In a traditional e-tendering system, there is usually a central server to receive and route queries and response messages (such as an RFQ, an acknowledgment, or a counter offer). However, in a B2B environment, it is reasonable to assume that the peers are behind firewalls and NATs (Network Address Translations). Therefore, some peers are needed to take care of jobs like routing and translating. These peers, known as relays, include rendezvous peers, router peers and gateway peers. For some large-scale Intranet systems, dedicated peers may be specialized to perform each kind of job.

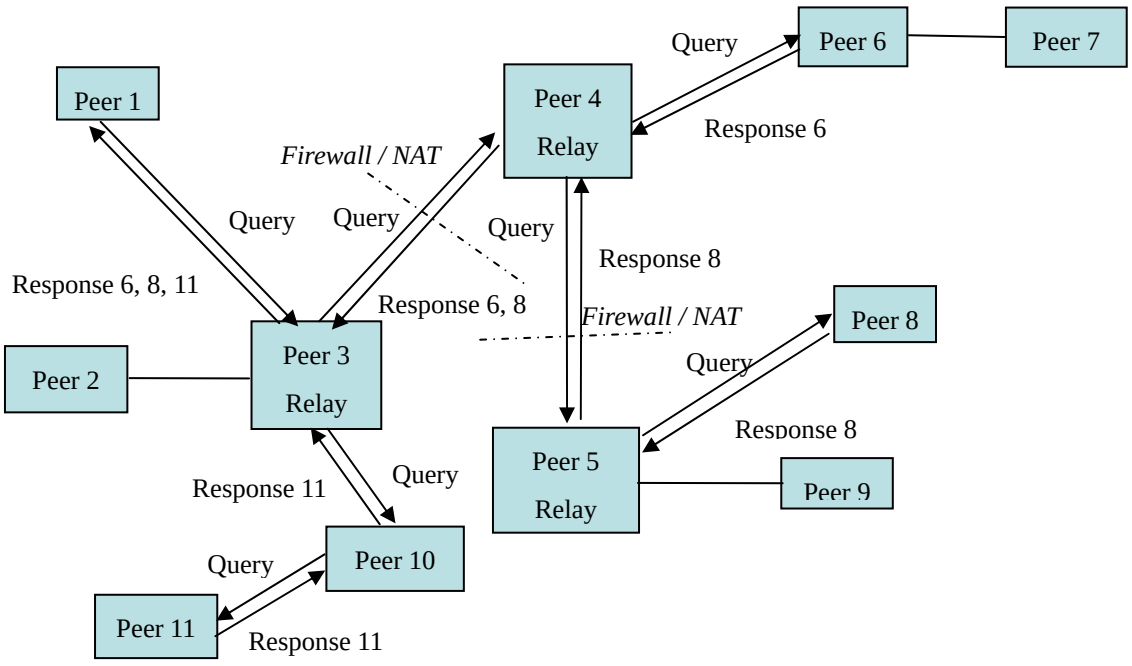

Figure. An Example of Locating Peers in P2P.

With the help of JXTA technology, the workflow becomes simple. For example, in Figure, Peer 1 searches suppliers for a product.

(1) Peer1 initiates a search request for suppliers.
(2) As the partners are outside the company, peer 1 will not search peers within the same intranet.
(3) As only relay peers can be searched by outside parties as defined by JXTA, a node searches its relay peer first. In this example, peer 1 hopes to communicate with peers beyond the firewall, so it sends the query to a relay peer, i.e. peer 3.
(4) Peer 3 has cached information about the other relay peers that it should associate with. In this example, it finds relay peers 4 and 10.
(5) Peers 4 and 10 search peers belonged to their local network and obtain responses from peer 6 and peer 11, respectively.
(6) A relay peer can forward the query to other relay peers from its cached information in case these relay peers have not yet participated. Here peer 4 forwards the query to peer 5 and gets a new reply from peer 8.
(7) All of the replies are sent back to peer 3 and eventually sent back to the initiator, peer 1.

CONCLUSION

In the new era of B2B e-commerce adoption, services such as auctions, data exchange, and negotiations have gained greater attention. However, Web content is currently designed for human consumption rather than computer manipulation. The consequence is that a user has to make a tremendous amount of effort to find needed information from millions of search results based on selected keywords. Fortunately, a new approach, the Semantic Web, structures the meaningful content of Web pages into semantic data. This provides the possibility of Web automation. This study explored the possibility of Web automation in an e-tendering system characterized by the different risk preferences of the negotiators. The architecture is built in a P2P environment to simulate a two-player game although each player can aggregate the needs of many buyers or sellers. In the P2P environment, the negotiation is conducted in a one to one manner and the best offer is selected as the tender. It is found that the ontology of semantic information can be used to locate suppliers who qualify for the negotiation to commence. The bargaining power of each party is then determined by the relative magnitude of the negotiators' respective costs of haggling and the utility varying with the degree of their risk preferences. In the future, the study could be expanded into one-to-many (auctions), many-to-one (reverse auctions), and many-to-many (exchange) negotiations.

REFERENCES

[1] I. King, C-H. Ng, and K-C. Sia. "Distributed Content-Based Visual Information Retrieval System on Peer-to-Peer Networks," *ACM Transactions on Information Systems*, vol. 22, no. 3, 2004, pp. 477-501.
[2] J.S.H.Kwok and S. Gao. "Knowledge sharing community in P2P network: a study of motivational perspective," *Journal of Knowledge Management*, vol. 8, no. 1, March 2004, pp. 94-102.
[3] A. Muthoo. *Bargaining Theory with Applications*, Cambridge University Press, Cambridge, UK, 1999.
[4] J. Zhu. "A Buyer-Seller Game Model for Selection and Negotiation of Purchasing Bids: Extensions and New Models," *European Journal of Operational Research*, vol. 154, no.1, 2004, pp. 150-156.