

## Chapter 6.5

# Contract Negotiation in E-Marketplaces: A Model Based on Dependency Relations

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### ABSTRACT

E-transactions via shopping agents constitute a promising opportunity in the e-markets. In this article we will discuss the problem of contract negotiation in e-marketplaces. We succinctly present an overview of protocols commonly used to implement negotiation in e-markets. An analysis of the interaction process within e-markets according to different situation of individual and joint profit/cost is presented. We also present a case study of a marketplace for e-services using dependency relations within the negotiation process. The experimental results of this negotiation model show that a combination of utility functions and dependency relations increase the number of contacts and reduce the differences between agents' individual profit. Finally, we conclude the article with the introduction of some potential research problems related to e-markets, which will be explored within future extensions of this work.

### INTRODUCTION

The advancement in distributed and intelligent computing has facilitated the use of software agents for implementing e-services. Most electronic market places offer to their customer's virtual agents that can do their bidding (i.e., eBay, onSale). E-transactions via shopping agents constitute a promising opportunity in the e-markets (Jennings, Faratin, Lomuscio, Parsons, Wooldridge, & Sierra, 2001; Chen, Vahidov, & Kersten, 2004). In fact, the software agents can be used in different stages of the e-business process: (i) attracting the customer, (ii) knowing how they buy, (iii) making transactions, (iv) perfecting orders, (v) giving effective customer service, (vi) offering customers recourse for problems such as breakage or returns, and (vii) providing a rapid conclusion such as electronic payment. In the distributed e-market paradigm, these functions are abstracted via agents representing both contractual parts. It becomes then critical to study and determine what kind of information and what

kinds of bargain policies need to be used both by agents and by the market place. Many researchers in intelligent agents' domain have focused on the design of market architectures for electronic commerce (Fikes, Engelmores, Farquhar, & Pratt, 1995; Zwass, 1999; Schoop & Quix, 2001; Guan, 2002; Koning, 2002; Chiu, Cheung, & Till, 2003; Lamparter, Ankolekar, Studer, & Oberle, 2006; Ng, Chiu, & Hung, 2007), and on protocols governing the interaction of rational agents engaged in such transactions (Hogg & Jennings, 1997; Cheung, 2003; Kersten, 2005; Chiu, Cheung, Hung, Chiu, & Chung, 2005; Cheng, Hung, & Chiu, 2007; Neumann, Schnizler, Weber, & Weinhardt, 2007). New Web technologies such as ontologies and semantic Web are also becoming increasingly important components of e-marketplaces. In fact, ontologies provide machine-understandable semantics of data, which facilitate negotiation and automatic configuration of products and services. Many recent negotiation frameworks (Chiu, Poon, Lam, Tse, Sui, & Poon, 2005; Chiu, Cheung, Hung, & Leung, 2005; Chiu et al., 2005; Lee, Chiu, & Hung, 2006; Cheng et al., 2007) use ontology to facilitate matchmaking, recommendation, and negotiation.

While providing support for direct agent interaction, most of existing architectures for multi-agents virtual markets usually lack explicit facilities for handling negotiation protocols, since they do not provide such protocols as an integrated part of the framework.

In this article we will discuss the problem of contract negotiation in e-marketplaces. In the next section, we will present related models commonly used to implement negotiation in e-markets, game theory models, auction models, and contract-net protocols. The third section continues with interaction analysis by presenting the e-market bargaining process and identifying relevant types of dependency relationships between agents. It evaluates goal satisfaction under weak or strong dependency as well as the associated costs. The fourth section presents a case study of a marketplace for e-services where agents collaborate for

the elaboration and provisioning of integrated services. We define the bargaining process that uses a negotiation protocol based on dependencies and a negotiation strategy based on risk evaluation. The fifth section presents some experimental analysis of the negotiation model implemented. The conclusion presented in the sixth section summarizes the article and paves the way for further research concerning the truth in the negotiation strategy and the use of temporal aspects on commitments and executions of contracts.

## **CONTRACT NEGOTIATION PROTOCOLS FOR E-MARKET PLACES**

The interaction between agents inside the marketplace is managed by a negotiation protocol. In fact, the negotiation protocol defines a set of public rules that allow agents to set up transaction contracts or co-operation agreements. Previous work and significant achievements are reported on various related fields of research and concrete solutions. Most of the Internet based market-places use auction protocols, especially the English auction.

Hereafter, we present and evaluate some negotiation models developed either in some research works or implemented in some practical systems: game theory, auction models, contract-net protocols, and ontology-based negotiation.

### **Game Theory Models**

Game theory models address many aspects of the agents' interaction: contract elaboration, profit repartition, and conflict resolution (Roth, 2000). Many negotiation models have been proposed in this topic (Rosenschein, & Genesereth, 1985; Genesereth, & Ginsberg, 1986; Zlotkin & Rosenschein, 1991; Ephrati & Rosenschein, 1992; Khedro & Genesereth, 1994; Kraus, Wilkenfeld, & Zlotkin, 1995). These models have some desirable properties, such as insuring the negotiation convergence, the Nash-equilibrium, and the

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