Auction-Based Pricing Model for Web Service Providers

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ABSTRACT

Applying auctions to Web services selection and invocation calls for examination due to the unique features of Web services, such as interoperable machine-to-machine interactions and re-enterable bargaining services. In this paper, we propose a formal model for Web services-based auctions. Examining a one-sided sealed auction type, we prove mathematically that service requestors’ risk preferences could lead to different pricing strategies for service providers towards higher profit. We argue that Service Level Agreement (SLA) documents can be used to analyze service requestors’ preferences. On top of WS-Agreement, we propose a basic service requestor risk preference elicitation algorithm, as well as a historical data-based service requestor risk preference prediction model. Guidelines are provided to iteratively approach the learning rate of the proposed risk preference prediction model. The methods and techniques presented in this paper can be reused to investigate and examine more facades of services-oriented auctions towards establishing a new research realm on comprehensive services-oriented auctions.

Keywords: services-oriented auction; service level agreement; Web services

INTRODUCTION

The paradigm of Web services has opened a new era for business service providers. This new model not only allows easier management and maintenance for provider-hosting services, but also creates a lot more potential business opportunities for service providers. Gartner Group, a leading industry analyst firm, predicted that by 2008 more than 60% of businesses would adopt Web services and transform into new types of enterprises (Gartner, 2003).

As for traditional server providers, how to establish appropriate pricing models to pursue the highest profits is an essential concern for Web service providers. To date, there are two major pricing models in the field of Web services that are derived from traditional business: periodic pricing and fluctuant pricing. Periodic pricing...
means that a service provider predefined a fixed price for a period of time, when every service requestor is subject to the same price value. In recent years, to attract more customers, many service providers offer a variant of the periodic pricing model, called the staging price model. As shown in Figure 1, Comcast, a cable company, offers a $0 first-month trial benefit for new customers, and a fixed $40/month service fee afterwards. Fluctuant pricing means that the price of a service is ever-changing, based on marketing situations. Stock pricing is a typical example of the fluctuant pricing model. The price of a stock symbol constantly changes depending on the number of transactions at the moment. Figure 1 shows the stock price curve of Yahoo (Nasdaq: YHOO) from Nov. 15, 2005 to February 15, 2006 according to published data from E*TRADE financial (Etrade, 2006).

As shown in Figure 1, the fluctuant pricing model automatically adjusts the service price subject to market demand, activity capacity and changing environment. It obviously promises higher flexibility and larger optimization space for service providers. However, to date, most service providers merely adopt traditional fluctuant pricing models without adaptation. There rarely is research focusing on justification and verification of traditional pricing models in the context of the Web services paradigm. We argue that because of the unique features of Web services, such as dynamic service discovery and invocation and heterogeneous interactions, traditional pricing models deserve re-examination.

Auction, as one of the fundamental business operation approaches, can be used as one fluctuant pricing model. However, both traditional physical auctions and recently emerged electronic auctions (e-auctions) are basically conducted by human beings, although computer technology is adopted in e-auctions to facilitate auction processes. Conducting auctions in the context of Web services pose significant challenges, because the unique features of Web services implies machine-to-machine interactions; re-enterable bargaining services; ideally, more independent bidding; and so forth.

To our best knowledge, to date there is no published research formally modeling Web services-oriented auctions. Some reported works adopted the basic format of auction as a negotiation method between Web service providers and requestors (Esmaeilsabzali, 2005). Some other researchers adopted the Web services technology to implement e-auctions, such as eBay (eBay, n.d.) In contrast with their work, our research aims at establishing a fundamental model for adopting an auction mechanism to facilitate Web services negotiation and interactions.

The ultimate goals of our research are to examine the feasibility of applying traditional auction theories to the field of Web services, and establish corresponding Web services-specific auction models. In detail, we first examine the specific features of Web services towards applying auctions. Then, we establish a Web services-oriented auction model. We focus on investigating and mathematically proving how service providers can decide different service auction strategies to obtain higher profit. Furthermore, we propose to utilize the technique of SLA documents as resources to deduce service requestors’ preferences.

The remainder of the paper is organized as follows: After preparing readers for the basic concepts of traditional auctions, we motivate our research. Then we construct a formal model of a Web services-based, one-sided sealed auction, and mathematically prove that different auction strategies bring different profits to service providers. We propose our technique of eliciting service requestors’ risk preferences from SLA documents. Basic risk preferences eliciting algorithms and a historical data-based risk preferences prediction model are presented. We then discuss the implementation details of a prototype as an intelligent engine that helps service providers select an optimal auction strategy. Afterwards, we discuss related work. Finally, we make conclusions.

**BASIC AUCTION CONCEPTS**

In this section, we briefly introduce the basic auction concepts. McAfee formally