Marketplace Architecture for Enterprise Integration

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INTRODUCTION

Businesses today must be fast and flexible, responsive to customers, and cost effective in their operations. They must collaborate more frequently with partners to build virtual organizations and supply-chains that reduce times-to-market and costs. *E-business* is the use of the Internet along with other electronic means and technologies to conduct within-business, business-to-consumer, business-to-business, and business-to-government interactions. A basic model of an e-business is the *e-shop* model, which is based on providing a self-service storefront to a customer by displaying the company catalogs and product offers on a Web site. An *e-procurement* model focuses on the buying aspect of the business. A typical architecture for *e-procurement* consists of a browser-based self-service front-end to the corporate purchasing system or its ERP. The supplier catalogs are presented to end-users through a single unified catalog, thereby facilitating a corporate-wide standard procurement process. Online auction models have also received much attention for automating dynamic trading. Other models are based on creating value-chain businesses, such as service provisioning of specific functions for the value-chain, and electronic payments or logistics.

Although each of the above models attempts to provide an e-business solution, none of them addresses the challenge of how to create and leverage services and supply operations in a way that seamlessly integrates business entities (customers, suppliers, partners, and competitors) in a dynamic trading community. A very important and promising model is the *e-marketplace*. It supports value-chain integration and provisioning in its structure and services. The objective is to develop an e-business solution that relieves business entities of much of the burden of participating effectively in the e-business domain. This model combines the advantages of the sell-side, the buy-side, and the value-chain models.

BACKGROUND AND LITERATURE REVIEW

There have been several recent attempts to promote e-marketplace models by the academic and industrial communities. For example, the Electronic Market-Place (Boll, Gruner, Haaf & Klas, 1999) is an attempt to develop a business-to-business system architecture. It is viewed as a DBMS solution to support many-to-many relationships between customers and suppliers. The Global Electronic Market system (Rachlevsky-Reich, Ben-Shaul, et al., 1999) attempted to develop a logical market framework and infrastructure. In this system, the market provides trading mechanisms that include bids and offers. A more complex architecture for an e-marketplace is MAGMA (Tsvetovatyy, Gini, Mobasher & Wieckowski, 1997), with its special focus on the infrastructure required for conducting commerce on the Internet. OFFER (Bichler, Beam & Segev, 1998) proposed a brokering-based architecture marketplace. A customer can search for a service either directly in the e-catalog of the supplier or use the e-broker to search all the e-catalogs of the suppliers that are registered with this broker. E-brokers employ a simple auction mechanism. MOPPET (Arpinar, Dogac & Tatbul, 2000) proposed an e-marketplace system as agent-oriented workflows. MOPPET viewed the market as a workflow management system carried out by several types of agents: task, scheduling, facilitator, and recovery agents.

Another approach was driven by the bottom-up modeling of market processes with self-organizing capabilities (Arthur, Holland, LeBaron, Palmer & Tayler, 1997). The objective was to develop a computational study of economies modeled as evolving systems of autonomous interacting agents, and known as agent-based computational economics (ACE) (LeBaron, 2000; Timmers, 1999). The ACE researchers relied on computational laboratories (McFadzean, Stewart & Tesfatsion, 2001) to study the evolution of decentralized market economies under controlled experimental conditions.

Several companies have emerged to automate logistics and re-supply within specific industrial segments. For example, Ariba (2000) developed a marketplace based on procurement portals and dynamic exchanges for horizontal marketplaces. The SAP Service Marketplace (SAP AG) is an Internet portal for the SAP community. It provides basic online services, such as catalog browsing, matchmaking, and ordering from SAP and its partners. Other approaches were directed to support vertical marketplaces, such as PaperExchange (PaperExchange Marketplace), which enable customers and suppliers to negotiate pricing and transact directly with one another. VerticalNet (VerticalNet® Marketplaces) also built a set of Web-based marketplaces for specific industrial segments, such as financial services, healthcare, and energy. Each Web site forms a community of vendors and customers in a specific area.

Another direction adopted by major software vendors is to develop Internet-based commerce platforms. Examples are IBM CommercePOINT (IBM Corporation CommercePOINT Payment), Microsoft Site Server Commerce Edition (Microsoft Corporation. Internet Commerce, 1998), Oracle Internet Commerce Server INTERSHOP (Intershop Communications, Inc., 1998), and Sun JavaSoft JECF (Java Electronic Commerce Framework, Sun Microsystems). These proprietary attempts focus on providing infrastructure services, such as security payment directories and catalogs, to be integrated with existing systems and the Web.

In our research work, we view e-marketplace as a cooperative distributed system that integrates participating business entities, including consumers, suppliers, and other intermediaries. This architecture enables and facilitates common economic services and commerce transactions between the buyers and sellers, such as brokering, pricing, and negotiation, as well as cross-enterprise integration and cooperation in an electronic supply-chain. In this architecture, the e-marketplace exists as a collection of economically motivated software agents.

DESIGN ISSUES AND TRENDS

As e-business grows and becomes viable in the real world, its corresponding e-marketplaces must expand to support a broader base of services ranging from baseline interaction and directory services to specialty services, such as dynamic trading, cooperative supply-chain integration, and management. In this new e-marketplace environment, there are significant interactions among the systems deployed by the participating business units of an enterprise, their customers, and other businesses. Therefore, designing e-marketplaces requires embodying greater levels of business knowledge within the e-marketplace transactions, activities, and service definitions. Additionally, it requires a greater degree of communication, coordination, and cooperation within and among the business entities and their systems in the e-marketplace. In other words, the e-marketplace architecture represents an integrated body of people, systems, information, processes, services, and products.

Enterprise Model and Ontologies

At the heart of the integration architecture for an e-marketplace is a model of the enterprise. It is an abstract representation of the structure, activities, processes, information, resources, people, behavior, goals, rules, and constraints of the e-marketplace. From an operational perspective, the enterprise model captures what is planned, what might happen, and what has happened. Therefore, it supplies the information and knowledge necessary to support the operations of an e-marketplace. An appropriate e-marketplace architecture should support enterprise-modeling ontologies. An ontology is a vocabulary along with some specification of the meaning or semantics of the terminology within the vocabulary. The objective is to provide a shared and common understanding of a domain that can be communicated to people, application systems, and businesses. In an e-marketplace model, ontologies are integrated or related to support reasoning among the elements of the model.

Market Structure and Economy Model

An important aspect of the e-marketplace is the economic model of its structure. A market structure governs the trading process and defines the formal rules for market access, traders' interactions, price determination, and trade generations. In classical economic theory there are several market models for specific trading situations and structural behaviors. In the commodity market model, various suppliers and consumers participate to trade goods/services (commodity) of the same type. The market price is publicly agreed upon for each commodity independent of a particular supplier. All consumers and suppliers decide whether and how much to buy or sell at each agreed-upon price. The challenge in this market structure is to deploy a pricing methodology that produces price adjustments that bring about market equilibrium (i.e., equalizes supply and demand). In an auction-based market, each participant (both consumers and suppliers) acts independently and contracts to buy or sell at a price agreed upon privately. An auction-based e-marketplace is a form of centralized facility, or clearinghouse, by which costumers and suppliers execute trades in an open and