MATE – MOBILE AGENT TECHNOLOGY FOR ECOMMERCE

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ABSTRACT

The present short paper discusses the application of mobile agent technology in the e-commerce domain. It describes the architecture of MATE (Mobile Agent Technology for Ecommerce), which aims on delivering a solution for current and emerging B2B and B2C e-commerce requirements and outlines its implementation.

KEYWORDS

E-commerce, Mobile Agents, B2C, B2B

1. INTRODUCTION

E-commerce can be viewed as a set of processes that support commercial activities within an information network. These activities produce information about products, events, services, suppliers, consumers, publicists, transactions, advanced search algorithms, transactional security, authentication, etc. In brief, e-commerce entails the development of a business vision, supported by information technology with the goal of enhancing efficiency within the process of trade [Adam99].

From the appearance of EDI in the early seventies to today's internet boom, e-commerce has had a significant boost in its development, where technology has served as a fundamental role in its process. The problem now is how to handle the growth of offer that can be found on the Internet, specially regarding non-tangible goods. With the implementation of automatic facilities to deliver non-tangible goods immediately to the end-user [Chaves03], the important task now is to construct an efficient brokerage system that helps the customer find the best possible offer for his needs. Mobile agents play an important role in this process, as they represent the user in his interaction with the ever-growing marketplace.

The popularity of software agents, on the execution of tasks related to information filtering, mapping of people with similar interests and automation of repetitive behaviors is well known [Maes99]. It is thus,

without surprise that agent based technology is seen as the one that will revolutionize e-commerce in the way it is seen today, promising a new and innovative approach in the way transactions are processed, may these be business-business, business-consumer or even consumer-consumer.

Using mobile agents represents an important leap in the development of first generation (static) agent systems. The possibility of working offline, thus saving network resources, is one of the main advantages. There is no need to keep a connection active while a transaction is processed. Other advantages are [Lange99]:

- They overcome network latency
- They encapsulate protocols
- They execute asynchronously and autonomously
- They adapt dynamically and react autonomously to changes
- They are naturally heterogeneous, providing optimal conditions for seamless system integration
- They are robust and fault tolerant

A buying agent may migrate to merchant servers and execute locally functions for search, filter, negotiation and payment. In this context, the involved entities are:

- A buying agent for each merchant
- A buying agent for each client
- Objects that contain information that represents products
- Monetary values and currency

Fig. 1 illustrates how a commercial transaction can be executed using mobile agents. In this case, the buying agent migrates to the merchant's site where all requests and replies needed to complete a transaction will be processed. All of the required processing is performed on the merchant's site. Finally, the buying agent returns to the client's site where it will present the results.
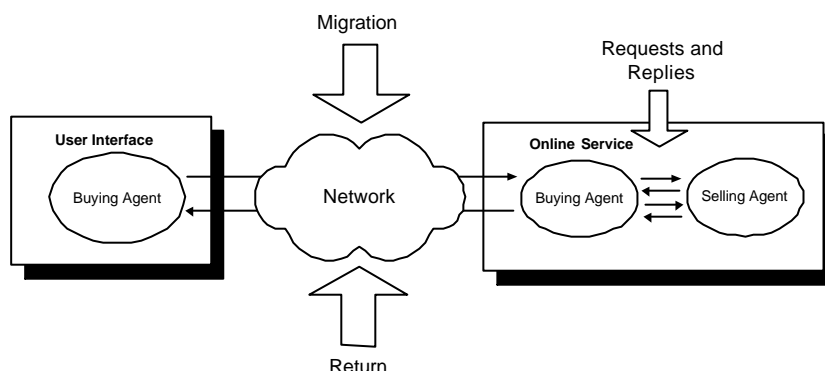

Figure 1. Transactions involving mobile agents

2. MATE ARCHITECTURE

MATE is not intended to replace actual e-commerce systems, but to expand them with mobile agent support. In fact, this platform is aimed to be part of the generic e-commerce platform proposed in [Chaves02] and [Chaves03]. The architecture is illustrated in Fig. 2:
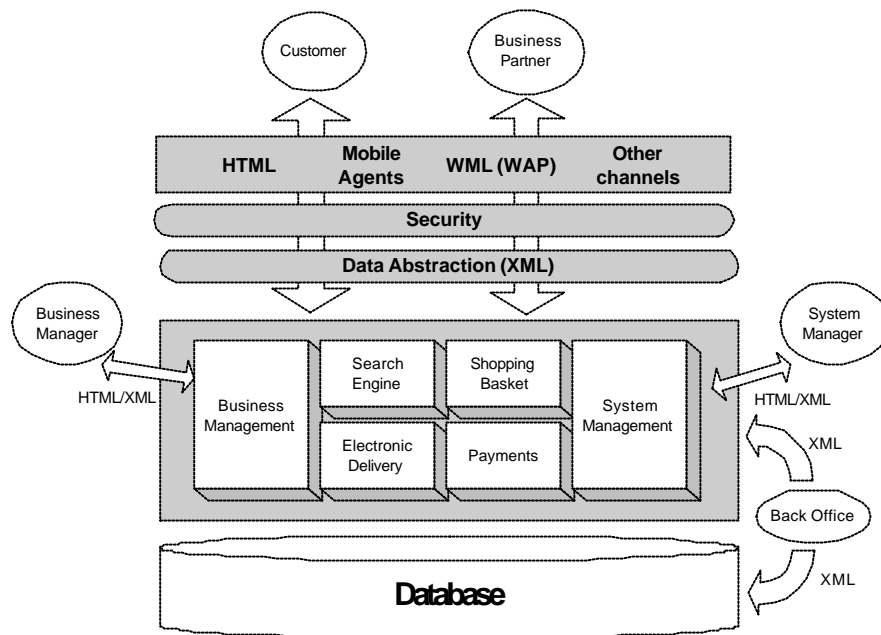
Figure 2. Components of the proposed e-commerce System

External entities (customers, business partners, managers) interact with the system through specific communication channels (HTML, WML, mobile agents, etc.) to access the main modules that build up the core of the platform (search engine, shopping basket, payments, etc.). A specific security layer takes care of all aspects regarding to authentication, privacy, integrity and non-repudiation. Although the system supports several communication channels, the internal applications interface with external modules and entities using XML, which is becoming a standard in e-commerce applications. All information is stored in a database (data layer), which is accessed by the *backoffice*, via structured XML documents (i.e. queries and replies).

Since integration is performed via specific interfaces, the systems become multidimensional and open to several communication channels, be them standard http or mobile agents. This is the main advantage of following a modular approach to systems development. Modules can be developed and integrated independently.

From a conceptual point of view, MATE can be divided into several domains, which are closely related to the entities that take part in current "real world" transactions:

Buyer Domain – It is associated with the potential buyer involved in a transaction. This is where the *Buying Agents* (BA) are generated and parameterised in order to search and eventually purchase products.

Mediation Domain – It contains all information about suppliers and respective areas of business. The agents that are generated in this domain are called *Mediating Agents* (MA) and have the main goal to interact with the BA so that these can fulfil their objectives. This type of cooperation between agents is quite similar to current mediation services.

Seller Domain – It contains information regarding to the catalogue of products of a seller that wants to take part in the marketplace. The corresponding agents are called *Seller Agents* (SA) and they have the function of "talking" to the MA to promote their products and "talking" to the BA to supply the results for product brokerage. Eventually they will also complete commercial transactions with the BA.

Payment Domain – Normally, in commercial transactions, payments are carried out by external entities that provide this service to merchant and customer. This is the case of, for example, credit card payments and wire transfers. The proposed system offers the flexibility of performing payments via an external entity or this can be carried out directly at the seller domain. Associated to the payment domain are the *Payment Agents* (PA) that will perform in accordance to the parameters of a particular negotiation.

Fig. 3 illustrates the functional model of the MATE architecture, with its domains, associated agents and interactions between them.
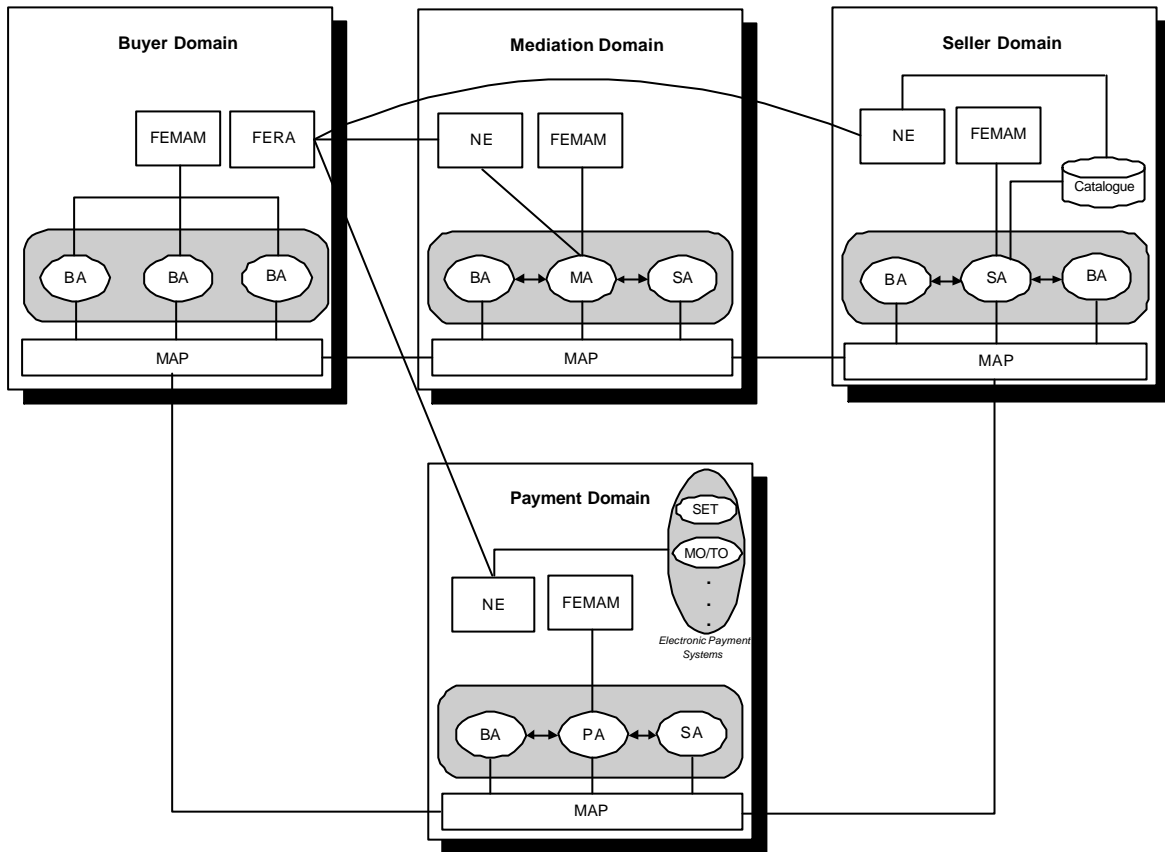
Figure 3. Transactions involving mobile agents

Table 1. Components of MATE

MAP	Mobile Agent Platform
BA	Buying Agent
MA	Mediating Agent
SA	Selling Agent
PA	Payment Agent
FEMAM	Front-End for Mobile Agent Management
FERA	Front-End for Remote Access
NE	Navigation engine
SET	Secure Electronic Transactions
MO/TO	Mail Order / Telephone Order

Agents will cross several seller domains searching for the best options, based on multi-criteria evaluation of characteristics that are based not only on price. In fact there are other important characteristics that value a product, such as size, color, availability, delivery time, etc. The weight of each criterion is a configurable parameter of the system.

A successful implementation of MATE is directly dependent on its ability to integrate with the e-commerce platform. Implementing MATE in a JAVA environment (to permit code and data mobility) enables the testing of the mobile agent functionality and the migration procedures. After integrating this system with the e-commerce platform it will then be possible to use real users and data. By respecting the XML definitions provided by the data abstraction layer, this task is possible, which means that all information transported by the mobile agents is coded in XML. Agents will also pass through the security

layer, which means that they should comply with the security requirements of the e-commerce platform, which has been tailored to support mobile agent interaction. In order to ensure the safety of both the agents and the domains, a security policy is applied. The policy contains rules for restricting or granting access to data and services, controlling the consumption of resources and restricting and granting agent capabilities. The agent system should also be able to evaluate the amount of trust in an agent, depending on the sender of the agent, successful authentication and integrity checks.

3. CONCLUSIONS AND FUTURE WORK

MATE will be integrated within the current e-commerce platform and tested with concrete use case scenarios. The main goal is to offer a complete transaction system that covers the needs of modern users. Selection of catalogues and real users representing sellers and buyers is very important to also measure the overall success of the system. Results will be important to fine-tune all parameters (i.e. criteria weights for product evaluation, agent decision and negotiation capabilities, XML messages, encryption keys, etc.) and also to predict how users will accept this new form of conducting electronic transactions. The visual interface of the mobile agent client program, that runs on the customer's side, should be easy to understand and intuitive, so that the management of each user's mobile agent(s) is straightforward. With the development of mobile communications, specially with the arrival of next-generation mobile systems, the client programs for mobile agents will run on the customer's mobile terminal, which will then be one of the main instruments for conducting commercial transactions, regardless of time or location.

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