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AGENT-MEDIATORS IN MEDIA-ON-DEMAND ELETRONIC COMMERCE

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Abstract

This paper explores the requirements and issues related to media-on-demand electronic commerce using agents as mediators in the customer-to-business and business-to-business relations and propose an architecture for multi-agent systems acting on a wide range of situations. Agent technology is suitable since media-on-demand is a personalised service by nature. The agents' roles are examined in the context of a Consumer Buying Behaviour (CBB) model.

1. Introduction

A Media on Demand system (MoD) is a distributed multimedia application that allows a user, through a remote device (e.g. a television and a set-top box), to access a media catalogue composed of multimedia presentations stored in several servers distributed in a network. Examples of MoD systems are video- and music-on-demand systems, interactive-radios and web sites or web-based multimedia systems. There are new media-delivery services being created on the World-Wide-Web everyday.

The sort of product (or service) provided by media-delivery systems has a very subjective value to its users. Distinct users have their own perception of quality. For that, this class of systems is considered personalised and the individual characteristics of the customers are very important in the process.

Since the customer might have total freedom in choosing which "media program" he/she will watch and also in which interaction level (in video-on-demand for instance: broadcast, NVod, QVod, TVod [13]), this class of systems has an enormous potential of marketing application. Some prototypes have been developed, particularly in the areas of education and entertainment. Several researches have accomplishments in the area; however, most approaches are related to aspects of communication, storage and location of the multimedia information, that is, the focus is the technological point of view, willing to obtain great performance of storage means and communication channels. Otherwise, very few projects have addressed points regarding the abstract modelling of this class of systems [15] and its economic and social opportunities. Those studies became extremely desirable, especially when one wants to build MoD applications of larger complexity and maintain long-term relationship with customers.

Media-on-demand systems, like other information systems (such as on-line bookstores and supermarkets) need to implement efficient forms of presentation to show alternative options to its customer, due to its great amount of information and also great complexity trading scenarios. The majority of the present MoD applications provide interfaces that are similar to static mail-order catalogues. Software agents can be used to automate a variety of tasks, including buying and selling products, such as movies, books, CDs and other forms of entertainment [1]. In this scenario, agents might play important roles in filtering and retrieval, personalised evaluation and decision making. Agent technology is applied where the continuously running, semiautonomous and personalised nature of agents can be explored [2].

We explore the requirements and issues related to MoD electronic commerce using agents as mediators in the customer-to-business and business-to-business relations and propose an architecture for multi-agent systems acting on a wide range of situations in the MoD scenario. The agents' roles are examined in the context of a Consumer Buying Behaviour (CBB) model presented in [3].

Both the environments of e-commerce and MoD applications are information-rich and process-rich, making agent technology more suitable to meet both the user and provider expectations.

The next sections are organised as follows: Section 2 present the agent-augmented media-on-demand architecture and explore the agent-roles based on the CBB model. Section 3 explores issues on privacy and trust in the agent system. Finally, Section 4 presents conclusions and perspectives.

2. The Multi-Agent System Architecture

The provider of media is an entity called AMS (Application Management System). Its main purposes are: to offer the user media transport and management functionality, and last, to mediate the communication and also the trading activities in both a customer-to-business base (terminal-AMS) representing providers' issues and customers' interests and in a business-to-business base (AMS-provider and AMS-AMS). The term terminal is used without loss of generality to designate any device for accessing information in a communication network. Due to the nature of this paper no further details about the physical distribution will be considered.

The Multi-Agent System MoD architecture and the market relations considered can be seen in the diagram bellow:

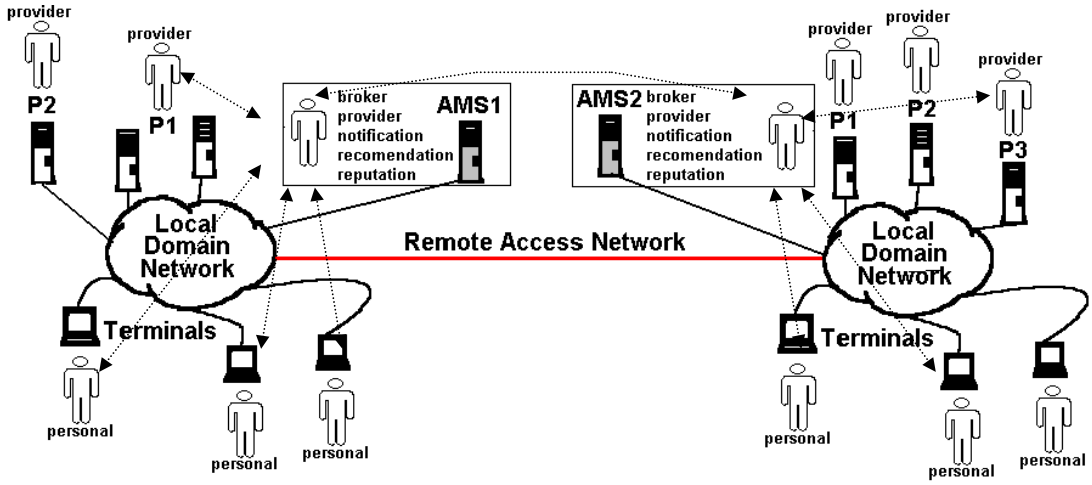

Figure 1 – MoD Multi-agent system augmented conceptual architecture

A Consumer Buying Behaviour (CBB) model, presented by Guttman et al. which augments traditional marketing research is used to analyse consumers' actions in electronic markets [3] and identify agents' roles. Six stages in shopping experience are considered:

1. *Need Identification* - the consumer realises some unmet need

2. *Product Brokering* - information is retrieved so as to evaluate *what* to buy
3. *Merchant Brokering* - merchant-specific information used to determine *who* to buy from,
4. *Negotiation* - prices and other aspects of the commercial deal are determined
5. *Purchase and Delivery*
6. *Service and Evaluation* - post-purchase stage: evaluation of satisfaction.

The purpose of the multi-agent system is to strengthen the relationship between customer and supplier exploring the CBB stages. Long-term relationships with customers to maximise customer satisfaction are desired.

It is important to notice that the boundaries between the stages are not necessarily well defined and this model is an approximation of complex behaviours. We will see specifically in the proposed multi-agent system that the product brokering and merchant brokering might be promoted simultaneously.

Following this approach, the AMS can delegate its tasks to an agent community that will interact to accomplish the AMS's objectives. The agents are:

- *Notification Agents*
- *Recommendation Agents*
- *Broker Agents*
- *Program Reputation Agents*
- *Personal Agents* (are located on customer terminals)
- *Provider Agents* (interact with the system layer in providers)

Figure 8 shows a view of the architecture where the agents are bound to specific AMS. In fact, *Notification, Recommendation* and *Program Reputation Agents* might be AMS-independent. That must not be neglected, once these entities are usually independent such as movie rating and parental guidance organisations.

1.1 Notification Agents

In the proposed architecture *Notification Agents* area responsible for anticipating customers' needs through the suggestion of new products which are likely to be of their interest. The Need Identification buying stage is addressed.

This is accomplished by the use of a knowledge base with customer data (user profile) shared with the *Recommendation Agents*. Mechanisms of social or automated collaborative filtering are used to identify "like-minded" people extracting correlation between user profiles as explored in [6], and implemented in Firefly [11] and Movie Critic [12]. Other approaches for speculating on users' interests include genetic algorithms, neural networks [7] and content based filtering [9].

Social filtering mechanisms are suitable to explore feedback from many users to generate predictions to a specific user. Statistical correlations are calculated comparing the profile of the user to the profiles of other users, weighing them according to their level of similarity. These mechanisms overcome the limitation of content-based filtering where the items must be of parsable form (hence excluding video and images). Besides that, media filtering must handle quality, style or point-of-view, an absent concern in content-based filtering [6].

In the MoD scenario *Notification Agents* are entitled to propose richer forms of notification to *Personal Agents,* such as: movie trailers, making-offs and movie

reviews, i.e., advertising on multimedia as opposed to e-mail text-only alerts. These notifications explore the autonomous nature of agents.

Concerning AMS-AMS relations, Need Identification is explored by having *Notification Agents* trying to sell their products to other *Broker Agents*. Customers' requests for specific programs not available identify possible AMS-AMS relations.

1.2 Recommendation Agents

Recommendation Agents are responsible for the Product Brokering stage. They share the knowledge base with the *Notification Agents*. Their goal is the reduction of consumers' search costs and therefore the transactions costs [8]. *Recommendation Agents* should satisfy more complex requests than those handled by usual catalogue systems.

Communication with *Personal Agents* includes proactive program suggestions, hard-constrained program recommendation (for instance, for movies-on-demand: director, language, genre, casting, release date, etc.), group program suggestions, customer rating prediction on specific programs, etc.. All recommendations are accompanied by probable customer rating, like-minded people reviews, confidence level, average rating, traditional reviews and general information about the program. Traditional catalogue functions are also in the AMS. These are static catalogues, with keyword and hard-constrained search.

Personal Agents provide rating and reviews on programs already seen, and suggest new programs for the catalogue, helping to build the user profile. Especially, the social filtering mechanism enable customers to combine and share experiences either indirectly (through "like-minded" approach) or directly (through written program reviews).

Statistics are typically useful for System/Marketing Managers, generating dossiers on programs, popularity statistics and correlation between programs or classes of programs.

1.3 Broker and Provider Agents

On behalf of the customer, the AMS Broker Agent will consider different options supplied by the Providers.

Product offerings might be compared within a specific provider (merchant) or across provider boundaries (cross merchant). Within-Merchant product comparisons, are usually promoted by users dealing with a single media-provided (such as users browsing a web-site).

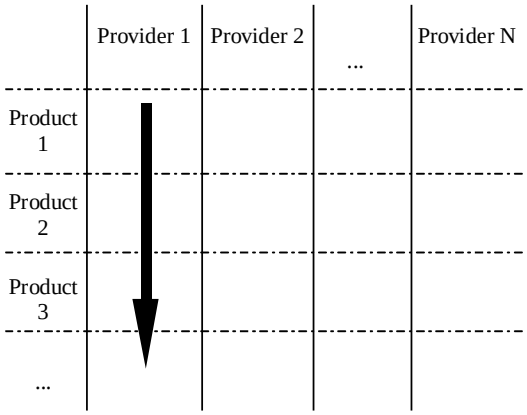

Figure 2 - Within-provider comparisons

Non-mediated cross-provider comparisons would demand extra effort by the customer, visiting several web sites and browsing catalogues.

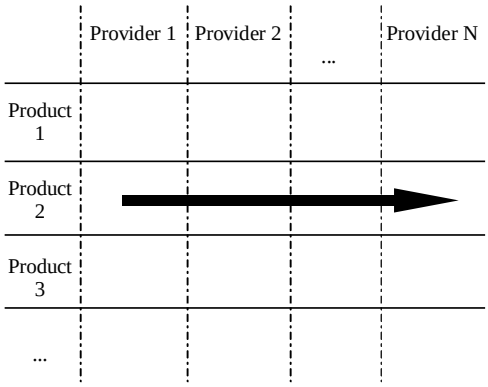

Figure 3 - Cross-provider comparisons

To preserve *merchant differentiation* price-only comparison is avoided and *value-added services* are considered in the buying decision [5].

Some *value-added services* in the MoD domain are:

- QoS parameters
- Interactivity levels
- Advertising levels
- Customer service and support, return policies, promotions and coupons
- Provider personal preference and reputation.

These services distinguish different providers and are critical to one's buying decision: *value-added services* are known to modify completely the MoD customer experience. For instance, there are users who will accept to watch their favourite movies on delayed broadcast and others who would rather pay extra to have full video on demand sessions. Other services might become of interest to the negotiation phase, given the popularisation and future market differentiation.

Co-operative rather than competitive negotiation allows agents to negotiate over multiple dimensions, using Multi-Attribute Utility Theory and Distributed Constraint

Satisfaction. It is known that auctions and other forms of competitive negotiation are generally "win-loose" relations [10].

As noted in [3], the CBB model is an approximation of complex behaviours. The Product Broker stage might not be finished yet and the Broker Agent might select *what* to buy and *who* to buy from simultaneously in what we will call *cross-merchant multiple-products comparison*. This augments the comparison strategies considered by [5].

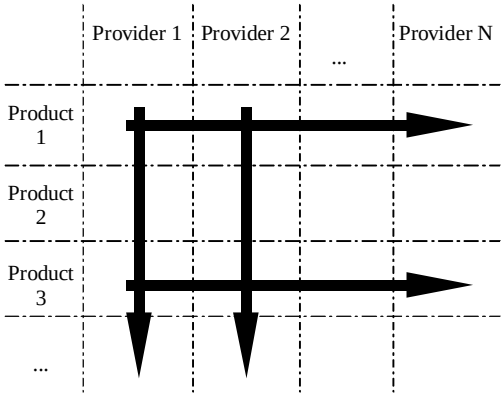

Figure 4 - Cross-provider multiple product comparisons

The definition of *how* to buy, i.e., the *value-added services* should also be of concern in the negotiation. Price of delivery in other electronic commerce systems are substituted by network and server resource charges. For instance, full video-on-demand sessions are more expensive than delayed broadcast.

1.4 Purchase and Delivery

The result of the electronic commerce negotiation phase is a set of multimedia programs associated with specific media/playback parameters. These programs are to be viewed by the customer.

For that, the delivery of products is handled by the Broker Agent, and its interface with the system layer. The system layer is responsible for video storage, transmission

and synchronised playback and user interaction handling. An implementation-oriented discussion about the system layer is out of the scope of this work.

1.5 Service and Evaluation

This post-purchase stage is characterised by the evaluation of satisfaction.

The functioning of the Need Identification, Product Brokering and Merchant Brokering is quite influenced by the feedback provided from the user at this stage. The customer might rate or review the program, adding important data to the system as a whole.

Agents acting at this stage play an important role in the Need Identification for products that are likely to be consumed after the session. Impulse buying should be explored initiating new purchasing processes. Those new purchasing processes are by no means restricted to the media-on-demand domain.

3. Privacy and Trust

Competence develops over time, as the number of user profiles used to generate predictions increase [6].

As long-term satisfaction is aimed, the evaluation performed by Recommendation and Notification Agents should be trustworthy and reliable, even alerting users of products they will dislike. We try to achieve "win-win" relationships.

The agents must be able to explain their decisions, and exhibit predictable behaviours to increase users' trust [2].

Customers' data policies should be clearly stated, since privacy is of great users' concern. Lack of user knowledge of the mechanisms being used to share their preferences and historical data might lead to mistrust. It is so unlikely that under this

situation users will allow the system to track their decisions, preventing us from obtaining feedback to our social filtering mechanisms. Lack of user feedback due to mistrust will restrict the work in the early stages: Need Identification and Product Brokering. The user must be notified that the whole process considers his/her profile from an anonymous point-of-view and specific data about him/her will remain private.

4. Perspectives

The one-to-one marketing becomes closer to reality in media-on-demand agent-mediated systems since they are personalised by nature. The architecture discussed might be extended to transcend the media-on-demand domain, being applied for books, compact disks and other products. The analysis of the system based on a consumer buying behaviour model helps us to understand the high-level interaction between customer and provider, and avoid missing opportunities to generate profit and enhance customer satisfaction.

Recommendation Agents will profit considerably from advances in natural language queries and video and audio recognition and semantics extraction. Automatic attribute information extraction in content-based filtering algorithms for video will allow consumers to specify other objective properties, with hybrid social and content information filtering. Concepts that have a specific meaning in a specific domain might be inferred from the colour, shape, and motion of objects present in the presentation. (e.g. "I would like to see that movie in which Charles Chaplin is shown as a labour", or "A scene with a soccer game"). Besides that, clustering techniques to identify emergent program "genres" or "types" might be used in the prediction algorithms.

Personal agents can be extended to participate more actively in the process of *Need Identification*, anticipating predictable consumer behaviour, such as habits.

Agent technology as a whole will benefit from the definition of common agent languages and protocols. Agent-mediated e-commerce applications will have major advances when standards for defining products, value added services, consumer profiles, payment mechanisms, etc. are established.

The following list is a non-exhausting list of developments that will impact the shaping of future e-commerce processes:

- Software agents
- Data mining and machine learning
- Information Retrieval Algorithms
- Systems for defining, manipulating and exploring ontologies
- Internet security
- Electronic payments
- Web languages and systems, XML and associated mark-up languages
- Wireless communication networks
- Authentication, authorisation and trust management
- Auctions, electronic markets, negotiation protocols and algorithms
- User modelling and profiling
- Recommender systems
- Intelligent user interfaces

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