

# Design an Electronic Market Framework Using JADE<sup>1</sup> Environment

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**Abstract**—The daily growing use of agents in software environments, because of many reasons such as independence and intelligence is not a secret anymore. One of such environments in which there is a prominent job for the agents would be e-marketplaces in which a user is able to give those agents the responsibility of buying and selling, instead of searching the e-marketplace himself. Making up a framework which has sufficient attention to the required roles and their relations, is the first step of achieving such e-markets. In this paper, we suggest a framework in order to establish such e-markets and we will continue investigating the roles such as seller or buyer and the relations in JADE environment in details.

**Keywords**—Framework, software agents, e-commerce, e-market.

## I. INTRODUCTION

THE daily growing use of agents in software environments, because of many reasons such as independence and intelligence is not a secret anymore. One of such environments in which there is a prominent job for the agents would be e-marketplaces in which a user is able to give those agents the responsibility of buying and selling, instead of searching the e-marketplace himself. Making up a framework which has sufficient attention to the required roles and their relations, is the first step of achieving such e-markets. In [1] there are some certain points indicated, that should be in great attention. Problems like security and privacy and also dealing methods are considered in general. In [2] authors deal with the problems that primarily emerge while an e-market is established. However, the details of some agents like advisor agents and the relation between the agents is discussed in general. In [3], a model for an e-market including the advisor agents for buyer and seller and the market manager is presented. The article is mainly about the processes that give useful information for managing the store. Reference [4] gives a model in which it is tried to make up a model based on the normal needs of a real store. Reference [5] suggests a method

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for analyzing and developing the agent-oriented systems. Reference [6] is all about agent-oriented patterns in order to use in an e-market. In this paper, it is tried to probe the details that each agent needs during its life. We focus on e-market framework, agents and their relations using FIPA<sup>2</sup> compatible JADE agent environment. Currently, FIPA is the most common standard in multi agent systems and JADE is one of the best open-source environments for agent development. For more information about FIPA-ACL<sup>3</sup> messages see [7]. For additional information on JADE environment see [8]. The rest of paper is organized as follows:

In next section we propose a framework for electronic market and survey its agents and their relations in a global view. Then we describe the roles outside of e-market framework. After that we describe the roles exist in e-market framework and their communication messages. Finally we discuss about our work and propose some future works.

## II. GENERAL FRAMEWORK OF AN E-MARKET

Any e-market that is to make use of agent-oriented structure should have a specific framework in which there are definitions of each agent's duty and its relation to others as well. Fig. 1 is a sample of such framework that shows the roles needed in an e-market.

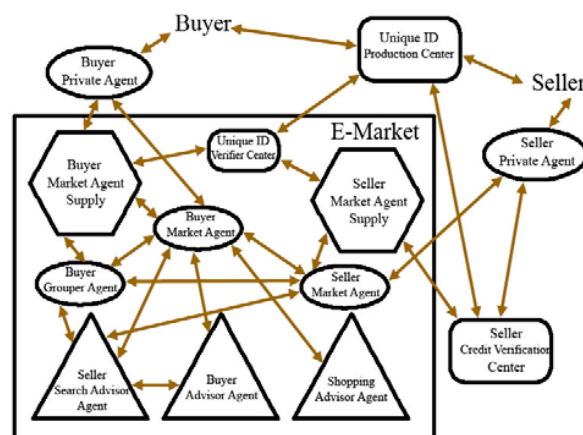


Fig. 1 Roles and relations exist in an electronic market framework

<sup>1</sup> Java Agent Development framework

<sup>2</sup> Foundation for Intelligent Physical Agents

<sup>3</sup> FIPA Agent Communication Language

In this framework, agents such as buyer's agent, seller's agent, and buyers grouper agent in order to deal, and supplies of producing agents like supplies for producing buyer's and seller's agents, and some advisor agents like buyer advisor agent, and also some credit-check centers like unique identifier production center, and also selling credit verification center, and also identifier confirmation center exist, which will be discussed in detail.

### III. E-MARKET OUTER ROLES

In this section, unique identifier production center, and also selling credit verification center which are actually outer roles of an e-market and must have an independent management system are discussed. Also, the buyer and seller and their private agents and their working method are indicated.

#### A. Unique Identifier Production Center

The user security aspect enforces the prohibition of the foreigners' entrance and their deals either. Of course, the privacy of users is of much importance and should only be visible by trusted supplies. Therefore, we require a center for authorization. This center should have a separate management system than that of the whole e-market and should also be responsible for the user confirmations for his/her authorization which should be sent to him/her. In the suggested framework, the buyer and seller are identified and after the confirmation of their identification physically, they receive a license and can lean to their private agent. The selling credit determination center and the unique identifier center use this center for confirming their customer license. For this propose they must send a "query-if" ACL message to unique identification production center with content of "registered license for user  $u_i$ " and received an "inform" ACL message with content of "registered license for user  $u_i$ " or "not registered license for user  $u_i$ ".

#### B. Selling Credit Verification Center

Sellers that are going to show their stuff in markets should receive a selling license from a verification center. This duty, selling credit determination, is done by a center named as stated. The seller will receive the verification license from the center physically for the first time. After that, the seller's private agent license will be verified by the center. Afterwards, the selling credit determination after checking the credit, checks the credit and the identification of the seller's private agent, communicates with the e-market seller's agent supply, and gives the authority to the seller's private agent. To allocate a new seller's market agent for seller's private agent at first seller's private agent sends a "request" ACL message with content of "acquire license for selling credit  $c_i$  for agent  $a_i$ " to selling credit verification center and if credit exists and user license is valid it sends an "inform" ACL message to seller's market agent supply with content of "agent  $a_i$  licensed to sell goods  $G$ " and then sends "inform" ACL message to seller's private agent with content of "license granted to agent  $a_i$ ". Elsewhere sends an "inform" ACL message to seller's private

agent with content of "license request for agent  $a_i$  rejected, reasons are  $R$ ".

#### C. Seller

The seller must primarily attend the unique identifier production center and get a license with which he will be identified. After that, with the aid of private agent, the seller should determine the selling license credit and make use of the selling agent in the desired e-marketplaces, and also supervise the seller's private agent.

#### D. Seller's Private Agent

The seller's private agent is located in the seller system and investigates the e-market situation, signs up in the related e-marketplaces, and monitors the e-markets' situations using the information from the license and also the private information. This agent also goes around other e-markets regularly and after finding a good marketplace to make a deal, signs up for a seller's agent in that special e-marketplace and waits for the e-market agent to make decisions based on the information received, and broadcast the decision to the e-market in order to act. (Noting that this agent has no access to the private information) A single seller's private agent is able to be in contact with one or more e-market selling agents in one or more e-markets simultaneously. To acquire a seller's market agent it must request selling credit verification center with agent ID of new seller's market agent just created.

#### E. Buyer

The buyer of an e-market must also receive a license from the unique identifier production center, and then determine the buyer's private agent authority.

#### F. Buyer's Private Agent

The Buyer's private agent must go around other markets responding to the buyer's requirements of buying stuff, having the private information of the buyer on his own system, with the help of markets agents, sign up for an appropriate market purchase agent and manage its actions and give some information to the market agents if the buyer person wishes to. This agent can simultaneously be in contact with one or more market agents in one or more e-marketplaces. To register buyer's market agent it must send a "request" ACL message with content of "register agent  $a_i$ " and gets an "inform" ACL message with content of "agent  $a_i$  registered" or "agent  $a_i$  registration rejected, reasons are  $R$ ".

### IV. THE ROLES IN E-MARKET

In this section we'll discuss about the existing roles in an e-market for buying and selling stuff and their agents in four groups. These groups include the roles related to the buyer and seller and their related agents as well.

#### A. Roles Concerning the Seller

This group of roles is all about the seller's private agent and should be guided by the seller, which include the supply of the seller's market agent and the seller's market agent.

### 1. The seller's market agent supply

This supply is responsible for registering the seller's market agent if the selling credit verification center verified before. Also, in case the buyer's market agent or buyers grouper market agent sends a request in order to authorize the seller's market agent, this supply informs the requester about the status of registration of seller's market agent. When it wants to register an agent in its list sends a *"request"* ACL message to the unique identity verifier center with the content of *"verify identity for agent  $a_i$ "*. If verifier center find an identity for  $a_i$  sends an *"inform"* ACL message with content of *"agent  $a_i$  identity verified"*. Elsewhere sends and *"inform"* ACL message with content of *"agent  $a_i$  identity rejected, reasons are R"*.

### 2. The seller's market agent

The seller's market agent is controlled by the seller's private agent and signs up in the advisor agent after establishing the information related to the seller and the stuff he wants to sell with the aim of seller's market agent supply. By checking the buyer's market agents or the buyers grouper agents, firstly it confirms the identification information with the help of The buyer's market agent supply and gives some information about the seller and the stuff to the buyer's market agent and after that, if the buyer's private agent wishes, the market agent can go in debate for the best possible selling status controlled by the seller's private agent. For this purpose the seller's market agent sends a *"propose"* ACL message with the content of *"goods descriptions GD"* and gets an *"accept proposal"* ACL message in the case of acceptance with an empty content or *"reject proposal"* ACL message in the case of rejection with the content of *"proposal rejects, reasons are R"* or with a content of new *"proposal"* ACL message or an empty content. In the case of acceptance of proposal before agent send an accept proposal it should check the identity of requester by its related supply to validate the identifier.

The other duty that is due to this agent would be the investigation between the rivals in the market and monitoring the results to the seller's private agent, to make the best strategies and updating the information for the advisor agents in order to find the customers. It can monitor other seller's market agent goods by requesting attributes for goods like its own goods from seller's search advisor agent.

## B. Roles Concerning the Buyer

This section of roles is mainly concerning the buyer. The buyer will be able to guide these roles with the help of his own private agent. These roles include the buyer's market agent supply and the buyer's marker agent and the buyer's grouper agent, which will be discussed.

### 1. The buyer's market agent supply

This supply is responsible for registering the buyer's market agent which is done by checking the identification of the buyer's private agent with the aim of unique identity verifier agent. Also, on demand of the seller's market agent, it looks at its list and decides to verify the buyer's market agent

identification or not. The messages are similar to seller's market agent supply in case of verification of seller's market agent identity. Just role of buyer and seller replaced.

In case the buyer's market agent requests to use the buyer's grouper agent, a list of such agents is given to the market agent and introduces the related agents of the current purchase. If such agents do not exist, a buyer's grouper market agent created. At first the supply set the goods description of buyer's grouper market by sending *"inform"* ACL message with the content of *"goods G"*. Then supply registers its ID and goods in its lookup table.

### 2. The buyer's market agent

This agent is produced by the buyer's market agent and is handed to the buyer's private agent. This agent is responsible for finding the appropriate seller's market agent which is mostly related to the buyer's purchase. Of course, the decision makings which are out of its authority, is passed to the buyer's private agent. If the buyer demands, the information which is taken from the private agent is given to the advisor agents. This agent has also the duty of communicating with the buyer's grouper agent (if existed) and using the help of the advisor agent, it makes efficient use of the shopping cart with respect to the customer needs. At first buyer's market agent sends a *"query ref"* ACL message with the content of *"buyers grouper agents for good  $g_i$ "* and buyer's market agent supply responses an *"inform"* ACL message with the content of *"buyers grouper agent BG"*. Then buyer's agent negotiates to buyers grouper agent if wants. It also can send a *"request"* ACL message to buyer's market agent supply with the content of *"create a buyers grouper agent for goods G"* and get an *"inform"* ACL message from that with the content of *"buyers grouper market agent  $a_i$  for goods G created"*.

### 3. The buyer's grouper agent

This agent has the responsibility of collecting the market agents which are interested in buying a certain kind of stuff. The advantage of such agent over the market agent would be its efficiency which is gained due to a more exclusive purchase order to the market. This agent, should find the appropriate stuff in the market using the advisor agents and go in debate with their corresponding seller agents. Afterwards, the agent makes up a poll among its own members (in group) and selects the best situation and again contacts with the best seller's agent and goes in debate about the quantity of that stuff, and after buying it, the agent also shares the stuff for the buyers in group. It can register new buyer's market agent in response to their *"request"* ACL message with content of *"register agent  $a_i$  for goods G"* and sends an *"inform"* message with content of *"registration for agent  $a_i$  accepted"* or *"registration for agent  $a_i$  rejected, reasons are R"*. Otherwise this agent act like a buyer's market agent as described above.

## C. Advisor Roles

This section of roles has got the responsibility of keeping the information concerning the buyers and sellers in a market

which is divided into three general categories in order to find the sellers, buyer advisor agent, and shopping cart advisor agent.

#### 1. Seller's search advisor agent

This agent is responsible for information the buyers need about the existing stuff in the marketplace and their corresponding sellers, and also the seller grades with respect to their experience in the market. The agent gives this information to the buyer. It responds to "query ref" ACL message from the buyer's market agent with the content of "seller's market agent for goods G" by sending an "inform" ACL message with content of "seller's market agent descriptions SD for goods G".

The agent also allows some changes in the situation in specific intervals in order to update the list of stuff from the seller side. The seller grade is actually asked from the buyer advisor agent who is aware of the buyers. To respond to a seller's market agent "request" ACL message with the content of "register for goods G" it first verify the identity of agent with the aim of seller's market agent supply and then sends an "inform" ACL message to requester with the content of "registration accepted for goods G" or "registration rejected for the goods G, reasons are R".

#### 2. The Buyer advisor agent

This agent makes up a profile for the customers which like to use this feature, and gives suggestions about other stuff to the buyer's market agents whose buyers have similar profiles of stuff saved. It is impossible to use this agent anonymously but using this feature is more accurate and appropriate than the shopping cart advisor agent due to the processing nature of this agent. The buyer's market agent sends an "inform" ACL message with the content of "buying goods G" and also can send "request" ACL message with the content of "advise for goods G" which followed by an "inform" ACL message from buyer advisor agent with content of "try to advertise new goods NG to user".

#### 3. Shopping advisor agent

As stated by name, this agent gives out suggestions to the buyer's market agent corresponding to the shopping cart of the customers who are using it. It is possible to use this agent anonymously by the buyer's market agent but the suggestions remain up to the shopping cart level. The buyer's market agent just send a "request" ACL message with content of "shopping goods G" which followed by an "inform" ACL message with content of " try to advertise new shopping goods NS to user ".

#### D. The Unique Identity Verifier Center

It is inevitable to have a center for concentrating the communications to the unique identifier production system through, and also to have a unique buyer's and seller's identifier. The duty of confirming the identifier is defined as responding to the e-market agent supply request for confirming the buyer's identification and making up a unique

identifier for the e-market agent and also confirming it if necessary. Despite the fact that this section is included in the e-market framework, it should be confirmed by the identifier production center. For verifying an identifier the unique identity verifier center sends a "query-if" ACL message to unique identification production center with content of "registered license for agent  $a_i$ " and received an "inform" ACL message with content of "registered license for agent  $a_i$ " or "not registered license for agent  $a_i$ ".

#### V. CONCLUSION

In this paper, a suitable framework for an e-market and the roles needed for such a framework were discussed. Also, we could discuss about the agents relationships and their required messages under standards of FIPA in the JADE agent-oriented platform in more detail. Furthermore, we could think about the use of "Negation Algorithms" on the agents in the e-market as a future task. Also, preparing some methods for user profile collection, the way the stuff is suggested to the users, and a stuff grading system are great topics to focus on. Moreover, there could be some other paces like including algorithms for the overall price prediction in standard discounts as a future task for this paper.

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