AMMAS: Ambient Mobile Multi-Agents System Simulation of the M_Commerce

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Abstract: *Today the ambient intelligence presents a fundamental approach to satisfy our daily needs and requirements. Specifically in this work, we aim to study, model and simulate an ambient mobile system based on intelligent agents for the Mobile Commerce (M-Commerce). The mobile agent concept is not based on the traditional client-server model, but on distributed executive models. The present article proposes a mobile intelligent agents-based architecture for the M-Commerce that aims to automate the buyer/seller's transaction process under dynamical buyer's preferences changes.*
In our work we proceed as follows: first, we introduce the scope and the genesis of our research, second, we hold out the related works, afterwards, we present our AMMAS (Ambient Mobile Multi-Agents System) model for the M-Commerce and an overview of the system implementation, and finally we conclude our work et give some perspectives..

Keywords: *Ambient intelligence; mobile agent, ambient system, m-commerce; Aglet*

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1. Introduction

Nowadays, many people need mobile devices such as Personal Digital Assistants (PDA) or mobile phones to access distributed information and to make use of the web-services. These devices can be based on pervasive computing (ubiquitous or ambient intelligent) systems that allow an automated network connection and a real-time information access.

In this paper, the ambient intelligent system is based on independent mobile agents that present the user's changed preferences and needs in an M-Commerce framework. The M-Commerce is an attempt to resolve some E-commerce' problems, like the customer's passivity (that only sends requests and waits the server responses), the servers 'request answering independently of the customer(s')'s terminal device(s), and the users' data exchanges depending of the QoS (Quality of Services) of the physical client-server connection.

Our aim is to integrate the AMMAS (Ambient Mobile Multi-Agents System) in the M_commerce framework to, first, allow the personalized offers/counter-offers' traders exchanges via wireless mobile devices, second to resolve agents' communication, collaboration and competition problems by using a decentralized approach of data processing.

In our approach we choose the M-Commerce because of to the eminent role of the mobile agent to move, in a network via wireless technologies, from a mobile device (like Smartphone, Tablets, etc.) to another device to get information in real-time that satisfy user's needs. Also Mobile agents are useful to insure the business transaction anytime and anywhere, the mobility can be strong or low according to elements involved in the process of transfer (code, data, pile, heap, and meter) [9].

The M-Commerce is viewed as an ambient system because of the dynamic variation of the traders' needs and preferences and the continuous change of the transaction's data content. This system interacts with the environment changes and behaves according to these changes [8].

This article proposes a feasible architecture that combines agent mobility and intelligence for costumer-oriented e-business applications. It allows a user to create a mobile, intelligent agent via a mobile device (Android).

The main objective of our study is to propose architecture of AMMAS for the M-Commerce based on the mobility of intelligent agents via heterogeneous mobile devices.

In this architecture, a consumer can connect his mobile device, such as a PDA or a Smartphone, to the application server (service of creation mobile agent) via a wireless connection and sent then a request of creation of a mobile agent for a specific business task on his behalf.

In the following sections, we will present: first the related works, second the proposed approach, third our contribution, fourth the experimental results, afterwards the conclusion, and finally some perspectives.

2. Related works

In this section we will present some existing architectures, which are modulated for mobile shopping using ambient mobile agent approach, then we will finish with a summary.

2.1. System of Zerdoumi Ossama and Okba Kazar

Zerdoumi Ossama and Okba Kazar [11] presented an architecture that consists of three main parts: the moving part, the server part and the seller sites.

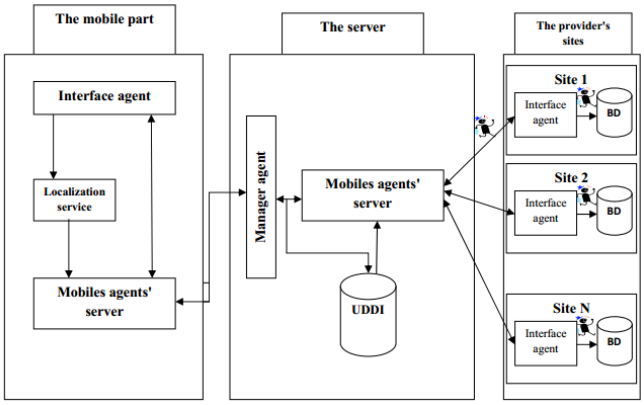

Figure 1. The overall system architecture.

- **Mobile Part :** It is formed by the following modules:
  1. An interface agent
  2. The location service
  3. The mobile agents server
- **Server Part :** It defines the interface between the customer and the supplier or she is an agent manager who is responsible for the management of all stains, suppliers and mobile agents' server to create mobile agents that will outputs to supplier sites.
- **The provider site Part :** The sites of suppliers are formed by a database and two types of agent, this is the first interface and the second is the agent researcher.

2.2. System of Kalpana N. Maher, Sanjay Jadhav and PS Lokhande

Kalpana N. Meher, Sanjay Jadhav and PS Lokhande [4] presented a system architecture and operation process. As shown in Figure 2, users can manage the system with mobile devices and desktop computers. Become portable devices, they support through agents and employees connect to the server via wireless connections mediator.

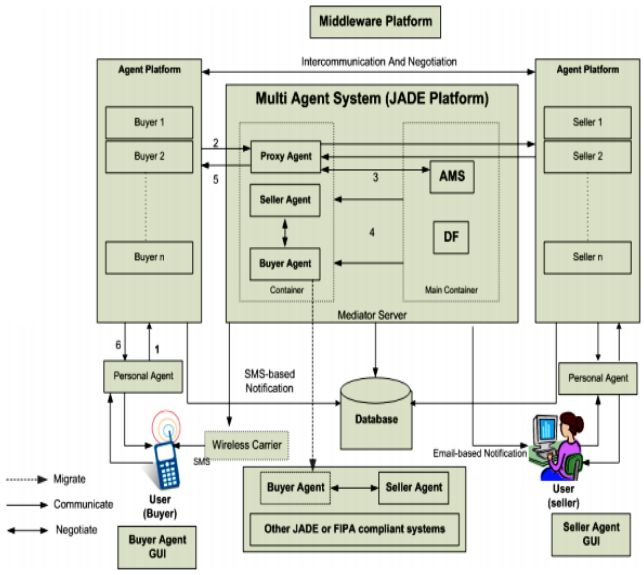

Figure 2. System Architecture.

As illustrated in Figure 2, the procedures described in (1) to (6) describe how to place a buy or a sale:

1. At the first step, the user selects a shopping mode, and then configures the user preferences via the personal agent (residing on the mobile device).
2. The personal agent then sends a request based on XML for the mediator server.
3. An instance of the platform agent accepts the request and communicates with the proxy agent via the platform of the agent.
4. The agent proxy cooperates with the AMS agent who lives in the main container of the middleware platform to create a purchase or sale of a product.
5. If the purchase or sales agent is successfully created in the container; it could be mobilized for other systems to undertake the task of the user.
6. And the personal agent proxy agent receives the reply via the agent platform and informs the user of the relevant mobile agent being created.

2.3. The Ambient B2B System Jinping Hu Wei Fu Chang and Bruce Spencer

Hu Xiping, Weichang Du and Bruce Spencer [10] proposed an ambient B2B system, it is a service management agent-based architecture ambient environment allowing users easy access to data and services figure 3.

In addition, as shown in the figure above, customers can get many services that use the automated system with A frame room. The authors create a system based on ad-hoc networks A frame and deployed in all the places that offer services to customers, such as the kitchen, the refrigerator, the conference room, etc. After customers complete the registration on receipt of B & B, the computer will automatically propagated

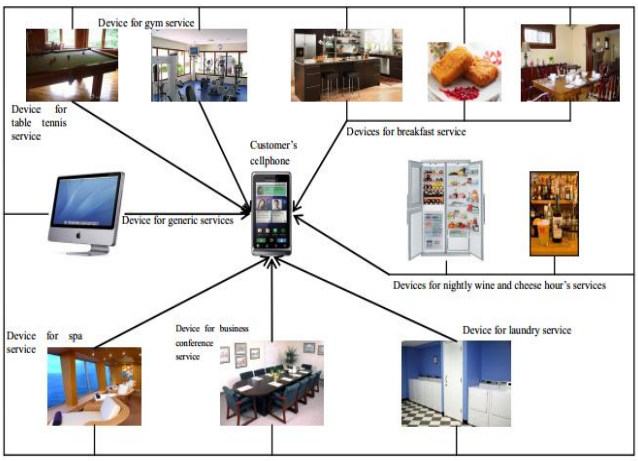

Figure 3. System Ambient B to B.

service agents and public services on the mobile phone of the customer, such as the list of services currently available. In addition, the computer will update the list of services to customers other services and devices on a regular basic. Then, from the user interface of this phone, the customer can choose the services they need. For example, if you want to book a conference room at the time of the program, simply select the Conference Service to companies in the user interface and the mobile phone will automatically release a mobile device factor in the conference room. Only once in receipt of the conference room that do the service of the mobile agent, and it will automatically verify the identity (or name) of the client computer with the service at the reception. If it passes in the identification, the device will check in a conference room at the time the program are available, mobile workers can get the result, automatically sent to the mobile phone of the customer? At the same time, if the customer wants a meal or rendezvous breakfast, to the list of devices and kitchen, dining room and all service work. The customer can get the first information about breakfast, that the current list, available time or extra services from the Kitchener area, then set a new breakfast and his time on the basis of this information.

2.4. Presentation of IMAGO System

The IMAGO System (Intelligent Mobile Agent Gliding Online) is an infrastructure to develop mobile applications agents, such as M-Commerce or distributed data mining. [5] This proposal focuses on mobile commerce determined by the consumer, that is to say, an e-commerce model in which the consumer initiates a business transaction. Specifically, this structure represents a distributed environment that allows consumers to send mobile agents of their handheld devices to visit online shops for research, comparing, and evaluating the purchase and payment of goods. Figure 4 shows an example of agents that occur in the mobile commerce system IMAGO and indicate their basic behaviors.

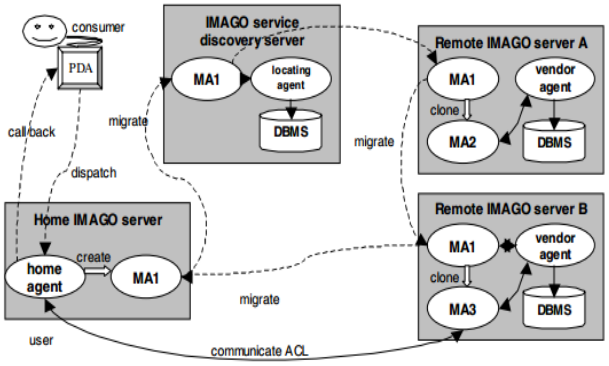

Figure 4. An Example of Deploying Mobile Agents in M-Commerce.

This architecture IMAGO M-Commerce is three main types of agents:

- Device agent.
- Stationary agent.
- Mobile agent.

2.5. Discussion

In this section we have presented four architectures for mobile commerce (M-Commerce) using mobile agents and intelligent agents (Ambient). First, it presented architecture Zerdoumi Oussama and Okba and Kazar who proposed a mobile agent based structure that allows customers and suppliers to execute the purchase applications using mobile devices. This architecture is based on multi-agent systems (MAS), which, by their nature, facilitate the inclusion of the great dynamics of the environment in which run business using mobile devices. The authors proposed the migration process where the mobile agent server creates a single mobile agent, If we have N site, the agent will visit these N site sequence in a limited time by the mobile agent server. The advantage of this architecture uses location services to find the position. However, the disadvantage in this approach is: the mobile agent server sends mobile agents at all provider sites. Secondly an architecture Kalpana N. Meher, Sanjay Jadhav and PS Lokhande who developed an architecture based on the mobile agent that allows buyers and sellers to execute purchase applications with mobile devices and desktop, The main advantage of this approach is that the agent is created by the user based on preferences and also the user of this system can always receive notification SMS from mediator server. The disadvantage of this approach is that the proxy agent cooperates with the AMS agent to create a purchase or sale of a product.

The third, presented the approach of Hu Xiping, Weichang Du and Bruce Spencer who developed an ambient system BtB (business to business), that provides the user more specifically and easier to access different services in ambient environment for example booking a conference room and table tennis etc. This

system utilizes the mobile agent takes the need of the customer and provides the service appropriate to an ambient from a mobile device. The main advantage is based on the time factor. The latest architecture is proposed by IMAGO Li Xining, this architecture is a distributed environment that allows consumers to send mobile agents from their mobile devices to visit online shops to research the products, comparing and evaluating the purchase and payment for goods. The disadvantage of this approach is that consumers are sending the mobile agent from their mobile devices (such as the long-term connection with the Internet). Another disadvantage is that the mobile agent makes cloning in remote servers.

3. Proposed Approach

3.1. The Proposed Approach

In this paper, we propose a model and an implementation of a mobile room system based on AMMAS for M-Commerce, wherein a consumer can connect with mobile devices, such as a PDA or a mobile phone or a Smartphone, to procure specific request related to his preferences and needs. In fact, for each system connection, the customer receives a notification of an added new offer according to his specific stored preferences. The consumer is able to consult the basket, to buy specific products from different devices categories such as mobile phones and computer equipments.

We use mobile agents because of their ability to search quickly information in smarter way. Moreover, they are able to communicate and cooperate with each to accelerate and facilitate research. As a platform for agent creation and supervising we have used the "Aglet" platform.

The goal of our information support system is to promote a smart web research with the best prices deal and the high qualities, also to support the main M-Commerce objectives, which are:

- Improve business' services
- Select and receive notifications from deferent sources
- Collaborate with other users of the M-Commerce via heterogeneous devices.

The environment is based-on AMMAS that facilitate collaboration between several M-Commerce users in selecting and recommending services, especially in the current environment. The collaboration between users can enable the identification and the choice of the best wireless communications based on its service quality. The collaboration can also allow several users to negotiate a group price: For example 20 users, located in the same place, can buy the same product and get profit from the group promoted price. The ambient aspect in our system is the search on the web of the best price, the best offer, the best quality of a product based on the mobile device's user's preferences. Our system is based on the AMMAS for the M-Commerce that insure the automation of business transaction in heterogeneous environment to satisfy the dynamic users' needs and preferences. In our platform we distinguish two kinds of intelligent agent: the situated agents (fixed) that act locally and the mobile agents that move to collect in time eminent information.

4. System Architecture

4.1. The Proposed Architecture

Figure 5 illustrates the detailed architecture of our AMMAS system and figure 5 shows a distributed C2C (costumer to costumer) wireless M_commerce environment. This architecture includes the internal agents, the agent's interactions, the agent migration and communication, and the scenario of new offers notifications receiving.

So our proposed architecture (see Figure 5) consists of four main parts are:

- Part User (Part application)
- Part Server (Agent server Mobile)
- Part Seller (Websites)
- Part Access in data (Data Base)

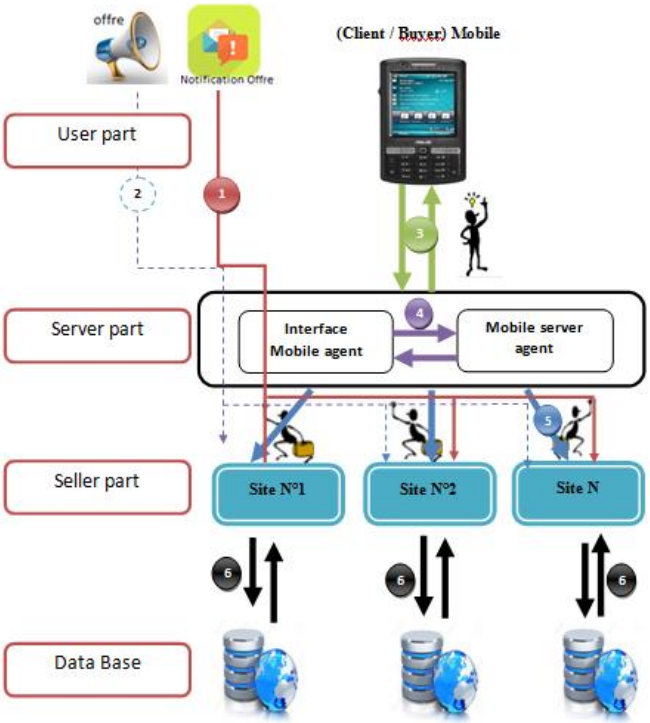

Figure 5. Architecture of the system.

Notification receiving of a new offer corresponding with the user's preferences 1
The list offers study 2
Ambient Mobile Agent (select the best price / Offer / quality according to user's preferences) 3
The agent's migration 4

The mobile agent interface 5
Communication with mobile agents BBD database agents 6

4.2. Different Types of Agents in our System

Our system contains a set of autonomous agents that collaborate to meet the customer's purchases and to update (adding, deletion, modification) customer's sales, we distinguish: the client agent, the directory agents (manager), the mobile ambient research Officer and the seller's agents, the bargaining agent, the Aglet: The ambient intelligent agents are described as follow:

- A customer t agent: Single user who uses the system.
- The mobile ambient Research Officer: agent that researches offers on the internet to return the most appropriate.
- Aglet: Mobile Agent that moves among sites.
- Agent directory: mobile agent server directory.
- Agent Seller: agent that publishes the products (product update).
- Buyer Agent: agent that buys products (add to cart).
- Negotiate Agent: agent that negotiates (price / quality / number / location) with the agent seller.

4.3. Architecture of the Multi-Agent System

The multi-agent architecture shown in figure 1 includes both static and mobile agents.

4.3.1. Communication Schemes

The AMMAS architecture highlights the interaction between mobile agents to satisfy user preferences, we distinguish among figure 6 six types of communication.

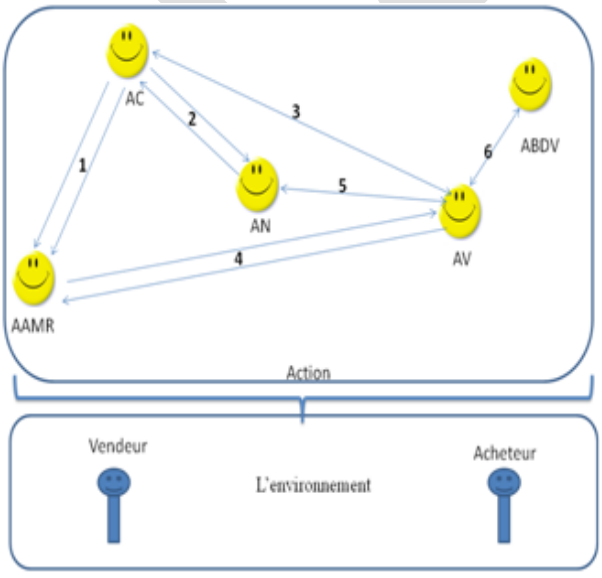

Figure 6. An overview of the proposed framework: Some possible communication actions among mobile devices.

Figure 6 shows the system basic schema where all requests and responses are handled by the AMMAS agents.

4.3.2. Identification of the Agent Roles

The AMMAS defines six global agents' roles. In following we will use the next abbreviations: agent Buyer = AC, mobile ambient Agent of research = AAMR, Agent Negotiator = AN, Agent seller = AV, seller agent Data base = ABDV.

So, the different agents' interactions are:

1. The interactions between the AC and the AAMR agent:

- The AC agent spends a request of a product to the AAMR,
- The AAMR informs the AC about the search result of the desired product, AAMR is endowed with a proactive behavior
- The AIM is responsible of the AAMR creation.

2. The interactions between the AC the AN agent:

- The AC agent gives the AN agent the required information about product (wished criteria, reserved price, etc.)
- The AN agent supplies the AC agent with the available best sellers' prices of the wished article.
- The AC agent is responsible of the AN creation and destruction.

3. The interactions between the AC Agent and the AV:

- The AC agent registers and connects to the AV site: its sends the necessary information about wished buyer product.

4. The interactions between the AAMR agent and the AV agent:

- The AAMR spends a request to the AV
- The AV answers the request to the AAMR

5. The interactions between the AN Agent the AV agent:

- The AV agent communicates the product's agreed price, after that the AN agent sends it to the AC agent.

6. The interactions between the AV agent and the ABDV agent:

- The ABDV agent is responsible for the accounts creation and the agents' identification.
- The ABDV agent supplies to the AV agent the information about the sold products.

6. System Implementation

We have implemented a simple prototype to evaluate the concepts proposed in our architecture, using the Java programming language.

6.1. Development Tools

6.1.1. Aglet Platform

Aglets Software Development Kit is an environment for programming Internet agents in Java, developed by a team of researchers of the research laboratory of IBM Tokyo, Japan. The name was created from the words and Agent Applet, which expresses quite clearly what Aglet. Aglet distribution comes with a server called Tahiti. [3]

6.1.2. Android

Android is a mobile operating system based on the open source Linux kernel and currently being developed by Google. The system was initially designed for touch Smartphone and tablets, and has specialized in objects such as connected TVs (Android TV), cars (Android Auto) and smart watch (Android Wear) [7].

6.2. System Interface

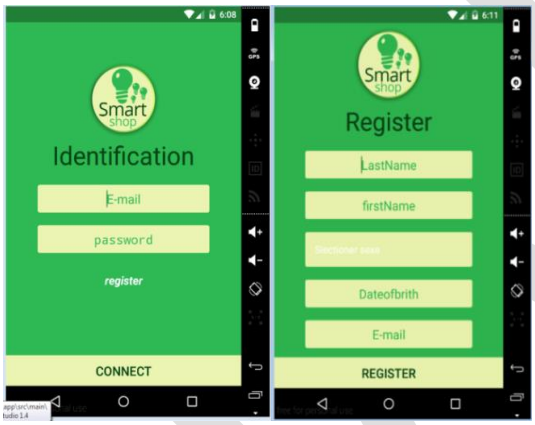

Figure 7. The authentication and Registration page print screen.

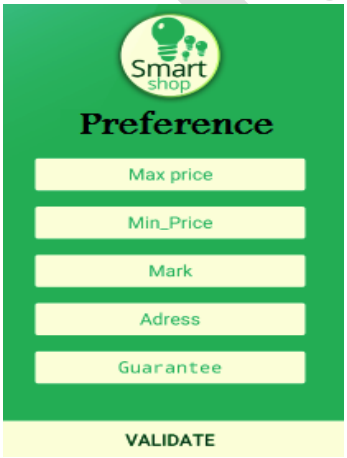

Figure 8. The printed customer preference page screen.

In this interface the client files the interface fields with personalized data.

According to this interface (Figure 9), the customer, logged on the system, receives real-time notifications of relevant offers corresponding to his preferences (already introduced into the system).

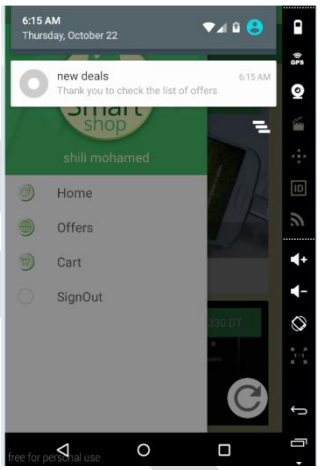

Figure 9. The printed page notification screen.

For example, if a seller adds a new offer on its database that corresponds to the client's preferences the latter will be informed by a notification. Hence the bid notification comes from website (of the seller).

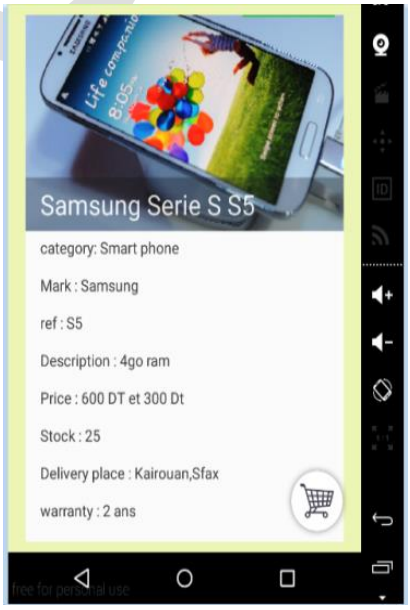

Figure 10. Result of Search page result screen.

6.3. Mobile Agent

Then we run an aglet application known as Tahiti. We can run multiple servers (Tahiti) on a single computer by assigning them different ports.

In our study, we used Aglets in the server part and the websites part, because Aglets is more specified in mobility than the other platforms, wherein the mobile agents offer several advantages improving the

performance of distributed applications. The improvement can be resumed in:

- The reduction of the network traffic;
- The dynamic distribution of charge;
- Surmount the latency of the network;
- Encapsulation of the protocols;
- Asynchronous and autonomous execution;
- Heterogeneous remote models;
- Robust and tolerant with the failures and;
- The ability to continue the interaction with a user on a disconnected network [6].

6.3.1. Mobile Agents in our System in Aglet

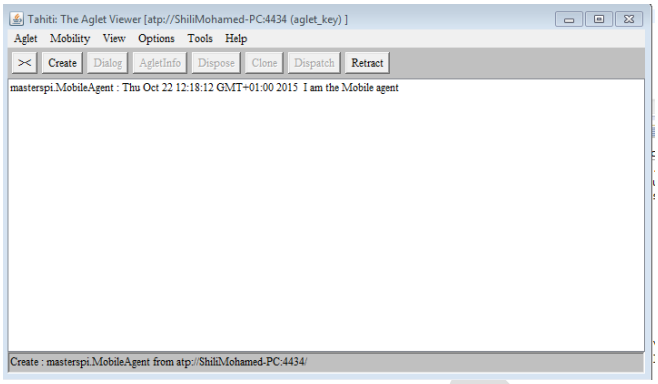

Figure 11. Aglet application Tahiti running at port 4434.

6.3.2. Mobile Search Agent

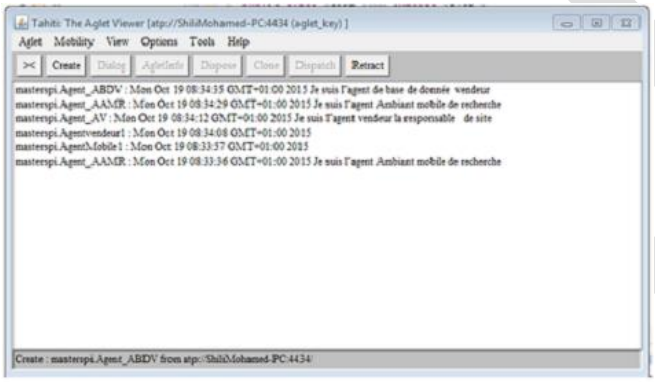

Figure 12. Mobile search agent.

6.3.3. Agent Seller

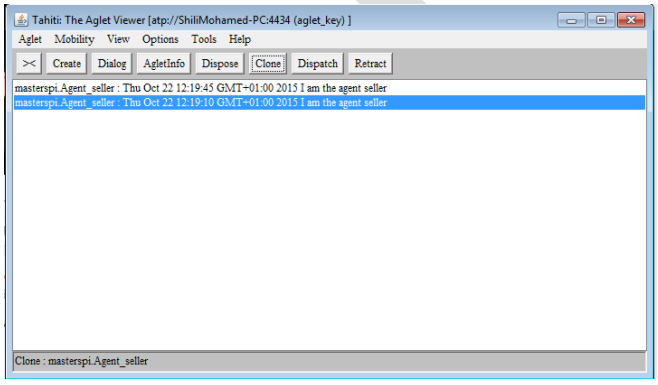

Figure 13. Agent seller.

7. Conclusion and Future Work

In this paper we have presented AMMAS architecture for the M-Commerce, We propose in this article an M-Commerce architecture that allows traders to do business at remote locations by means of mobile intelligent agents; the agents of our system are implemented using the JAVA language and the Aglets platform. The advantage of the proposed approach is the use of ambient mobile agents as a communication entity to satisfy dynamically the users' preferences changes. These allow the reducing of the network traffic and the amount of exchanged information. In this case, the agent moves to the information source and performs local exchanges. The highlight of this architecture is to allow the user to manage purchases' requests by using smart phones (laptops, PDAs, etc ...) at anytime and anywhere. So the proposed system minimizes firstly the customer's wait time, and secondly the amount of transferred information.

The application of AMMAS in M-Commerce allow created mobile agent independently responsible in their moving to perform the task requested by the buyer.

In Perspective, we have to integrate the security issue in the AMMAS platform to protect mobile agents from external attacks, also we can execute mobile agent on remote computers using ontology and semantic web.

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