

AN OVERVIEW OF MOBILE AGENTS TECHNOLOGY AND ITS ADOPTIONS IN ELECTRONIC COMMERCE.

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Abstract

This paper presents an overview of Mobile Agent. A mobile agent is an executing program that can migrate during execution from one machine to another in a heterogeneous network. It focuses on its adoption in E-Commerce. E-Commerce is a platform for the online activities of commerce, Mobile agents are useful tools to help individuals to undertake their activities on E-Commerce surroundings and create different paths for communication. They help do things like find and filter information, customize views of information, and automate work. Finally, this paper examines some real agent-enhanced applications to explore the value of agents, summarizes the characteristics that differentiate agents from other software.

Keywords words: *Agent, collaborative agent, E-business, E-Commerce, ecommerce analysis, Mobile agent, reactive agent, Software Agents, technology*

1.0 Introduction:

Agents can be classified into two major categories: resident and mobile [3]. Resident agents stay in the computer or system and perform their tasks there. For instance, many of the wizards in software programs are designed to carry out a very specific task while you are using your computer. Mobile agents move to other systems, performing tasks there. A mobile agent can transport itself across different system architectures and platforms. Mobility is the degree to which the agents themselves travel through the network. Mobile scripts can be composed on one machine and shipped to another for execution in a suitably secure environment; in this case, the program travels before execution, and so no static data need be attached [11]

Finally, agents can be mobile with state, moving from machine to machine in the middle of execution and carrying accumulated state data with them. Such agents can be viewed as mobile objects that travel to agencies where they can present their credentials and obtain access to services and data managed by the agencies. Agencies can also serve as brokers or matchmakers, bringing together agents with similar interests and compatible goals and providing a meeting point at which they can safely interact [9]. Mobile agents can move from one Internet site to another and send data to and retrieve data from the user, who can focus on other tasks in the meantime. Mobile agent can be very helpful to a user, for example, a mobile agent travels from site to site, looking for information on a certain stock as instructed by the user. If the stock price hits a certain level or if there is news about the stock, the agent alerts the user. What is unique about a mobile agent is that it is a software application that moves on its own to different computers to execute tasks [7]. Non mobile agents can be defined by two dimensions and mobile agents are defined in a three-dimensional space

2.0 Characteristics of Mobile Agents.

A mobile agent is a software agent. A software agent differs from other programs because of the following properties [6].

- **Intelligence:** a software agent employs a technique from the field of artificial intelligence which makes it possible for them to act and perform task(s) on behalf of their owners in such a way that one would think that the tasks were carried out by human. That is to say, they can actually act as if they have intelligence.
- **Autonomy:** this is the ability of the agent to exercise control over its own actions. It can decide the sequence of action to perform in order to achieve the user's task once specifications are given to the agent.

- **Responsiveness:** this is the ability of an agent to perceive its environment and respond in real-time to changes in the environment. Apart from being reactive to their environment they are also goal oriented (proactive and purposeful), taking advantage of opportunities when necessary.
- **Communicative ability:** an agent does not work in isolation. They are sociable entities and as such interact and collaborate with other software agents in carryout their tasks. For this reasons, agents should provide a friendly interface to allow for easy interactivity with other agents.
- **Adaptability:** agents learn about user's behaviour and adjust to changes based on previous experience [13].
- **Ragged:** mobile agents usually have the ability to recover from errors whenever they occur.

3.0 Mobile Agent Life Cycle

Mobile agents go through some processes to get job done. The entire process is termed Mobile Agent Life Cycle highlighted as follows [6].

- **Creation:** this is the first phase of a mobile agent life cycle. Once a request is made to a mobile agent, an instance of the mobile agent is created and its state is initialized.
- **Dispatch:** this involves the movement of the mobile agent from one node to the other and can be achieved by specifying the address of the destination.
- **Cloning:** this refers to creating a copy of the original mobile agent object. That is to say, a twin agent is born and the current state of the original is duplicated in the clone.
- **Deactivation:** a mobile agent is put to sleep and its state is stored on a disk of the host.
- **Activation:** a deactivated mobile agent is brought back to life and its state is restored from disk. Retraction: an agent is brought back from a remote host along with its state to the home machine after the completion of its job.
- **Disposal:** this is done at the end of the mobile agent life cycle. The agent is terminated and its state is lost forever.

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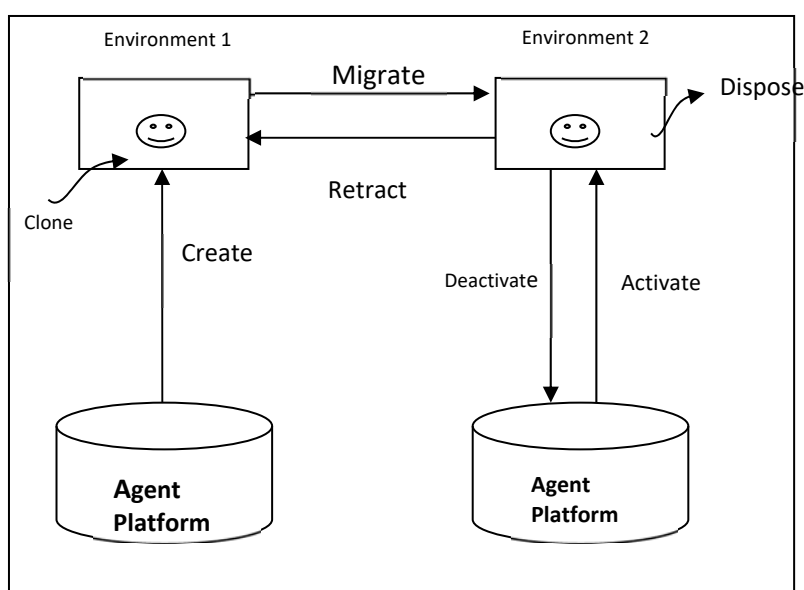


Figure 1. Life Cycle of a Mobile Agent. (Sources: [10].

4.0 Applications Of Mobile Agents technology

According to [14], mobile agents are well suited to the following applications:

- **E-commerce.** A commercial transaction may require real-time access to remote resources, such as stock quotes, and perhaps even agent-to-agent negotiations.

- Personal assistance. Mobile agents' ability to execute on remote hosts makes them suitable assistants for performing tasks in the network on behalf of their creators. Remote assistants operate independently of their limited network connectivity; their creators can even turn off their computers. For example, to bid in an auction, a user can send a mobile agent to interact with the bidding agent to monitor the price change and perform auto bidding according to the instructions of the creator.
- Secure brokering. An interesting application of mobile agents is in collaborations in which not all the collaborators are trusted. The parties could let their mobile agents meet on a mutually agreed secure host where collaboration takes place without risk of the host taking the side of one of the visiting agents.
- Searching and filtering. Collecting information from a network often amounts to searching through vast amounts of data for a few relevant pieces of information. On behalf of a user, a mobile agent could visit many sites, search through the information available at each site, filter out the irrelevant information, and build an index of links to pieces of information that match a search criterion.
- Monitoring and notification. Sometimes information is not spread out across space but across time (e.g., financial data). New information is constantly being produced and published on the network. Agents can be sent out to wait for certain kinds of information to become available.

5.1 What is E-Commerce:

Modern methodology of news selling and merchandising tools that refers to the need of market by cost reduction in turns giving quality goods and services. E-commerce means doing business over interconnected networks [14]. The term commerce is treated as transactions between business clients. But E-Commerce is not just buying and selling but also providing services to the clients and providing both inter and intra transactions of information in the organization irrespective of the type of company. This extended use of internet for trade and business led to the use of software agents in E-Commerce.

5.2 Role of Mobile Agents In E-Commerce:

Greater portion of daily activities such as shopping, socializing, and working are being transferred to the internet environment. Over the past few decades, human computer interaction, and electronic transactions are being used. Individual's online activities are getting more and more complex with growing opportunities of internet environment. The internet that has grown dramatically in the past few years would by now becomes unmanageable without E-Commerce for business [13]. It is claimed that within the next decade the internet could be populated with billions of agents exchanging information, goods and services with one another.

5.3 Benefits of Adopting Mobile Agent Technology in E-Commerce

There are at least six good reasons why mobile agents should be used in E-Commerce. They are highlighted as follows [7].

1. They reduce the network load. The distributed system model used in the business world today often generates considerable network traffic, which is due to the interaction of applications with the server. Mobile agents allow the interaction to take place locally by dispatching themselves to the destination host. This means that the computations are moved to the data rather than the data to the computer.
2. They overcome network latency. Critical real-time systems in e-business, such as online stock trading, require immediate response to events, with no delay. Mobile agents offer a solution to this need, as they can be dispatched from a central controller to act locally and to directly execute the controller's direction.
3. They execute asynchronously and autonomously. Mobile devices often require an established connection with the server to perform their function. However, maintaining the connection for mobile devices could be very expensive or not technically feasible. Mobile agents can work independent of the mobile device asynchronously and autonomously, so that the mobile device can reconnect to the server at a later time to transmit the data.
4. They are naturally heterogeneous. Computer networks are heterogeneous. Different business entities have different standards on their networks. Mobile agents are generally computer and transport-layer independent and depend only on the execution environment (e.g., Java Run Time Environment). Therefore, they can work within a wide range of computer systems and with different hardware configurations [5].
5. They encapsulate protocols – when data is exchanged in a distributed system, each host owns the code that implements the protocols needed to properly code outgoing data and interpret incoming data. However, as protocols evolve to accommodate new requirements for efficiency or security, it is cumbersome if not impossible to upgrade protocol code properly. As a result, protocols often become a legacy problem. Mobile agents on the other hand can move to remote hosts to establish channels based on proprietary protocols.

6. They adapt dynamically – mobile agents can sense their execution environment and react autonomously to changes. Multiple mobile agents have the unique ability of distributing themselves among the hosts in the network to maintain optimal configuration for solving particular problem

7.0 Language for Implementing Mobile Agents

There are different languages for implementing mobile agents. Some languages such as obliq and telescript have been designed specifically for writing mobile agents. There are also many mobile agent technology and platforms implemented in general purpose languages with an extended special library. Some of these languages are described as follows [1].

7.1 Obliq. This is a lexically scoped, un-typed interpreted language that supports distributed object computation. The language supports objects and not classes. It uses the prototype based model of object oriented programming. Obliq uses runtime type checking. It has built-in procedures for importing and exporting procedures and objects between machines.

7.2 Java. The Java environment is an approach to distributed computing. It is a general purpose language. It is an object oriented language. Java programs are compiled to Java byte codes, binary instructions for the Java Virtual Machine. More so, Java programs can run on any platform with JVM interpreter which makes its programs highly portable. Though the language was not designed for writing mobile agents, it has the necessary capabilities for mobile agent programming which has made it a basis for many implementations of mobile agent systems. Most of the systems make use of Java RMI - Remote Method Invocation. For example Aglet- uses an event driven approach to mobile agents that is analogous to the Java library Applet class [8].

7.3 Perl 5. .Penguin is a Perl 5 module with functions enabling the sending of Perl scripts to a remote machine for execution and for receiving perl scripts from remote machines for execution. The scripts are digitally signed to allow authentication and are executed in a secure environment. Mobile agents written in Perl are restricted in that they must always restart execution at the same point. There is also no support for agents saving their state on migration. A new Agent Module v3.0 is being created to give Perl 5 more sophisticated mobile agent capabilities. The additional features include giving agents the ability to save their state on migration.

7.4 Python. Python is an object-oriented scripting language. The Corporation for National Research Institution, USA uses Python as a language for implementing Know bot programs. It is also one of the languages used in developing Tacoma [2].

7.5 Telescript. It is a Remote Object Oriented mobile agent language. It claims to be “a platform that enables the creation of active, distributed network applications”. Its main achievement is in its use in the Magic Link Project, Magic cap product and electronic market places. Telescript has three main concepts; agents, places and the “go” instruction. Agents travel from places to places using the “go” instruction. They can interact with each other and any services located at the places visited through the use of “meet” instruction. Telescript is a whole new platform independent system consisting of a language and an interpreter called the Telescript Engine. The computational model is the Telescript language itself and the agent model is simply a Telescript object. Special instructions implement part of the other models. The navigational model is implemented by the concept of places and the “go” instructions. The “meet” and “connect” instructions are the basis of communication model. Finally, the security model is implemented with the authority, region and identity concepts. In general, any language used for writing a mobile agent must support some of the following [2], agent migration, communication between agents, access to server resources, security mechanisms, appropriate efficiency, the ability to run on multiple platforms, and ease of writing mobile agent application. Besides, the degree to which a language can support the above listed characteristics determines its level of suitability (usefulness) for writing mobile agent applications.

8.0 Agent Systems

Agent systems are implemented through agent platforms. Platform define a standard around which a system can be developed. Platform may provide support for migration, naming, location and communication services. Furthermore, an agent system consists of one or more execution environment or agencies. How an agency is constituted or built is dependent on the type of agent system one is building, but a generic architecture is as depicted in figure 2.

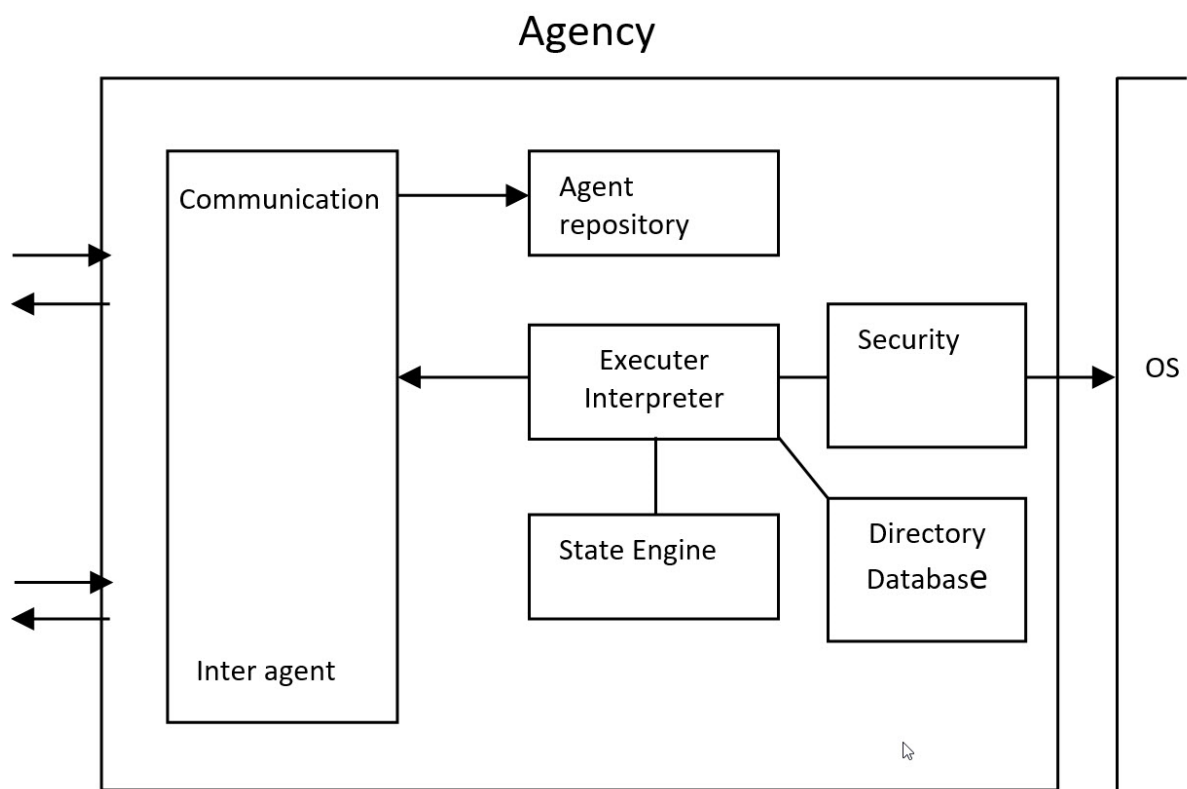


Figure 2. A Mobile Agent System Architecture. (Source:[5])

9.0 Challenges of mobile Agents include the following:

- Transportation: how does an agent move from place to place? How does it pack up and move? •
- Authentication: how do you ensure the agent is who it says it is, and that it is representing who it claims to be representing? How do you know it has navigated various networks without being infected by a virus? [12].
- Secrecy: how do you ensure that your agents maintain your privacy? How do you ensure someone else does not read your personal agent and execute it for his own gains? How do you ensure your agent is not killed and its contents ‘core-dumped’?
- Security: how do you protect against viruses? How do you prevent an incoming agent from entering an endless loop and consuming all the CPU cycles?
- Cash: how will the agent pay for services? How do you ensure that it does not run up an outrageous bill on your behalf?
- Performance issues: what would be the effect of having hundreds, thousands or millions of such agents on a WAN?
- Interoperability/communication/brokering services: how do you provide brokering/directory type services for locating engines and/or specific services? How do you execute an agent written in one agent language on an agent engine written in another language? How do you publish or subscribe to services, or support broadcasting necessary for some other coordination approaches?

10.0 Conclusion:

Mobile agent technology is a paradigm that involves the migration of an agent from one host to the other in performing a task on behalf of the user, suspending execution at one location and resuming at another location from where it stopped. Various benefits have been put forward for the use of mobile agent technology. Mobile agents provide security to the information. Since E-commerce deal with business online, security plays the heart of business. Business needs lots of communication skills which is provided by Mobile agents. Mobile agents are responsible for customer satisfaction in terms of B2B E-commerce. Mobile agents can be thus proved as an important entity with respect to E-Commerce. Without Mobile agents E-Commerce is like “a man having his leg cut”.

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