Mobile Agent : A Review

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Abstract

Mobile Agent is an alternate approach to compose a dignified distributed system. The mobile agent avenue extends the applet approach by moving code, information setting starting with one host then onto the next too. The agents moving at one location, move with their information to another host, and at that host execution extended. A comparative study is done and classification according to the performance of the JADE and Aglet mobile agents characteristics and also focuses on jade and aglet framework as a suitable architecture for distributed system for multi agent organization. The goal of this paper is to study the mobile agent platforms and their life cycles and comparison.

Keywords: Mobile Agent, JADE, Aglet**.**

1. Introduction

User authentication is a service crucial for many electronic transactions. Without a secure verification of users, it would be impossible to provide many services both on the Internet and during everyday life. We need authentication methods for the verification of identities and person’s authorizations. Users release a lot of personal information while using authentication services. Each time a user gains access to an authentication service, it releases his/her identity, which can be abused by the service providers for tracking their behavior , profiling our usage of the service or even for impersonation. It is not only the security of service providers which is at stake but also the security and privacy of users that must be also protected. The mobile agent approach has been proposed an extension to mobile code approach. The mobile agent approach extends the applet approach by inspiring code, information and context from one host to another as well. The agents running at one location, move with their context to another host, and continue processing at that host. A mobile agent executes on a machine that will provide a resource or service that it needs in future to complete its task. If it does not find the required resource/service on that machine then the state information of that mobile agent is saved and migration to a machine consist the important resource/service is started, thus resuming the processing at the new machine. A mobile agent is a software entity which exists in a software environment. It inherit some of the characteristics of a software agents . Mobile agents are a special kind of mobile objects. They are autonomous, intelligent programs that move through a network, searching for and services on the user’s behalf. They have behavior, state and location. It continues where it left off. Mobile agents can migrate from space to space carrying their States with them. The space is a server of some kind and is also an object where agents travel to. As opposed to mobile agents, spaces are static objects. Once an agent is accepted at a space, it is loaded into a space where it can execute. Agent execution is subject to resource availability and security constraints that spaces impose on them. In this paper discussed about the mobile agents and their platforms, study the literature survey and compare the mobile agent platforms aglet and jade on different parameters.

2. Mobile Agents

The mobile agent approach has been developed as an extension to mobile code approach (e.g. applet). This approach could replace the traditional client-server model in the near future. The mobile agent approach extends the applet approach by moving code, data and context from one host to another as well. The agents running at one location, move with their context to another host, and continue execution at that host. Mobile code and mobile objects are normally moved by an external entity whereas mobile agents are usually migrated autonomously.

A mobile agent executes on a machine that will provide a resource or service that it needs in future to complete its task. If it does not find the required resource/service on that machine then the state information of that mobile agent is saved and migration to a machine containing the necessary resource/service is initiated, thus resuming the execution at the new machine.

An agent is a computational entity which:

- Acts on behalf of other entities in an autonomous fashion.
- Performs its actions with some level of proactivity and or reactive less
- Exhibits some level of the key attributes of learning and Co-operation.

A mobile agent is a software entity which exists in a software environment . It inherit some of the characteristics of a software agent (as defined above). Mobile agents provide different way of communicatio11 from traditional client server approach .A mobile agent must contain all of the following models: an agent model. A model, a computational model, a security model, a communication model and finally a navigation model . Mobile agents are a special kind of mobile objects. They are autonomous, intelligent programs that move through a network, searching for and services on the user’s behalf. They have behavior, state and location. Mobile agents are autonomous because they can decide where they will go and what they will do. They can control their lifetimes, decide whether or not to comply with external requests and decide to perform actions, such as travel across a network to a new computers independent of any external request. It doesn’t restart execution from the beginning at the new computer, it continues where it left off. Mobile agents can migrate from space to space carrying their States with them. The space is a server of some kind and is also an object where agents travel to. As opposed to mobile agents ,spaces are static objects. Once an agent is accepted at a space, it is loaded into a space where it can execute. Agent execution is subject to resource availability and security constraints that spaces impose on them.

2.1 Mobile Agents Objective

The mobile agent archetype is suited in various function range from which some fields are especially identifies as computerized jam and stock market. These range need high activity of cash. Now the customer will put his cash in mobile-agent only when he is satisfied that his cash is protected and the agents can be believe that those who are concern with his cash or swap some protected messages. This is one cause which considered a lookup power in privacy of mobile-agents which has its own choice when used in these fields. Agents are mobile in nature, which adjust them to navigate freely in the network, due to this reason the agents grow into more unprotected to various attacks. These attacks bare the disadvantages of mobile agents in the field of privacy. Most of these incursion are determine the usage of mobile-agents to its full probably will remain a restraint.

2.2Mobile Agent Life Cycle

In accordance with FIPA specification, APLC i.e. Agent Platform Life Cycle, of JADE agent fall in any of states; Figure shows the various life cycle states which are explained below.

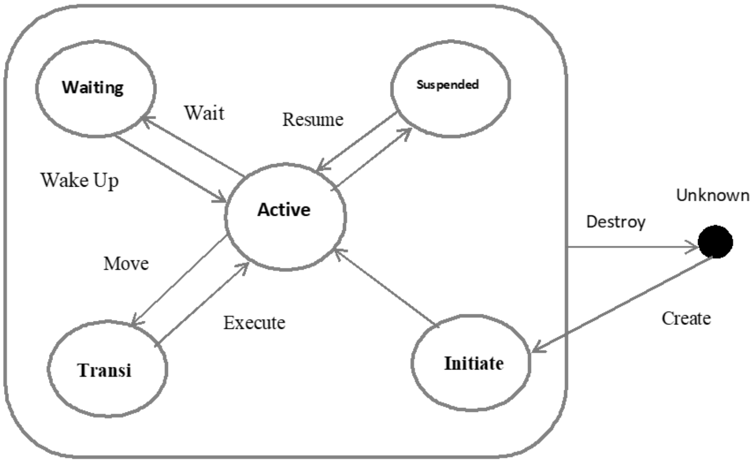

Fig 1.3 Life-Cycle of Mobile Agent

- INITIATED- Even if the object agent is created, doesn't get a name and address unless it is registered with the AMS, and not able to talk other agents or systems.
- ACTIVE – Register with AMSTD , agent object have their own regular name and address which make them enable for using the JADE framework.
- SUSPENDED - this is state which indicates that Agent object is stopped at present. So agent behavior is not executed.
- DELETED - the Agent is definitely dead. The MA will not remain registered with Agent Managing Service and the internal thread has terminated its execution
- WAITING - when the object agent wants some resources, it is blocked. This is called as a waiting stage.
- TRANSIT – while migrating, it within different node of same AP, the MA is enters in this state. All the buffered messages will be sent to the new place of agent by the system.

To perform transitions between the various states, Agent class comes with public methods. For example, the method named do Wait() is used to put an agent into a WAITING state when it is in a state ACTIVE.

2.3 Mobile Agent Architecture

The framework of the structure which subsist of some segments, their particular performance and their interconnection with each other . The primitive framework of the mobile agent can be speculation of as a client sends out an agent who move the network staying servers in series to achieve some appropriate action. The framework subsists of:

Agent Manager: Responsibilities performed by the Agent Manger are:
From remote hosts it send and receive agents.
By severalizing the agent it provide agents for transport.
Reassemble received agents and creates the agents beheading situation.

Security Manager: Security manager responsibility are:
Authenticates agents before allowing execution.
Automatically entreat when the agents effort to use any scheme resource or assets for any unapproved movement. Secure the host and agent from unapproved approach.

Directory Manager: Directory Service help the agents, for find out the details or find the agents .
Language: The structure of a mobile agent gadget describes the flow of data amongst the number factor of the system. The language used for the environment friendly switch of records and gives the developer with the equipment to efficaciously implements the system.

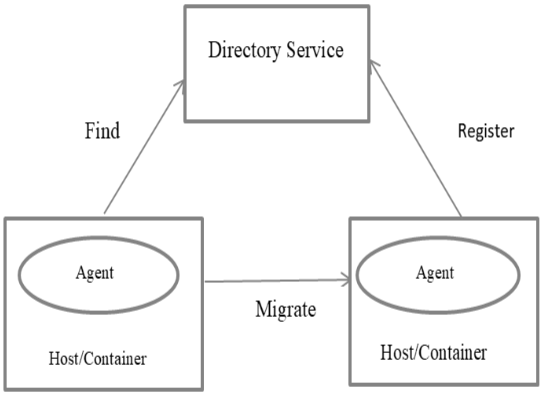

Fig 1: Mobile Agent Framework

Mobile agents could be used in following fields:

User could use them to find resources and complete tasks for them while they are off- line.

They could be used in network management to notify appropriate people when something breaks down.

Mobile agents could be used for data collection from many places. One natural application of mobile agents is collecting information spread across many computers connected to a network.

Mobile agents could be used for searching and filtering. On behalf of a user. A mobile agent could visit many sites, search through the information available at each site, and build an index of links to pieces of information that match a search criterion.

Mobile agents could be used for monitoring application. This kind of application highlights the asynchronous nature of mobile agents. When an agent is sent, it is not necessary to wait for the results of its information gathering. An agent can be programmed to wait as long as it takes for certain information to become available. Also, you needn't stay connected to the network until an agent returns. An agent can wait until reconnection to the network before making its report.

Mobile agents could he used for targeted information dissemination. Another potential use of mobile agents distributing interactive news or advertising to interested parties.

Mobile agents could be used for negotiating. Besides searching databases and files, agents can gain information by interacting with other agents.

Mobile agents could be used for parallel processing. Given that mobile agents can move h.om node ta node and can spawn subagents. One potential use of mobile agent technology is as a way to administer a parallel processing job. If a computation requires so much CPU time as to require breaking up across multiple processors. An infrastructure of mobile agent hosts could be an easy way to get the processes distributed.

Now we discussed in the next section platforms of mobile agents AGLETS and JADE.

2.3.1Aglet

In 1997, IBM originally refined Aglets. Since 2001, control by the Open Source Community is apparently the most suitable mobile agent platform refined so far. Aglets are composing of single thread architecture for agents and exchange a framework mainly based on message passing. Agents in Aglets use intermediary as a conducive absorption to assign a remote agents. These aglets interface with the aglets API and its implementation, the aglets runtime layer, needed for the proper management and execution of aglets consists of two parts: a core framework and a set of extensible system management components:

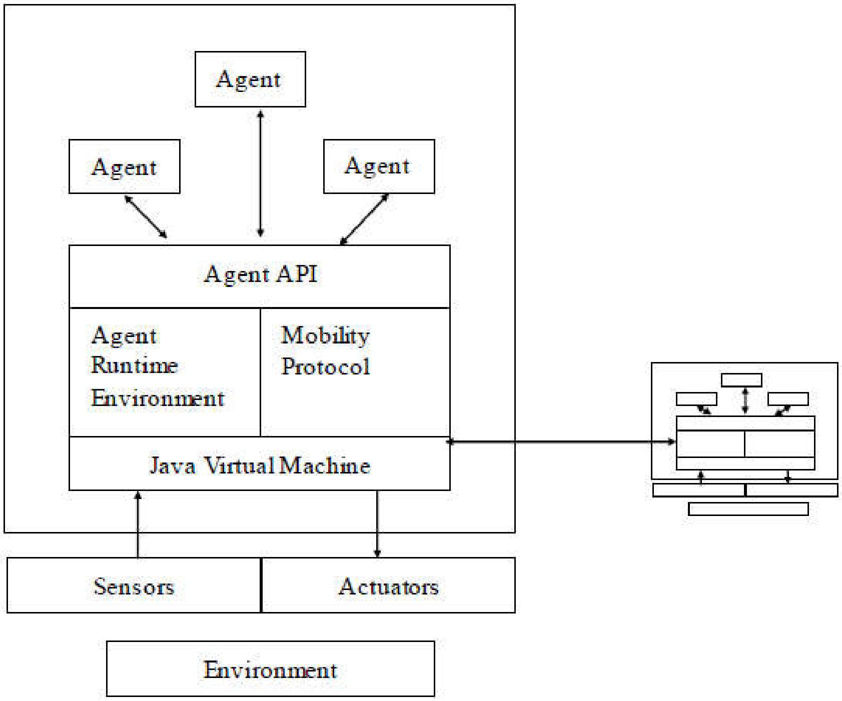

Fig 2.Aglet Framework

Java agent an aglet capable of unrestrictedly and automatically migrate from one host to another. Aglets totally made in Java, Aglets incorporates both a total Java mobile agent stage, with a stand-alone server called Tahiti, It provides users with a good GUI and allows users to create & dispatch an agent, monitor it, dispose it off when required. It gives user the ability to set agent's access privileges on the server.

2.3.2 JADE

In February 2000, JADE was openly launched , developed with the aid of Telecom Italia Lab . It is a very eminent FIPA-flexible agent platform. An agent is self-assured of exceptional coincident behaviors, which can be conveyed domical. Through the benefits, we should point out that there is a large range of equipment furnished and it can be built-in with exceptional software. Finally, it is also well worth bringing up its help for the development of ontologies to represent the know-how of agents. The most important drawback is that mobility is no longer a key aspect in JADE.

Thus, it focuses on different functionalities applicable to the improvement of multi agent systems. JADE (Java Agent Development Framework) is a mobile agent based architecture fully implemented in Java language. It includes a runtime environment where JADE agents can perform the desired actions such as cloning, migration and messaging. Moreover, JADE is very flexible, usable and tailored to be used on devices with limited assets such as PDAs and mobile phones. JADE has been globally and broadly used over the final years with the aid of many tutorials and industrial companies varying from tutorials or educating support in agent related university publication to industrial prototyping.

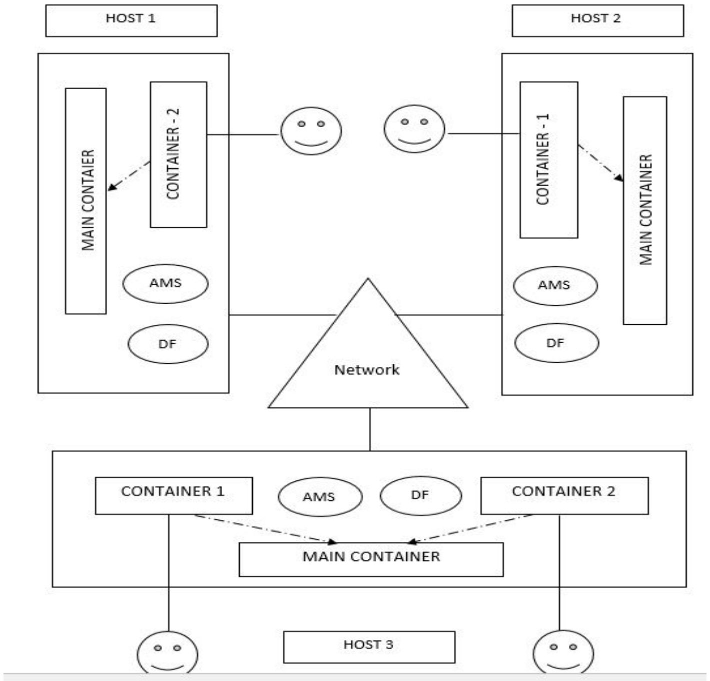

Fig 3. JADE Framework

A JADE platform comprises of agent containers that can be dispensed over the network. Agents stay in containers which are the Java system that offers the JADE run-time and all the services required for web hosting and executing agents. There is a one-of-a-kind container, known as the major container, which represents the bootstrap point of a platform: it is the first container to be launched and all different containers have to join to a foremost container via registering with it. The programmer identifies containers via truly the use of a logical name by way of default the fundamental container is named 'Main Container' whilst the others are named 'Container-1', 'Container-2', etc.

In the give table below we summarize the various features of AGLETS and JADE on the basis of different parameters.

Table 1. Features of Mobile Agent Platforms

FEATURES	AGLETS	JADE
1. Models	Events	Behaviors
2. Elements	-Contexts -Tahiti -Agents(Aglets)	-Containers -Main Containers -Platforms -Agents
3. Proxies	Yes	No
4. Dynamic Proxies	No	No
5. Synchronous Communication	Yes	No

6. Asynchronous Communication	Yes	Yes
7. Messages	Yes	Yes
8. Remote Calls	No	No
9. Callbacks after movements	No	No
10.Call/messages by Name	No	Yes
11.Movements by Name	No	Yes
12.Available for Downloads	IBM Public License	LGPL
13. GUI Tools	Some	Yes
14. Level of activity	Very Low	Very High
15. Security Mechanism	Basic	Yes
16. Some Other Features	-ATP -Itinerary	-FIPA

3. Literature Survey

Nimbalkar ,*et al,* [3] introduced a development of load balanced of migrating the agents on different platforms. This provided improved work in assassinate the movement in distributed environments, which allowed processing from host to host dynamically to any point . A migration algorithm was introduced to migrate the processes dynamically to host having low load using the load of CPU as parameter.

Shrouf,*et.al.,*[4] pattern of mobile agent design classification are expanded which also define optimization patterns. The distribution of mobile agent architecture are extended to comprise optimization patterns. there are basically Two (2) optimization design patterns in mobile agents: Optimization Pattern of V-Agent and Optimization Pattern P-Agent . On the support of mathematical computing model these were proposed, which support reusability of designs in mobile computing area. Specimen of four master mobile agents which created three slave mobile agents were used.

Dada E. G.*,et .al* [5] Mobile Agent is an alternate way to compose a dignified distributed system. The mobile agent advent extends the applet approach by moving code, information setting starting with one host then onto the next too. The agents moving at one location, move with their information to another host, and at that host execution extended. A provisional discussion is done and allocation according to the execution of the JADE and Aglet mobile agents characteristics and also focuses on jade and aglet architecture as a suitable framework for distributed system. The goal of this paper is to study the mobile agent platforms and their life cycles and comparison.

N. Asokan, *et al.,* [6] proved that when a authentication protocol at the client is tunnelled within another protocol, it is necessary for every last entity to show their participation in both protocols and if not done then the whole authentication is perceptibility to man-in-the-middle attack. These type of protocols are created by joining of two protocols: an authentication and a tunnel protocol. A cryptographic binding facility is required between the tunnel protocol and the authentication protocol. A secret key is required by the authentication protocol for the use of the binding.

Mohamed Bahaj, *et. al*, [7] developed a FIPA compliant agent model called Mobile-C for mobile C/C++ agents. Mobile-C library that can embed Mobile-C into any C/C++ programs to facilitate the design of mobile agent-based applications, also the possibility to combine the migration of the mobile agent over the network and the synchronism mechanism existing in Mobile-C. They also proposed to combine the mechanisms of agent migration and their synchronization.

U. Kumar,*et. al.*, [8] showed that fingerprint and mobile agent based key distribution can be done with all the benefits of mobile agent approach. In this approach the fingerprints of the user are converted into the cancellable template for transmission. KDC serves as the key distribution center for key distribution. Number of message transfer for key distribution and traffic for the same is being minimized.

S. Srivastava ,et al, [9] Mobile agent paradigm is one such science which has sever a applications where it can be beneficial to identify a few areas the place the mobile retailers have practicably deployment is database search , distributed framework and e-commerce. It can produce very proper results in confined resources or in poor surrounding the place bandwidth and memory are giant constraints. But still it is not broadly normal due to its protection issues. This work seeks to explain the targets and properties of the mobile marketers in currently used architecture and platform of mobile world from the presently used strategy RPC(Remote Procedure Calling) and new approach RP (Remote Programming) of the mobile network we can distinguish the quite a number used unused and new features of mobile agents.

Preeti Sharma, *et.al.,* [10] proposed a secure migration process known as Mobile-C for mobile agent transportation from one host to another host. SSH protocol is the active force behind the migration and ACL messaging of mobile agents in Mobile-C. To improve the security they used digital signatures for authentication and DES for encryption.

Table 1. Comparison of Mobile Agent Framework

Features		**JADE**	**AGLET**
Communication		Very Good : Following standards for agents communication it compatible with FIPA standards.	Weak: Does not follow standard they use paradigm for agent interoperability (MASIF). Because the aglet created when the FIPA is proposal. But not updated till now.
Security	Authentication	**Very good** mechanism before attaching any container must be authenticated.	**Weak** mechanism. Authentication for starting the Tahiti interface. So any agent can access the Tahiti.
	Permission	**Good**: Each agent must to be authorized	**Good**: Each agent must to be authorized
	Message Encryption	Have services to encrypt and sign of message	Does not support
	Dispatch of agent.	Very good and simple method to dispatch the	Very good and simple method to dispatch the agent

Mobility		agent	
	Optional method for dispatch agent.	**Yes**: It has an optional services execute when the start to move	**Yes**, very good Services
	Return Back agent.	**No GUI** services **Code only**	**Code and GUI**
	Clone of agent	**Very good** services and simple method for clone agent	**Simple** method for clone agent

In the above table, comparisons are made between Mobile agents frameworks implemented by several researchers. Comparison are done on the features like Communication, Security and Mobility .

4. Conclusion

A comparative study between JADE and Aglet has been submitted, the comparison was based on three parts of evaluation. In first part we used a framework of evaluating the agent . The evaluation based on running same scenarios on this toolkits, three criteria has been selected in evaluation the criteria was (communication, security and mobility), the results showed that the communication in JADE is better than the communication in Aglet. The security criteria in JADE is better than Aglet In the mobility criteria the showed the preference of Aglet versus JADE. While the results obtained in phase three showed JADE has many features for management and monitoring the agent included in its GUI while Aglet has simple GUI.

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