Security Method: Cloud Computing Approach Based on Mobile Agents

Ali Alwesabi¹, Kazar Okba²

¹Computer science department, university of Batna,
²Computer science department, university of Biskra
elwessabi@gmail.com¹, kazarokba@yahoo.fr²

ABSTRACT

The cloud computing is a new computer model that provide computer services in the form of services on demand, accessible from anywhere, anytime and by anyone, the cloud computing are mainly used for the treatment of loads computer work very intensive and provide very large storage of data, these two objectives are combined with the third goal of potentially reducing management costs and use.

In this paper, we present an architecture based on mobile agent for cloud computing, today most applications of cloud computing use the model "client / server" where the exchange is done by sending messages across the network , this model has the disadvantage of increasing the traffic on the network and requires a permanent connection.

In this paper, we propose a new approach that uses mobile agents in cloud computing, our architecture is based on mobile agents that have kept the goal of security communication in cloud computing, we are relying on the ability of security of agents.

KEYWORDS

Multi-agent system, mobile agent, cloud computing, cloud security, virtualization architecture.

1 INTRODUCTION

The Cloud computing is a concept that combines several technologies for deliver different services (Figure 1).

The Cloud Computing is a passage from the computer to the Internet. Users are no longer owners of their computer servers but may gain many services online scalable without having to manage the underlying infrastructure, often complex. Companies in this context would no longer need for clean rooms or servers or computer scientists.

All applications are leased and run through the browser or application servers.

The providers of cloud distinguish three services of cloud computing.

- **Software as a Service (SaaS)**
  SaaS software is used directly on the network, without being downloaded first in the local computer user environments. The software applications are available on the Internet via a SaaS provider, and are executed in the computing environment predefined from this supplier [1].

- **Infrastructure as a Service (IaaS)**
  IaaS is a complete computing infrastructure used as a service. To create and use their computing infrastructures freely, according to their needs and only when they need it, users or tenants, access to specific parts of a consolidated pool of federated resources [2].

- **Platform as a Service (PaaS)**
  PaaS is a computing environment available and accessible, as needed, from a service provider. Used to develop and run software [3].
We distinguish three types of cloud computing: the public cloud, private cloud and hybrid cloud is actually a combination the first two (Figure 2).

- The Public Cloud: the idea is to host applications, Web applications in general, on shared environment with an unlimited number of users. The implementation of this type of cloud is managed by third parties (such as Amazon, Google, etc...) and is available on a pay-as-you-go model [4].
- The Private Cloud: this is a deployed environment within an enterprise. Thus, it must manage its infrastructure alone. In this case, implement a private cloud signify transform the internal infrastructure using technologies such as virtualization to deliver services to request, more simply and faster. The advantage of this type of cloud from the public cloud lies in the aspect of security and data protection [4].
- The Hybrid Cloud: in general, the term hybrid cloud cohabitation and communication between a private cloud and a public cloud in an organization sharing data and applications.

The Cloud computing enlarged the area of distributed computing systems by providing advanced Internet services complement and complete functionality of distributed computing provided by the Web, grid computing and Peer-to-Peer. [5]

Multi-agent systems are often used to solve problems using a decentralized approach where multiple agents contribute to the solution by cooperating with each other. Although several differences between cloud computing and multi-agent systems, they are two of distributed computing models, so many common problems can be identified and several advantages can be obtained by integrating the use of cloud computing systems and multi-agents.

This article is structured as follows: in the next section we will briefly present a number of studies linking technical virtualization and his relation with cloud computing. Thereafter, our new approach to cloud computing which based on mobile agents will be detailed in the third section. The proposed method will be discussed in Section 4 and the experimental results in Section 5. Finally, a conclusion is a summary of the research and presents the perspectives considered.

2 CLOUD COMPUTING AND TECHNICAL VIRTUALIZATION AND REALTED WORK

In Cloud, the flexibility is achieved through the virtualization of operating systems. The virtualization is the set of techniques and tools to run multiple operating systems on one physical machine to deliver a better use of resources.

The virtualization tools most used are: OpenVZ, Xen, KVM, Virtual Box, VMware and HyperV.

- OpenVZ is a virtualization solution type isolation based on the Linux kernel and allowing one physical server to run multiple instances of isolating systems operating [6]. OpenVZ offers less flexibility in the choice of system operating. In fact, the guest operating system and host must be of type Linux.
Xen is a free virtualization solution to run multiple operating systems on one physical machine running. It is hypervisor is considered a solution based paravirtualization, because guest systems must be modified to cohabit [7].

Cloud computing represents a new challenge in the information technology world. Several solutions are proposed: proprietary solutions and open source solutions. The establishment of a cloud computing environment for research purposes initially requires the choice of an open source solution and then its installation. The decision is often very difficult to take since each solution has its own characteristics. Here is an overview of the two tools open-source cloud computing providing an infrastructure as a service and allowing simplified management of complex hardware architectures.

- **Xen Cloud Platform (XCP)** is a platform open-source of Cloud Computing developed by the Xen community and distributed under GPL license, it aims to provide a free open-source platform to build and interact of Cloud Computing services (Figure 3) [8].

  - **XCP Host:** it consists of a Xen operating system.
  - **Master XCP Host:** it manages XCP hosts.
  - **Shared storage:** this is an optional component that stores machine virtual, this component allows administrators to move machines virtual from XCP host to another.

  - **AbiCloud:** mainly developed by Abiquo, it’s a platform of Cloud Computing to create and manage public cloud, private and hybrid (Figure 4).

    - **AbiCloud server:** it consists of a Xen operating system.
    - **AbiCloud WS (AWS):** is responsible for managing virtual machines.
    - **Virtual System Monitor (VSM) WS:** This is the component that allows follow the entire virtual cloud infrastructure.

![Figure 3: architecture of Xen Cloud Platform (XCP).](image)

![Figure 4: architecture of AbiCloud.](image)
In the work of Priyank S et al [9], they studied the Xen virtual environment and they propose a trust model based on security agents for its, which are simple mobile agents that provide security at the virtual machine and the entry point of the network cloud to cloud customers and service providers to manage their resources and data safely and efficiently. These mobile agents not only provide security measures, but also ensured the accounting and monitoring activities in the virtual machine if its malicious or normal state, so that the client is kept informed of the data. If alarming conditions, the client is informed and can take the necessary measures required.

3 OUR ARCHITECTURE

In this section we are first presented the objectives of the proposed system, its overall architecture, highlighting its four main layers and overall functioning.

3.1 The Objectives Of The Systeme

Most of cloud computing applications use the traditional client/server model in which an operation requires generally a permanent and stable communication between the user and the server, thus the traditional client/server approach constitute an obstacle to the development of cloud computing applications. The concept of mobile agent appears in this context as a solution to facilitate the implementation of dynamically adaptable applications, and provides a generic framework for the development of cloud computing applications. In this model "mobile agent" means an agent is a process with an execution context, including code and data can move from machine to machine (called servers) to perform the task assigned to it [10] .

A priori, the advantages of mobile agents are numerous:

I. The execution of specialized agents offer advantage of flexibility more that running a standard procedure on the server site, and allows transactions more robust than remote transactions.

II. Agents are able to search for information in a smarter way, for example searching by concepts. Agents are also able to correct queries the user, based on the model attached to them.

III. Agents can create their own knowledge bases that are updated after each search. If the information exchange site, agents are able to find it and subsequently adapt to this change. In addition, agents are able to communicate and cooperate with each other (and this is their real strength), which accelerates and facilitates research.

As we have already mentioned, the architecture proposed in this work is a mobile agent based approach designed for the execution of a service in cloud computing. It defines a set of components (agents) and functional modules described in terms of their behavior and interfaces, and how these components interact in order to accomplish all the tasks correctly in the system.

3.2 Our Proposed Framework Architecture

The general architecture of our system, shown in Figure 5,

![Diagram of architecture](image)

**Figure 5:** Representation of our system.

The Figure 6 presents our architecture, which is based on the concept "mobile agent" for cloud computing, which divided into two main layers interact: First the virtual server layer and the second is the cloud computing layer.
Figure 6: The architecture proposed.
3.2.1 Virtual server layer

This layer contains the application that allows the client to query the system. Its primary role is to capture the purpose of the user to meet his best needs. It includes an interface that interacts with the user to help achieve specific task. This interaction results in a transformation of the demands of the user, then sent to cloud computing layer.

It’s composed of four agent detailed suite:

- **Interface agent**

  This agent can be seen as simplifying allowing users to interact with the system, it’s a stationary agent that runs on a user's device and provides a graphical interface to interact directly with our system it’s primarily responsible to acquire all user queries, send those requests to appropriate agents and present the results to users (Figure 7).

  - User interface: this module allows the interaction with the user so that it can interact with our system.
  - Treatment module: the role of this module is to analyze the data of users and allows collecting information from the graphical interface and after that it creates the request and send it to the mediator agent.
  - Communication module: is responsible for security interaction between this agent with other agents in the system
  - Data base: this module is stored all the knowledge of the agent like the information transmitted by the agent interface and the profile of the current user.

- **Mediator agent**

  The mediator agent is an intelligent agent that treats service request; he plays the role of interface between the user poses a query or request for service or resource and all sources of cloud computing that provides services, for each request the mediator agent will generate a mobile agent to move to the task manager of the cloud to find adequate demand services acquired. When the execution of request is completed, the mediator gathers the results found by the mobile agent as a service that is requested by the user. The mediator agent has the ability to control the motivations of transfer agents who come to him thereby increase the level of system security (Figure 8).

  - Management module and control: this module is responsible for taking care of all the activities related to the execution of a user's query, it also maintains a list of users and their cloud
  - Module generation agents: this module allows the generation of mobile agents and defines where they start their executions.
  - Module control agents: this module allows the mediator agent to control all the agents created, a mobile agent system should provide mechanisms to secure execution of agents in the system.
  - Communication module: is responsible for security interaction between this agent with other agents in the system.

![Figure 7: The interface agent.](image-url)

![Figure 8: The mediator agent.](image-url)
• **Analyzer agent**

This agent communicates with the mediator agent to analyze the authentication information and to analyze the request and the response of the system at the request of users. So its role is based on a request of the user, the analyzer agent selects a list of cloud provider that has the requested information with service using a database and when performing the application is complete, the analyzer shows the results found by the transfer agent and the analyzer agent then returns the result to the mediator agent (Figure 9).

- Treatment module: this module is responsible for analyzing the authentication of each user and the analysis of information or services provided by the cloud layer via the transfer agent.
- Authentication Security Module: the role of this module is to authenticate users of cloud computing and cloud computing corresponding to each user.
- Data base: this module is stored all the knowledge of the analyzer agent, information services, users and their authentication, providers of cloud computing and the history of services offered by each.
- Communication module: is responsible for security interaction between this agent with other agents in the system.

These transfer agents migrate to a cloud specified to satisfy the request by the interaction with the task manager located in a cloud specified, and then he returned to the mediator agent to get the answer to the analyzer agent. Finally, he destroys himself (Figure 10).

- Mobility Module: this module allows you to manage migration of the agent running from server to cloud or a cloud to cloud across the network.
- Treatment module: from this module, the mobile agent may need to run a treatment process.
- Communication module: is responsible for security interaction between this agent with other agents in the system.

![Figure 9: The analyzer agent.](image)

• **Transfer agent**

The transfer agent in our system is the mobile agent and it’s created by the mediator agent who tells him the task.

![Figure 10: The Transfer agent.](image)

### 3.2.2 Cloud computing layer

This is a class capable of receiving service requests, process and returns the results. This layer includes all task managers, security agents and executor agents which are distributed over the cloud to manage all service associated with it.

- **Task manager**

The role of this agent is to maintain order in the cloud; it provides all the necessary information for each agent. For example notice security agents of arrival of a transfer agent. It controls and manages all the other agents of cloud as executor agent and security agent. The agent task manager is a temporary agent responsible for carrying out the service requested by the customer service (Figure 11).
Control and planning module: this module responsible to support all activities related to the execution of a service and managing virtual machines in cloud computing.

Communication module: is responsible for security interaction between this agent with other agents in the system.

Knowledge: it is a database containing a list of virtual machine of cloud computing with their corresponding tasks, it’s include all information about planning in cloud computing, the overall plan of this agent, task, resolutions rules of conflicts between agents cloud and constraints to be respected for each service.

Information register: this register contains information about the virtual servers (registration name and password etc…) so that it can authenticate when connecting, this register also contains information about the data exchanged between agents (signature data) to verify their authenticity that draws and it also knows the authorization of each virtual server (user).

Communication module: is responsible for security interaction between this agent with other agents in the system.

• Security agent

The role of this agent is to maintain the security, data integrity and authentication of partners cloud (Figure 12).

Generator degree of safety: this module generates a degree of security for each virtual server resister in cloud computing and wants to request a service.

Authentication and analysis module: the role of this module is to authenticate the virtual server and their user of cloud computing.

Executor agent

It is a local agent at the cloud, it is responsible for responding to requests from mobile agents arriving at its cloud computing. Executor agent is represented by a structure comprising a communication module, a module for planning and coordination, execution module and treatment module. The executor agent has two other knowledge modules, which are: individual knowledge and knowledge of cloud computing (Figure 13).

Communication module: contains all the process of management messages, reception, filtering and translation of incoming messages and the formulation and sending outgoing messages.
Planning and Coordination: this is the module responsible for the management of cooperation and formulation of offerings to meet the goal announced by the task manager.

Execution module: this module does not contain the resources cloud computing, but also it contains the information of the internal resources of cloud computing (application, users, sources of knowledge, etc..) that allow the realization of the tasks assigned to the local cloud, this module has the role to achieve correspondence between the task assigned to the agent and the internal resources or cloud capable of completing this task.

Knowledge of cloud computing: contains information about the organizational and operational rules defined by the cloud, it explains that for this cloud each agent is part of it, list of all members agents, this module also contains the information of the rights and obligations of agents in the cloud.

Individual knowledge: contains the information about the agent itself, abilities and skills, status and current workload, that is to say, for each task it assigned indicators to determine the availability and cost of this task.

Our approach describes a secure method of communication between the cloud service provider and users in a cloud, all users and service providers are expected to be honest in the registration phase. After the registration phase is completed, any user or service provider is secure.

![Figure 13: The executor agent.](image)

![Figure 14: Proposed rules of the server registration.](image)

![Figure 15: Proposed rules of the user registration.](image)
4 PROPOSED METHOD

We arrive in the proposed model at the proposition of our architecture, it is based on the concept of the mobile agents to realize an approach of cloud computing, here cloud environment is considered to have three components which are client, virtual server and cloud service provider. The whole procedure can be summarized in following steps:

STEP 1: The users send his identification to an agent interface, and then the agent interface sends the identification information to the mediator agent. After that the mediator agent sends the access information to analyzer agent.

STEP 2: The analyzer agent returns the response to the mediator agent, if the access information is correct the mediator agent will be informed the interface agent to load the interface otherwise the request of access will be abandoned.

STEP 3: the interface agent establish secure connection and get the request of user and send it to mediator agent, the mediator agent will be create a transfer agents (mobile agent), and the transfer agent migrates to the cloud computing layer to transfer the information or service requested by the user.

STEP 4: the task manager sends the request to the security agent to determine where the request arrival and verified the information access and the degree of security of our system where the arrival request, after that the security Agent sends the response back to the task manager, if the information access is correct and our system where the arrival request are confident the request will be passed otherwise be abandoned.

STEP 5: if the response of the security agent was positive the executor agent will be launched and the executor agent performs the service requested and return the result to mediator agent.

STEP 6: The task manager sending the result to the transfer agent and transfer agent migrates to our system, and the transfer agent sending results to the mediator agent.

Figure 16: Representation of proposed rules to launch request “part virtual server”.

Figure 17: Representation of proposed rules to launch request “part cloud computing”.

The Society of Digital Information and Wireless Communications, 2014 (ISSN: 2220-9085)
STEP 7: The mediator agent sends the results to the analyzer agent, the analyzer agent sorted the results sent by the mediator agent if that needed and returns the answer to mediator agent, the mediator agent sending the result to the interface agent and displaying the result to the client et end the secure connection.

5 EXPERIMENTAL RESULTS

To show the validity, reliability and scalability of our architecture, we have interest in a case study. Hence, we will apply our approach on an organization such as travel, this example considered a simple example to simulate working on a cloud. Assume the following scenario: Walid lives in Batna; he wants Skip the vacancy to another city. It prepares travel arrangements. It can use an airport near Batna and an airport near the city you want. He should consult an airline flight, it must determine the price and must determine the desired location and desired time and then he started to request from their device.

From the previous scenario, we can say that the process of organizing the travel is the consultation site of an airline to make a reservation for a flight; this example represents an application come a service whose purpose is to seek reservation a flight, good price in the desired time and to the desired city.

We note that this process is complex and requires more time and attention. Our goal is to automate this process by our system using the technology of mobile agents.

Our system consists of several agents that cooperate to meet the service demands of user, we distinguish: The interface agent, the mediator agent, analyzer agent, transfer agent and security agent task manager agent and executor agent.

The agents in our system are implemented using the Java [11] language and development platform Aglets [12].

- **The Aglet Platform**

Aglet is a platform specified for the development of mobile agents, the original of this platform is the research group of IBM research laboratory in Tokyo in the early in 1995, its aim is to provide a uniform platform for the mobile agent in a heterogeneous environment such as the Internet, and to provide a better security [12].

In our study, we used Aglets in the server part and the cloud computing part, because Aglets it has specified in mobility than the other platforms, with this for the use of the advantages of the mobiles agents, where the mobile agents offer several advantages improving the performance of distributed applications.

- **The System Interfaces**

In this interface showing in figure18, (a) the user send his identification and after the verification the interface will be loading (b) The user filling the fields by the necessary information’s (the Arrivals & Departures city, number of children’s, the date of flight). After filling it in the fields, he launches a search and waits the result.

Our system is constituted by several agents who cooperate to satisfy purchase orders or propositions of service of the user, the (c, d, e, and f) illustrate that, another interface appears and shows the result (figure19).
a) Shows the interface to launch the application.

b) Shows the interface after verification the ID.

c) Arrive a request to agent mediator and move the request to task manager of cloud computing.

d) Launch the service after checking security.

e) Shows the result from executor agent of cloud.

f) Arrive the result to the analyzer agent to analyze and return the result to agent interface.

Figure 18: the system interface
6 CONCLUSION AND PERSPECTIVES

In this paper, we are interested in the technology of mobile agents and their use for cloud computing environments. The purpose of the movement of these agents is generally access data locally or remote resources, making the local treatment and move only useful data. That is why we propose in this context, a new approach based on mobile agents to execute a service in cloud computing.

The advantage of this architecture is that it uses mobile agents as a communication entity. This is to reduce traffic on the network and reduce the amount of information exchanged, in which case the agent moves to the source information and performs local exchanges.

We believe that the use of multiple mobile agents to execute services improves the quality of the proposed solution and to reduce the waiting time of the user.

The different results obtained in the experience presented show that mobile agents can positively contribute to the development of a cloud computing system. Further research can be undertaken to improve the work presented.

That we propose the following:
- Integration techniques of natural language processing including user interface level, in order to make the system more efficient.
- Take into account the adaptability of agent’s appearance.
- Use of cooperation mechanisms between mobile agents in order to effectively perform the tasks required.

7 REFERENCES


4. MySaaS blog
http://mysaas.fr/2010/10/04/private-cloud-publique-cloud-et-hybrid-cloud/


6. OpenVZ,

7. The Xen project,
http://www.xenproject.org/.

8. The Xen wiki,


12. IBM’s Aglet Workbench Team, Aglets Software Development Kit,2000