

IABCF Smarter: An Intelligent Agent-Based Cloud Framework

^{1,3}Amr Tolba, ^{2,3}Ahmed Ghoneim

¹Riyadh Community College, King Saud University, Saudi Arabia

²College of Computers and Information Sciences, King Saud University, Saudi Arabia

³Faculty of Science, Menoufia University, Egypt

Abstract

Cloud applications that built based on service oriented architecture have dynamic natural behavior. These kinds of applications enable the stakeholders to customize their resources and software's they need based on the domain they want to build. There are many challenges during these harmonic structures such as how to face the changes of the stakeholder requirements at run-time, how to reconfigure the constituted architecture dynamically to consistency with new resources and software, finally the integrated cost very expensive. To cope with these challenges, we propose a new cloud framework that uses features of multi-agent systems that able to reconfigure the behavior of both allocated resources and software at run-time. The proposed framework is composed of three main parts: the first part is the cloud infrastructure, which extracts the user requirements using special service GUI and generates the user views that match the original requirements, then the second part which has two main functions: parsing the generated view and adapting this view using an agent adapter to face the run-time changes, the third part is the agent utilities that are used by the engines at the second component to reconfigure and continuously adapt the views.

Keywords

SOA, Cloud Computing, Multiagent System (MAS), Resource Allocation

I. Introduction

Coupling the cloud computing and agent aspects faces a lot of challenges such as intelligent resources, autonomous and dynamic behavior, requirement changes, and efficient visualization. Cloud computing promises a very powerful approach, reliable, predictable and scalable computing infrastructure for the implementing and executing of agent-based systems. On the other side, software agents make cloud computing systems more adaptive, flexible, and autonomic in resource management, service provisioning and in running large-scale applications [11].

A software agent is a computer entity that has some features that make it unique like being intelligent, proactive, perceivable, reasonable, autonomous and cooperative with other agents. Also, it may have an idea to conduct its own targets. Cloud computing is a model based on sharing services and information among network nodes. The main concept of using cloud environment is to put all services into the share place (cloud), and allow all users/nodes wherever or whenever they are having the ability to access them [10].

In a cloud computing environment, design techniques are required to adapt the dynamic behavior of clouds and its users. These techniques are helpful for users to achieve their targets. Software Agents with their features are used in a cloud environment to adapt the behaviors of cloud customers. The elastic feature of cloud makes it flexible to be used according to customer demands. Software agent features can match with the elasticity feature of cloud and this will be of great help in building a self-adapted

framework [9].

In this paper, we propose a new cloud framework that used the autonomous and learning features of software agents that able to reconfigure the behavior of both allocated resources and software at run-time. The output of the proposed framework is full consistent resources and software image.

The rest of this paper is organized as follows. In Section II, the proposed approach is described; we describe in details the following items: the layer structure, pseudo code, structural representation, and behavioral representation. Section III, illustrates the related works. Finally, In Section IV, conclusions and future work are discussed.

II. Proposed Approach

In fig. 1, we introduce the full structure of the Intelligent Agent-Based Cloud Environment (IABCF). Our framework is composed mainly of four main components: Cloud infrastructure, Agent features, view controller and agent adapter. The framework functionality will be illustrated using two views: abstract and concrete.

A. IABCF Functionality Abstract View

Cloud infrastructure enables the user to choose his required resources and software, after that constitute the matched image, then pass the execution to view controller that able to use the agent feature to dynamically adapt both the structure and behavior of the generated image based on the agent capability and the run-time changes (user changes or environmental changes).

B. IABCF Functionality Concrete View

We will illustrate the detailed scenario for the big picture of the framework functionality. The first core framework component is cloud infrastructure, which is composed of the following sub-components: The cloud infrastructure uses the cloud user service GUI to extract user views. The cloud user service GUI is responsible for providing an efficient interface with embedded engine that extracts the user requirements. After that, it uses the message adapter that handles the required consistency and requirements logical-ability. Then, the cloud service bus sub-component starts its functions as a path strategy as follows: allocated the suitable resources based on the matched requirements after that allocates the required software to match the user's software requirements, finally constitute a consistent image that includes the match resources and software's. The views of the constituted image are generated by the component Generated User views.

When the image view is constituted then the view controller starts its process by checking the usability and consistency of this view's. Moreover, it checks the satisfactory level of these views. The output after processing these components is a request for changes that includes both the user feedbacks and the inconsistency issues.

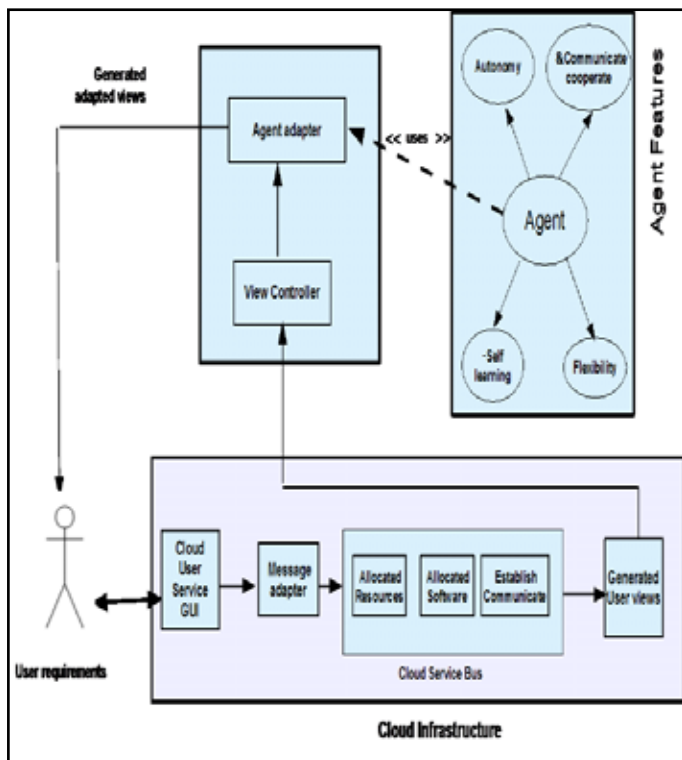


Fig. 1: An Intelligent Agent-Based Cloud Framework (IABCF): Abstract View

Finally, the agent adapter component reconfigures both the constituted image and views based on the generated request of changes and facing environmental changes. The agent adapter uses the agent features as shown in fig. 1, to apply the changes.

The structural diagram of the proposed framework is shown in fig. 2, which illustrates the core classes and their attributes and functions. The behavioral diagram of the proposed framework is illustrated using the sequence diagram as shown in fig. 3, that illustrates the dynamic behavior of the framework components and how it cooperate together to illustrate the big picture behavior of the framework. The pseudo code algorithm illustrates the core framework components function as shown in Table 1.

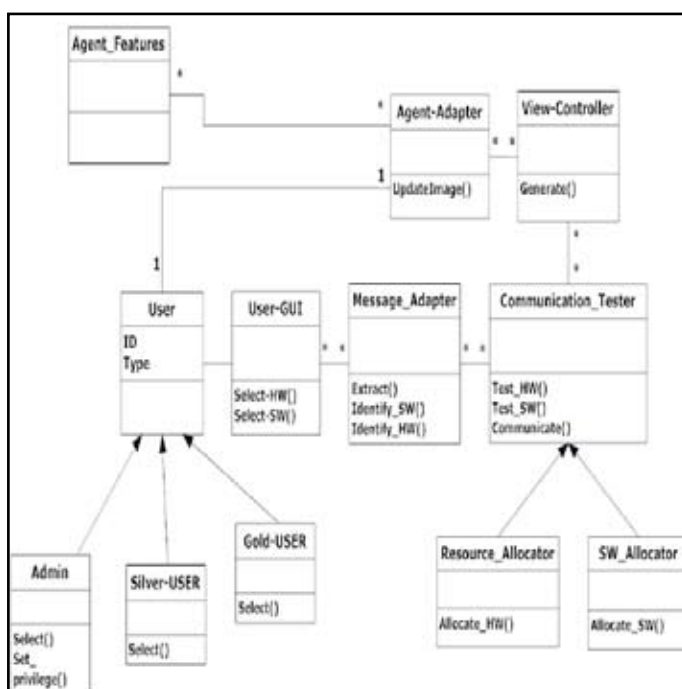


Fig. 2: IABCF Structural Representation: Class Diagram

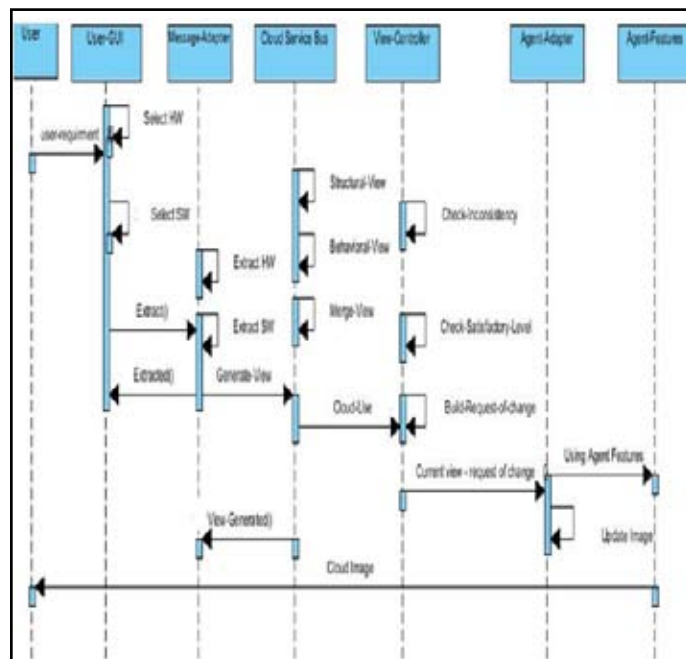


Fig. 3: IABCF Behavioral Representation: Sequence Diagram

Table 1: IABCF pseudo code: detailed big picture Algorithm

```

Inputs: User resources requirements, User Software Requirements.
Out puts: Consistent up-to-date Cloud Image

BEGIN- Main
    USEN_GUI (select(HW, SW));
    Message_adapter(extract, HW-Specifications);
    Message_adapter(extract, SW-Specifications);
    Call Cloud_Bus (HW-Specifications, SW-Specifications, OutPut: Cloud Image)
    For each Cloud Image Component
        Generated_User_View (GUV: generates (structural_view);
        Generated_User_View (GUV: generates (behavioral_view);

    EndFor
    For Each View
        View_Controller (VC.generate(request_of_changes, inconsistency));
        View_Controller (VC.generate(request_of_changes, user_satisfactory_level));
        Merge_request_of_changes(inconsistency, User_satisfactory_level); // for each view
    EndFor
    While request_of_changes exists Do
        Agent_adapter (request_of_changes, current image, OutPut: Up-to-date Cloud Image);
    End Do
END- Main

Subroutine Cloud_Bus(HW, SW, OutPut: Cloud_Image)
    BEGIN- subroutine
        Allocate_HW(HW, consistent_HW);
        Allocate_SW(SW, consistent_SW);
        Constitute_Image(consistent_HW, consistent_SW, OutPut: Cloud_Image);
    END- subroutine

```

III. Related Work

In the following, we will illustrate some related work for applying software agent in a cloud computing environment. In [4], the model for multi-agent system with data mining is applied in a cloud computing environment for information retrieval.

The multi software agent is used in a cloud environment to allow the users to retrieve information from virtual resources easily and with less infrastructure and storage cost. Ontology-based agent generation framework has been presented in details how the user submits a request to retrieve information in the cloud [8].

In [6], the CiteSeerx and SeerSuite systems has been built and introduced a case for helping information retrieval systems through Virtualization adopt and cloud services environment. The design of scalable information retrieval model has been described how virtualized resources in the cloud and, how the network behavior can affect the virtualized resources [7].

Software agents and clouds are working together to produce an intelligent cloud service with high performance software agent has been discussed in [2]. An enhancement to the work described in [2] for improving the explicit features for both cloud and agent, by making clouds more flexible and providing software agent a reliable environment to execute a large application [3].

Another kind of direct relationship between software agents and cloud has been introduced by [5]. The researchers proposed an intelligent multi- agent model for resource Virtualization (IMAV) that automatically allocates suitable services to mobile node. A model where agents portrayed as a new cloud computing services that will represent clients in a virtual environment has been introduced by [1].

Based on the above related works, we can realize that most of the above models and frameworks are implicitly structured and lacks some components to control the constituted cloud environment. Moreover, most of them lack of a method for facing and applying the runtime changes; this case implies us to adapt both the structure and behavior of the constituted cloud images.

IV. Conclusion and Future Work

In this paper, we presented a novel agent-based cloud framework that enable users to have an updated and consistent cloud image by increasing the satisfactory level of the users. The big picture of the proposed framework is illustrated in details. Moreover, the structural and behavioral representations of the proposed framework are design by UML class diagram and sequence diagram consequently. Finally, the implemented algorithm that illustrates the framework processes is well defined. In future work we are planning to model the internal behavior of the framework using Petri Net simulation and using the graph theory aspects to optimize the framework execution.

References

- [1] Ignacio Lopez-Rodriguez, et al., "Advances in Intelligent and Soft Computing", Vol. 88, 2011, pp. 271-276.
- [2] Domenico Talia, "Cloud Computing and Software Agents: Towards Cloud Intelligent Services", Whitepaper, 2011
- [3] Domenico Talia, "Clouds Meet Agents: Toward Intelligent Cloud Services", IEEE Internet Computing, Vol. 16, No. 2, 2012 pp. 78-81
- [4] Vishal Jain, Mahesh Kumar Madan, "Information Retrieval through Multi-Agent System with Data Mining in Cloud Computing", IJCTA Vol. 3, No. 1, 2012, pp. 62-66.
- [5] Myoungjin Kim, et al., "IMAV: An intelligent Multi- agent based on cloud computing for resource Virtualization", IPCSIT, Vol. 6, 2011
- [6] Pradeep Teregowda, et al., "Cloud Computing: A Digital Libraries Perspective", IEEE 3rd International Conference on Cloud Computing (CLOUD), 5-10 July 2010.
- [7] M.Shoaib, et al., "A Distributed information retrieval model for virtualized resources in clouds", Pakistan Journal of science, Vol. 63, No. 2, 2011.
- [8] Yue-Shan, et al., "An ontology based Agent Generation for information Retrieval on Cloud Environment", Journal of Universal Computer Science, Vol. 17, No. 8, 2011.
- [9] Qi Zhang, et al., "Cloud computing: state- of-the-art and research challenges", Journal of Internet Services and Applications, Vol. 1, Issue 1, pp. 7-18, 2010.
- [10] Michael Armbrust, et al., "A View of Cloud Computing", Communications of the ACM, Vol. 53, No. 4, 2010, pp. 50-58
- [11] Bu-Qing Cao, et al., "A Service-Oriented Qos-Assured and Multi-Agent Cloud Computing Architecture", Cloud Com '09 Proceedings of the 1st International Conference on Cloud Computing, 2009, pp. 644 – 649.



Dr. Amr Tolba received his M.Sc. and Ph.D. degrees in computer science, Menoufia University, Egypt, in the area of databases and Multi-Agent systems, in 2002 and 2006 respectively. He joined the king Saud University (KSU) in August 2006 as an assistant professor at the department of computer science. His research interests include databases, multi-agent systems, system analysis and design, and cloud computing.



Dr. Ahmed Ghoneim received his M.Sc. degree in software modeling from University of Menoufia, Egypt, and the Ph.D. degree from the University of Magdeburg (Germany) in the area of software engineering, in 1999 and 2007 respectively. He is currently an assistant professor at the department of software engineering, king Saud University. His research activities address software evolution; service oriented engineering, software development methodologies, scripting languages.