A Management of Resource Ontology for Cloud Computing

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Abstract. Cloud computing is a new trend in web based service. It could be use in service based application such as Infrastructure as a Service(IaaS) or Service as a Service(SaaS). However cloud computing has more wide meaning than service or application. In cloud computing environment, we don't have to have any platform to use computing resources. All the computing-source and resources is in the web and can be manage them for user. Therefore the efficient method that is to control and manage the resources on the web is necessary. In this paper, we proposed management method to control and interface cloud computing resources. For this purpose, we made ontology for cloud computing resources and agent model to interface between the resources by the ontology.

Keywords: Cloud computing, resource ontology, ontology management, cloud-sourcing, cloud computing service.

1 Introduction

Computing is being transformed to a model consisting of services that are commoditized and delivered in a manner similar to traditional utilities. In such a model, users access services based on their requirements without regard to where the services are hosted or how they are delivered. Several computing paradigms have promised to deliver this utility computing vision and these include cluster computing, Grid computing, and more recently Cloud computing. The latter term denotes the infrastructure as a "Cloud" from which businesses and users are able to access applications from anywhere in the world on demand [1]. Cloud computing uses the Internet and central remote servers to maintain data and applications. It is broken down into three segments: "applications", "platforms", and "infrastructure". The cloud is the term for networked computers that distribute processing power, applications, and large systems among many machines. Applications like Flickr, Google, YouTube, and many others use the cloud as their platform, in the way that programs on a desktop computer use that single computer as a platform [2]. Actually,

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cloud is not a new concept. Anyone who has a web-based email account such as 'Hotmail' or 'Gmail', is using a simple form of cloud-computing [3]. Although not the first to propose a utility computing model, Amazon EC2 contributed to the popularization of the Infrastructure as a Service (IaaS) paradigm, which became closely tied to the notion of cloud computing. An IaaS cloud enables on-demand provisioning of computational resources, in the form of VMs deployed in a cloud provider's datacenter (such as Amazon's), minimizing or even eliminating associated capital costs for cloud consumers, allowing capacity to be added or removed from their IT infrastructure in order to meet peak or fluctuating service demands, while only paying for the actual capacity used. In general, an IaaS cloud consists of three main components, namely: a virtualization layer on top of the physical resources including network, storage and compute; the virtual infrastructure manager (VIM) that control and monitor the VMs over the distributed set of physical resources; and a cloud interface that provides the users with a simple abstraction to manage VMs. Cloud computing has emerged as a very promising paradigm to simplify and improve the management of current IT infrastructures of any kind and, in particular, grid ones. Clouds, in their IaaS form, have opened up avenues in this area to ease the maintenance, operation and use of grid sites, and to explore new resource sharing models that could simplify in some cases the porting and development of grid applications [4]. Therefore the method which is to control, manage, and share the various resources is necessary to operate process and interface in cloud computing environment efficiently.

In this paper, we proposed management method to control and interface cloud computing resources. And we also made ontology for cloud computing resources and agent model to interface between the resources. This paper is organized as follows. Section 2 describes the environment of cloud computing service. The agent for ontology of cloud computing resources is described in section 3. Benefits of proposed method are discussed in Section 4, and conclusions can be found in Section 5.

2 Cloud Computing Service

The cloud computing service has been implemented as a multi-agent system. A schema of the system is depicted in Figure 1. First of all, a distributed and parallel system has to define how tasks are assigned to an agent. In order to minimize response and execution time, the implemented system uses a load balancing technique for distributing tasks between agents. Each agent has a local task queue, but a central information agent. Benefits of using load balancing algorithms for multi-agent, parallel and grid systems have been extensively studied [4, 5, 6]. Load Balancing uses three principal functionalities:

(i) Service advertisement and discovery is used by different agents to locate where other agents can be accessed and to publish their own location.
(ii) Performance prediction is used to assign new tasks to a determined agent in order to equilibrate execution time for different agents. Each agent registers its

system performance for each type of operation (division, storage, and morphological operations). Using task parameters (for example, number of regions or untreated pixels), execution time is predicted using a logarithmic regression function. And the task is assigned to the agent that has less estimated pending processing time.

(iii) Queues of tasks are employed for scheduling purposes. When a new task is assigned to an agent, maybe other tasks are being executed by this agent. Each agent queues the tasks pending execution in a local queue.

An important issue in multi-agent systems is the role assignment of the agents that exist in the system. As Figure 1 shows, there are three kinds of agents in the system:

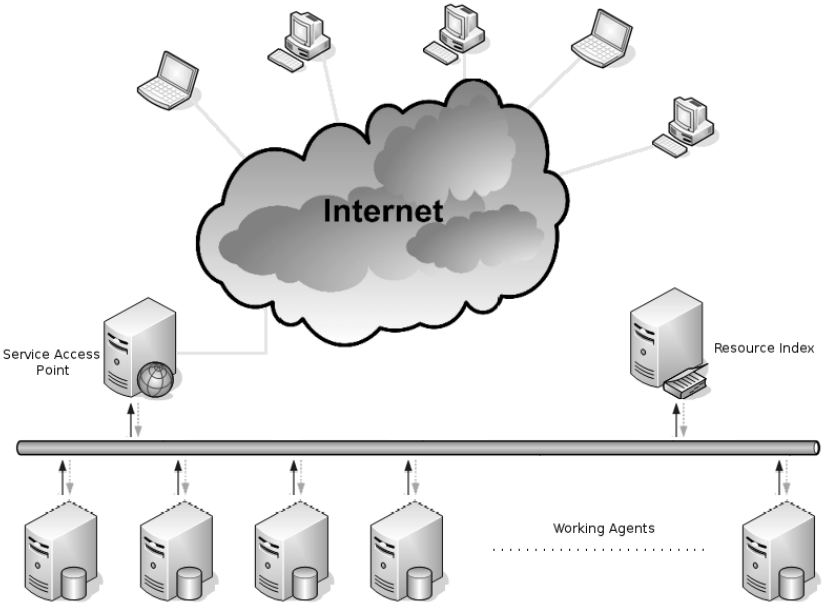


Fig. 1. Cloud Computing Service Schema

- The service access point agent is a unique agent in the system. This agent is the entrance point for final users. It offers the methods for storing and applying operations of the cloud computing service.
- The resource index agent is also a unique agent in the system. It implements the service directory. This agent collects information about the working agents in the system. The collected information contains the location of each agent, its current load, the estimation function for performance prediction, and the image processing status.
- The working agents are the main agent role in the system. Each working agent manages a relational database containing the complete data-structure. They have all necessary functionalities for storing and analyzing images on its own. So,

every working agent is capable of (a) dividing an input image (when it is too large), (b) extracting image regions and descriptors, (c) storing image information into the data structure, and (d) applying certain filters and graph-based operations on stored images in their own database [7].

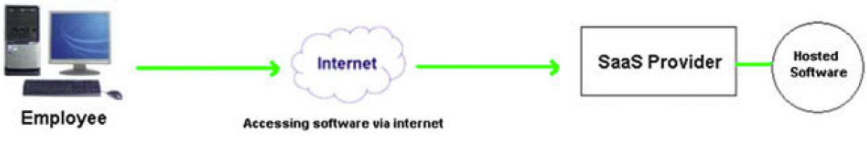
3 An Agent Model for Ontology of Cloud Computing Resources

3.1 Cloud-Sourcing

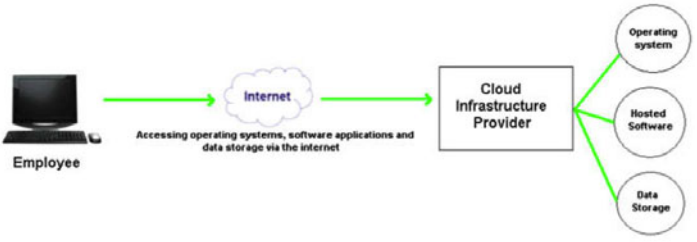
There are three main types of cloud-sourcing products widely available: [3]

• Cloud storage : Cloud storage is typically where a business stores and retrieves data from a data storage facility via the Internet. Storing data in this way offers near unlimited storage and can provide significant cost savings as there is no need for the business to buy, run, upgrade or maintain data storage systems with unused spare capacity.

• Cloud service : This is also known as ‘‘Software as a Service’’ or ‘‘SaaS’’. In SaaS, software applications are run on a SaaS provider’s system and accessed by a customer usually through a webbrowser via the Internet. This means that the software application itself is not hosted on the user’s PC or within a business’s servers but within the SaaS provider’s facilities.



• Cloud infrastructure/platform : In a cloud infrastructure or platform arrangement the provider operates the whole computing platform or operating system for the customer which is accessed via the Internet. Applications can then be run on the cloud platform/operating system in conjunction with utilising cloud storage. All that is required for the user to access the service is a computer with Internet access but little else in the way of computing hardware or ancillary support, maintenance or operating efforts.



3.2 The Ontology for Cloud Computing Resources

Lamia, Maria, and Dilma [8] proposed cloud computing ontology as Figure 2. In their research, the model depicted as five layers, with three constituents to the cloud infrastructure layer. The layered figure represented the inter-dependency and composability between the different layers in the cloud.

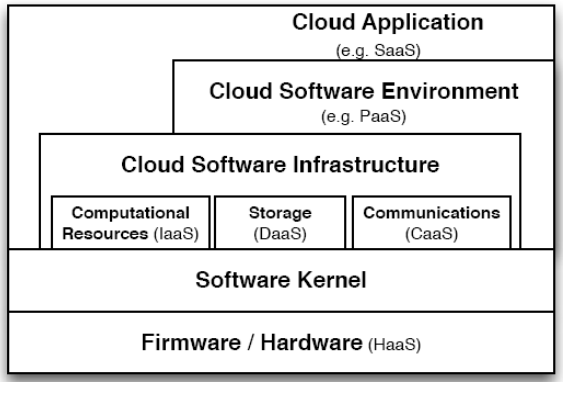


Fig. 2. Cloud computing ontology by Lamia, Maria, and Dilma [8]

Our proposed ontology model is similar than their model as shown in Figure 3.

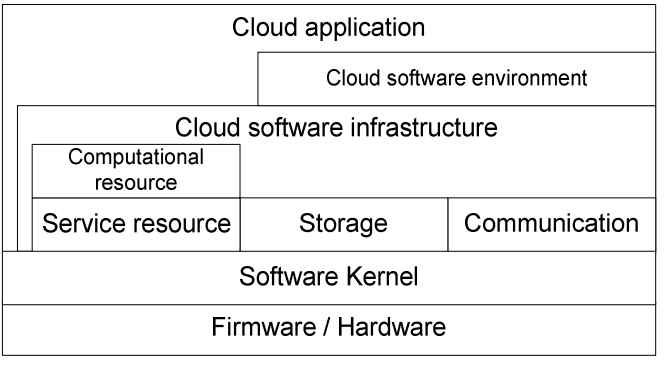


Fig. 3. Proposed cloud computing ontology

The *cloud application* is to the users of the cloud. Normally, the users access the services provided through web-portals, and are sometimes required to pay fees to use them. And the users of the *cloud software environment* are cloud applications' developers, implementing their applications for and deploying them on the cloud. The providers of the cloud software environments supply the developers with a programming-language-level environment with a set of well-defined APIs to facilitate the interaction between the environments and the cloud applications, as well as to accelerate the deployment and support the scalability needed of those cloud applications. And the *cloud software infrastructure* provides fundamental resources to other higher-level, which in turn can be used to construct new cloud software environments or cloud applications. *Software kernels* at this level can be implemented as an OS kernel, hypervisor, and virtual machine monitor and/or clustering middleware. *Hardware and Firmware* is the actual physical hardware and switches that form the backbone of the cloud [8].

3.3 Agent Model for Cloud Computing

In this research, we considered an agent to process and handle each of resources in cloud computing and the ontology. Figure 4 depict the proposed agent model for cloud computing.

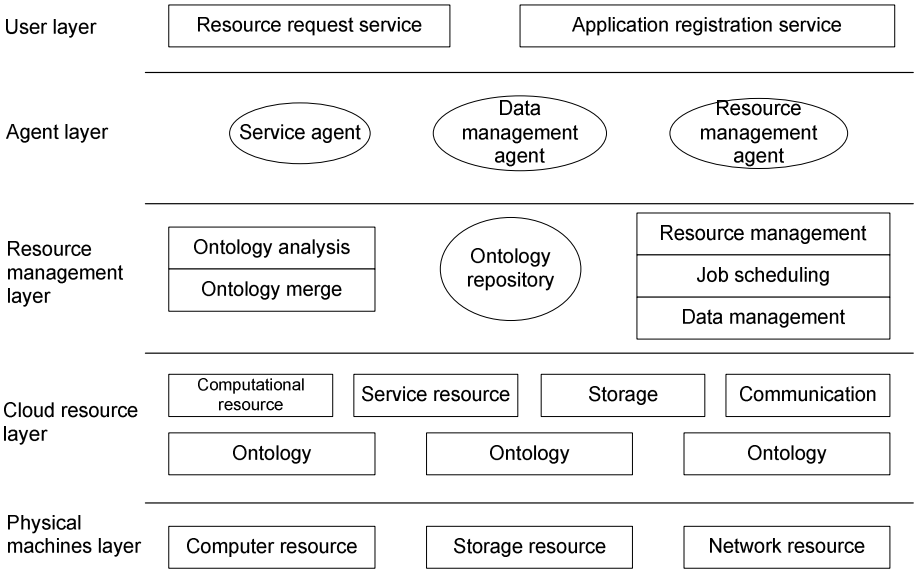


Fig. 4. Proposed agent model for cloud computing

The proposed model consists of five layers; *Physical machines layer, Cloud resource layer, Resource management layer, Agent layer*, and *User layer*. The *Cloud resource layer* supports resources which adapted to Cloud by using ontology. And the

Resource management layer is able to perform management ontology, resource, job, and data in cloud computing. The *Agent layer* has three types of agent; *Service agent, Data management agent, and Resource management agent*. Each agent deals with process between the user and system resources.

4 Benefits of Proposed Method

Our proposed agent model with ontology illustrates that cloud applications can be developed on the cloud software environments or infrastructure components. In addition, cloud applications can be perform efficiently as a service by use agent. It also can manage cloud resources by ontology. For example, using the agent with ontology can analyze cloud resources more easy and efficient than the environment without using agent and ontology for cloud computing. Because there are lots of resources for cloud computing, and therefore it need a management method for the resources. In this model, agent cloud perform the handling such as a service in cloud computing. Moreover using an ontology model for cloud computing could manage heterogeneous resource for cloud computing by analysis the ontology analysis and merge.

5 Conclusion

In this research, we proposed management method for cloud computing resources. For this process, we also made ontology model for manage the cloud computing sourcing and resource. Proposed cloud computing ontology has four steps; *Firmware/Hardware step, Software kernel step, Cloud software infrastructure, and Cloud application step*. To interact each step, we construct architecture of agent with ontology as five layers; *Physical machines layer, Cloud resource layer, Resource management layer, Agent layer*, and *User layer*. Finally, using this method has some benefits such as easily develop the cloud software environment and use the application.

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