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A REVIEW OF CLOUD SIMULATION TOOLS

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ABSTRACT
Cloud computing in simple terms is internet-based computing or rental computing. Users can use applications from any computer through the internet on demand. This technology allows for much more efficient computing by centralizing storage, memory, processing and bandwidth. Many cloud simulator tools and frameworks have been developed to aid the simulation of cloud environments in order to test any newly proposed algorithm, model or concept without having to incur the cost of deploying the same on an actual cloud infrastructure. It can be observed that although most of the cloud simulators and frameworks have similar architectures and functions, they considerably differ when comes to capability and extensibility. In this paper, we have done a study and analysis of various simulators available for cloud computing environment. It is also observed that few Cloud Computing concepts cannot be satisfactorily simulated by any of these simulators.

Keywords - Cloud Computing, Simulators, Open Nebula, Nimbus, Open stack.

INTRODUCTION
The basic idea of cloud computing had first been mentioned back in 1960s by John McCarthy, when he opined that computing may someday be organized as a public utility [1].The internet is often represented as a cloud and the term "Cloud Computing" arises from that analogy. According to NIST[2], Cloud Computing is a model for enabling ubiquitous, Convenient, On-demand network access to a shared pool of configurable computing resources (e.g. networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. Cloud Computing is broadly categorized as Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS). Cloud Computing or simply rental computing, is a new technology currently being studied in the academic world [3]. The definition of the cloud computing from the Gartner "A style of computing where massively scalable IT-related capabilities are provided as a service across the internet to multiple external customers using internet technologies [4][5]. Many cloud simulator tools and frameworks have been developed to aid the simulation of cloud environments in order to test any newly proposed algorithm, model or concept without having to incur the cost of deploying the same on an actual cloud infrastructure. It can be observed that although most of the cloud simulators and frameworks have similar architectures and functions, they considerably differ when comes to capability and extensibility. The key advantages of using simulation tools in cloud computing are: Simulators facilitate dynamic and flexible configuration and development environments; Simulators provide easy-to-use command/graphical interfaces with lots of customisation options that help researchers visualise real world scenarios, thus avoiding all sorts of real-time problems; Simulators also enable researchers to simulate cloud environments with their own proposed performance, security and other provisioning algorithms. Cloud tools and technologies such as Eucalyptus, Open Nebula, Nimbus and Open Stack are being discussed in this paper with their architecture, implementation and features.

RELATED WORK
Several research works have been done in the area of cloud computing. In this section, literature is reviewed within the context of cloud simulation tools. Researchers need to perform experiments to test the behavior of cloud. Testing the behavior in a real environment is a difficult task. SimGrid [6] is a simulation tool for grid computing and distributed systems that studies scheduling algorithms for

distributed application. CloudSim [7], designed by Buvya et al, for cloud computing experiments that supports modeling and simulation of cloud computing environments, and allows the simulation of multiple data centers. I Can Cloud [8], a simulation platform, for conducting large-scale experiments in cloud computing. It can determine cost per user by predicting the trade-offs between cost and performance for each application executed on a particular hardware [9]. Cloud Exp[10], designed by Jararweh et al., can be used to overcome certain limitations of the Cloud Sim tool. Its efficient GUI is built on top of Cloud Sim. In addition, this simulator is used to evaluate and analyze cloud components such as processing elements, data canters, storage platforms, and networking. It integrates most of the technologies related to cloud computing such as big data management and mobile cloud computing. Cloud Exp introduced a specialized modeling and simulation environment for mobile cloud computing [10, 11]. Cloud Analyst [12] is an extension to Cloud Sim, and used to simulate a large-scale internet application on the cloud. Cloud Report [13] is a GUI Cloud Sim-based tool with an easy-to-use interface.

SIMULATION TOOLS AND TECHNOLOGIES

Many cloud simulator tools and frameworks have been developed to aid the simulation of cloud environments in order to test any newly proposed algorithm, model or concept without having to incur the cost of deploying the same on an actual cloud infrastructure. It can be observed that although most of the cloud simulators and frameworks have similar architectures and functions, they considerably differ when comes to capability and extensibility.

a. **Eucalyptus :**Eucalyptus , an acronym for "Elastic Utility Computing Architecture for Linking Your Programs to Useful Systems." is a Linux-based open-source software architecture that implements efficiency-enhancing private and hybrid clouds within an enterprise's existing IT infrastructure and is accessed by users over enterprise intranet. Thus, sensitive data remains entirely secure from external intrusion behind the enterprise firewall. Eucalyptus can be deployed without modification on all major Linux OS distributions, including Ubuntu, RHEL, Centos, and Debian. And Ubuntu distributions now include the Eucalyptus software core as the key component of the Ubuntu Enterprise Cloud [16].

b. **Open Nebula:** OpenNebula provides the most simple but feature-rich and flexible solution for the comprehensive management of virtualized data centers to enable private, public and hybrid IaaS clouds. OpenNebula interoperability makes cloud an evolution by leveraging existing IT assets, protecting your investments, and avoiding vendor lock-in[17]. OpenNebula is used to manage data center virtualization, consolidate servers, and integrate existing IT assets for computing, storage, and networking. In this deployment model, OpenNebula directly integrates with hypervisors (like KVM, Xen or VMware ESX) and has complete control over virtual and physical resources, providing advanced features for capacity management, resource optimization, high availability and business continuity. OpenNebula also provide a multi-tenant, cloud-like provisioning layer on top of an existing infrastructure management solution (like VMware vCenter).

c. **OpenStack:** OpenStack software controls large pools of compute, storage, and networking resources throughout a datacenter, managed through a dashboard or via the OpenStack API. OpenStack works with popular enterprise and open source technologies making it ideal for heterogeneous infrastructure. Hundreds of the world's largest brands rely on OpenStack to run their businesses every day, reducing costs and helping them move faster. OpenStack has a strong ecosystem, and users seeking commercial support can choose from different OpenStack-powered products and services in the Marketplace [18].

d. **Nimbus:** Nimbus is an open-source toolkit focused on providing Infrastructure-as-a-Service (IaaS) capabilities to the scientific community. Nimbus focuses on three goals: Nimbus Enable providers of resources to build private or community IaaS clouds; enable users to use IaaS clouds; enable developers to extend, experiment and customize IaaS **[1**9].

COMPARISON: Following is the comparison of various cloud simulation tools on the basis of various properties [20].

TABLE I: COMPARISON OF CLOUD TOOLS AND TECHNOLOGIES

Tools / Properties	Eucalyptus	OpenNebula	Nimbus	OpenStack
Cloud types	Private	Public, Private and Hybrid	Private and Public	Public, Private and Hybrid
Storage compatibility	Elastic CC S3	Open Multi Platform	Amazon EC2 and other tools	EC2, OpenStack API
Deployment strategies	Command Line tool as euca2tool and Web UI	Web Interface	Command Line	Command Line tool euca2tool And NOVA API
Scalability	Scalable	Dynamic Scalable	Scalable	Massively Scalable
Hypervisor support	VMware, KVM, Xen and ESX, Virtio	VMware, KVM, VirtualBox, Xen and libvirt	Xen 3.x or KVM and bash, ebtables, libvirt	Xen, KVM, Hyper-V QEMU, UML (User Mode Linux), XenServer, LXC
SSH Management	SSH	SSH or NFS	SSH and for server side Java Secure Channel (JSch)	SSH
Scheduling and policy algorithm	Round Robin And GREEDY	Rank matchmaker, packing, striping, load-aware, affinity-aware	PBS and SGE	Diablo v3
OS Supported	Linux, can host Linux and Windows VMs	Linux	Linux	Linux
Supported languages	Java, C	C++, C, Ruby, Java, Shell script, lex, yacc	Java1.5 +, Python2.4 +	Python
Version Under	Proprietary, GPL v3	Apache License version 2	Apache License version 2	Apache License
Security Management	X509 certificate	In latest release it support X509 certificate	X509 certificate	X509 certificate
Image management	YES	YES	YES	YES
Linux VM Management	YES	YES	YES	YES
Binary packages Support	CentOS, openSUSE, Debian, Fedora and UEC	Ubuntu 10.04 and CentOS 5.5	Ubuntu 10.04	Ubuntu 11.04
Storage Management	Walrus	S3 (Simple Storage Structure),scp-wave	Cumulus or Distributed Storage	Amazon S3 and SWIFT
Web service and API	Web services	OGF OCCI API, EC2 query, vCloud	WSRF, EC2 WSDL interfaces	EC2 and OS APIs
Disk allocation	Eager Disk allocation	Support both Lazy and Eager Disk allocation	Do not know	Do not know
Service type	IaaS	IaaS	IaaS	IaaS
Latest release name	Eucalyptus *v 3.0*	OpenNebula *v* 3.0.0	RC2 Nimbus *v* 2.8	Cactus
Suggested configuration requirement	VT Enables Processor 64-bit, memory 2 GB RAM, disk space 200 GB.	A 64 core cluster will typically run around 80VMs, each VM will require an average of 10GB so disk space around 1TB required.	2.2 GHz AMD64 Processors for each nodes, 4 GB RAM, and 80 GB local disk,it depends upon the need.	Processor 64-bit x86, memory 12 GB RAM,disk space 30 GB and 1 GB NIC.

CONCLUSION

This paper focuses on the architecture and implementation issues of Eucalyptus, Open Nebula, Open Stack and Nimbus. Analyzing various open-source cloud computing frameworks, we find that there are differences between them regarding the overall scheme of their design. These tools may not emphasis on long-term support because of the version and OS dependency. Performance of cloud simulation tools depends on the efficiency of scheduling algorithm used in the tools.

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