Cloud Simulation Tools: A Comparative Analysis

Rizwana Shaikh,
Assistant Professor,SIES GST,
Research Scholar, NMIMS

M. Sasikumar
Research Director,
CDAC, Kharghar

ABSTRACT
Cloud computing is a way of delivering computing power and other resources on pay-per-use basis. Cloud can be of type public or private depending on the type of network is used for delivering the services. A cloud service comes under various categories depending on the level of resource that is Infrastructure, platform or service. Many cloud computing services are available today to fulfill the user needs and demands. Cloud computing has also attracted many researchers for experimentation for new or existing services. Before deployment of actual cloud experimentation can be done with respect to available tools to perform testing and setting up the benchmarks. An analysis by considering various parameters of such tools is presented to provide guidelines about their working with cloud.

General Terms
Cloud computing, Simulation tools, CloudSim, uec, xen, openstack.

Keywords
Cloud Computing, Cloud Simulation, tools, Comparison of tools.

1. INTRODUCTION
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 as defined by NIST in [10]. Various service models are available like Infrastructure-as-a-service, Platform-as-a-service and Software-as-a-service. Cloud computing has captured a sufficiently large market share in the business. It has also become the area of research and experimentation. Before deployment of service to actual cloud, simulation tools can be used to perform testing. Testing before actual implementation of cloud is becoming must for any organization providing cloud services. It reduces the risks associated with the actual deployment. Various cloud computing tools and simulation environment is available to give hands on experience. We have implemented various clouds using some of them. A comparative analysis of these tools is presented. Various parameters are identified to perform the comparisons. Any user can make use of this study to select a particular tool depending on his needs and type of experiment.Paper is organized as follows; section 2 deals with cloudsim tool. Xen hypervisor is discussed is section 3. Section 4 includes UEC implementation. Section 5 contains openstack. A comparison is done in 6 and finally section 7 concludes the paper.

2. CloudSim
CloudSim is an extensible simulation toolkit that enables modeling and simulation of Cloud computing systems and application provisioning environments as given in [1, 2, and 11]. The CloudSim toolkit supports both system and behavior modeling of Cloud system components such as data centers, virtual machines (VMs) and resource provisioning policies. It is framework for modeling and simulation of cloud computing infrastructure and services.The main advantage of using CloudSim for initial performance testing includes:

1. Time effectiveness: it requires very less effort and time to implement Cloud-based application provisioning test environment and
2. Flexibility and applicability: developers can model and test the performance of their application services in heterogeneous Cloud environments (Amazon EC2, Microsoft Azure) with little programming and deployment effort.

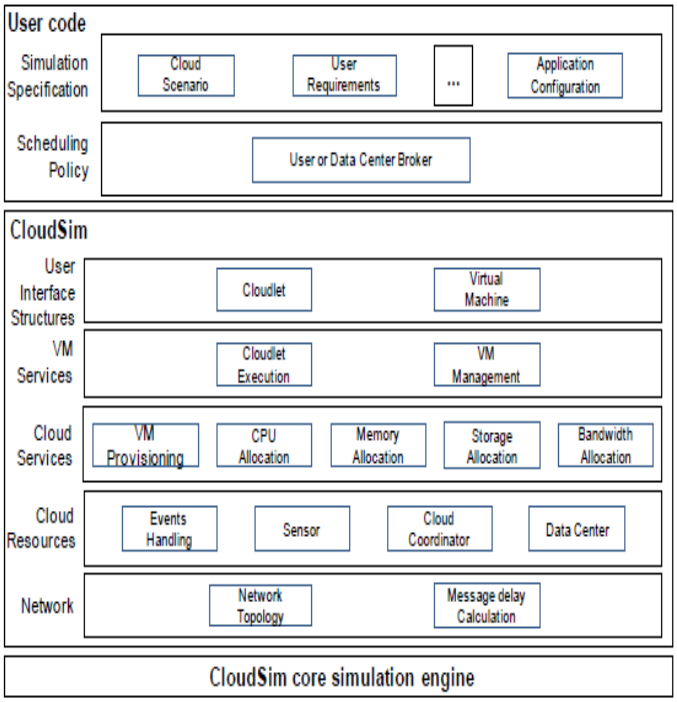

Fig.1 Layered Architecture of CloudSim

Figure1 shows the multilayer design of the cloudsim software framework and its architectural components. First layer is a simulation engine that supports several core functionalities, such as queuing and processing of events, creation of Cloud system entities (services, host, data center, broker, and virtual machines), communication between components, and management of the simulation clock. The CloudSim simulation layer provides support for modeling and simulation of virtualized Cloud-based data center environments including dedicated management interfaces for virtual machines (VMs), memory, storage, and bandwidth. The fundamental issues such as provisioning of hosts to VMs, managing application

execution, and monitoring dynamic system state are handled by this layer. The top-most layer in the CloudSim stack is the User Code that exposes basic entities for hosts (number of machines, their specification and so on), applications (number of tasks and their requirements), VMs, number of users and their application types, and broker scheduling policies.

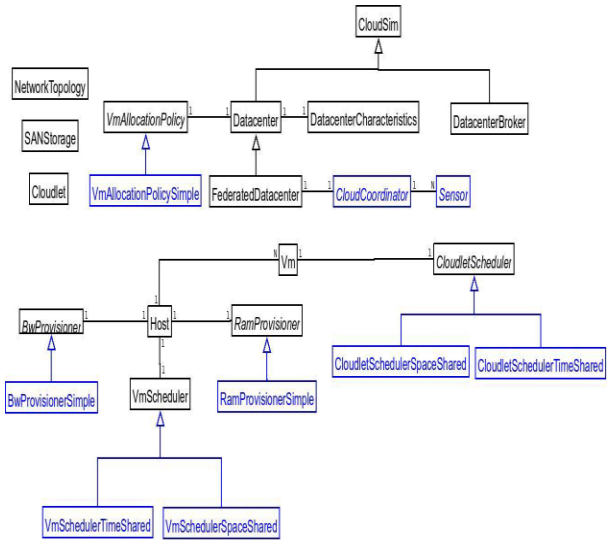

Fig. 2- Class diagram of CloudSim

Figure 2 indicates the class diagram of CloudSim. These classes are building blocks of creating cloud applications and services. The existing classes and interfaces can be extended for experimenting and research solutions. Risk associated with the change of policy and technology is greatly simplified with simulation step with the cloudsim. Challengingand risk oriented applications of cloud computing can be formulated and tested with the cloud environment provided by the cloudsim toolkit. The simulation and modeling environment provided by this is greatly helpful for the organizations seeking change with respect to the existing cloud services. Researchers as in [3] can simulate and verify their research problem and accordingly take the corrective steps, if some issues remain unresolved.

3. XEN HYPERVISOR

The Xen hypervisor is a layer of software running directly on computer hardware replacing the operating system thereby allowing the computer hardware to run multiple guest operating systems concurrently. It's Support a variety of platform and other common operating systems as guests running on the hypervisor as given [3, 4]. A computer running the Xen hypervisor contains three components.

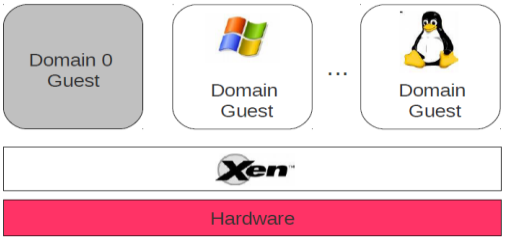

Fig.3- Xen Hypervisor setup

Figure 3 indicates the setup and components require to build xen hypervisor which is the basis for cloud computing. It includes Xen hypervisor that runs directly on the hardware and becomes the interface for all hardware requests. By separating the guests from the hardware, the Xen hypervisor is able to run multiple operating systems securely and independently. The Domain 0 Guestreferred to as Dom0 is launched by the Xen hypervisor during initial system start-up and can run any operating system except Windows. The Dom0 has unique privileges to access the Xen hypervisor that is not allocated to any other Domain Guests. The Domain Guestsreferred to as DomUs are launched and controlled by the Dom0 and independently operate on the system. These guests are either run with a special modified operating system referred to as Para-virtualization or un-modified operating systems leveraging special virtualization hardware (Intel VT and AMD-V) referred to as hardware virtual machine (HVM). The setup which uses in our case is Para virtualization.

4. UEC

Ubuntu Enterprise Cloud (UEC) is a stack of applications from Canonical included with Ubuntu Server Edition. UEC includes Eucalyptus along with a number of other open source software. UEC makes it very easy to install and configure the cloud. Canonical also provides commercial technical support for UEC.

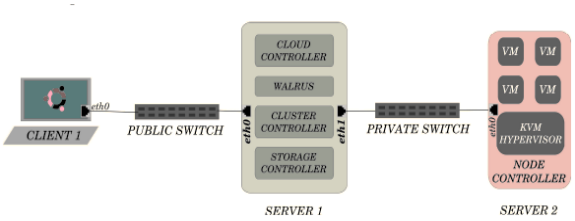

Fig.4 UEC basic setup with three machines

UEC consist of various components as shown in figure 4, that are: Node Controller, Cloud Controller, Cluster Controller, Walrus Storage Controller and Storage Controller. The details of the individual components [6, 12] are summarized as follows:

1. Node Controller (NC): A UEC node is a VT enabled server capable of running KVM as the hypervisor. UEC automatically installs KVM when the user chooses to install the UEC node. The VMs running on the hypervisor and controlled by UEC are called instances. Node Controller runs on each node and controls the life cycle of instances running on the node. The NC interacts with the OS and the hypervisor running on the node on one side and the Cluster Controller (CC) on the other side. NC queries the Operating System running on the node to discover the node's physical resources like number of cores, the size of memory, the available disk space and also to learn about the state of VM instances running on the node and propagates this data up to the CC.

2. Cluster Controller (CC): CC manages one or more Node Controllers and deploys/manages instances on them. CC also manages the networking for the instances running on the Nodes under certain types of networking modes of Eucalyptus. CC communicates with Cloud Controller (CLC) on one side and NCs on the other side.

3. Walrus Storage Controller (WS3): WS3 provides a persistent simple storage service using REST and SOAP APIs

compatible with S3 APIs. WS3 should be considered as a simple file storage system.

4. Storage Controller (SC): SC provides persistent block storage for use by the instances.

5. Cloud Controller (CLC): The Cloud Controller (CLC) is the front end to the entire cloud infrastructure. CLC provides an EC2/S3 compliant web services interface to the client tools on one side and interacts with the rest of the components of the Eucalyptus infrastructure on the other side. CLC also provides a web interface to users for managing certain aspects of the UEC infrastructure. CLC has a comprehensive knowledge of the availability and usage of resources in the cloud and the state of the cloud.

A private cloud setup is configured and instances are registered and made available for use by various cloud users as per their requirements.

5. OpenStack

It is a collection of open source technology that provides massively scalable open source cloud computing software as mentioned in [8, 9]. Currently OpenStack develops two related projects: OpenStack Compute, which offers computing power through virtual machine and network management, and OpenStack Object Storage which is software for redundant, scalable object storage capacity. Closely related to the OpenStack Compute project is the Image Service project, named Glance. OpenStack can be used by corporations, service providers, VARS, SMBs, researchers, and global data centers looking to deploy large-scale cloud deployments for private or public clouds. There are 3 main service families under OpenStack

- Compute Infrastructure (Nova)
- Storage Infrastructure (Swift)
- Imaging Service (Glance)

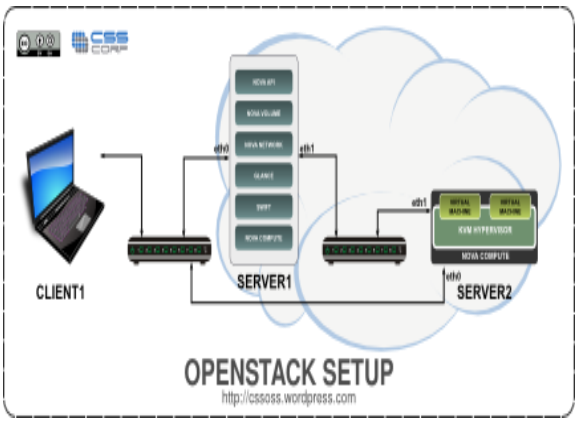

Fig.5 OpenStack cloud setup

6. COMPARITIVE ANALYSIS

Lists of parameters are identified based on which comparison between various tools can made as given in the following table1.

Table 1- Comparison of cloud implementation

Sr.No.	Parameter	Eucalyptus	Openstack	Xen Cloud	CloudSim
1	Time/popularity/ newness	Basic version of ubuntu eucalyptus cloud is the first IaaS cloud	Advance version of ubuntu comes along with the openstack cloud	Very basic and exist before cloud also	The first version is of the year 2009 and upgrading versions are evolved further
2	Version	All the versions of ubuntu processes eucalyptus cloud features	11.10 version onwards openstack cloud option is made available	Xen comes along with the linux distribution of which latest version is 4.2.2	The latest version of it is 3.0.3
3	API	Small set of API	More API providing as a backbone for building private and public cloud	Sufficient set of APi to perform basic operation	Large set if classes that can be modified to suit user requirements
4	Main Support	Amazon EC2 and S3	Suitable for all cloud applications	Most preferred virtualized environment	Simple simulation that can used independenly along with java and C programming
5	Scalability	Used for small scale application	Scalability issue is solved	Scalable as per the resources	It's a simulation kit give good performance with increased users also

6	Openness	Not completely open. Certain features like VMware etc cannot be modified	Fully open Source Software	Not much modificationscan be possible	Fully open source can be modified completely
7	Implementation (commands and instruction)	Simple and less number of commands and instructions set is required	Complex command and large set of instructions require for implementation	Setting of Xen Cloud Platform is easy and fast	Compare to others fewest number of instructions are required.
8	Resources (high configuration systems)	Testing and implementation requires large set of resources	Small set of resources is sufficient to play with it	A dedicated xen server is must.	A simple desktop machine is sufficient
9	Community	Limited support for developer, deployer and user	Unlimited opportunity for community	Limited support	Unlimited support for testing
10	Lock-in	Cloud provider lock-in is not much prevented	Completely prevents the lock-in problem	Not much prevented	Prevents lock in to Some extent
11	Web Service Support	Not supported by any web services	Support provided by AWS (Amazon web services)	No support	Can support to some extent

7. CONCLUSION

Cloud computing simulation tools are available with various specifications. Some of them we have used to implement private cloud setup. These tools are then compared based on some parameters listed. Based on the choice of the experiment needed for a particular service any of them can be used. So these parameters can be act like a checklist to consider specific implementation tool for specific service. Currently we are focusing on the actual measurement of these parameters.

8. REFERENCES

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