Introduction of Cloud Computing and Survey of Simulation Software for Cloud

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ABSTRACT

Cloud computing is a buzzword opening doors to a new technology. However there are different definitions of cloud computing still there is no common consequences. Some feel it is purely a business perspective others take it as a research challenge. Researchers find it difficult to work on this concept as implementing a cloud is a costly affair and simulations software are not too common. In this paper we cover the concept of cloud in detail and also focuses on different software which can be used for research purpose in cloud computing.

1. INTRODUCTION

Cloud Computing is not a completely new concept; it has intricate connection to the relatively new but thirteen-year established Grid Computing paradigm, and other technologies like cluster computing, utility computing and distributed computing in general.
Cloud computing is a technology in which we work on third party setup without investing in our own setup. In it we use the computing and storage utility of some third party. In fact, back in 1961, computing pioneer John McCarthy predicted that "computation may someday be organized as a public utility". The vision is to reduce the cost of computing, increase reliability, and increase flexibility by transforming the scenario of buying computers and computing to third power computing.

2. Defining CLOUD
There are various definitions of cloud, in this section we discuss some of the definitions to make the concept of cloud very clear to our upcoming researchers.

- Cloud Computing is a general term used to describe a new class of network based computing that takes place over the internet.
- Basically a step on from Utility computing
- A collection/group of integrated and networked hardware , software and internet infrastructure (called a platform)
- Using the internet for communication and transport provides hardware, software and networking services to client.
- Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources that can be rapidly provisioned and released with minimal management effort or service provider interaction. [22]
- Cloud computing is a broad array of web-based services aimed at allowing users to obtain a wide range of functional capabilities on a 'pay-as-you-go' basis that previously required tremendous hardware and software investments and professional skills to acquire. Cloud computing is the realization of the earlier ideals of utility computing without the technical complexities or complicated deployment worries.[14]
- Cloud is a new type of user experience. It means being able to aquire services without needing to understand the underlying technology.
- Cloud computing is internet based computing whereby shared resources , software and information are provided to computers and other devices on demand like electricity grid.
- Cloud computing is an umbrella term used to refer internet based development and services.[mark baker]

- Cloud computing is a new revolution where user can use anytime, anywhere , any amount of resource and pay as per the usage. Where sky is the limit…this is how we perceive the cloud is.

- Buyya et al. have defined it as follows: "Cloud is aparallel and distributed computing system consisting of a collection of inter-connected and virtualised computers that are dynamically provisioned and presented as one or more unified computing resources based on service-level agreements (SLA) established through negotiation between the service provider and consumers.[5]

- Vaquero et al. [have stated "clouds are a large pool of easily usable and accessible virtualized resources (such as hardware, development platforms and/or services). These resources can be dynamically reconfigured to adjust to a variable load (scale), allowing also for an optimum resource utilization.

This pool of resources is typically exploited by a pay-per-use model in which guarantees are offered by the Infrastructure Provider by means of customized Service Level Agreements.
[31]
McKinsey and Co. report claims that "Clouds are hardware based services offering compute, network, and storage capacity where: hardware management is highly abstracted from the buyer, buyers incur infrastructure costs as variable OPEX and infrastructure capacity is highly elastic." [21]
There are many definitions of cloud computing but all of them have share common features like i) pay per use ii) flexibility iii) third party support iv) internet based service.

3. CHARACTERISTICS

Essential characteristics as per NIST are:

- *On-demand self-service.* A consumer can unilaterally provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with each service provider.

- *Broad network access.* Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, tablets, laptops, and workstations).

- *Resource pooling.* The provider's computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand. There is a sense of location independence in that the customer generally has no control or knowledge over the exact location of the provided resources but may be able to specify location at a higher level of abstraction (e.g., country, state, or data enter). Examples of resources include storage, processing, memory, and network bandwidth.

- *Rapid elasticity.* Capabilities can be elastically provisioned and released, in some cases automatically, to scale rapidly outward and inward commensurate with demand. To the consumer, the capabilities available for provisioning often appear to be unlimited and can be appropriated in any quantity at any time.

- *Measured service.* Cloud systems automatically control and optimize resource use by leveraging a metering capability1 at some level of abstraction appropriate to the type of service (e.g., storage, processing, bandwidth, and active user accounts). Resource usage can be monitored, controlled, and reported, providing transparency for both the provider and consumer of the utilized service.

4. Models

There are two basics models of cloud computing depending on the user view and technical view. Technically it is viewed as a layered architecture with each layer supporting the layer above it , this type of model is called Service model. It deals with the services provided by cloud. Another approach

is to deploy a cloud, how a cloud is used by the user. Who can access the services of the cloud, it is called Deployment model.

Service Model: There are basically three layers in cloud architecture:

Infrastructure as a Service(IaaS) : Offering virtualized resources (computation, storage, and communication) on demand is known as Infrastructure as a Service (IaaS) .[30]
In it the provider makes entire infrastructure available as a service. The end user can use the entire infrastructure on pay per usage basis. The ability to support an IaaS architecture is through a combination of some of the special characteristics of cloud computing. They include dynamic provisioning, fine-grained measurement and metering, virtualization, broadband access, and flexible billing. Infrastructure services are considered to be the bottom layer of cloud computing systems [26]

Platform as a Service(PaaS) : A cloud platform offers an environment on which developers create and deploy applications and do not necessarily need to know how many processors or how much memory that applications will be using. In addition, multiple programming models and specialized services (e.g., data access, authentication, and payments) are offered as building blocks to new applications [1]. In it the cloud provides software platform or middleware as service on which the applications run. The user is responsible for creation, updating and maintenance of the application.
Platforms in the cloud are an interesting offering that takes the pain away from having to set up and configure the software platform or middleware.

Software as a Service(SaaS) : This is the topmost layer of the architecture , it has all the applications residing in it. Applications are provided as a Service and these Services can be accessed by end users through Web portals. Therefore, consumers are increasingly shifting from locally installed computer programs to on-line software services that offer the same functionally. Traditional desktop applications such as word processing and spreadsheet can now be accessed as a service in the Web. This model of delivering applications, known as Software as a Service (SaaS), alleviates the burden of software maintenance for customers and simplifies development and testing for providers [12].
Besides the above three models other service models are Data as a Service(DaaS) , Testing as a Service (TaaS), Human as a Service (HaaS). We can conclude that now Everything is a Service(EaaS).
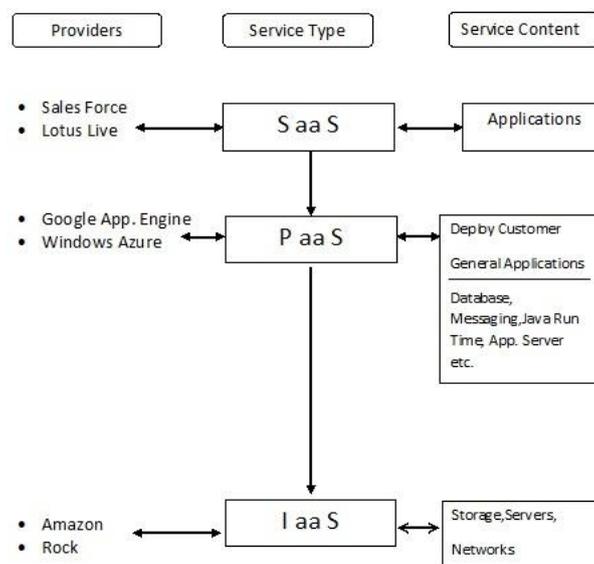
Fig 1 : Layered Architecture

Deployment Model: There are four basic deployment model of cloud. These models show how the cloud can be deployed and who can access the features of it.It is based on the variations in physical presence and distribution.Four models are

- Public Cloud
- Private Cloud
- Hybrid
- Community Cloud

Public Cloud: A public cloud is one in which a third-party provider makes avialable resources, such as applications and other computing resources, to the general public via the Internet. A public cloud does not necessarily mean that it is free, although it can be free or inexpensive to use. It may be offered on a pay-per-usage model.

The cloud service provider is responsible for setting up the hardware, software, applications, and networking resources. Public clouds do not imply that the user's data is public. In many cases, access control mechanisms are required before the user can make use of cloud resources.
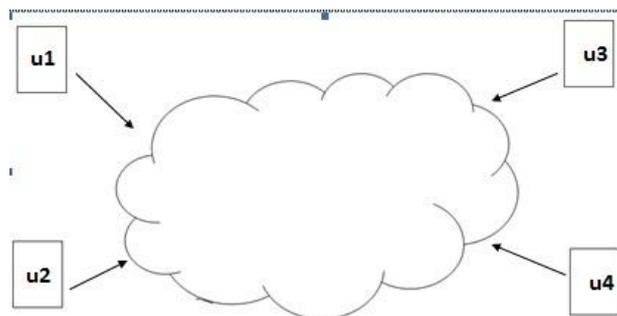

Fig 2 : Public Cloud

Private Cloud:

A private cloud is one which is used internally in an organization .With a private cloud, computing resources are pooled and managed internally. This provides for greater efficiencies. Resources can be applied dynamically according to demand. A private cloud allows the enterprise to continue to follow workflow and security procedures.

This ensures that the correct level of "code" is executing. These types of clouds are not burdened by network bandwidth and availability issues or potential security exposures that may be associated with public clouds. Private clouds can offer the provider and user greater control, security, and resilience.

Armbrust et al. discussed public cloud as a "cloud made available in a pay-as-you-go manner to the general public" and private cloud as "internal data center of a business or other organization, not made available to the general public." [2].
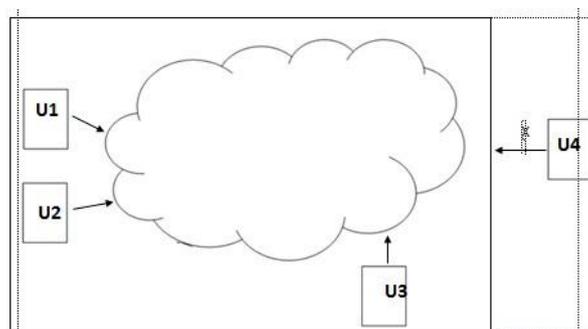

Fig 3 : Private Cloud

Hybrid Cloud:

Hybrid clouds are combinations of public and private clouds that work together. In this model, IT typically outsources noncritical information and processing to the public cloud, while keeping business critical services and data in their control. The hybrid cloud environment works to seamlessly integrate external applications on other private and public clouds, with your in-house processes.

A hybrid cloud takes shape when a private cloud is supplemented with computing capacity from public clouds [Sotomayer]. The approach of temporarily renting capacity to handle spikes in load is known as "cloud-bursting" [15].
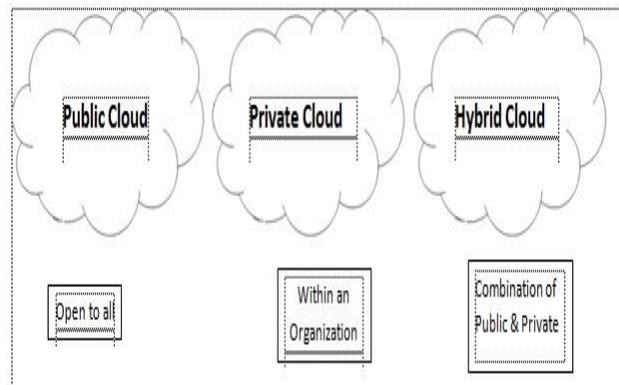

Fig 4 : Deployment Models

Community Cloud:

A community cloud can be a private cloud purchased by a single user to support a community of users, or a hybrid cloud with the costs spread over a few users of the cloud.

A community cloud is often set up as a sandbox environment where community users can test their applications, or access cloud resources.

A community cloud is "shared by several organizations and supports a specific community that has shared concerns (e.g., mission, security requirements, policy and
Compliance considerations) " [22]

5. TOOLS

Having discussed the concepts of cloud computing. Let us focus on the simulation tools available for research purpose. Energy efficiency and performance of cloud computing are well discussed in [3] [33] [27]. Our survey focuses on simulation tools that can be used by researchers entering in the field of research.
Initially simulators for Grid Computing were used for cloud also but these were limited [4] [8] [18]. Now simulators like Cloud Sim, MDCSim, iCanCloud etc can be used for cloud computing simulations.
CloudSim simulation framework [6] shows to instantiate 100,000 machines in less than 5 min, requiring only 75 MB of RAM. It is based on the SimJava [13] discrete event simulation engine at the lowest layer, while the higher layers implement the GridSim toolkit [4] for the modelling of the cluster, including networks, traffic profiles, resources, etc. CloudSim effectively extends the GridSim core functionalities by modelling storage, application services, resource provisioning between virtual machines, and data centre brokerage, and can even simulate federated clouds.

CloudSim has been modified and extended by several research groups. For example, it has been used as is for the evaluation of energy aware algorithms in [24], and its communication flow has been modified in [9] to evaluate a green scheduling algorithm that uses neural networks to predict the future load demand based on historical data of the demand. In [10], CloudSim has been improved in terms of its ability to represent the user's rather than the provider's perspective. The end result is CDOSim, a simulator that allows the integration of fine-grained models, for example for determining the best trade-off between costs and performance or for comparing runtime reconfiguration plans. The veracity of its enhancements has been confirmed against a 5-node experimental EC2 implementation.

CloudSim has also been used for education purposes in [16]. The end result is TeachCloud, which provides a simple graphical interface through which students can modify a cloud's configuration and perform simple experiments.
Cloudsim authors [11], have introduced NetworkCloudSim where the focus is on the network flow model for data centres and the topologies, bandwidth sharing and latencies involved. Also, the modelling of applications has become more detailed by being able to represent multiple tasks for each application and tasks that are completed over multiple stages. As a result, it has been shown to be well suited to simulate advanced scheduling and resource allocation mechanisms.

Yet, being network flow-based rather than packet-based, CloudSim's network model cannot be as accurate as Green- Cloud's [17], which has been designed on top of the network simulator ns-2 [20]. Also, unlike CloudSim, which is a generalist simulator, GreenCloud focuses specifically on the measurement of energy consumption [17]. The power models used to estimate the energy consumption assume proportionality of the power consumption to the CPU load in servers, and that the power consumption of switches is almost constant and proportional to the transmission rate only at a very small scale. It allows the configuration of different workload arrival rates and patterns, and can implement different power management techniques of putting components to sleep. Although it can support a relatively large number of servers, each server is considered to have a single core and there is no consideration of virtualisation, storage area networks and resource management.

Thus, it is unclear whether it can be used to conduct experiments for evaluating the trade-off between performance and energy consumption [28] in a precise manner.
Another cloud simulator is MDCSim[19], which has been designed with an emphasis on multi-tier data centres. It can analyse a cluster-based data centre with detailed implementation of each individual tier. It has been configured into three layers, including a communication layer, a kernel layer and user-level layer, for modelling the different aspects of a cloud, and can estimate the throughput, response times, and power consumption. The latter is approximated using linear functions of the server utilisation, which in turn is calculated based on the number of nodes, number of requests and average execution time of requests.

More recently, Nunez et al. [25] [24] have developed the iCanCloud simulator. It is based on SIMCAN [23], which is a software simulation framework for large storage networks. iCanCloud can predict the trade-off between costs and performance of a particular application in a specific hardware in order to inform the users about the costs involved.
They have focused in particular on Amazon-like policies which charge users in a pay-as-you-go manner. iCanCloud has a full graphical user interface from which experiments can be designed and run, but existing software systems can only be modelled manually. It also allows parallel execution of one experiment over several machines.

6. CONCLUSION AND FUTURE WORK
The paper covered the basics of cloud computing and also provides a comparison of different simulators which can be used for simulation of cloud computing by researchers.

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