

An Overview and Trends in Cloud Computing

Anubhav Jain

Department of Computer Science
Harayana engineering college
Jagadhri,India

Manoj Kumar

Department of Computer
Engineering
Malaviya National Institute of
Technology, Jaipur, India

Anil Lambha

Kurukshetra University
Harayana engineering college
Jagadhri, India

ABSTRACT

Cloud computing has emerged as a technology that has surrounded us. The technology has become backbone within few years. Earlier technology which was used in networking was distributed computing. The cloud computing has change whole situation at present. With cloud computing virtual network, the capability of handling million of users becomes easy. The main characteristics cloud possesses are scalability, location independence and virtualization. These characteristics have attracted many IT giants like Amazon, Microsoft, Google, Intel, VMware etc.. Amazon is now providing two services first Amazon S3 a Simple Storage Service and Amazon EC2 Elastic Cloud Computing. This paper gives an overview of the technology which comprises of introduction to cloud computing, its service model, deployment model, platforms, roystonea pluggable interface, security issues, benefits and TCG remote attestation. The paper also describes about energy consumption by cloud infrastructure and the amounts spend on cooling infrastructure.

General Terms

IaaS, PaaS, SaaS, Eucalyptus, Nimbus, Open Nebula, Public Cloud, Private, Hybrid and community cloud.

Keywords

Cloud Computing, Virtualization, Security issue, Property based remote attestation, Energy consumption.

1. INTRODUCTION

[1]NIST defined, cloud computing as a dynamic system which can be connected and released as per the consumer's requirement. Some characteristic as ubiquities, convenient and shared polling. The birth of cloud computing took place in early 1990's. At that time it was visualized as future perspective in computing system. That would handle millions of user request at a time. Since then there has been a number of modifications in the field of cloud computing. Cloud computing is a virtual world. Now a question arises, how it is virtual? Suppose there is client who wants access to server, it will generate a request; after the request is generated it will look for available server which will serve the request for the client. After the available physical machine is identified it will create a virtual image of the physical machine. For the client, he is connected to the real machine, where as it is connected to virtual machine. All the queries will be served by the virtual image of the actual physical machine. Whole system is also interconnected with virtual networks. Cloud can have different users which include users from personal computers, laptops, Tablets, smart phones etc. which can access the cloud application either wired or wirelessly. What is required to a user is the internet connection. Internet is accessible from MODEM's for PC's ,laptops and most of the telephone

service providers also give an access to internet on phones it could 2G, 3G and 4G which has highest bandwidth. All these services to access internet allowed millions of users to use service thereby making huge network. To maintain such huge network we have cloud which could handle it efficiently without many complexities.

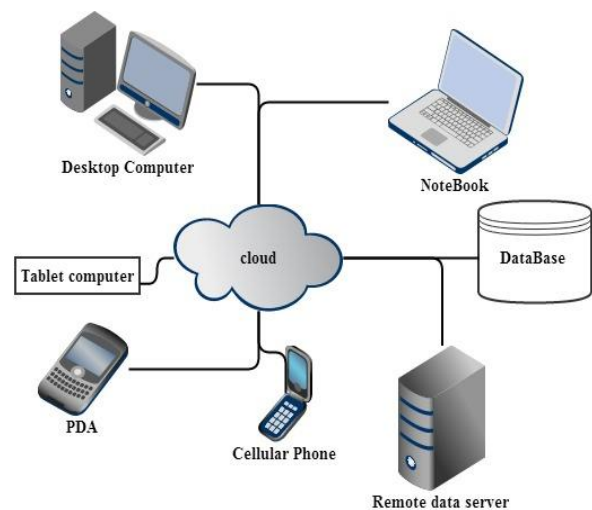


Fig 1: Image representing different devices connected to cloud

The main advantages cloud computing posses are:

- Easy to maintain
- Low cost
- Any where access
- Large network

With simplicity in the model architecture and large number of positives in the usage has attracted big IT firms to work on it and create their own clouds. Some of the major public cloud hosts are Amazon, Google, Microsoft, IBM, 3Tera, Oracle, Hp and Intel etc.

2. ARCHITECTURE

There are three layers in cloud service model architecture.

1. (SaaS)Software as a service
2. (PaaS)Platform as a service
3. (IaaS)Infrastructure as a service

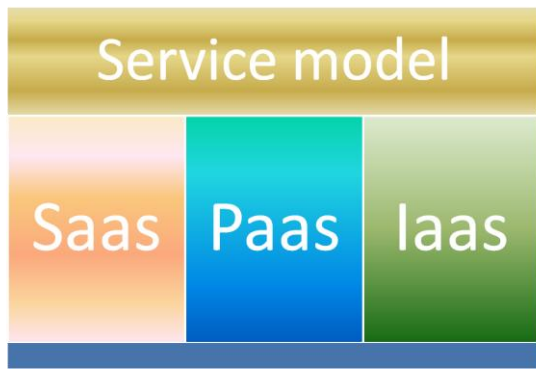


Fig 2: Service Model

2.1 Software as service (saas)

It provides user to get access to some of the applications on cloud. Service providers will deploy applications on internet the client will search for the best service according to their needs and use the service. The consumer will be able to access the software only when he is connected to internet. The user will be able to customize application according to the requirement. Some of the software as a services are free and some are paid. The paid services are based on pay as you go model. The pay as you go services are much secured than free services because of the SLA which is signed between the user and the service provider. The client needs not to control the cloud infrastructure. [1]The user applications can be accessed either by interface or with the help of thin clients. Example as browsers (Gmail, Hotmail etc.), Microsoft Office365.

2.2 Platform as a Service (PaaS)

Cloud also provides application for the users on the infrastructure of service provider. By using paas user is deployed onto cloud. The platform can be some specific operating system or some driver. These are custom applications which are created in some programming language, services, and tools from service providers. Applications can be from consumer or acquired applications [1]. The user does not control cloud infrastructure but he can customize applications. Example: [11] Amazon web services. In AWS, app is uploaded by the developer and its deployment details are handled by Elastic Beanstalk, details also include load balancing, auto scaling etc., and Googleapps allow users from enterprise and normal users to create web applications and deploy on Google cloud in simple way.

2.3 Infrastructure as a Service (IaaS)

IaaS provides hardware infrastructure to users. The infrastructure could be in terms of data storage space, or consumer computing services which can be used by user to run or install arbitrary software's. The infrastructure such as operating system, storage disks and other software's installed on user system can be managed by consumer. Example: Amazon S3. The S3 stands for simple storage service which provides the storage infrastructure at low price which is divided into three parts first standard storage, reduced redundancy storage, glacier storage. The Amazon S3 provides storage from 1Tb to over 5000Tb which cost from 0.010\$ to 0.095\$ per Gb for a month[11]. The price of storage varies with amount and category of storage.

Table 1: Comparison between the three layers

Saas	Paas	Iaas
Directly used by user. By installing the software	Provides platform Developed by developer in some programming language	It is the infrastructure provided by some service provider.
These are small applications.	These are large operating systems deployed on client's computer	Infrastructure such as data storage space provided by service provider on their infrastructures.
Act as applications	Act as middleware	Act as virtual hardware
Example: email services, Oracle, Cloud9, SAP	Example: OpenStack, Windows Azure, Salesforce.com's	Example: Amazon, Rackspace, AT&T, Datapipe.

3. PLATFORM IN CLOUD COMPUTING

3.1 Eucalyptus platform

[2],[17],[12]The eucalyptus is cloud computing platform which is an open source system and software platform for private IaaS cloud. Current eucalyptus system was built with a view of open source. Eucalyptus cloud is also compatible with private enterprise cloud and hybrid cloud computing. It is written in java and c language. It was designed to implement IaaS (infrastructure as a service) platform by using an API which supports Amazon EC2 and Amazon S3.

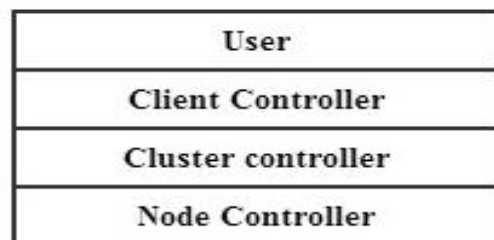


Fig 3: Eucalyptus layered architecture

Features of eucalyptus platform:

- Compatible with AWS API
- Elasticity and flexible clustering
- Can host Linux
- Scalable

Major customers: Sony, Infosys, Net App, Fujifilm's, Red cloud etc.

3.2 Nimbus platform

Nimbus is an open source technology which provides IaaS, Nimbus platform provides a Nimbus toolkit. Once the tool kit is installed on a cluster it provides IaaS cloud to its clients through EC2 Web Services Description Language(WSDL) or Web Services Resource Framework (WSRF)[2]. The type of cloud which nimbus platform provides is public .There are different mechanism for virtualization with that we can separate virtual machine from cloud system , Xen hypervisor & KVM are supported by nimbus platform. Nimbus support Linux operating system and was built in java and python language.

Features of nimbus platform:

- Scalable
- Lite component
- Can host linux
- Easy to configure

3.3 Open nebula platform

Open nebula is an open source tool which manages the storage center or repository placed at different locations which might not be similar to each other. The open nebula tools can create all the clouds by managing the data centers at various locations .The open nebula comes with key features as dynamical scalable, data storage planning, resource preemption and integrity features. It was built with java language and supports various web interfaces as EC2, OCCI, API LIBVIRT and XEN, VM WARE hypervisors. The open nebula is dynamic in nature which enables it to have multiple combinations for hardware and software in storage planning. It is mostly used by telecom companies, organization that provides web hosting services, big IT firms, research labs etc.

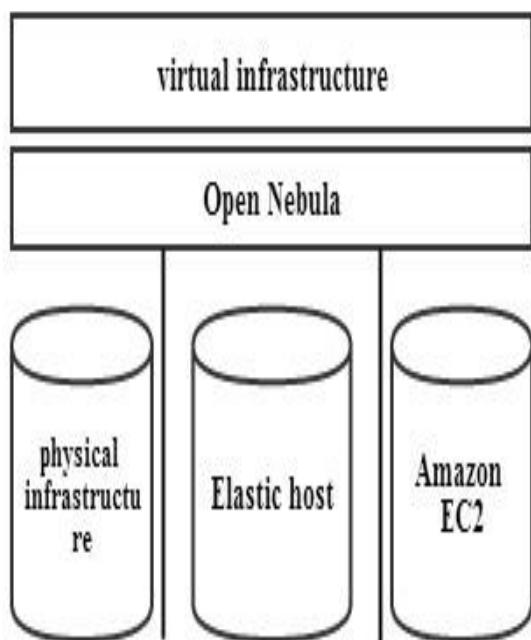


Fig 4:Open Nebula

Table 2: comparison among eucalyptus, nimbus and open nebula cloud platform

Service types	Eucalyptus platform	Nimbus platform	Open Nebula platform
Service model based	IAAS	IAAS	IAAS
Hypervisor support	XEN,kvm	Xen, kvm	Xen ,kvm ,vm ware[13]
Cloud support	Public	Public	Private
Unique feature	User management	Virtual network	Virtual network
Supported os	Linux	Linux	Linux and windows Xp
Language used	Java	Java	Java
Gui	Ec2	Ec2	Not available by default
Scalable	Yes	Yes	Yes
Deployment	Dynamic	Dynamic	Dynamic
Fault tolerance	Persistent database backend to store	---	Recovery

4. DEPLOYMENT MODEL

The cloud can be deployed according to the content, by the organizations. It is quite feasible to manage the content by cloud computing system. We can create different clouds as public, private and hybrid cloud.

4.1 Public cloud

This type of cloud generally has applications, data and other information which is useful to general public. In this system there are heterogeneous users. Heterogeneous include the devices with different devices and operating system. The content is available which can be publically shareable. This type of cloud has unpredictable number of users which can access the cloud at a time. The public cloud supports the infrastructure at extremely low price to operate. One of the service provider of public cloud is VMware. Which have more than 480,000 public clouds deployed using VMware vSphere virtualization platform with partners from industry. These public cloud service provider provides services to millions of users and own large infrastructure.

4.2 Private cloud

The private cloud is the cloud created by an organization is organized and maintained either by the organization itself or by some third party which provides private cloud service. The range of private cloud is smaller than public cloud and the content is available only to the members of the organization and not to the general public. The users are almost the same kind in the private cloud and good knowledge level. This

helps smooth functioning among different levels in an IT industry. It is scalable in datacenter using automation, resource pooling, and dynamic provisioning and also provides agility and efficiency which are characteristics of public cloud. Example Rackspace which provides a complete open source package and rackspace private cloud software for no cost [14] . IBM SmartCloud offers private cloud with IaaS and PaaS capabilities [15].

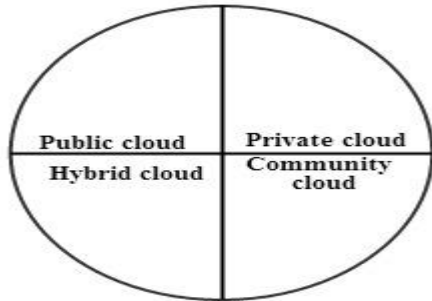


Fig 5: Deployment model

4.3 Community cloud

This cloud refers to specific people in an organization. This cloud can be maintained either by the organization itself or the maintenance lies in the hand of some other organization. This cloud has minimum number of user from all the cloud in the deployment model. [16]An example of community cloud is SolaS, which belongs to Lockheed Martin. The cloud offers secure, multiple tenant environment for government agencies. The SolaS incorporates cyber security and IT governance. Benefits achieved by Lockheed Martin in terms of cost efficiency.

4.4 Hybrid cloud

Combination of public and private clouds will result in hybrid cloud. It has limited number of entities supporting public as well as private deployment model. Example Windows azure, Google app engine, Amazon S3 and EC2

Table 3: Comparison between cloud models

Public cloud	Private cloud	Community cloud	Hybrid cloud
Unlimited users	Limited users	Ultra limited in number	Very high
Security depends on service provider	Secured enough	Highly secured	Secured
Not good in performance	Good in performance	Very good in performance	Good in performance
Reliability depends on service provider	Highly reliable	Highly reliable	Reliable
Maintained by third party	Can be maintained by third party or the organization on itself	Within or outside	Third party
Uses internet	Intranet	Intranet	Both intranet and internet

5. ROYSTONEA A PLUGGABLE INTERFACE

[3]The cloud computing is a virtual network in which service is provided at IaaS layer to user which includes virtual resources like Hypervisors (which is part of cloud to create and runs the virtual machines), networks and storage memory. When a user request for a virtual machine it creates a virtual image of the physical machine. The network between physical and virtual machine is mapped by the subsystem manager. This will create a virtual topology network requested by the user. But the simple cloud does not allow the user to switch from one infrastructure and decision algorithm to another. To avoid this restriction the roystonea pluggable interface has been developed so that it is easy to switch from one infrastructure to other. It creates a specific interface between cloud computing system and sub system manager. The development of the interface between the cloud computing system and sub system roystonea make the two system look as two individuals. So to switch from one infrastructure to another it does not need interaction with the whole cloud computing system whereas it will only be concerned with related interface. Chao shared the experience of the working of roystonea in which he says the roystonea started working in September 2010. There are more than 70 valid users from different scientific fields. Some of the services provided by roystones are apache Hbase, Hadoop clusters, apache web services and data storage services in Taiwan university. Trend Micro provided cluster to the roystonea of Taiwan University which has 15 servers. The server has 24Gb memory, double quad core CPU's and 1500GB of HDD.

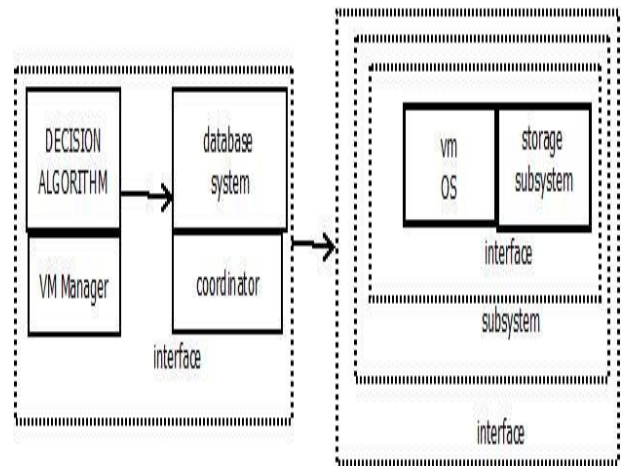


Fig 6: Roystonea interface

6. SECURITY ISSUES

In the cloud the ultimate repository does not lie with single server, rather it is distributed. Example web hosting allows user to save their data on web. The cloud provides basic essentials as low cost and efficient storage management. Still it has been shown by the hackers that they can intrude into the network. Various threats can be seen from within or outside. Threats within organization might occur from lost smart phones and notebooks of employees. But now days the hacker use virtual network as a platform for hacking or their might be some espionage within the organization for the security breach. The threat from outside might not be that harmful as from within the organization.

Security On Data

This include three major areas

- Data integrity
- Data intrusion
- Availability

Integrity:[7]The data ware house of the cloud where all the data is kept must be secured enough from the intrusion and other damages. The possibility of losing data integrity could be from inside or outside. From inside it could be from malicious insiders and from outside it could be hackers, attackers or crackers. Alzain discusses about some of the breach which occurred in various organization like attack on Red hat server, Google docs got attacked in 2009, Amazon S3 was also attacked in recent years with result it faced many integrity problems.

Intrusion:[7]Alzain discussed about the attack on service provider such as Amazon cloud in which there would be lots of damages if cloud is hacked. The user password could be changed or the personal details can be leaked easily. Even after the service provider tries to allow the user to change their password the Hacker might even know the changed passwords.

Availability:[7]Availability of service is one of the major issue with cloud. The user before accepting the license must take availability an issue in its mind. In this zain discusses about the Amazon which had mentioned in their license about the unavailability time to time. The service cloud be unavailable due to some cause and if there are some damages to the consumers data there will be no charges to the service provider.

Security Issues with Service Provider

The security is an important segment from the service provider's side. It includes user identity, secured data transfer, access management and privacy. The service provider organization must give the access rights to only those users who have registered and should not allow the unauthorized or guest user to access data. The access management of the organization must go for the three AAA structures which include auditing, authentication and authorized for the better access management. Following the triple A formula we actually increase the privacy of the system.

7. TCG REMOTE ATTESTATION

This method allows us for accessing the remote computer platform with trust. In this system there are two actors one is verifier and other is attester. A verifier is the one who wants to use the resource or platform from remote location. The attester is the one which is called by the verifier for access to the platform at remote location. Example: if X (verifier) wants to use the remote location of Y (attester) it will first request and submit task to Y (attester). But before that X (verifier) need to make sure that whether the remote location can be trusted or not. This system of ensuring whether the remote location for using platform is genuine or not, method is called remote attestation for computing platform.

TCG (Trusted computing group) is a club of (AMD, Hp, Microsoft, IBM, Intel) which provides trusted computing platform. The organization has two components in their TPM (Trusted platform module) which are secured storage and computing unit. The platform gives hardware protection by giving an interface to access the objects of the TPM. The TPM uses AIK key (attestation identification key) which us

the identity for security and the allows to sign message only with the private key so that it came to know about the origin of the message. TPM also consist of a PCR (Platform Configuration register)

8. ENERGY CONSUMPTION

The idea of cloud existed in many different forms due to recent development in the field of virtualization. The key benefits of adopting cloud virtualization are reliability and scalability. Besides these the cloud aims to provide cost effective solution to both consumer and service providers. For user, it must pay for what it uses and from the service providers respect its priority is to gain maximum profits by using minimum hardware with maximum output and energy efficient solution. Consumption of energy by cooling system not only raises the cost of cloud but also raise environmental issues like carbon emission.

To overcome the issue of carbon emission new ways of computing has gained attention called green cloud and sustainable computing. The green cloud is not restricted to virtualization, processors or datacenters rather it reaches to the components which are associated to main components. A survey was done by Jonathan G.Koomey, in the field of consumption of energy by servers in world and United States. The total energy consumption by servers is 0.6% of the energy sales in U.S. during 2005. The figures increased when the cooling and auxiliary infrastructure was included and reach 1.2% which double the energy consumed by the datacenters servers. In terms of calculating the amount of the of energy in 2005 was 2.7 billion US Dollar in US alone and it was around 7.2 billion US Dollar for the rest of the world[13].

The huge consumption of energy is due to overloading the resources or less utilization of infrastructure. However to overcome this problem various techniques and algorithm has been developed so as to make the dynamic and versatile computing technique energy efficient.

9. BENEFITS OF CLOUD COMPUTING

- The cost of the system is reduced due to less physical hardware and low maintenance cost.
- The cloud computing provides us the privilege of remotely accessing the system
- The cloud service is based on demand self service[1] i.e. only the required users will access the service as and when needed.
- The cloud computing is a scalable network, so if there is dramatic increase in the number of user the system will not fail to perform.
- The visions of applications are upgraded automatically y by the system, so the personnel's need not to worry about the up gradation.
- In case of any natural calamity the cloud do have the backup facility, the data remain secured.
- The cloud is independent of the heterogeneity so there no limitations with the hardware or software for getting onto cloud. Different hardware devices are
- It gives flexibility for consumers who are interested to swap from CapEx(capital expenditure) to OpEx(operating expense)[9].

- It provides huge storage space in the form of resource pool. The space is provided to user on request at any time.

10. REFERENCES

- [1] <http://www.nist.gov>
- [2] Muhammad Baqer Mollah, Kazi Reazul Islam*, Sikder Sunbeam Islam 2012. "Next Generation of computing through the cloud computing through the cloud computing technology". 2012 25th IEEE Canadian Conference on Electrical and Computer Engineering (CCECE).
- [3] Chao-En Yen , Jyun-Shing Yang, Pangfeng Liu, Jan-Jan wu 2011. Roystonea: A Cloud Computing System with Pluggable Component Architecture". 2011 IEEE 17th International Conference on Parallel and Distributed System. Chao-En Yen , Jyun-Shing Yang, Pangfeng Liu, Jan-Jan wu.
- [4] Gurudatt Kulkarni & Jayant gambhir, Tejswini Patil, Amruta Dongare 2011 . "A security in Cloud Computing" 2012 IEEE.
- [5] Akhil behl 2011. "Emerging Security Challenges in Cloud Computing An insight to Cloud security challenges and their mitigation" 2011 IEEE
- [6] Siyuan Xin, Yong Zhao, Yu Li 2011. "Property based Remote Attestation Oriented to cloud computing". 2011 Seventh International Conference on Computational Intelligence and Security
- [7] Mohammed A.AlZain, Eric Pardede, Ben Soh, James A.Thom 2012. "Cloud Computing Security: From Single to Multi-Clouds" 2012 45th Hawaii International Conference on System Sciences
- [8] Sushil Bhardwaj, Leena Jain, Sandeep Jain 2010. "Cloud computing: A STUDY OF INFRASTRUCTURE AS A SERVICE (IAAS)". IJEIT 2010, 2(1), 60-63
- [9] Young choon lee Albert Y.Zomaya May 2012 "Energy efficient utilization of resources in cloud computing systems" Springer US, volume 60, issue 2, pp 268-280
- [10] <http://www.cloud360.com/>
- [11] <http://aws.amazon.com/s3/pricing/>
- [12] Peter Sempolinski and Douglas Thain 2010 "A Comparison and Critique of Eucalyptus, Open Nebula and Nimbus". University of Notre Dame
- [13] J G Koomey 2007 "Estimating total power consumption by servers in U.S. and the world" 2007
- [14] What is a private cloud? Available at <http://www.rackspace.com/cloud/private/>
- [15] <http://www.ibm.com/cloud-computing/us/en/private-cloud>
- [16] <http://www.lockheedmartin.com/us/products/community-cloud>
- [17] <http://www.eucalyptus.com/>