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Cloud Computing: A Review

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Abstract*— Cloud computing is a way to run IT industry in a better way. Instead of running applications themselves, these business organisations run it on a shared data center. The term "cloud" is borrowed from telephony after introduction of concept of VPN, from those telecommunications companies, who until 1990s primarily offered point-to-point dedicated data circuits, began to offer Virtual private network services with almost same quality of service but it costs very less. Cloud computing stretches this boundary, it covers servers and network infrastructure also. Cloud computing claims to reduce cost greatly and capital expenditure is reduced to operational expenditure. The independence provided in device and location enable users to access systems through a web browser unconcerned of user location or which device they are using.

Keywords*— Cloud Computing; Cloud; Virtualization; Hypervisors; Resiliency; Multitenancy;

I. INTRODUCTION

Cloud computing is an fast growing area that affects IT infrastructure, applications, and network services. This study introduces various aspects of cloud computing, including its logics, underlying models, and infrastructures. Also this study will provide details about some of the specifically used technologies and scenarios in cloud computing.

The term "cloud computing" has different definitions for professionals of IT, depending upon their own point of view and their own products and services. The NIST (*National Institute of Standards and Technology)* definition of Cloud computing is as follows:

"Cloud computing is a model for enabling on-demand, convenient network access to a shared pool of computing resources which are configurable (for e.g., networks, storage, servers, applications, and services) that can be quickly provisioned and released with minimal effort in management or service provider interaction."[1]

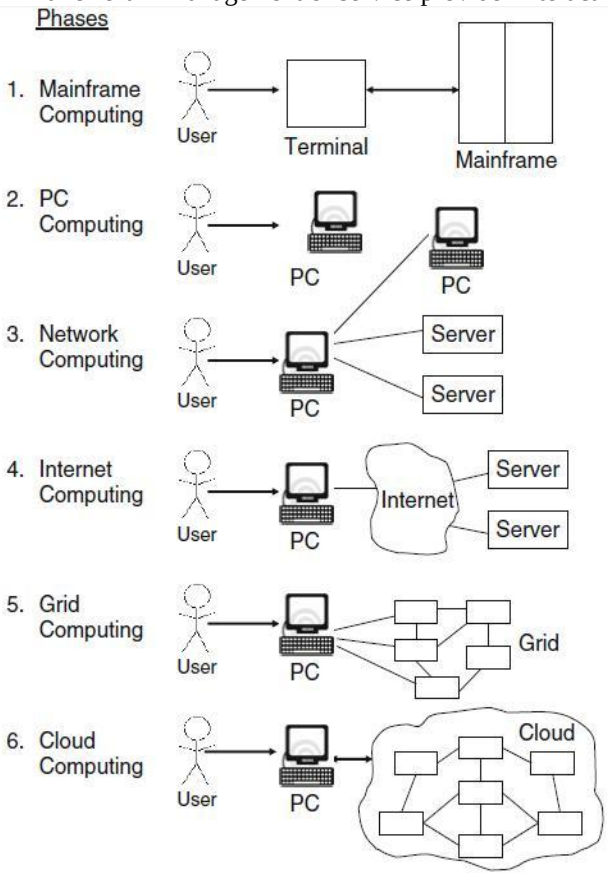

Fig.1 Six computing paradigms (adapted from [2][12])

In 1st computing paradigm, many users shared powerful mainframe computers using dummy terminals. In 2nd second computing paradigm, PCs which are stand-alone became powerful enough and meets the majority of users' needs. In 3rd computing paradigm, servers, laptops, and PCs were connected together through local networks to increase performance and share resources. In 4th computing paradigm, global network is formed by connecting one local network to other local networks such as through the Internet to access remote applications and resources. In 5th, grid computing provided shared storage and computing power through a distributed computing system. In 6th paradigm, cloud computing provides shared resources on the Internet through web browser in a simple and scalable way.[2][12]

II. CLOUD COMPUTING BACKGROUND

A. Cloud Computing Features: [3]

The following is the list of characteristics of cloud-computing environment. All characteristics may not be present in a specific cloud solution:

- *On demand*: Cloud Services are not permanent parts of IT infrastructure, because they are invoked only when needed—which is a significant advantage for cloud use in IT industries. With cloud services there is no need to have resources which are dedicated and waiting to be used, as is the case with internal services.
- *Elasticity and scalability*: Using Cloud computing one can expand or reduce resources according to ones specific service requirement. For example, there may be need a large number of server resources only for the duration of a specific task. After completion of task, client can then release these server resources.
- *Resiliency*: The failure of server and storage resources can completely be isolated from cloud users through the resiliency of a cloud service offering. Work is migrated to different physical resource in the cloud and user may or may not be aware of it.
- *Pay-per-use*: Client pay only when they use cloud services, either for the short term (for example, CPU time is required for short term) or for long term (for example, for cloud-based vault or storage services).
- *Multitenancy*: The cloud services for multiple users can be hosted within the same infrastructure by public cloud services providers. Storage and server isolation may be physical or virtual—depending upon the specific requirements of user.
- *Workload movement:* This characteristic is related to cost considerations and resiliency. Here, workload can be migrated by cloud-computing providers across servers—both across the data center and within the data centers. This migration might be necessitated by efficiency considerations (for example, network bandwidth) or by cost considerations (running a workload in a data center which is in another country might be less expensive based on power requirements or on time of day). Another reason could be that certain types of workloads have different regulatory considerations.

B. Virtualization in Cloud Computing: [3]

Virtualization means hiding the actual physical characteristics from the user and giving them a feel that they are provided service separately. Virtualization concept adoption accelerated the cloud computing and it becomes popular, specifically server virtualization. Now what is virtualization?

Virtualization software runs multiple *Virtual Machines* (VMs) on single physical server to provide the similar functionality as multiple physical machines; this is known as a hypervisor. The virtualization software at server side performs the abstraction of the hardware to the individual virtual machines.

Virtualization is not new—as it was first popularized and invented by IBM for running multiple contexts of software on its mainframe computers. In the past decade, it regained popularity in data centers because of concerns of server usage. The data centers are consisted of multiple physical servers. It is noted from measurement studies on these server that individual server usage very low due to various reasons, including the nature of the applications and traffic loads, among others. The result of this server sprawl with less usage was large financial outlays for both Capital expenditures and Operational expenditures—extra machines, related power, cooling infrastructure and real estate.

A hypervisor is implemented on a server in two ways, either directly running over the hardware (*Type 1 hypervisor*) or by running over an *operating system* (OS) (*Type 2 hypervisor*). The running of multiple Virtual Machines is supported by hypervisor and it schedules the VMs along with providing them a consistent and unified access to the CPU, I/O resources, and memory on the physical machine. A Virtual Machine typically runs an OS and applications. The applications are not required to be changed as applications are not aware that they are running in a virtualized environment. Fig 2 depicts these scenarios. The OS inside the Virtual Machine may be aware of virtualization and require modifications to run over a hypervisor—this scheme is known as para-virtualization (which is just opposite of *full virtualization*).

The some of the advantages of using virtualization in cloud computing is as follows:

- *Elasticity and scalability:* Less effort is involved in firing up and shutting down VMs than to bringing servers up or down.
- *Resiliency:* Through migration of VMs failure of physical server can be isolated from user services. This is how virtualization provides resiliency.
- *Workload migration:* Through facilities such as live Virtual Machine migration, one can do workload migration with much less effort as compared to workload migration across physical servers at different locations.

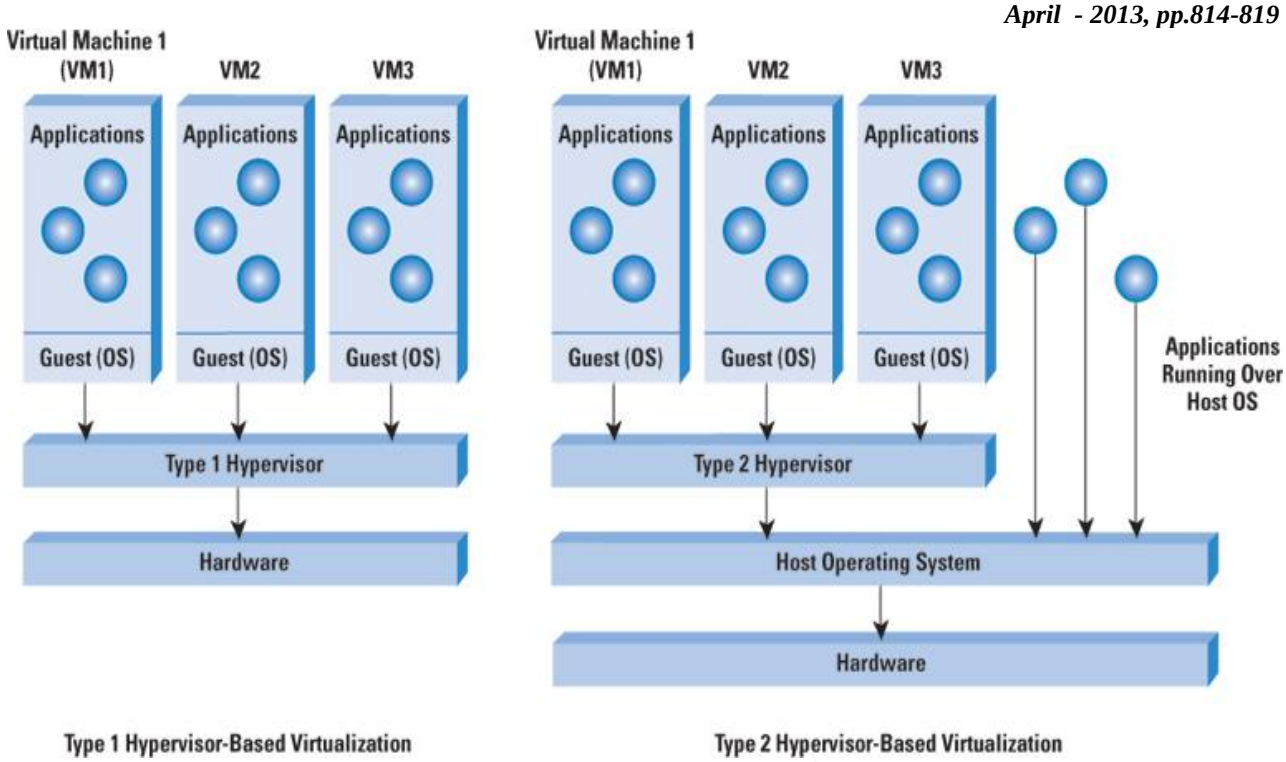

Fig. 2 Hypervisors in Virtualization (adapted from [3])

III. CLOUD TYPES

A. THE NIST MODEL:[4]

The NIST (*National Institute of Standards and Technology)* separates cloud computing into two distinct sets of models:[13]

- *Deployment Models*: This refers to the location and management of the cloud's infrastructure.
- *Service models*: This consists of the particular types of type services that can be accessed on a cloud computing platform.

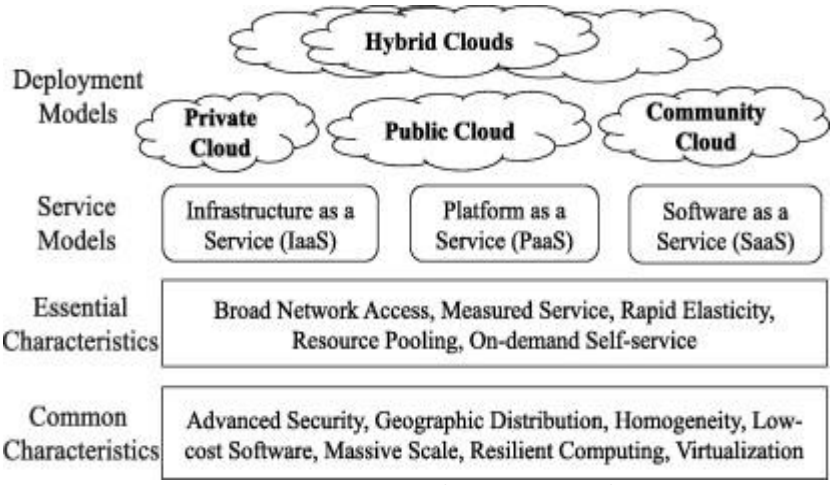

Fig. 3 The NIST cloud computing definitions (adapted from [4][13])

The NIST definition for the four deployment models is as follows:

- *Public cloud*: The organisation providing cloud services provides public cloud for the use in large industry groups and the services are generic in nature.
- *Private cloud*: The private cloud infrastructure is created exclusively for the use within an organization. The cloud may be managed or owned by that organization or any third party. Private clouds may be either on the premises or off the premises.
- *Hybrid cloud:* In hybrid cloud multiple clouds (private, community or public) are bound together as a unit where these clouds retain their unique identities. A hybrid cloud may offer proprietary or standardized access to applications and data, as well as portability of applications.
- *Community Cloud:* In community cloud, cloud has been organized to serve a common purpose or function. It may be for several organizations or for one organization, but they share common concerns such as their policies, mission, regulatory compliance needs, security, and so on. A community cloud may be managed by the corresponding organization/ organizations or by a third party.

Three service types have been accepted universally:

- *Infrastructure as a Service:* Iaas provides virtual machines, storage, infrastructure, and other hardware assets as resources that clients can provision but all virtual. The IaaS service provider manages the entire infrastructure, while the client is responsible for deployment aspects. This can include the OS, apps, and user interactions with the system. Examples are Amazon EC2 (Elastic Compute Cloud), Eucalyptus, GoGrid, FlexiScale, Linode, Terremark, RackSpace Cloud etc.
- *Platform as a Service:* Paas provides virtual machines, OS, applications, services, development frameworks, transactions and control structures. The client can deploy its apps on the cloud infrastructure or client can use applications that were programmed using languages and tools supported by the PaaS service provider. The services provider manages the cloud infrastructure, operating systems, and enabling softwares. The client is responsible for managing and installing the application that it is deploying. Examples are GoGrid CloudCenter, Force.com, Windows Azure Platform, Google AppEngine etc.
- *Software as a Service*: SaaS is a complete operating environment with applications, management, and user interface. In this model, the application is provided to the client through a client interface (a browser, usually), and the client's responsibility begins and ends with entering and managing its data and the user interaction. Everything from the application to the infrastructure is the vendor's responsibility. Examples are Oracle On Demand, GoogleApps, Salesforce.com, SQL Azure etc.

B. THE CLOUD CUBE MODEL:[5]

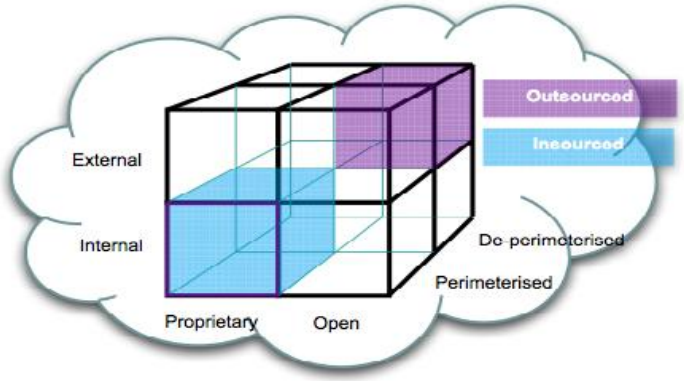

Fig. 4 The Jericho Forum's Cloud Cube Model (adapted from [5][13])

The Four dimensions of the Cloud Cube model are shown in Fig. 4 and listed here:

- *Physical location of the data:* Internal (I)/External (E) determines organization's boundaries.
- *Ownership:* Proprietary (P)/ Open (O) is a measure of not only the technology ownership, but of interoperability, ease of data transfer, and degree of vendor application lock-in.
- *Security boundary:* Perimeterised (Per)/ De-perimeterised (D-p) is a measure of whether the operation is inside or outside the security boundary or network firewall.
- *Sourcing:* Insourced or Outsourced means whether the service is provided by the customer or the service provider.

IV. COMPARISION OF SOME POPULAR CLOUD SERVICE PROVIDERS

A. AMAZON EC2 (IAAS)

Table 1. Amazon EC2 characteristics[8]

S. No.	LEVEL	FOUND CHARACTERISTICS
1.	Service	IaaS
2.	License	Proprietary base framework
3.	User group	Corporate use
4.	Payment	Pay-per-use
5.	Agreements	SLA (incl. compensation)
6.	Security	PKI
7.	Standards	Public API
8.	Openness	Moderate
9.	Supported OSs	Non-preconf. Or prec. With Linux, Windows Server or OpenSolaris
10.	Supported Applications/frameworks	Non-prec. Or prec. With databases e.g. MySQL, Oracle; batch processing, e.g. Hadoop; web hosting e.g. Apache HTTP, IIS/Asp.Net
11.	Dev. Tools	Command-line tools, developer API
12.	Virtualization	Xen

B. MICROSOFT AZURE:

Table 2. Microsoft Azure Characteristics[9]

S.NO.	LEVEL	FOUND CHARACTERISTICS
1.	Service	PaaS
2.	License	Proprietary
3.	User group	Corporate Use
4.	Payment	Pay-per-use, free promotion offers
5.	Agreements	SLA
6.	Security	Unknown
7.	Standards	Supports SOAP and REST API [6]
8.	Openness	Basic
9.	Supported languages/env.	.NET, PHP
10.	Supported OSs	Windows
11.	Supported applications/frameworks	Live Services, MS .Net Services, MS SQL, Services, MS SharePoint, and MS Dynamics CRM Services

C. GOOGLE APPS:

Table 3. Google Apps. Characteristics[7]

S.NO.	LEVEL	FOUND CHARACTERISTICS
1.	Service	SaaS
2.	License	Proprietary
3.	User group	Corporate and Private use
4.	Payment	Free (private use), 50$ per account per year (corporate use)
5.	Agreements	No SLA (Private); SLA (corporate)
6.	Security	HTTPS/SSL
7.	Standards	No standards (Single-sign-on API for corporate use
8.	Openness	Moderate
9.	Domain	Office suite, incl. email, calendar, etc.

V. CLOUD COMPUTING CHALLENGES

Though cloud computing has a number of benefits, there are some challenges as addressed in [10]

- *Performance:* The major issue in performance can be for some intensive data-intensive and other transaction-oriented applications, in which cloud computing may lack adequate performance. Users who are far from cloud providers may experience high delays and latency.
- *Privacy and Security:* Security is the issue about which companies are still concerned when using cloud computing. Customers are worried about the vulnerability to attacks, when critical IT resources and information are outside the firewall. The solution for security assumes that cloud computing providers follow some standards to take care of it.
- *Control:* Some IT departments are concerned because cloud computing service providers have a full control of the platforms. Cloud computing providers mostly do not design platforms for specific organizations and their business practices.
- *Reliability:* Cloud computing still does not always offer reliability round-the-clock. There are cases where cloud computing services suffered few-hours outages.
- *Bandwidth Costs:* With cloud computing, companies can save money on hardware and software; however higher network bandwidth charges can be incurred. Bandwidth cost may be low for smaller applications, which are not data intensive, but could significantly high for data-intensive applications.

VI. CONCLUSIONS AND FUTURE

In summary, cloud computing is definitely a type of computing paradigm/architecture that will remain for a long time to come. In the near future, cloud computing can emerge in various directions. One possible scenario for the future is that an enterprise may use a distributed hybrid cloud as illustrated in Fig. 5 According to this scenario, the enterprise will use the core applications on its private cloud, while some other applications will be distributed on several private clouds, which are optimized for specific applications.

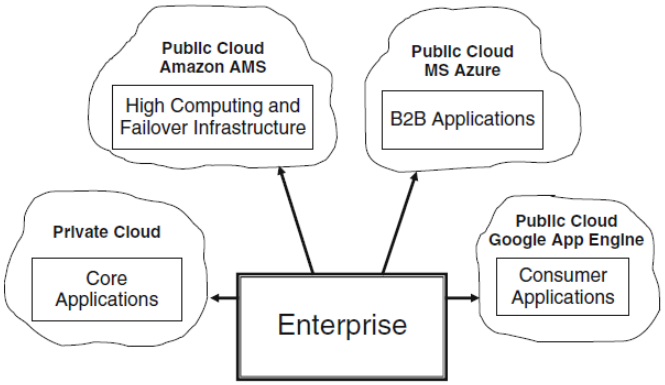

Fig. 5 Distributed Hybrid Cloud Architecture (adapted from [11])

REFERENCES

[1] Mell, P., Tim, G. (July 2009). The NIST Definition of Cloud Computing, National Institute of Standards and Technology, Version 15. Information Technology Laboratory.
[2] Voas, J., & Zhang, J. (March/April 2009). Cloud computing: New wine or just a new bottle? IEEE ITPro, 15-17.
[3] T. Sridhar, Internet Protocol Journal, CISCO Volume 12, Number 3, September 2009.
[4] The U.S National Institute of Standards and Technology (NIST) has a set of working definitions(http://csrc.nist.gov/groups/SNS/cloud-computing/cloud-def-v15.doc)
[5] The open group called Jericho Forum paper "The Cloud Cube Model: Selecting Cloud Formations for Secure Collaboration" (http://www. Opengroup.org/Jericho/cloud_cube_model_v1.0.pdf).
[6] Buyya R, Yeo CS, Venugopal S, Broberg J, Brandic I (2009) Cloud computing and emerging IT platforms: Vision, hype, and reality for delivering computing as the 5th utility. Future Generation Computing System 25(6):599–616
[7] Google App Engine. (http://appengine.google.com)
[8] Amazon Web Services. http://aws.amazon.com
[9] Microsoft Azure. http://www.microsoft.com/windowsazure
[10] Leavitt, N. (January 2009). Is cloud computing really ready for prime time? *IEEE Computer*, 15–20.
[11] Lakshmanan, G. (April 2009). *Cloud computing – Relevance to enterprise.* Infosys White Paper.
[12] Handbook of cloud computing, editor Borko Furht and Armando Escalante.
[13] Cloud Computing Bible by Barrie Sosinsky.

