A COMPARATIVE STUDY ON CLOUD MODELS AND SERVICES

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***Abstract*—The concept of cloud computing is one of a user sitting at a terminal taking advantage of services, storage space, and resources provided somewhere else - on another computer, through an Internet connection. In this paper we discuss the different cloud computing strategies, solutions, services, benefits and limitations. Cloud computing holds a great deal of economic potential. It makes resources available to small businesses that were previously the privilege of only large corporations. In a nutshell, cloud computing means getting the best performing system with the best value for money. The range of cloud computing as part of services offered covers the complete spectrum of information technology and includes, among other things, infrastructure (such as processing power, disk space), platforms and software .**

***Index Terms*— cloud computing, models, services, solutions**

I. INTRODUCTION

"Cloud Computing," to put it simply, means "Internet Computing." The Internet is commonly visualized as clouds; hence the term "cloud computing" for computation done through the Internet. With Cloud Computing users can access database resources via the Internet from anywhere, for as long as they need, without worrying about any maintenance or management of actual resources [1]. Besides, databases in cloud are very dynamic and scalable.

A cloud is a "Computing as a service over the Internet" – It is, often referred to as simply "the cloud," is the delivery of on-demand computing resources—everything from applications to data centers—over the Internet on a pay-for-use basis. They are Elastic resources which Scale up or down quickly and easily to meet demand , Pay for use metered service so you only pay for what you use , Self Service where all the IT resources you need with self-service access .

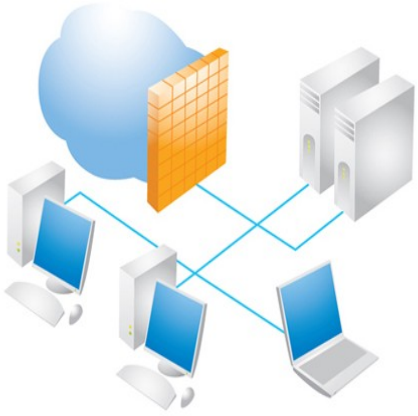

Fig-1

Cloud computing describes the approach, abstracted IT infrastructures (computing capacity, data storage, network capacity, or even finished software) dynamically adapted to the needs of a network to provide. From the user point of view, provided abstracted IT infrastructure seems distant and obscure, hidden in a "cloud" to happen. Supply and utilization of these services take place exclusively via defined technical interfaces and protocols.

In simplified terms one can follow the concept which can be described as: A part of the IT environment (in this context, such as hardware such as data center , data storage and software) is on the user side not operated or be provided locally, but with one or more providers hired as a service usually located geographically far away. The applications [4] and data are no longer on the local machine or in the corporate data center, but in the (metaphorical) cloud. The design element of an abstract outline of clouds in network diagrams often used to represent an unspecified part of the Internet.

The access to the remote systems of a network, such as that of the internet is in use. But there are also companies in the context of so-called private clouds, where provision of a corporate intranet is done. Most providers of cloud solutions leverage the pooling effects that arise from the sharing of resources for their business model.

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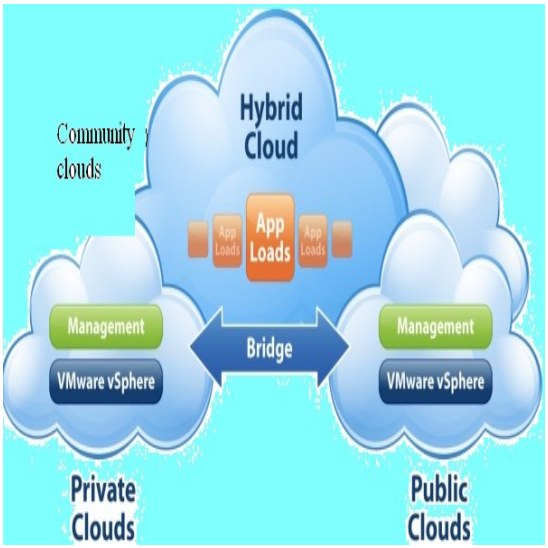
Table1: Comparison of various types of clouds their pros &cons, Services, infrastructure and for what they are ideal for are given below:

Type of cloud	**Pros**	**Cons**	**Services and infrastructure**	**Ideal for**
Public cloud	No Vendor lock-in concerns. Low resource requirement.	Concerns include data privacy, security and compliance with regulations and standard.	Provided off-site over the Internet.	Small and medium sized organizations. That does not own any QA infrastructure and have short term testing requirements.
Private Cloud	No Vendor lock-in concerns. No resource required to manage the public cloud since the cloud is service vendor.	Additional compliances like the SAS70 validation Would be needed .	Maintained on a private network.	Organizations Of all Sizes that Do not Want to Own any QA related infrastructure assets, but have short term testing needs that require security and compliance to standards.
Hybrid cloud	Improved utilization Of an organization's existing assets. On demand provisioning can be customized to the QA infrastructure.	Integration between Public and Private clouds can be a challenge When applications from these Types of cloud deployment models need to interact with each other for simulating end to end testing scenarios.	A variety of public and private options with multiple providers.	Large organizations that have the capability to handle majority of their long term QA infrastructure needs within their own private clouds and have certain short-term/sporadic QA infrastructure needs, at regular intervals, which can be handled in a public cloud.
Community cloud	Community clouds can be either on-premise or off-premise.	Concerns include data privacy, security and compliance with regulations and standard.	Service model that is shared among several or organizations and that is governed, managed and secured commonly by all the participating organizations or a third party managed service provider.	Organizations of all Sizes.

Fig:2 The Four Types of Cloud Computing Models



Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources[2] (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. This cloud model is composed of five essential characteristics, three service models, and four deployment models.

Private cloud

The cloud infrastructure is provisioned for exclusive use by a single organization comprising multiple consumers (e.g., business units). It may be owned, managed, and operated by the organization, a third party, or some combination of them, and it may exist on or off premises.

Community cloud

The cloud infrastructure is provisioned for exclusive use by a specific community of consumers from organizations that have shared concerns (e.g., mission, security requirements, policy, and compliance considerations). It may be owned, managed, and operated by one or more of the organizations in the community, a third party, or some combination of them, and it may exist on or off premises.

Public cloud

The cloud infrastructure is provisioned for open use by the general public. It may be owned, managed, and operated by a business, academic, or government organization, or some combination of them. It exists on the premises of the cloud provider.

Hybrid cloud

The cloud infrastructure is a composition of two or more distinct cloud infrastructures (private, community, or public) that remain unique entities, but are bound together by standardized or proprietary technology that enables data and application portability [3](e.g., cloud bursting for load balancing between clouds).

The three types of Cloud Computing Service Models

- Software as a Service (Saas)
- Platforms as a Service (Paas)
- Infrastructure as a Service (Iaas)

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Fig: 3 Three service models

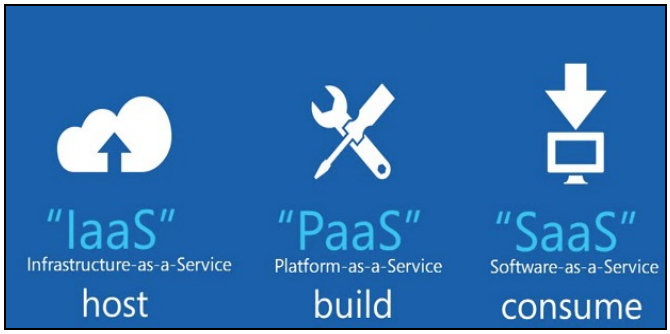

Table 2. Comparison of Some Cloud Computing Platforms

Property	Different Platforms				
	Amazon Elastic Compute Cloud (EC2)	Microsoft Azure	Google App Engine	Sun Network.com (Sun Grid)	GRIDS Lab Aneka
Focus	Infrastructure	Platform	Platform	Infra-structure	Enterprise clouds
Service Type	Compute, Storage (Amazon S3)	Web and non-web application	Web Application	Computing	Computing
User Access interface	Amazon EC2 command-line tools	Microsoft windows azure portal	Web-based administratio n	scripts, Sun Grid web portal	Work-bench, web-based portal
Value-added service providers	Yes	Yes	No	Yes	No
Virtualization	OS level running on a Xen hypervisor	OS level through fabric controller	Application container	Job management system (Sun Grid Engine)	Resource manager and scheduler
Web APIs	Yes	Yes	Yes	Yes	Yes
Dynamic negotiation of QoS	None	None	None	None	SLA-base resources reservation
Programming frame-work	Amazon Machine Images (AMI)	Microsoft.NET	Python	Solaris OS. Java, C, C++, FORTRAN	APIs supporting models in c# .Net

Software as a Service (SaaS)

The capability provided to the consumer is to use the provider's applications running on a cloud infrastructure. The applications are accessible from various client devices through either a thin client interface, such as a web browser (e.g., web-based email), or a program interface. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, storage, or even individual application capabilities, with the possible exception of limited user-specific application configuration settings.

Platform as a Service (PaaS)

The capability provided to the consumer is to deploy onto the cloud infrastructure consumer-created or acquired applications created using programming languages, libraries, services, and tools supported by the provider. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, or storage, but has control over the deployed applications and possibly configuration settings for the application-hosting environment.

Infrastructure as a Service (IaaS)

The capability provided to the consumer is to provision processing, storage, networks, and other fundamental computing resources where the consumer is able to deploy and run arbitrary software, which can include operating systems and applications. The consumer does not manage or control the underlying cloud infrastructure but has control over operating systems, storage, and deployed applications; and possibly limited control of select networking components (e.g., host firewalls).

Table 3. Comparison of cloud platforms with implementation aspects

	Eucalyptus	Nimbus	OpenNebula
Cloud Character	Public	Public	Private
Scalability	Scalable	Scalable	Dynamical, Scalable
Cloud Form	IaaS	IaaS	IaaS
Compatibility	Suppot EC2, S3	Support EC2	Open, Multi-Platform
Deployment	Dynamical Deployment	Dynamical Deployment	Dynamical Deployment
Deployment Manner	Commandline	Commandline	Commandline
Transplantability	Common	Common	Common
VM Support	VMWare, Xen, KVM	Xen	Xen, VMWare
Web Interface	Web Service	EC2 WSDL, WSRF	Libvirt, EC2, OCCI API
Structure	Module	Lightweight Components	Module
Reliability	-	-	Rollback host and VM
OS Support	Linux	Linux	Linux
Development Language	Java	Java, Python	Java

Advantages of Cloud Computing

1. Lower computer costs

You do not need a high-powered and high-priced computer to run cloud computing's web-based applications. Since applications run in the cloud, not on the desktop PC, your desktop PC does not need the processing power or hard disk space demanded by traditional desktop software. When you are using web-based applications, your PC can be less expensive, with a smaller hard disk, less memory, more efficient processor...

In fact, your PC in this scenario does not even need a CD or DVD drive, as no software programs have to be loaded and no document files need to be saved.

2. Improved performance

With few large programs hogging your computer's memory, you will see better performance from your PC. Computers in a cloud computing system boot and run faster because they have fewer programs and processes loaded into memory…

3. Reduced software costs

Instead of purchasing expensive software applications, you can get most of what you need for free is most cloud computing applications today, such as the Google Docs suite. It is better than paying for similar commercial software which alone may be justification for switching to cloud applications.

4. Instant software updates

Another advantage to cloud computing is that you are no longer faced with choosing between obsolete software and high upgrade costs. When the application is web-based, updates happen automatically available the next time you log into the cloud. When you access a web-based application, you get the latest version without needing to pay for or download an upgrade.

5. Improved document format compatibility

You do not have to worry about the documents you create on your machine being compatible with other users' applications or OSes .There are potentially no format incompatibilities when everyone is sharing documents and applications in the cloud.

6. Unlimited storage capacity

Cloud computing offers virtually limitless storage. Your computer's current 1 Tbyte hard drive is small compared to the hundreds of Pbytes available in the cloud.

7. Increased data reliability

Unlike desktop computing, in which if a hard disk crashes and destroy all your valuable data, a computer crashing in the cloud should not affect the storage of your data. if your personal computer crashes, all your data is still out there in the cloud, still accessible. In a world where few individual desktop PC users back up their data on a regular basis, cloud computing is a data-safe computing platform!

8. Universal document access

That is not a problem with cloud computing, because you do not take your documents with you. Instead, they stay in the cloud, and you can access them whenever you have a computer and an Internet connection .Documents is instantly available from wherever you are.

9. Latest version availability

When you edit a document at home, that edited version is what you see when you access the document at work. The cloud always hosts the latest version of your documents as long as you are connected; you are not in danger of having an outdated version

10. Easier group collaboration

Sharing documents leads directly to better collaboration. Many users do this as it is an important advantage of cloud computing multiple users can collaborate easily on documents and projects

11. Device independence

You are no longer tethered to a single computer or network. Changes to computers, applications and documents follow you through the cloud. Move to a portable device, and your applications and documents are still available.

Disadvantages of cloud computing

Moreover, an online service is more prone to threats than your PC. Having said that, however, most would agree that with cloud computing, the good outweighs the bad.The main disadvantages are Security and Privacy, Dependency (loss of control), Cost, Decreased flexibility, Knowledge and Integration.

1. Security & Privacy

The biggest concerns about cloud computing are security and privacy. Users might not be comfortable handing over their data to a third party. This is an even greater concern when it comes to companies that wish to keep their sensitive information on cloud servers.

While most service vendors would ensure that their servers are kept free from viral infection and malware, it Is still a concern considering the fact that a number of users from around the world are accessing the server.

Privacy is another issue with cloud servers. Ensuring that a client's data is not accessed by any unauthorized users is of great importance for any cloud service. To make their servers more secure, cloud service vendors have developed password protected accounts, security servers through which all data being transferred must pass and data encryption techniques.

After all, the success of a cloud service depends on its reputation, and any sign of a security breach would result in a loss of clients and business.

2. Dependency (loss of control)

• Quality problems with CSP (Cloud Service Providers).No influence on maintenance levels and fix frequency when using cloud services from a CSP.

• No or little insight in CSP contingency procedures. Especially backup, restore and disaster recovery.

• No easy migration to another CSP.

• Measurement of resource usage and end user activities lies in the hands of the CSP

• Tied to the financial health of another Company.

3. Cost

Higher costs. While in the long run, cloud hosting is a lot cheaper than traditional technologies, the fact that it's
Currently new and has to be researched and improved actually makes it more expensive. Data centers have to buy or develop the software that'll run the cloud, rewire the machines and fix unforeseen problems (which are always there). This makes their initial cloud offers more expensive.

Like in all other industries, the first customers pay a higher price and have to deal with more issues than those who switch later (although it would be very hard to create and improve new technologies without these initial adopters).

4. Decreased flexibility

This is only a temporary problem (as the others on this list), but current technologies are still in the testing stages, so they don't really offer the flexibility they promise. Of course, that'll change in the future, but some of the current users might have to deal with the facts that their cloud server is difficult or impossible to upgrade without losing some data, for example.

5. Knowledge and Integration.

Knowledge:

More and deeper knowledge is required for implementing and managing SLA contracts with CSP's, since all knowledge about the working of the cloud (e.g. hardware, software, virtualization, and deployment) is concentrated at the CSP, it is hard to get grip on the CSP.

Integration:

Integration with equipment hosted in other data centers is difficult to achieve. Peripherals integration. (Bulk)Printers and local security IT equipment (e.g. access systems) is difficult to integrate. But also (personal) USB devices or smart phones or groupware and email systems are difficult to integrate.

Limitations of Cloud Computing

For those who follow trends in web hosting [9], cloud computing is a term that they come across often these days. There are many benefits of cloud computing irrespective of the size of the organization. The benefits include secure and affordable managed hosting, accessibility of data from anywhere at any time, offsite backup, no need of internal IT resources, scalability and so on.

But there are some limitations as well since it is still an evolving technology. Some weaknesses of cloud computing is listed below:

Cascading effect

If there is a problem in data center, all virtual machines are affected. There might or might not be a backup of the data if an enterprise relies only on the cloud for its data management needs.

Network connection

The concept assumes that the client has reliable network connection. If there are problems of network connectivity, accessing the cloud also becomes a problem. Performance of the cloud applications also depend on the performance of network at clients' side. Upload and download speeds are slower as compared to that of a local server.

Control of data security

In a public cloud, the client does not have the control over security of his/ her own data. The clients' data can be susceptible to hacking or phishing attacks. Since the servers on cloud are interconnected it is easy for malware to spread.

Additional costs

Although cloud computing offers cost benefits, it has some hidden or additional costs as well. Clients are charged extra for data transfer or other services. Initial offerings are priced higher, till economies of scale work out for the service provider.

Peripherals

Peripheral devices like printers or scanners might not work with cloud. Many of them require software to be installed locally. Networked peripherals have lesser problems.

Integration

Integrating internal applications with those on cloud can be complex and in some cases not viable.

Generic

Public cloud offerings are very generic and offer multi-tenancy service which all organizations might not be comfortable with. Implementing an in-house cloud is more complex to implement and are burdensome on internal resources if the organization is not large enough.

Cloud service providers are continuously evolving solutions to overcome the above mentioned hurdles. Some enterprises are seeing clear benefits in shifting to the cloud and are adopting it unconditionally while some enterprises are moving non-critical applications to test the waters. Some others want to wait and watch how the technology evolves before deciding.

Conclusion

cloud computing seems to be more than just another buzzword, it's important to find out which cloud service model is right for which size of business, but there is no "right" cloud for a particular type of business. You need to understand the advantages and disadvantages, both from a business and from a technical perspective, of each of the different kinds of cloud service. Then you can determine how they should integrate with, or replace, the services already provided by your in-house IT department.

A cookie-cutter approach will not result in an effective use of the cloud. When considering cloud computing services, there are two important dynamics to consider.

First, what is the right resource model for the cloud-based application? Second, what is the right tenancy model for the business? But, which model to use depends on the services and how effectively they can be provided by a cloud provider.

FUTURE ENHANCEMENT

Many of the activities loosely grouped together under cloud computing have already been happening and centralised computing activity is not a new phenomena. Grid Computing was the last research-led centralised approach However there are concerns that the mainstream adoption of cloud computing could cause many problems for users Many new open source systems appearing that you can install and run on your local cluster should be able to run a variety of applications on these systems.

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