

A Comparative Study: Cloud Computing Service Providers

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Abstract: With the development of ICT infrastructure, a new technology, cloud computing, has emerged. Cloud computing is the latest computer model in which IT services and applications are delivered via the World Wide Web. Cloud computing is one of the hottest technologies that allows businesses to manage resources and securely store and share data online. Today, a variety of cloud services are offered to leading companies such as Amazon, Google, and Microsoft in the form of reliable, customized, and inexpensive web applications. Choosing the right cloud computing for your business needs is no easy task. The purpose of this study is to help businesses select the right cloud computing for their needs and requirements. In addition, the research presented in this white paper will help people make informed decisions about the benefits and costs of cloud computing technology before moving their business to this new location.

Keywords: Cloud computing, Google cloud platform, Amazon AWS, Microsoft azure.

1. Introduction

Now-a-days, most of the world is connected to the internet. Recent advances in the field of computer networks have made it possible for us to access anything stored on the WWW, anywhere, online. Cloud computing is the latest development in the field of online computing that allows users from all over the world through the internet to access online and app-based applications. These services and services are accessible by the normal internet and social networking systems and systems. In the case of Cloud, resources are limitless and real. The configuration of the machines where the cloud computing related software works, is extracted from the end user. Cloud services are studied under three cloud service models I) Infrastructure-like Service (IaaS) ii) Platform-as-a-Service (PaaS) iii) Software-as-a-Service (SaaS). These cloud services are represented by a stack known as Cloud-stack such as OSI or TCP/IP stack. The central layer of this stack is PaaS (Platform-as-a-service). Cloud-based OS provides basic support for storage interaction, application implementation, other equipment in the provision of services such as remote storage. Development teams wish to create an application cloud-based applications should consider calling a cloud platform that provides cloud services to create support applications. A new SaaS application can be built in a cloud environment instead of building a customized base. In recent times, a number of cloud

platform services have been developed and developed. Google cloud platform, Amazon, Microsoft Azure.

An overview: Cloud Computing

Cloud computing service utilizes a built-in virtual reality technology that allows the hiring of virtual infrastructure for a small fee per use compared to traditional web software design methods. In addition, it provides cloud platform tools to speed up the development process. Cloud computing is a model that allows easy access, where required a shared set of configurable computer resources (for example, storage, servers, networks, services, and applications) that can be delivered and deployed quickly with minimal interaction with a service provider or minimal management effort.

A. Features of Cloud Computing

a) Scalability: Cloud is a great solution, for example Google, Yahoo, Amazon has hundreds of thousands of servers worldwide. CSPs can add new nodes and servers to obscure minor changes to cloud infrastructure and software.

b) Virtualization: The cloud separates the visible resources from end users at a virtual level, hence, users can access any of the services and resources they need without having to worry about location or virtual contact information.

c) Reliability: The use of many less efficient nodes ensures higher reliability of services and utilities and makes cloud platforms more reliable than portable computers.

d) Versatility: Cloud computing doesn't aim to certain special application. A lot of applications are supported by the cloud and can be run in parallel.

e) Expandable Service Integration: Users view the cloud as a host of services and services that can be quickly and expanded and deployed based on their need.

f) Demand Measurement Services: You can rent cloud services according to your need; cloud services such as electricity, water, and toll gas as you use them.

g) Economics: The cloud can be built on less expensive nodes and focused managers do business to avoid the administrative costs of data centers that go up very quickly.

h) Security: Maintenance of software infrastructure or computer hardware, is the responsibility of Cloud Service Platforms. This puts a few heads in the IT team in the organization.

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i) *Easy Management*: Storage-based applications are easier to use and manage in a cloud environment compared to within an organization. And at the end user level, all you need is a web browser with a valid internet connection.

j) *Cost Reduction*: Using cloud computing significantly reduces IT usage in SMEs. Expensive systems are not required for the use of computer resources from time to time. And the manpower needed for such programs is greatly reduced. Even simple apps, such as email, can be set up and usually free of charge with apps like Google Apps.

k) *Availability*: Cloud services are available at anytime from anywhere via network access through various types of platforms (e.g., mobile phones, laptops, and PDAs). Lower outages are provided by CSPs, thus providing uninterrupted services to the user. However, some occurrences of outages have occurred in the past, such as the Gmail outage in 2009. Also, another cloud vendors such as Amazon EC2 have failed in point of time, however, they are much more dependable compared to the infrastructure installed on the organization.

l) *Disaster Management*: In case of disasters, an offsite backup is always helpful. Keeping important data backed up using cloud storage is the need of the time for organizations. In addition, CSPs ensure that they have systems in place for disaster recovery.

m) *Green Computing*: Harmful emissions due to the extensive use of systems in organizations, electronic waste which is generated as the time goes and energy consumption are becoming main disadvantage of the computing systems. This can be reduced by using cloud computing services which preserves the environment and generates e-waste to minimum extent.

B. Types of Cloud Models

There are four cloud models:

1. *Public Cloud* is maintained and managed by third parties. It is a computer cloud. In public cloud both processes and several customer data are integrated into storage systems, servers, and other cloud infrastructure. The last cloud client does not know what other users might be working on in the same storage systems, server, network, etc. Storage systems, applications, and other resources are publicly available through the cloud service provider who owns all the infrastructure in its data centers. Access to services is only provided remotely, usually via the Internet. An example of this model is Gmail.

2. *Private Clouds* may be the best choice for companies which require a high level of protection and security for their data. Private clouds are in an infrastructure on demand, managed by one client who controls what applications should work and when. In private clouds, companies own the storage disk, network, and server and can decide which users are authorized to use this infrastructure. Internal management of services gives companies preference in maintaining the privacy of their information and allows unifying of access to corporate applications for their users. An example of this model is the data centres in which the servers and infrastructure of a particular organization are maintained and that host their applications and data.

3. *Hybrid Clouds* integrates public cloud with private cloud models. In cloud computing, the user can own parts and share them with others. The user owns some parts and shares some, in a controlled manner. This model offers the promise of measuring external demand and supply, but with additional problems in determining how applications are distributed across different locations.

4. *Public Cloud* is one of the platforms that allows many independent environments to operate in the arena, where these companies may have similar functions or concerns (such as security, policy, compliance, etc.). An example of this is testing a new defense product. The public cloud is managed internally or by external companies and is hosted internally or externally.

C. Cloud Service Models

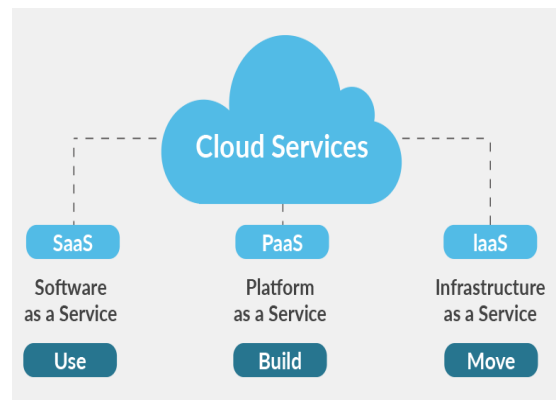


Fig. 1. Cloud service model

A generalized cloud service model is represented as a cloud-stack in figure 1. Cloud Computing service models are known as reference models. Cloud computing relies on these models significantly. These models can be categorized into three as listed below.

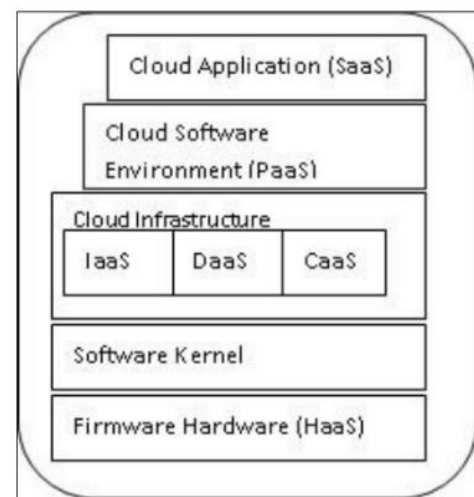


Fig. 2. Cloud service model

1) Infrastructure-as-a-Service (IaaS)

IaaS means to provide access to the infrastructure part of the cloud such as fundamental resources like virtual memory, physical and virtual machines, etc. The capability of each user is to make use of basic functionalities like networks, storage,

processing where the user can implement and execute arbitrary software which includes operating systems and other application software.

2) Platform-as-a-Service (PaaS)

PaaS provides the runtime environment for development and deployment tools, applications, etc. The capability provided to the user as PaaS is to install the above created cloud infrastructure or other applications created using tools and programming languages supported by the CSP.

3) Software-as-a-Service (SaaS)

SaaS model allows use of software applications as their fundamental service to the users. SaaS is a term that basically points to software in cloud. It is typically the capability with the consumer to use the applications provided by CSP; running on the cloud IaaS. These applications can be used from different client end machines with the help of a user-interface like a web browser or web-based email app like Gmail.

2. Cloud Service Providers

1) Amazon

amazon.com is one of the most popular CSPs, it offers a lot of cloud services including:

- Amazon EC2 (Amazon Elastic Compute Cloud): provides computing capacity on the cloud.
- Amazon S3 (Simple Storage Service): It is dedicated for highly reliable storage on the cloud.
- Amazon RDS (Amazon Rational Database Services): provides powerful tools for managing databases on

the cloud.

- Amazon Simple DB: provides the core database functions.
- Amazon Rout 53 (Amazon scalable DNS): provides secure routing servers over the Internet.
- Amazon CloudFront: It is dedicated for distributing and managing contents over the Internet with highspeed.
- Amazon Elastic MapReduce: This is a web service that enables customers to process large amount of data on the Cloud.

2) Google

Google joint the cloud market in 2007 by simple services such as email, calendars, online documentation.

Google also have various cloud services such as:

- Compute Engine: An IaaS where customers can run large-scale work load in virtual servers hosted in Google's infra-structure.
- App Engine: Is a PaaS where customers develop applications using built-in high-performance platforms.
- Cloud Storage: where customers can store any type of files with any size using secure, reliable, storage services from google.
- Cloud SQL: It deals with relational Databases with different Database Management Systems.
- Cloud Datastore: This is a service to deal with the

Table 1
Comparison of platforms

	Google Cloud Platform	Amazon	Microsoft Azure
Initial Release Date	2008	2006	2010
Cloud Service Model	IaaS PaaS SaaS	IaaS PaaS SaaS	IaaS PaaS SaaS
Billing	Pay per hour or month. Discounts proportional to consumption hours (on average a 24% discount)	Payment per hour or per Second, with a one-minute minimum. Discounts on contracts of 1 or 3 years (Only for Reserved Instances).	Pay per hour, except virtual machine (per minute). Discounts on contracts of 1 or 3 years
Backups	Make On-demand backups or Automated backups copies around the world.	Make 3 copies in the same geographical area, Possibility of duplicating copies to other areas.	Make 3 copies in the same geographical area, Possibility of duplicating copies to other areas.
Worldwide availability	20 regions worldwide. More than 200 countries.	25 regions worldwide. 206 countries	54 regions worldwide. 140 countries.
Support	24x7 Free support (access to knowledge center). 4 hours response time: \$100 per month 1-hour response time: \$250 per month.	Free support (access to knowledge center). Contact by email during office hours: \$29 /month. 24x7 phone, email, and chat contact with 1-hour response time: \$100 /month.	24x7 Free support (access to knowledge center). 8 hours response time: \$29 / month, via email. 2 hours response time: \$100 / month, via email and phone
Virtual Machine Types	59	170	195
Volume Type	Network-attached HDD, Locally-attached SSD, or Network-attached SSD	The default: General Purpose SSD, it can be customized to highest performance SSD or HDD	Standard HDD, can be customized to SSD
Other Cloud Services	Computing and hosting, Networking, Storage, Databases, AI and Machine learning, API management, Data Analytics, Internet of Things, Networking, Security	Data Analytics, Storage, Databases, Computing, Internet of Things, Machine learning, Networking and content delivery, Security	Computing, AI and Machine Learning, Storage, Databases, Office 365, Internet of Things, Data Analytics, Management and Governance, Networking, Security
Security	40 certifications	25 certifications	87 certifications
Stability	99.99% monthly availability. Between 99.00% and 99.99%: 10% penalty. Between 95.00% and 99.00%: 25% penalty. Below 95%: 50% penalty.	99.99% monthly availability. Between 99.99% and 99%: 10% penalty Between 99% and 95%: 30% penalty. Below 95%: 100% penalty	99.95% monthly availability. Between 99.00% and 99.99%: 10% penalty. Between 95.00% and 99.00%: 30% penalty. Below 95%: 100% penalty
Server Migration	Accept VMware. No cost.	Accept VMware and Hyper-V servers. No cost.	Accept Hyper-V, VMware, and physical servers. In most cases, no cost

unstructured database.

- Big Query: with the recent big data revolution google provide a specific service to process vast amount of data.

3) Microsoft

In 2009, Microsoft started the cloud service by introducing Microsoft Azure. Microsoft Azure is a cloud platform that offers various types of services such as:

- Infrastructure: scalable, on-demand infrastructure with high performance and full support.
- Web development: provides very powerful platform which allows developers to build, test and deploy web applications.
- Mobile development platform: provides services to build and test a mobile application on the cloud itself.
- Media: one of the competitive advantages of Microsoft azure and is dedicated for editing, publishing, and creating any type of media.
- Storage: a cloud storage solution to process and manage vast data even if they are large scale or regular data.
- Big data cloud: a big data solution which supported by the apache Hadoop.
- Identity and access management: user can keep active directory on the cloud and control access via a single sign.

3. Comparison of Platforms

To evaluate the possibilities of the main platforms studied, a comparative analysis method has been applied to the cloud computing giants as detailed in table 1.

4. Conclusion

In this paper, we made some comparison between most famous cloud computing service providers. This comparison will help individuals and organizations make critical decisions on benefits and cost of cloud technology before they move their business to this new environment. Cloud computing has a very promising potential market. Hence, it needs more effort to explore from researchers and technical specialists. Comparative studies between cloud models, cloud methodologies, and specific cloud techniques are still needed. In addition, innovative solutions to cloud computing security challenges need more investigation.

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