

A Comparative Review of Cloud Computing Service Providers

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1 Introduction

Cloud computing is the on-demand availability of computer systems. Especially cloud storage. The term is used to describe the data centers available to many users on the internet. Cloud storage really helps us out storing even sharing data through the internet is much easier. Cloud computing was popularized with “Amazon.com” with the release of its elastic compute cloud in 2006. The goal of cloud computing is to allow users to take benefit from all of these technologies, without the need of a deep knowledge about the technologies. The cloud aims to cut costs and helps the users focus on their core business instead of being stuck by IT obstacles. There are several deployment models for cloud computing which are; private cloud, public cloud, hybrid cloud and the one that might be really popular right now big data there are also many other models. Though cloud computing has several downsides that we will have limited customization options, privacy and confidentiality are big concerns in some activity. The main objective of this paper is to evaluate and compare the cloud computing service providers from many aspects. This paper is organized into 7 sections. The first section outlines the introduction for the review of Cloud Computing service providers. Section 2.0 describes the background of Cloud Computing. In section 3.0, reader will get to know about Cloud Models. Section 4.0 describes the Cloud services. Section 5.0 explains and compares the leading Cloud Computing providers and Section 6.0 will discuss the choice of cloud computing provider. Finally, section 7.0 presents the conclusion of this review.

2 Background of Cloud Computing

According to Steve Ranger from zdnet.com, Investopedia and other resources, cloud computing is the delivery of different services through the internet, typically on a pay-as-you-go basis. These resources include tools and applications like data storage, servers, databases, networking, and software. There are various benefits of cloud computing, and one of the most important uses of cloud computing is cloud storage. This allows companies and individuals to store their data remotely and safely and make it more accessible and usable. And that is ideal for most remote workers and offices. Furthermore, the cloud has an integrated data backup and recovery process, which keeps your data safe and protected all the time. Your data is always safe and secure from cyber-attacks, natural disasters, and even physical thefts. Moreover, with the great features and services that cloud computing provides comes great responsibility. There are various needs for a Service provider to provide cloud services. For example, Certification and Standards, like structured processes good knowledge and server status visibility. Also, Technologies and Maintenance, like managing data, power, cooling, etc., and of course having enough space and mass devices. And the list goes on, from data security and governance, to reliability and performance, etc.

3 Cloud Models

The term cloud computing can be varied from classifications, types, and architecture models. This networked computing model has transformed how we work—you’re likely already using the cloud. But the cloud isn’t one thing—cloud computing can be categorized into three general types.

3.1 Public Cloud

The public cloud is a computing service offered by third-party providers over the public internet, it makes them available to everyone that wants to purchase it. The difference between the public and the private cloud is most public cloud providers offer direct connection service that allows customers to securely link their data center to their cloud resident apps.

3.2 Private Cloud

Private cloud is a computing service that offers over the internet or a private internal network and only to select users and not the general public. This model infrastructure operated merely for a single organization, whether it's managed internally or by third party, and hosted internally or externally.

3.3 Hybrid Cloud

Hybrid cloud is a mix of a public cloud and a private environment. This will allow them to share data to each other's. Hybrid cloud has the ability to connect collocation, managed or dedicated service with cloud resources. The example of use in hybrid cloud is when an organization store sensitive client data in house on a private cloud apps, but interconnect that application to a business intelligent app provided on a public cloud as a software service.

4 Cloud Services

Service providers are designing cloud infrastructure services to address common commercial or research needs. There are three types of IT services that are used in these cloud deployments which are Software as a Service (SaaS), Infrastructure as a Service (IaaS), and Platform as a Service (PaaS). Cloud computing services are all typically configured to accommodate vast numbers of users and demand spikes.

Table 1. Platform types and examples

Platform types	Examples
IaaS	Amazon Web, Linode, Microsoft Azure, Amazon EC2
PaaS	Windows Azure, OpenShift
SaaS	Gmail, Salesforce, Cisco WebEx, Google Cloud Platform

4.1 Infrastructure as a Service (IaaS)

Platforms, in essence, rest on the infrastructure. Infrastructure-as-a-service systems typically hit the 'bare metal' level—physical servers, networking elements, and storage devices required to render platforms (and therefore services) usable. IaaS is popular among corporate customers, with tradeoffs between speed, expense and privacy that each provider balances in a number of ways.

4.2 Platform as a Service (PaaS)

The SaaS solution lies on the top of the platform. Vendors selling platform-as-a-service portfolios typically face corporate customers. PaaS products include virtual machines, operating environments, storage environments, and every other middleware aspect between the hardware and the consumer-facing programme.

4.3 Software as a Service (SaaS)

Cloud applications using a software-as-a-service model, or SaaS provide end-users with completely functioning programmes even if programmes do not exist on their local computers. Email services like Gmail and Outlook.com are SaaS apps, as well as any computer software operating within a browser. As such, SaaS is well known to home customers.

5 Top/Leading Cloud Computing Providers

5.1 Amazon EC2

Amazon Elastic Compute Cloud (Amazon EC2) is a web-based service that allows businesses to run application programs in the Amazon Web Services (AWS) public cloud. It allows a developer to spin up virtual machines (VMs) which provide compute capacity for IT projects. An AWS user can increase or decrease instance capacity as needed within minutes using Amazon EC2 web interface or an application programming interface (API). The benefits are Amazon EC2 allows for complete control of instances which makes operation is simple, the flexibility of multiple instance types, operating systems, software packages, and integrated with most AWS services makes it a secure solution for computing, query processing, and cloud storage. The weaknesses are UI for EC2 service is a little bit complex and at many places, it misses detailed explanation.

5.2 Google Cloud Platform

Google Cloud Platform is a suite of public cloud computing services offered by Google. The platform includes a range of hosted services for compute, storage, and application. It also offers services for networking, big data, storage, machine learning and Internet of Things (IoT). The core cloud computing products in Google Cloud Platform include Google Compute Engine (IaaS), Google App Engine (PaaS), Google Cloud Storage which is cloud storage platform to store large data and Google Drive (SaaS). The strength of the Google Cloud Platform is deep discount and flexible contracts, DevOps expertise, designed for cloud-native businesses, and commitment to open source and portability. While the weaknesses are late entrant to IaaS market, fewer features and services, and historically not as enterprise focused.

5.3 Microsoft Azure

Microsoft Azure is a Microsoft's public cloud computing platform. The Azure platform aims to help businesses manage challenges and meet the organizational goals. It offers tools that support all industries such as e-commerce, finance, and variety of Fortune 500 companies. It also compatible with open source technologies and provides the flexibility to use the preferred tools and technologies to the user. Azure offers 4 different forms of cloud computing which are IaaS, PaaS, SaaS and serverless. The strengths of Microsoft Azure are the second largest provider, Integration with Microsoft tools and software, broad feature set, Hybrid cloud, and support for open source. The weaknesses are the issues with documentation and incomplete management tooling.

Table 2. Comparison between Amazon EC2, Google Cloud Platform and Microsoft Azure.

	Amazon EC2	Google Cloud Platform	Microsoft Azure
Service Model (IaaS, PaaS, SaaS)	<ul style="list-style-type: none"> - Amazon EC2(IaaS) - AWS Elastic Beanstalk(PaaS) 	<ul style="list-style-type: none"> - Google Compute Engine(IaaS) - Google App Engine(PaaS) - Google Drive(SaaS) 	<ul style="list-style-type: none"> - Azure Search(PaaS) - Office 365(SaaS)

Virtual Machine (VM) instance types offered such as micro, small, medium, large, etc.)	Amazon EC2 VMs scaling up to 256vCPU and 24,000 GB of RAM 1. Shared core: – N/A 2. Storage-optimized: – d3.large – d3en.large – d3en.6xlarge	Google Compute Engine VMs scaling up to 416vCPUs and 11,776 GB of RAM 1. Shared core: – N/A 2. Storage-optimized – L8s v2 – L80s v2 – L4s – L32s	Microsoft Azure VMs scaling up to 416vCPUs and 11,400 GB of RAM 1. Shared core: – f1-micro - g1-small – e2-micro - e2-medium 2. Storage-optimized – N/A
Storage	Unlimited, worldwide accessibility and high durability.	Unlimited, worldwide accessibility and high durability.	Unlimited, worldwide accessibility and high durability.
OS environments offered	Supports most of the OS such as Amazon Linux, Ubuntu, Windows Server, Fedora, Debian, CentOS, Gentoo Linux, Oracle Linux, and FreeBSD.	Supports by most of the OS such as Windows Server, CentOS, RHEL, Debian, Ubuntu Server, and SUSE.	The operating system offered is Microsoft Windows. Also support third party OS such as Linux.
Security	Use of shared security responsibility model. Protected by Amazon Web Service (AWS) global network security.	It contains many security layers. Apply encryption at rest and during transit in Google Cloud. Apply Layer Transport Security to secure the data.	Use of shared security responsibility model. Usage of physical, infrastructure and operational control.
Performance and scalability	To leverage scalability, AWS can easily manage the workload increase by allocating the resources based on the demand, that too within minutes.	Provide features to help user achieve the scalability of applications which include Computer Engine virtual machine and Google Kubernetes Engine.	Has the capability of scaling including scaling up or down, scaling in or out and auto scaling.
Pricing model	On-Demand Instances, Reserved Instances, Spot Instances and Dedicated Hosts. On-Demand Instances is about the payment of compute capacity per hour or per second. Reserved Instances is about the capacity reservation.	Based on data storage, network usage, operation usage and retrieval, and early deletion fees.	Have three different pricing models which are pay-as-you-go, commitment consumption-based plan and free, on demand, reserved capacity, spot capacity dedicated.
Auto-Scaling/Elasticity	Amazon EC2 Auto Scaling lets the user scale Amazon EC2 capacity up and down. For apps that undergo weekly, daily, or hourly usage variability, auto-scaling is highly suitable.	The feature is called as Managed Instance Groups (MIGs). The auto scaling works as it will compare actual CPU utilization with the user's target to determine whether should be scaled up or down to maintain the best specified level.	The feature is called as instances Azure auto scaling lets the users' applications to scale up or down automatically regarding the criteria needed.
Monitoring tools/service provided	Monitoring tools include SolarWinds AppOptics, SolarWinds Papertrail,	Monitoring tools include Opsview Monitor's GCP Opspack. Offer cloud	Monitoring tools include Serverless360, Application Insights, Azure Monitor, etc.

	etc.	monitoring. Collect metrics in real time and visualize insights.	
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6 Opinion

Based on the three cloud computing service providers that had been discussed, Amazon EC2 is the most suitable cloud service provider for software development. Amazon EC2 is known to be the highest in market for its cloud service because of the benefits. It has service model Amazon Web Service (AWS) which can provide secure and resizable compute cloud. It also has the capability to obtain and boot new server instances only in a few minutes, allowing the user to adjust the capacity by using AWS auto scaling feature to optimize costs and performance as the requirement change. For the security, AWS make for a durable and secure technology platform. AWS also conducts regular audits to ensure its infrastructural security. Amazon EC2 also has a low costing which user only pay for the computing capacity that had been used. For variety of apps, Amazon EC2 provides storage, query processing, and computing solutions by working in conjunction with Amazon Simple Queue Service, Amazon Simple Storage Service, Amazon SimpleDB, and Amazon Relational Database Service. Amazon EC2 is an ideal cloud computing that can offer extensive cost savings, maximum uptime, and continuous support.

7 Conclusion

In conclusion, cloud computing has the potential to bring the good and positive impacts to the whole world even though cloud computing is a recent and new technological development. It provides a lot of advantages and benefits to the users and also businesses. However, to keep using this technology with efficient, there are a few challenges that should be overcome. One of the challenges is not fully believed by some of the people. People are very skeptical about the cloud computing which is how secure and private it is. There are no standards or regulations worldwide provided data through cloud computing. Still, the cloud computing will bring a whole new era and revolutionize the future once there are standards and regulation worldwide. This technology will ease a lot of work and reduce the cost, time and energy. Cloud computing should be utilized with its full function in the future.

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