An Evaluation of Cloud Computing Service Providers

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1. Introduction

Current time has shown us how the Internet changes our life, along with technology advancement. It is undeniable that the world today is connected through the Internet. Cloud computing is one of trends that enable us to save and access files or programs over the Internet, rather than using local storage devices. It has become the main choice for many people especially companies to help them in managing information from various resources.

The main objective of this paper is to explore more about cloud computing services and evaluate current cloud computing service providers.

This paper is organized into 7 sections. First section outlines the introduction of this paper. Section 2.0 will describe the background of cloud computing while section 3.0 explains about existing cloud models. In section 4.0, it describes the cloud services and section 5.0 will give information about top cloud service providers. In Section 6.0, we will choose a suitable cloud service provider and finally section 7.0 will conclude all the important points from this paper.

2. Background of Cloud Computing

Cloud computing can be defined as delivery of various services over the Internet that provide tools and applications such as databases, servers and software [1]. While [2] proposed that cloud computing has 2 different meanings. The first meaning is the general one which is running workloads through the Internet in the data center of a commercial provider. The second meaning is describing how actually it operates and the functions.

Cloud computing is important especially for well-established companies as it provides the flexibility in managing the data in one time. The price is also worth the service offered. In future, cloud computing is expected to evolve more and more with new functions that will be developed throughout the years.

2.1 Cloud Computing Requirements

In order to choose the quality cloud providers, it should fulfil all the requirements. Not all cloud providers have the same requirements, thus an evaluation should be conducted to choose the best one [3].

The first requirements are security and customer support. Security is the most important thing that should be evaluated as it involves our data and privacy. A cloud provider should have any backup storage or firewalls as alternatives if the whole system is hacked. Customer support is also needed as a guide for any issues when using it. It also ensures that the system is well-maintained from the customer's feedback.

The second requirements are ease of administration which means the cloud servers should be easy to use and understand. It has no use if the functions are powerful enough but the process is too complicated.

Next requirements are scalability. It is better to look out at cloud servers that provide flexibility like storage, functionality or price. A good cloud provider also needs to have the reliability to function and operate well. We also need to check whether it fulfills our standard.

3. Cloud Models

3.1 Public Model
It encourages technologies and programs to be readily available to the public at large. IT giants such as Google, Amazon and Microsoft deliver Internet-based cloud services. There are many advantages of deploying cloud as a public cloud model, such as cost effective, reliability, flexibility, location independence, utility style costing, and high scalability.

3.2 Private Model
It consists of tools used solely by one corporation or entity for cloud computing. The private cloud can be physically housed in the on-site data center of the enterprise, or a third-party storage provider can host it.

3.3 Hybrid Model
A type of cloud computing that integrates on-site technology with a public cloud, or a private cloud. Hybrid clouds allow the flow of data and applications between the two worlds.

4. Cloud Services

4.1 Infrastructure as a Service
IaaS provides businesses access to computing services such as storage space and servers. Companies can rent these infrastructures, rather than having their own services.

4.2 Platform as a Service
PaaS is a type of cloud computing offering in which a service provider provides customers with a platform, allowing them to construct, operate and manage business applications without the need to build and maintain the infrastructure usually needed by software development processes.

4.3 Software as a Service
SaaS is a software distribution model in which applications are hosted and made accessible to consumers over the Internet by a third-party provider.

5. Top/Leading Cloud Computing Providers
Due to the pandemic, cloud computing has become the right choice for companies to work as it can be accessed without needing to be at the workplace. According to [4], Amazon Web Services, Microsoft Azure and Google Cloud Platform are the top 3 cloud provider leading. It also mentioned IBM and Dell Technologies also although it used hybrid cloud and traditional data center.

5.1 Amazon EC2
Amazon Elastic Compute Cloud is a service that is based on the web. The interface of Amazon EC2 is easy to understand and allows us to control our resources completely. Amazon EC2 has its strength when users have complete power on their virtual servers. Users also can choose where to run the operating system (OS), considering there are some companies that have been using an OS

for a long time[5]. Amazon EC2 also has security features that are built together with the server. Users can select whoever they want to access the instances. However, Amazon EC2 has so many options, it makes it look complicated. It also provides multiple functions that have different pricing, so the billing also can be confusing. In addition, the customer support, especially on how to manage the servers are less.

5.2 Google Cloud Platform

Offered by Google, it is a suite of public cloud computing services with more than 90 services. Google Cloud Platform (GCP) was launched in 2008 and widely used in many fields. GCP has its strength when it specializes in high-computing services such as Big Data, analytics and machine learning. It also provides substantial balancing of size and load and also knows data centers and quick response time. It is built for cloud-native companies. Google Cloud Platform is an open source. It also offers deep discounts and flexible contracts. Its expertise for DevOps. On the downside, Google is a distant third in market share, possibly because it does not have the conventional relationship with business clients.Google Cloud Platform is a late entrant to the market for Infrastructure as a service (IaaS).It also has fewer attributes and facilities for its customers.Its not historically based as an organization

5.3 Microsoft Azure

In 2008, Microsoft first announced its plans to launch Windows Azure which is currently known as Microsoft Azure, a cloud storage service. Preview models of the service were made available and created in early 2010, prior to its commercial launch. Microsoft Azure is Microsoft's public cloud storage platform. It delivers a variety of services in the cloud, including computation, analytics, storage and networking; is also used as a platform for hosting databases in the cloud. Azure has good data loss prevention and has been listed as the market leader in Cloud Computing as a Service by Gartner. Scalable: One of Azure's greatest strengths is that it provides scalability. However, Microsoft Azure has a Steep learning curve. It is relatively difficult to use and handle. Compared to AWS and GCP, it is more expensive and has weak DevOps support.

Table 1. Overview and comparison of various cloud computing service providers

Cloud Computing Service Providers	Amazon EC2	Google Cloud Platform	Microsoft Azure
Service model	IaaS	PaaS and IaaS	SaaS, PaaS and IaaS
Virtual machine	Amazon Machine Image (AMI) is used when creating instances.	For a range of workloads, general-purpose machine types give the best price-performance ratio.	Azure Virtual Machine (VM) is used to create and use VM in the cloud as infrastructure as a service.
Storage	Provides storage options. Each option has a different combination of performance. The options include: 1. Amazon Elastic Block Store	Web-based storage using three different types: 1. Google Cloud Storage- A web service for online file storage to store and access	Microsoft Azure storage offers different types of storage, which are : 1. Blob Storage, helps to create data lakes for analytics needs and access unstructured data at scale. 2. Standard Disk Storage, designed to be

	2. Amazon EC2 instance store 3. Amazon EFS with Amazon EC2 4. Amazon S3 with Amazon EC2 There are also options to add storage.	data on the infrastructure of the Google Cloud platform. 2. Cloud SQL-A web service that lets you build, customize, and use Google Cloud-based relational databases. 3. Cloud Bigtable-A fast, fully managed NoSQL database service and a highly scalable one.	used with Azure VM. 3. Premium Disk Storage, to store higher IOPs workloads. 4. File Storage, for fully managing file share. 5. Table storage, for storing large amounts of data or structured and non-relational data. 6. Queue storage, stores high volumes of messages and processes them asynchronously.
OS environments	Supports a variety of operating systems including: Amazon Linux, Ubuntu, Windows Server, Red Hat Enterprise Linux, SUSE Linux Enterprise Server, openSUSE Leap, Fedora, Fedora CoreOS, Debian, CentOS, Gentoo Linux, Oracle Linux, and FreeBSD.	Supports AWS Linux, CentOS, Debian, RHEL, SUSE, Ubuntu and Windows Server.	Support Linux, including Red Hat, SUSE, Ubuntu, CentOS, Debian, Oracle Linux and CoreOS; and Microsoft Windows.
Security	Protected by the AWS global network security procedures.	Include disaster recovery plans, high visibility of the environment, monitoring of cloud activity logs, Google Cloud IAM Identity & Access Management which allows administrators to authorize who can take action on specific assets, along with integrated auditing, using automated services, and data encryption at all times.	Data is always encrypted in transit on the Azure platform, except for data that travels through customers. Azure Security Center is a security management framework for infrastructure that enhances the data centers' security posture and offers advanced threat protection through the cloud hybrid workloads.
Performance and scalability	Amazon EC2 instances can lessen the time needed for booting the server as well as the scale capacity	The internal Google Cloud Platform network currently operates at speeds of up to 16 gigabits per second (Gbps).	The ability to auto-scale is determined as one of the great features of the Azure service.
Pricing model	Pay-as-you-go and we can save money if we have already reserved it first. Discount also can be obtained if we use more.	Has no up-front expenditures, pay-as-you-go services, and no termination fees. Discounts also provided and each service have different prices.	It also utilizes pay-as-you-go pricing method, which refers to transactions that prevail only for used services and products.
Auto-scaling/Elasticity	Amazon EC2 Auto Scaling will maintain the services access. We can add or remove EC2 instances based on our need	Supported by the Compute Engine to automatically add or delete VM instances from a managed instance community based on load increases or decreases.	It allows Azure hosting services to be dynamically scaled in accordance with the demand and optimized parameters. This allows Azure Administrators the ability to automatically scale the infrastructure and resources of Azure when necessary.
Monitoring tools/ service provided	Amazon EC2 provides virtual computing environments	Provide services in compute, storage/databases, networking, big	The Azure monitor provides : Serverless360, Application Insights, Azure Monitor, Service

| | (instances), Amazon Machine Images (AMIs), instance types, multiple physical locations for resources, instance store volumes, Amazon EBS volumes, Elastic IP addresses, firewall and virtual network that can be created. | data and machine learning, as well as cloud management, security and developer tools. | Bus Explorer, Cerulean, CloudMonix, Datadog, Dynatrace, Log Analytics, New Relic, Nodinite, Site24*7, Splunk. Azure cloud services are sorted by Microsoft into almost two dozen groups, including: Compute, Mobile, Web, Storage., Analytics, Networking, Media and content delivery network (CDN), and Integration. |

6. Comparative Study of Various Cloud Service Platform

When the users want to select any service provider they must at least know about the advanced capabilities or features of each service provider. As it was discussed earlier, AWS has decent features compared to Microsoft Azure and GCP, according to the best information gathered by detailed literature analysis. IaaS, SaaS , and PaaS are all cloud computing service models, but these service models have separate functionality for each CSP. The study also indicates that enterprise serverless cloud computing systems are gaining fame; For companies, serverless cloud storage is useful because businesses have to pay because they need services, not set sums. With each day, CSPs aim to enhance facilities, and both customers and CSPs are benefited from this. Thus, CSP is a good option to use aside from its guaranteed security system.

7. Conclusion

Amazon's eventual advantageous position is experience. For over 14 years, Amazon has been advertising in this cloud, which has the perfect and skilled developers and architects in the world. However, it does not change the fact that Microsoft Azure is another decent AWS rival. At this point, Microsoft Azure is the fastest available cloud arrangement. While in the security section, we have GCP which provides one of the company's finest cloud protection. The GCP would be the perfect option for top security practices, such as accounting, insurance, and defense applications. To sum up, there might be a possibility of a new invention of cloud platform that would provide the combination of all these good features either from AWS, GCP, or Azure with less disadvantages, established since science and technology will keep developing as well as the programs.

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