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GROUP NAME / NUMBER : 08

1		Name : FELICIA CHIN HUI FEN Matric Number : A20EC0037 Phone Number : 0175459581 E-mail : feliciahui@graduate.utm.my
2		Name : ERICA DESIRAE MAURITIUS Matric Number : A20EC0032 Phone Number : 0128157778 E-mail : erica@graduate.utm.my
3		Name : MOHD FIRDAUS BIN ZAMRI Matric Number : A20EC0080 Phone Number : 01121897707 E-mail : mohd01@graduate.utm.my
4		Name : LUE GUO MING Matric Number : A20EC0073 Phone Number : 01155171681 E-mail : lueming@graduate.utm.my

Comparative Evaluation among Cloud Computing Service Provider

Felicia Chin Hui Fen [1], Erica Desirae Mauritius [2], Mohd Firdaus Bin Zamri [3] and Lue Guo Ming [4]

School of Computing, Faculty of Engineering, University Teknologi Malaysia.

[1] feliciahui@graduate.utm.my , [2] erica@graduate.utm.my , [3] mohd01@graduate.utm.my and [4] lueming@graduate.utm.my

1   Introduction

Cloud Computing is the delivery of computing services such as servers, databases, networking and so on over the Internet. It includes a lot of services which allow large enterprises to host all their data and run all of their applications in the cloud. Cloud computing can be divided into three models, Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS) and Software-as-a-Service (SaaS) [1]. There are three types of cloud which are public cloud, private cloud and hybrid cloud . There are a lot of benefits of using cloud computing which include cost savings, providing good security, business is more flexible, fast disaster recovery and so on [2]. There are three major Service Providers in cloud computing which are Amazon EC2, Google Cloud Platform and Microsoft Azure. This paper is organized into three parts. Section 2 outlines the comparative evaluation between the three major cloud service providers. Section 3 outlines the advantages and disadvantages among the three cloud computing service providers. Section 4 outlines the leading cloud computing service provider. Section 5 outlines the conclusion based on the comparative evaluation and opinion.

2   Comparative Evaluation

Amazon EC2 is the oldest cloud computing service provider, its features are mature and has the most numbers of services. Microsoft Azure has good integration with open-source and on-premise systems, most organizations are using it. More customer-friendly pricing models and discount models are available in Google Cloud Platform. Three types of service models are available in a cloud computing service provider, which are IaaS, PaaS and SaaS. IaaS offers virtual machines and IP addresses to create a platform to test applications. PaaS offers work on the environment including software and hardware on the Internet. SaaS offers a pre-package as a software which users need to install in their system to use it [3]. A software can be invented for many purposes. Generally, business services, document management, social networks and mailing services [4]. A virtual machine provides a virtual environment that functions as a virtual computer system with its own CPU, memory, network interface, and storage, created on a physical hardware system [5]. For storage, Amazon EC2 offers a hybrid platform through its Storage Gateway. Azure Microsoft has large-scale data storage and high-volume, critical workloads with their Queue Storage and Data Lake Store. Google Cloud Platform offers basic storage and database support [6]. Furthermore, the performance of the service providers depends on scalability and each of them have different scalability that stated in table 4. Moreover, they also offer different pricing models which show in table 5. The service providers also need use of auto-scaling or load balancing to reduce the backend task and each of the providers have its own way shown in table 4 [7]. Moreover, they also provide different types of monitoring tools or services for their provider as shown in table 4.

Table 1. Overview of service model between Amazon EC2, Microsoft Azure and Google Cloud Platform

Virtual Machine	Amazon EC2	Microsoft Azure	Google Cloud Platform
Max processor	128 nos	128 nos	96 nos
Maximum memory	3904 GiB	3800 GiB	1433 GiB

Table 2. Overview of virtual machine between Amazon EC2, Microsoft Azure and Google Cloud Platform

Service Model	Amazon EC2	Microsoft Azure	Google Cloud Platform
IaaS (Infrastructure as-a-Service)	Amazon Elastic Compute Cloud	Virtual Machines	Google Compute Engine
PaaS (Platform-as-a-Service)	AWS Elastic Beanstalk	App Service and Cloud Services	Google App Engine
SaaS (Software-as-a-Service)	AWS Data Exchange	Microsoft office 365	Google Apps

Table 3. Overview of storage between Amazon EC2, Microsoft Azure and Google Cloud Platform

Storage	Amazon EC2	Microsoft Azure	Google Cloud Platform
Object Storage	Amazon Simple Storage Service	Blob Storage	Google Cloud Storage
Virtual Server Disks	Amazon Elastic Block Store	Managed Disks	Google Compute Engine Persistent Disks
Cold Storage	Amazon Glacier	Azure Archive Blob Storage	Google Cloud Storage Nearline
File Storage	Amazon Elastic File System	Azure File Storage	ZFS/Avere

Table 4. Overview of some criteria some Amazon EC2, Microsoft Azure and Google Cloud Platform

Criteria	Amazon EC2	Microsoft Azure	Google Cloud Platform
OS environment	Core OS, Windows, SLES, Cloud Linux, Ubuntu, etc.	SLES, Windows, CentOS, Oracle Linux, etc.	Windows, SLES, CoreOS, FreeBSD, etc.
Security	Most core security features are available, example: GuardDuty, Macie, Shield, WAF	Lack of consistency and poor documentation, example: Security Center	Young cloud service provider but mature in its operation and features, example: Cloud PLD, Cloud Security Scanner
Performance and scalability	scheduled scaling, predictive scaling and dynamic scaling	depend on the app service plan such as free, shared, basic, standard and premium plan choose by the customer	uses many efficient apps to help maintain its scalability such as Compute Engine, Google Cloud's serverless platform, database products and cloud monitoring
Auto-Scaling/Elasticity	auto-scaling using fleet management	auto-scaling for many varieties of metrics sources such as storage account	load balancing and auto-scaling
Monitoring tools/service provided	Amazon Cloudwatch	Serverless360, Application Insights and Azure Monitor	Cloud Monitoring and Cloud Logging

Table 5. Overview of pricing model between Amazon EC2, Microsoft Azure and Google Cloud Platform

Pricing Model	Amazon EC2	Microsoft Azure	Google Cloud Platform
Smaller Instance	2 virtual CPUs and 8GB of RAM which cost around RM 279.97 per month	2 virtual CPUs and 8GB of RAM which cost around RM 284.03 per month	2 virtual CPUs and 8GB of RAM which cost around RM 210.99 per month
Larger Instance	3.48 TB of RAM, 128 virtual CPUs and cost around RM 16.11 per hour	3.89 TB of RAM ,128 virtual CPUs and cost around RM 27.55 per hour	3.75 TB of RAM , 160 virtual CPUs , cost around RM 5.32 per hour

3   Advantage and Disadvantage of each Cloud Computing Service Provider

The advantage of Amazon EC2 is the oldest service provider with advanced features and most of the services are available for this cloud service provider [8]. Besides that, based on table 5, the advantage of google cloud is it has the lowest price based on smaller and larger instances. For example, for a smaller instance, two virtual processors and 8GB of RAM costing approximately RM 210.99 a month. Meanwhile, for a larger instance, two virtual processors and 8GB of RAM cost about RM 284.03 monthly [9]. Furthermore, with respect to integration with open-source and on-premise applications, such as MS tools, which are mostly found in nearly all organizations, Azure is the champion. Hence, this is the strength of Microsoft Azure.

On the other hand, the disadvantage of Amazon EC2 is that it does not adjust the level of hardware, so if applications require any hardware improvements to boost their performance, then Amazon EC2 cannot do so. Besides that, based on virtual machine Google Cloud Platform is falling behind compared to Amazon EC2 and Microsoft Azure where it only provides 96 nos of processor and 1433 GB for memory. Next, for the drawbacks of Microsoft Azure is its security where it is lacking in reliability and has weak documentation [10].

4   Leading Cloud Computing Service Provider

As a software developer, we chose Amazon EC2 because it was the first in the cloud which indicates that it had more time to develop and expand their network. Amazon EC2, Google Cloud Platform and Microsoft Azure are hosting numerous locations worldwide respectively but the difference among them is the amount of their respective availability areas. For example, Amazon EC2 has larger availability zones which is 66 compared to Google Cloud Platform and Microsoft Azure which have 20 and 140 zones respectively. Moreover, we can say that Amazon EC2 computing services are the most advanced and structurally rich with its additional benefit of five years of start-up. Hence, another reason we chose this cloud service provider is because the number of services provided by Amazon EC2 is larger compared to Google Cloud and Microsoft Azure, where it offers up to 200 services whereas Microsoft Azure and Google Cloud Platform provides approximately up to 100 and 60 services respectively. This can be extremely useful and more efficient for us [9].

5   Conclusion

Cloud computing services keep on improving and updating from time to time with the improvement of network technology. We believe that cloud computing services can provide more functions other than compute, database, storage and social networking in future generations. During the lockdown situation in this Covid-19 pandemic, cloud computing services enable us to continue our working and learning process at home. It helps to maintain our normal lifestyle and society work with the access of the Internet. We expect that cloud computing fundamentals can make development with other technology such as Artificial Intelligence to create a new network hybrid system in the future. Hence, more job opportunities will be discovered with the development of cloud computing. Last but not least, we appreciate the contribution and effort of people who develop new technology and lead us to a new generation.

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