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**GROUP NAME/ NUMBER:**

| | | |
|---|---|---|
| 1 |  | Name: Shahril Bin Saiful Bahri<br>Matric Number: A20EC0144<br>Phone Number: 0192332195<br>E-mail: shahril5822@gmail.com/ shahril01@graduate.utm.my |
| 2 |  | Name: Gui Yu Xuan<br>Matric Number: A20EC0039<br>Phone Number: 0166291961<br>E-mail: guixuan@graduate.utm.my |
| 3 |  | Name: Phang Cheng Yi<br>Matric Number: A20EC0131<br>Phone Number: 0178268313<br>E-mail: phangyi@graduate.utm.my |
| 4 |  | Name: Nurzarifah Binti Azizan<br>Matric Number: A20EC0127<br>Phone Number: 0197766620<br>E-mail: nurzarifah01@graduate.utm.my |

# An Overview of Cloud Computing Service Providers

Shahril Bin Saiful Bahri [1], Gui Yu Xuan [2], Phang Cheng Yi [3], Nurzarifah Binti Azizan[4]
School of Computing, Faculty of Engineering, Universiti Teknologi Malaysia.
[1]shahril01@graduate.utm.my, [2]guixuan@graduate.utm.my, [3]phangyi@graduate.utm.my, [4]nurzarifah01@graduate.utm.my

## 1. Introduction

In cloud computing, the Internet acts as the "cloud" of the server, providing server applications as products instead of products to clients. (O'Leary, T. J., O'Leary, L. I., & Williams, B. K., 2008). The cloud computing fundamentals is the service's location and details such as the hardware or operating system running the service have nothing to do with the user. A few cloud computing services provided such as Amazon EC2, Google Cloud Platform and Microsoft Azure. The purpose of this paper is to compare the cloud computing service providers. This paper contains four sections which are introduction, comparison, opinion and conclusion.

## 2. Comparison

Amazon EC2, Google Cloud Platform, and Microsoft Azure provided Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS). Amazon EC2's IaaS provides access to manage and control IT resources. Google Cloud Platform's IaaS provides the environment companies need. In Microsoft Azure's IaaS, Windows Server and Linux can be set up and the usage can be changed according to the demand. (Amit Kumawat, 2013). Amazon EC2's PaaS carries out resource procurement, capacity planning, software maintenance, and other tasks in running applications efficiently. Google Cloud's PaaS automatically expands the system for more computing resources. Microsoft Azure's PaaS as a development, service hosting and service management environment, and applications can be easily changed to the configured in demand. (Amit Kumawat, 2013). Amazon EC2's SaaS provides a complete product run and managed by a service provider. Google Cloud Platform's SaaS uses differentiated technologies to build, modernize, expand business, and benefit from a concept-to-market partnership plan. Microsoft Azure's SaaS provides managed infrastructure, firewalls, operating systems and business applications. (Amit Kumawat, 2013).

According CloudHealth Tech StaffCloud Tech Journalist (2020), Amazon EC2 instances benefit the company from powerful and expensive hardware without purchasing, configuring, and maintaining the hardware. The virtual machine of Google Cloud provides the best performance ratio for memory-intensive and high-performance computing-intensive workloads. There are different sizes of virtual machine and they perform different functions in Microsoft Azure. For example, A-series VMs use servers and code repositories for proof of concept. (Jessie Reed, 2019).

Amazon EC2's storage on a disk for temporary storage and data that is replicated across instance storage. The data will be lost due to unpredictable accidents. Cloud Storage of Google Cloud Platform further divided into standard storage space, near-line storage, cold storage and archive storage to perform different functions. The benefits of cloud storage are unlimited storage, no minimum object size, global accessibility, low latency, high durability, and geographic redundancy. The cloud storage of Microsoft Azure including Azure Blob, Azure File, Azure Queue, Azure Table and Azure Disk. Storage services provide durable and highly available, secure, scalable, and accessible services.

Operating system is a platform for software to interact with hardware. It is an intermediary between computer's user and computer hardware. Operating system controls and coordinates the use of the hardware among the various application programs for the various users (Noopur Bardhan & Pooja Singh, 2015). The operating system environment used by Amazon EC2, Microsoft Azure and Google Cloud Platform are almost the same, but each provider has their own developed systems too such as Amazon EC2 has Amazon Linux.

Security is one of the top priority factors to evaluate the service provider. There are three security factors listed by the security experts that need to be considered to evaluate cloud service providers: physical security, technical or infrastructure security and data and access control (Yetunde Abass, 2020). Physical security is for protecting data centres in which the cloud services are protected by policies

protocol. Technical or infrastructure security is for monitoring network traffic and patching vulnerabilities. Data and access control is for controlling the users who access the data and data encryption (Yetunde Abass, 2020). Amazon EC2 has the most mature security system while Microsoft Azure lacks consistency and has poor documentation compared to Amazon EC2. Google Cloud Platform is the newest compared to Amazon EC2 and Microsoft Azure,. GCP provides organization-wide logging and is easier to manage centrally.

Scalability is the ability of the system to handle the change of the amount of workload or traffic the web application. Three of the cloud service providers offer auto scaling which automatically sets up application scaling plans for multiple resources across multiple services in minutes. The instance size can be modified according to the demand of users. Amazon EC2 makes scaling simple with recommendations that allow us to optimize and maintain application performance (Jeff Barr, 2018). The scaling features of Microsoft Azure are dependent on the service plan which autoscaling is available only on standard and premium plans. Google Cloud provides scaling that manages instance groups based on CPU utilization, load balancing, serving capacity, monitoring metrics and schedules. Although these three types of service providers provide a slightly different scaling plan, costs can be reduced by removing under-utilized resources without compromising performance or user experience.

For the pricing model, Amazon EC2 charges a fixed price for each hour of virtual machine usage with On-demand, Reserved Instances, and Spot Instances. The "pay-as-you-go" model is used by Microsoft Azure and Google Cloud. (May Al-Roomi et al., n.d.) Google Cloud provides a free usage, subscription-based pricing when pay monthly, Use-based pricing model according to the basis and the metrics and combined pricing that pays a basic subscription fee and additional charges based on usage. However, Azure provides pay per use and subscription based that combine special offers and pricing that can reduce cloud costs while Amazon EC2 supplies a cost-effective model and pays without long-term commitments. (Couesbot, 2019)

Auto scaling is the process of adding or removing software, storage and network services to meet the demands to maintain performance as efficiency increases. Amazon EC2 Auto Scaling helps to maintain the availability of the application and allows automatic add or remove EC2 instances according to the conditions and criteria. Azure Auto scale can be triggered by machine metrics without combining other monitoring services and allows applications to be scaled up or down automatically according to defined criteria while GCP autoscaling offered in combo with auto healing and auto updating like Compute Engine that enables autoscaling to instantly add or remove VM instances and Manage Instance Group support autoscaling that load increases or decreases. (Keary, 2020)

Monitoring tools are methods to manage and analyze accessibility and services of cloud computing before it affects the end-user experience. For example, Opsview monitoring tool provides all data in one place to offer proper accessibility for both Amazon EC2 and Microsoft Azure while Opsview for Google Cloud provides an efficient way to track performance metrics such as Compute Engine Instances, Cloud Storage Buckets, and Cloud SQL Database Instances. (Cloud Monitoring Tools, n.d.). Best services and tools for monitoring Amazon EC2 are SolarWinds Server and Application Monitor that can gather live performance metrics by engaging with Amazon CloudWatch while Microsoft Azure monitoring tools implement end-to-end tracking and recognize problems in infrastructure such as Serverless360 and Azure Monitor. (Choosing the Best, 2019).

Table 1: Comparison of Amazon EC2, Microsoft Azure and Google Cloud Platform

| Features | Amazon EC2 | Microsoft Azure | Google Cloud Platform |
|---|---|---|---|
| Virtual Machine (VM) instance | general purpose, calculation optimization, memory optimization, accelerated calculation, and storage optimization | General purpose, Compute optimized, Memory optimized, Storage optimized, GPU and High-performance compute | general-purpose, memory-optimized, and compute-optimized families |

| Storage | instance storage | Azure storage platform | cloud storage |
|---|---|---|---|
| OS environments | Amazon Linux, Ubuntu, Windows Server, Red Hat Enterprise Linux, SUSE Linux Enterprise Server, Fedora, Debian, CentOS, Gentoo Linux, Oracle Linux, and FreeBSD | Windows Server, Debian, Red Hat Enterprise Linux, Ubuntu LTS, SLES, Oracle Linux, ClearLinux, CoreOS Linux and CentOS | CentOS, COS,Debian, Fedora CoreOS, Red Hat Enterprise Linux, SQL server, SLES, Ubuntu LTS, Windows Client and Windows Server |
| Security | AWS Security Hub, most mature security system, provided security-specific tools and features across network security, configuration management, access control and data encryption | Azure Security Center, Lack of consistency and poor documentation compared to Amazon EC2, provide multi-layered security, detect threats daily | Cloud Security Command Center, newest compared to Amazon and Azure, provide organization- wide logging,easier to manage centrally |
| Performance and scalability | Use ManageEngine Applications Manager to monitoring performance, provide auto-scale | Use Applications Manager's Microsoft Azure to monitoring performance,provide auto-scale | Use PerfKit Benchmarker to monitoring performance, provide auto-scale |
| Pricing model | On-demand, Reserved Instances, and Spot Instances. | pay per use and subscription based pricing(Pay as You Go basis) | Free, subscription based, usage based and combined pricing |
| Auto-Scaling/Elasticity | Amazon Auto-Scaling provides developers and network managers with the ability to create fault systems | Azure Autoscale | Compute Engine, Managed Instance Groups |
| Monitoring tools/service provided | Opsview, SolarWinds Server and Application Monitor, Amazon CloudWatch | Opsview, Serverless360, Azure Monitor,Cerulean, CloudMonix | Opsview an easy way to monitor performance metrics |

## 3. Opinion

Based on the table above we can agree that the most beneficial cloud service provider between these 3 is the Google Cloud Platform. The reason being that we are already familiar with Google services and its cross platform between computer and smartphone. And its auto sync feature makes it easier for us to switch devices at anytime and anywhere. Based on the name, Google Cloud, it uses cloud storage. Cloud storage allows you to save data and files in a third-party cloud provider. And it has unlimited storage based on the plan that we use. Moving forward to its pricing model, it is free for every basic user, and there is a subscription based on how we plan on using the service provider, and we can say that Google Cloud has the cheapest price offered between Amazon EC2 and Microsoft Azure. Not just that it is outstanding capability working on many OS offered nowadays. Not to mention, the capability of it to run smoothly on any platform is something to be known about. Lastly, we really need good security to make sure that our files are safe, with Google Cloud Security Command Center which is the newest among the cloud service providers.

But it also comes with its disadvantages such as its Google Cloud Platform web interface is confusing (José Vidal, 2018). New users may get lost for their new time. Next is that it may have a complex pricing schema, so it is easy to get unexpected costs, support fee is quite hefty and downloading data from Google Cloud Storage is expensive.

Thus, this is the reason we choose Google Cloud Platform as our cloud service provider as it provides us with many things that could start up our software development in the future.

## 4. Conclusion

In conclusion, an overview of cloud computing service providers, we can say that the technology nowadays is advanced steadily for a human can process. Well, this is as much as we are getting towards Industrial Revolution 5.0, we have to get as much knowledge about technology because it revolves around us in our daily life. Same goes to cloud computing. Cloud computing is essential for everyone because not only it makes our life easier to manage, but it does more than just saving our data, files, etc…. Our vision for our future is that we can see how cloud computing evolves from only having in our computers and smartphones to maybe having a big take towards making new inventions towards the future. Hopefully we get to live to see the future of technology and the new Industrial Revolution.

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