# Cloud Computing Service Providers: Amazon EC2, Google Cloud Platform and Microsoft Azure

Muhammad Izwan Sazmin[1], Muhammad Shauqie Danish Bin Abas[1], Mohamad Hadif Nazhan Bin Halmey [1], Raja Muhammad Hafiz Bin Raja Alaudin Shah[1], Ilamuhil A/L Kathiravan[1]

[1]Faculty of Engineering, School of Computing, University Technology Malaysia, N28A, 81310 Johor Bahru, Johor
{muhammadsazmin, shauqie, mh.nazhan2001, rm.hafiz, ilamuhil}@graduate.utm.my

## 1 Introduction

In the era of modernization, new technologies are being developed from time to time to help people solve all the problems that require solutions that can be solved by the advancement of technologies. Cloud computing are one of the modern technologies that give a tons of benefits for its user. It provides many services and tools that can be used online such data storage, databases, software and servers (Jake Frankeinfield, 2020). Amazon EC2, Google Cloud Platform and Microsoft Azure the cloud computing service providers that well known and used by many companies and peoples around the globe. This article will explain the differences between these three platforms.

## 2 Service Model

In terms of Paas, AWS developed a wide-range cloud computing platform for enterprise. This type of infrastructure makes it possible for database storage and data delivery to be implemented faster (*AWS vs Azure vs Google: Cloud Services Comparison - Varonis*, 2019). Microsoft Azure provides services such as network, storage and web hosting which can manage all the platform needs. Google Cloud will provide support for development of applications and usage of built-in hosting facilities for tasks such as email and user services to monitor, extend and host, management and can be run and managed. AWS offers a convenient way for Saas, how to let the client handle their applications, such as user access, development of accounts, etc. Azures allow the users can connect to and use cloud-based software such as Microsoft Office 365 over the internet. Google Cloud allow the user to easily deploy their product across a network using the Google Kubernetes engine.

## 3 Virtual Machine

Microsoft Azure, Google cloud and Amazon Web Services(AWS) offers different types of Virtual Machine(VM) based on memory, storage and compute types such as general-purpose, computer-optimized, memory-optimized, storage optimized, GPU optimized for a high-performance computing. As for the general-purpose instance Azure provide B, Dsv3, Dv3 instance , AWS EC2 provide A1, M5, T3 instance and Google Cloud provides E2 and N2 for the customers. For computer-optimized instance, AWS EC2 provide C4, C5 instance, Google Cloud provides C2 while Azure provide Fsv2, Fs, F. Moreover ,AWS EC2 provide X1e, X1, R5 instance while Azure provide Esv3, Ev3, M instance and Google Cloud provide M2, M1 for the memory-optimized instance.

## 4 Storage

Cloud storage will be useful and become handy to customers to store, access, and monitor their data efficiently. One of the main types of storage that is available is block storage. Google Cloud Platform's (GCP) version of block storage is Persistent Disks (PDs). PDs are suitable for virtual machine backups, disks and to share read-only data. Elastic Block Store is a block storage provided by Amazon Cloud Services. EBS is aligned with Amazon EC2 to perform critical transactional workload. Apart from that, Microsoft Azure provides Managed Disks as block storage. It can create point in time backups, SSD and HDD disks and can create up to 1000 VM's in a single scale set. It also provides role-based access control for extra security.

## 5 OS Environment Offered

Microsoft Azure can operate in the operating system such as SLES, Windows, CentOS, Oracle Linux etc. AWS EC2 is designed to operate in Core OS, Windows, SLES, Cloud Linux, Ubuntu, etc. Google provides cloud runs in CentOS,Debian, Fedora Core OS, SQL Server, SLES, Ubuntu LTS, Windows client .

## 6 Security

When choosing a cloud service, security becomes one of the main concerns because it will give users a peace of mind when using cloud services and keeping files and documents securely. There are three main cloud services to choose from which are Amazon Web Services (AWS/EC2), Google Cloud Platform and Microsoft Azure. Each have their own levels of security which we will compare. Amazon Web Services runs on a virtualized, logical networking services that they call it Virtual Private Cloud (VPC). The Virtual Private Cloud is a complete and isolated logical network that runs inside the AWS cloud. Amazon Web Services includes core security features such as an activity monitoring API, basic threat intel (Guard Duty), Vulnerability Assessment (Inspector), security triggers for automations and the implementation of firewall. Overall, services found in Amazon's AWS are isolated from one another. Google Cloud Platform also runs on their VPC but their services are more centralized, meaning that they are easily accessible by users. Google's own VPC is unique since it avoids transferring data through public networks. GCP's security features include Cloud Security Command Center, Stackdriver Logging and open source Forseti to manage security settings. Lastly, Microsoft's Azure has a core networking product which is the Azure Virtual Network (VNet). VNet uses private IP addresses and subnets. Traffic flow is controlled by Network Security Groups (NSG) and Application Security Groups (ASG). Microsoft Azure includes features like activity logs cover console and API activity for an entire organization. It also includes Azure Security Center.

## 7 Performance and Scalability

Performance of the cloud computing system is said to be define as the productivity of the system when performing any workload given to the system at a time. The performance of the system will vary based on the workload and the type of system user are using. The performance of the cloud is measured and monitored by a measurement and scalability testing. This can be measured by using several measurements which are, the resource usage of the CPU, memory usage, disk I/O, database queries, response time. Scalability is the system ability in handling the increase in demand without impacting the performance of the system's application. There are two types of scalability which are vertical (scale up or down) and horizontal (scale out or in). the meaning of scale up or down vertically means that to either add or remove resources from the system. Several of which are CPU, memory and storage. The terms scale out or in vertically is used when there is system to add or remove.

Table 1: comparison between the performance and scalability of the different cloud computing services providers

| | Amazon EC2 | Google Cloud Platform | Microsoft Azure |
|---|---|---|---|
| Performance and scalability | Optimize the performance of the system by using AWS Auto Scaling | Use autoscalling to adjust the performance of the application to adapt to varying amounts of traffic | Azure Autoscale is used to match demand to the accommodate workload |

## 8 Pricing Model

The pricing model of cloud computing is the important aspect in pulling and attracting user as a cloud provider as there are many cloud providers possess an almost similar feature from each other. In order to attract future user that may convert to cloud computing, these providers have set an affordable price for various use for cloud computing either for personal use or for big company enterprises based on the features offered. Huge cloud providers used different pricing model to gain profit of the cloud computing services. Some of the pricing model are fixed pricing model, pay-per-use model, subscription, hybrid, pay for resources and price list. Free trial is also used to let the customer experience the service provided in the cloud computing system so that they will feel comfortable when paying for these services.

Table 2: comparison between pricing model of the different cloud computing service providers

| | Amazon EC2 | Google Cloud Platform | Microsoft Azure |
|---|---|---|---|
| Pricing model | Pay-as-you-go | • Free but limited<br>• Pay-as-you-go | Pay-as-you-go |

## 9 Auto – Scaling/Elasticity

AWS Auto-Scaling keeps simple user interface yet effective and maintain the performance of the applications with optimized availability and costs (*AWS Auto Scaling*, 2018). When more power is required, Azure Kubernetes Service (AKS) autoscaling automatically adds new instances to the Azure Virtual Machine Scale Collection and removes them when they are no longer needed. This allows for more effective scaling and running of the application without downtime (*Microsoft Azure*, 2019). Managed Instance Groups (MIGs) provide autoscaling capabilities that allow you to add or remove instances of a virtual machine (VM) from a MIG automatically based on load increases or decreases. Autoscaling allows the applications to gracefully manage traffic increases and reduce costs when there is a lower demand for services (*Compute Engine Documentation*, 2021).

## 10 Monitoring tools/Service Provided

Monitoring tools or the service provided in the cloud computing is an important aspect for in the system of cloud computing. Monitoring tools are used on keeping track of the system status in use. The monitoring tools provide many functionalities in cloud computing. Several of the functionalities are to alert the user or the administrator of the problem identified by the system, to keep a history log or real time log, finding optimal setting for the system and to monitors the traffic of the network.

Table 3: comparison between the monitoring tools/service provided of different cloud computing services providers

| | Amazon EC2 | Google Cloud Platform | Microsoft Azure |
|---|---|---|---|
| Monitoring tools /service provided | Amazon Cloudwatch | Google Cloud integration | Microsoft Cloud Monitoring |

## 11 Opinions

In my opinion, I would pick Microsoft Azure because I want to develop web application that can give benefit to others. Microsoft Azure is ideal for a developer because it's very easy and simple to connect the Visual Studio with Azure. Microsoft also provided two software for basic web application which are Web App and Web App with SQL. I can select either Windows or Linux to build a web app for the operating system. I will also save my money because Azure is working on a pay-as-you-go model that reduces small businesses' upfront expenses, and it is possible to give an additional company discount to those who sign a contract. (Muhammad Shauqie Danish Bin Abas)

From what I can gather from the comparison from this three cloud computing service provider, I can say that google cloud platform is a better option for me considering my status as a student. What did I mean by this is that Google Cloud Platform offer a service with better pricing offer than other cloud services provider and it's a better option for a student with no stable income. Google Cloud Platform also have an

easier usage than other cloud service provider in the sense of more user friendly and simple user interface. The service provided by Google Cloud Platform is also said to be state of the art as they provided the services as per user requirement and easy to access. (Raja Muhammad Hafiz Bin Raja Alaudin Shah)

Google Cloud Platform suits me the most compared to Microsoft Azure and Amazon EC2. From my point of view, every services provider have their owns identity that make them looks different compared to the others. As for GCP, it is the cleanest cloud in the industry. Google Cloud (2020) have stated they have neutralized all of their carbon emissions since 1998 and matched 100% of electricity consumption with renewable energy purchases since 2017. They are also practice circular economy environment into their cloud infrastructure as they reuse materials multiple times, refurbish and manufacture of the waste that have been generated. Google also is the one of the largest corporate purchasers of renewable energy in the world. This will make a big change for the earth to become a better place as the technology that is being used are eco-friendly. (Muhammad Izwan Sazmin)

In my opinion, I prefer Microsoft's Azure because Microsoft is well known for their cloud based services and their levels of security. In addition, their services are easier to access. Azure includes activity logs so I can monitor any suspicious activity lurking within my organization and personal account. Therefore, I feel confident and secure when using Microsoft Azure as my main cloud service provider since I know my personal data and documents are kept safe. (Mohamad Hadif Nazhan Bin Halmey)

The AWS has a clear advantage when it comes to number of services and applications provided to the customers . The Amazon Machine Images Business Application Catalog is by far the largest cloud vendor in the world.On top of that, simce Amazon is not restricted by any operating system, the additional advantage is that support for open-source applications is stronger. However, while AWS does help solutions such as container services, Elastic Beanstalk, Batch, and Lambda support the deployment of applications like Microsoft Azure Services.Moreover,the other downside of AWS is the cost which is actually one of the main concerns of the customers.On the other hand,GCP has a great advantage when it comes to affordability and it offers the most cost-effective services.In my opinion, the best of the cloud service provider for my software development is GCP.Because it will be easy for us to develop and scale up the app since we are familiar with GCP services like Gmail and Google Drive.Besides, as our project will be a startup I think it is the best for us to chose GCP which is an all rounder.(Ilamuhil A/L Kathiravan)

## 12 Conclusion

In a nutshell, every cloud computing services provider have their own specialties. It is up to the user to choose the one that suits them the most based on their needs. Service model, type of virtual machines, size of the storage, environment of operating systems, the security, performance and scalability, the price, the elasticity and monitoring tools/service provided are the most important things that user needs to know before choosing the services that they wanted to work with.

## References


1. Frankenfield, J. (2020, July 28). *Cloud Computing*. Retrieved from Investopodia: https://www.investopedia.com/terms/c/cloud-computing.asp
2. Google Cloud. (2020). *Cloud sustainability*. Retrieved from Google Cloud: https://cloud.google.com/sustainability
3. What is Monitoring tools in software testing? Retrieved from http://tryqa.com/what-is-monitoring-tools-in-software-testing/
4. What is cloud monitoring? Retrieved from https://www.netapp.com/knowledge-center/what-is-cloud-monitoring/
5. Pricing on the cloud, Hadi Fadlallah (November 22, 2018) Retrieved from https://towardsdatascience.com/pricing-on-the-cloud-9a2d3f61b67f
6. Cloud Computing: Pricing Model, Aferdita Ibrahimi (January 2017) Retrieved from https://www.researchgate.net/publication/318096610_Cloud_Computing_Pricing_Model
7. Using autoscaling for highly scalable applications, retrieved from https://cloud.google.com/compute/docs/tutorials/high-scalability-autoscaling
8. Overview of the performance efficiency pillar, (October 23, 2020) retrieved from https://docs.microsoft.com/en-us/azure/architecture/framework/scalability/overview
9. Amazon EC2 pricing, retrieved from https://aws.amazon.com/pricing/
10. Azure Pricing, retrieved from https://azure.microsoft.com/en-us/pricing/
11. Google Cloud Pricing, retrieved from https://cloud.google.com/pricing

12. 30 Cloud Monitoring Tools: The Definitive Guide For 2021, Bojana Dobran (August 10, 2020) https://phoenixnap.com/blog/cloud-monitoring-tools
13. *Azure Kubernetes Service (AKS) cluster autoscaler is now available | Azure updates | Microsoft Azure*. (2019). Microsoft.com; Microsoft Azure. https://azure.microsoft.com/en-us/updates/azure-kubernetes-service-aks-cluster-autoscaler-is-now-available/
14. *Autoscaling groups of instances | Compute Engine Documentation*. (2021). Google Cloud. https://cloud.google.com/compute/docs/autoscaler
15. *AWS Auto Scaling*. (2018). Amazon Web Services, Inc. https://aws.amazon.com/autoscaling/#:~:text=AWS%20Auto%20Scaling%20lets%20you%20build%20scaling%20plans%20that%20automate,you%20based%20on%20your%20preference.