

# **A study on cloud computing and its properties**

Iman Ehsan Bin Hasssan<sup>1</sup>Indira Thangaraj<sup>1</sup>,  
Hanis Rafiqah binti Hisham Razuli<sup>1</sup>,  
Goh Yitian<sup>1</sup>

University Teknologi Malaysia,  
81310 Johor Bahru,  
Johor, Malaysia.

{imanehsan@graduate.utm.my,indira @graduate.utm.my,hanisrafiqah@graduate.utm.my,gohyitian@graduate.utm.my }

## **1.0 Introduction**

What is cloud computing? Cloud computing is a process where different services through the Internet. These resources include tools and applications like data storage, servers and etc. By using cloud computing, we actually are easier to save data and files than saving in the hard drives. It is because only require internet. Cloud computing has a lot of benefit because it is cost savings, increased productivity and security. There are 3 types of cloud services which are software as a service, infrastructure as a service and platform as a service. Software as a service is the licensure of a software application to customers such Microsoft office's 365. Cloud computing is actually a dream came true because it help nowadays technologies to became more efficient. It is actually a utility business such as electricity because people that uses this technologies have to subscribe. Cloud computing actually lessen the burden of the people as it is combining all the devices to only one cloud services.

## **2.0 Main cloud service providers**

Some of the main service cloud providers are Amazon EC2, Google Cloud Platform and Microsoft Azure. Amazon EC2 (Amazon Elastic Compute Cloud) is one of the cloud computing services provided by Amazon.com. It is resizable and secure cloud computing. On the other hand, Google Cloud Platform is a cloud computing service provided by Google.com and it runs by the same infrastructure that runs GMAIL.COM, GOOGLE search and YouTube. The next cloud service provider is known as Microsoft Azure a service provided by Windows. It is also known as Azure. Azure is used to build, test, deploy, and manage applications and services through Microsoft-managed data centers. All this three cloud computing service providers vary by many elements such as service model, pricing, storage, monitoring tool, performance and scalability, elasticity and extra.

## **3.0 Type of cloud computing**

There are three types of cloud computing which are public, private and hybrid. First is public cloud, which is a type of cloud can be viewed and accessed by the public. Although the cloud service is open to public the storage capacity vary by the service providers. Public clouds are inexpensive compare to private and hybrid clouds. Next is private cloud. Private cloud is maintained and used by internal information and technology and mainly used by single business entity. This private cloud cannot be accessed by public and can only be accessed by particular organization who owns the cloud. Lastly, hybrid cloud which is the mixed version of public and private cloud. This hybrid cloud gives exposure of both private and public clouds.

## **4.0 Comparative evaluation**

### **4.1 Comparative evaluation of cloud computing service modal.**

There are various type of service models such as IaaS(Infrastructure as a service),PaaS(Platform as a service) ,FaaS(Function as a service),SaaS(Software as a service). IaaS is a standardized way of getting computing capabilities on demand and over the web. This includes storage facilities, networks, processing power, and virtual private servers. SaaS provides applications that can be accessed in the web and not managed and monitored by our company and it will be monitored by the software provider. This helps the organization to reduce the pressure of maintaining software, managing infrastructure, network security, data availability and extra. PaaS is a midway between SaaS and IaaS. By using PaaS the consumers can create and deliver applications in the absence of IDE (Integrated Development Environment) because IDE is quite costly. FaaS means give access to users to develop, run, monitor and manage application functions without the complexity and difficulty of creating and maintaining the infrastructure typically associated with developing and launching an application. Among this service modals IaaS is considered to be the best because it is a self-service model. Amazon EC2 uses IaaS, Google Cloud Platform uses FaaS and Microsoft Azure uses PaaS.

### **4.2 Comparative evaluation of cloud computing security**

Amazon EC2, Microsoft Azure, Google Cloud Platform have high level of security to make sure our personal data is safe. Amazon EC2 has GuardDuty which monitors malicious activities and provides threat detection service. Amazon EC2 also security suites such as

Macie which prevents data piracy, Shield and WAF (Web Application Firewall) which provides web protection. Next, Google Cloud Platform has Cloud DLP (Data Loss Prevention) which gives us access to sensitive data. Google Cloud Platform also has Cloud Security Scanner is vulnerability scanner which scans weakness in the data protection. On the other hand, Microsoft Azure has one security suite which is Azure Security Centre. Azure Security Centre gives threat protection and protects our data from cyber-attacks. It also has Azure Defender which is integrated with Azure Security Centre. Azure Defender protects hybrid cloud workloads.

#### **4.3 Comparative evaluation of OS environment offered by cloud computing**

Firstly, Amazon EC2 supports operating system such as Amazon, Linux, Ubuntu, Windows, Red Hat Enterprise Linux, SUSE, SLES, CentOS AND Cloud Linux. Google Cloud Platform supports operating systems such as CentOS, RHEL, Debian, Ubuntu Server, Windows, OPENSUSE and SLES. Next, Microsoft Azure supports operating system such as CentOS, RHEL, Debian Ubuntu Server, Windows, Linux, and OPENSUSE and SLES.

#### **4.4 Comparative evaluation of storage provided by cloud computing.**

Amazon EC2 provides various storage services such Elastic Block Storage (EBS), Elastic File System (EFS), Amazon EC2 instance storage and Amazon S3. EBS provides long-lasting, block-level storage volumes which you can attach to a running instance. You can use Amazon EBS as the main storage device for data that needs frequent updates. EFS gives scalable file storage and customize our instances to mount the file system. Amazon EC2 instance storage gives short-term and non-permanent block-level storage for instances. Amazon S3 allow access to reliable and cheap data storage infrastructure. The first option for storage provided by Google Cloud Computing is Cloud storage which is an object storage suitable for companies. Then, Persistent disk storage which is a block storage and fully integrated with Compute Engine and GKE and Archival storage which is an inexpensive archival storage for online access speed followed by file storage which is a file managed service for file migration and storage and cloud storage for Firebase which is a scalable storage for our apps. Next, Microsoft Azure provides storages such as blob storage for storing huge amount of unstructured data, Queue Storage for storing easily accessible large message files, file storage and Disk storage.

#### **4.5 Comparative evaluation of monitoring tools of cloud computing services.**

Firstly, Amazon EC2 has 2 major monitoring tools which are CloudWatch and Cloud Trail. Cloud Watch functions to monitor and collect and track metrics, log files, set alarms, and automatically react to changes in our AWS resources. Cloud Trail is a monitoring tool that authorize governance, compliance, operational auditing, and risk and threat auditing of our AWS EC2 account. Next, Google cloud Platform uses Google Stackdriver as their monitoring and observation tool to observe and monitor the health of cloud resources and applications by allowing visibility into metrics like the usage of CPU , disk Input/Output, memory, uptime and network traffic. Besides, Microsoft Azure has Azure monitor and log analytics.

#### **4.6 Comparative evaluation of pricing model of cloud computing services**

The pricing of cloud computing services depends on the virtual machine instances type offered by the cloud computing service and also depends on the size of RAM. For Amazon EC2 the pricing for small instances is US\$ 69/month for 8GB and large instances is US\$3.97/hour for 3.48TB. The pricing for Google Cloud Platform for small instances is US\$52/month for 8GB and for large instances US\$5.32/hour for 3.75TB. The pricing for Microsoft Azure for small instances is US\$70/month for 8GB and for large instances US\$6.79/hour for 3.89TB.

#### **4.7 comparative evaluation of Virtual Machine (VM) instance types offered**

Instance types consists of various combinations of CPU, memory, storage, networking capacity and give you the flexibility to select from the appropriate mix of resources for your specific applications. There multiple types of instances types such as Shared-core gives a single virtual CPU that is permitted to run for a period of the time on a hardware hyper-thread on the host CPU running our **instance**. Computer optimized are perfect for compute-bound applications that is useful for high-performance processors and suitable for batch-processing. Then, memory optimized machine types created to deliver quick performance for workloads that process enormous data sets in **memory and suitable for high performance**. General purpose instance types gives a stability of compute, memory and networking resources, and used for a various of diverse workloads. Next is accelerator optimized instance types which provides huge amounts of parallel processing for tasks like graphics processing and Includes additional hardware (GPUs, FPGAs). Amazon EC2 has instance type such as General Purpose (E2,N2,N2D,N1),Compute Optimized (C2),Memory Optimized (n1-ultramem,n1-megamem),Accelerated Computing (A2),Shared-core Optimized (E2-micro,E2-small). Amazon EC2 has instance types such as General Purpose (A1, T2, T3, T3a, T4g, M4, M5, M5a, M5n, M6g),Compute Optimized (C4, C5, C5a, C5n, C6g),Memory Optimized (R4, R5, R5a, R5n, R6g, X1, X1e, X1d),Accelerated Computing (P2, P3, F1, G3, G4),Storage Optimized (D2, H1, I3, I3en). Microsoft Azure has instance types such as General Purpose (B, Dsv3, Dv3, Dasv3, Dav3, DSv2, Dv2, Av2, and DC), Compute Optimized (Fsv2), Memory Optimized (Esv3, Ev3, Easv3, Eav3, Mv2, M, DSv2, Dv2), Accelerated Computing (HB, HC, H), and Storage Optimized (Lsv2).

#### **4.8 Comparative evaluation of auto-scaling of cloud computing services.**

Auto-scaling or automatic scaling is a method to automatically scale up or down the number of compute resources that are being allocated to our application based on its needs at any given time. The auto-scaling feature used in Amazon EC2 is Amazon Auto-scaling and this feature helps us maintain the application availability and give access to automatically add or remove EC2 instances according to

conditions you define. Next the auto-scaling feature used in Google Cloud Platform is called Compute Engine auto-scaler .Compute Engine provides auto-scaling to automatically add on or remove VM instances from a managed instance group based on increment and decrement in the load. Then, the auto-scaling feature offered by Microsoft Azure is Azure auto-scaling. Using Azure auto-scaling feature we can set alerts and notifications based upon your scaling criteria.

#### **4.9 Comparative evaluation of performance and scalability of cloud computing service**

Performance of a cloud computing service is an indication of the responsiveness of the system to execute any instruction or action within a given time interval, while Scalability is the ability of a system to perform well when it is changed in size or volume. There are 2 types of scalability which are horizontal scalability and vertical scalability. Vertical scaling or scaling out means adding more machines to your resources and horizontal resources or scaling in means adding more power to your resources. All there cloud computing services has high-performance and both vertical and horizontal scaling features.

**TABLE 1: Table for comparative evolution of cloud computing service provider**

Elements	Amazon Ec2	Google Cloud Platform	Microsoft Azure
Service Modal	IaaS	FaaS	PaaS
Storage	Elastic Block Storage (EBS), Elastic File System (EFS), Amazon EC2 instance storage, Amazon S3.	Blob Storage, Queue Storage, File Storage, Disk Storage, Data Lake Storage	Cloud Storage, Persistent Disk, TransferAppliance, Transfer Service, Archival storage
Security	GuardDuty, Macie, Shield, WAF	Cloud DLP, Cloud Security Scanner	Azure Security Centre, Azure Defender
OS Environment Offered	CentOS ,RHEL,Debian Ubuntu Server ,Windows, Linux, Cloudlinux,OPENSUSE,SLES	CentOS, RHEL,Debian Ubuntu Server,Windows,Linux, OPENSUSE,SLES	CentOS ,RHEL,Debian Ubuntu Server,Windows,Linux,OPENSUSE,S LES
Monitoring Tools	CloudWatch, Cloud Trail	Google Stackdriver	Microsoft Cloud monitor, Log Analytics
Virtual Machine (VM) instance types offered	<ul style="list-style-type: none"> <li>General Purpose (A1, T2, T3, T3a, T4g, M4, M5, M5a, M5n, M6g)</li> <li>Compute Optimized (C4, C5, C5a, C5n, C6g)</li> <li>Memory Optimized (R4, R5, R5a, R5n, R6g, X1, X1e, Z1d)</li> <li>Accelerated Computing (P2, P3, F1, G3, G4)</li> <li>Storage Optimized (D2, H1, I3, I3en)</li> </ul>	<ul style="list-style-type: none"> <li>General Purpose (E2,N2,N2D,N1)</li> <li>Compute Optimized (C2)</li> <li>Memory Optimized (n1-ultramem,n1-megamem)</li> <li>Accelerated Computing (A2)</li> <li>Shared core(E2-micro,f1-micro)</li> </ul>	<ul style="list-style-type: none"> <li>General Purpose (B, Dsv3, Dv3, Dasv3, Dav3, DSv2, Dv2, Av2, DC)</li> <li>Compute Optimized (Fsv2)</li> <li>Memory Optimized (Esv3, Ev3, Easv3, Eav3, Mv2, M, DSv2, Dv2)</li> <li>Accelerated Computing (HB, HC, H)</li> <li>Storage Optimized (Lsv2)</li> </ul>
Performance and scalability	-High-performance computing -Vertical and horizontal scaling	- high-performance -Vertical and horizontal scaling	-high-performance -Vertical and horizontal scaling
Auto-scaling	Auto-scaling	Compute Engine auto-scaler	Azure auto-scaling
Pricing model	Small instances: US\$69/month Large instances: US\$3.97/hour	Small instances: US\$52/month Large instances: US\$5.32/hour	Small instances: US\$70/month Large instances: US\$6.79/hour

#### **5.0 Advantages and Disadvantages of Amazon EC2**

The advantages of the Amazon EC2 is that it has a complete control with ease of access. Users have complete administrative control over their virtual servers with Amazon EC2. Amazon EC2 provides the same level of access and control as a physical server operated locally in the office. Amazon EC2 has the ability to select a platform of our choice. Users can select from multiple Linux distributions or they can run Microsoft Windows Server. The Amazon EC2 is also very secure. It has a multiple built-in security feature. Amazon EC2 has security group that act as virtual firewalls to control traffic to one or multiple instances. The disadvantages of the Amazon EC2 is that the service is a bit difficult to consume and new users need a big learning curve to use this service effectively. Second, the EC2

service is a little complex and at many places, it misses detailed explanation. The one is that sometimes it takes too long to create images of EC2 instances. This keeps your EC2 up for that extra time. When instances are heavy, it penalizes a lot of money.

### **5.1 Advantages and Disadvantages of Google Cloud Platform**

The advantages of the Google cloud platform is it has enhanced execution. An individual can access the data from any location via remote. It has a big infrastructure so it allows executing various complex operations easily at its network. The second advantage is that it has private network. Users get maximum time and efficiency due to the private network. A private network means Google is providing its own network to every customer so that they have more control and scalability over the network. Google Cloud Platform also offers redundant backups. If some part of a component is not functioning, then Google will create a backup. This means you are storing your data in a different location. In case something happens, users would not lose their data. The disadvantages of Google Cloud Platform is that several products are “global” which is great when they work but inevitable problems mean everything is down with recourse. The second one is, it has a lot of small components, and therefore it is difficult to start.

### **5.2 Advantages and Disadvantages of Microsoft Azure**

The advantages of Microsoft Azure are that it has flexibility. In the quickly moving technology sector you need a hosting solution that can quickly evolve as your need change. Azure is simple to adapt and offers a host of application building blocks and services that will allow you to customize the cloud as needed. It also has industry-specific applications. Due to high risk and sensitive nature of certain industries, Microsoft Azure has designed specific applications to address unique needs. Government and health care from Azure’s many features including offline cloud services, simplified compliance and modernized customer apps. The disadvantages of Microsoft Azure are it requires platform expertise. Microsoft Azure requires expertise to ensure all moving parts work together efficiently. With common mistake, the server’s compute power does not translate equivocally in the cloud and potentially costing business a lot of money per year. The second one is no access to Window Client Images. You can upload your own custom images but they are unsupported and requires you to maintain them as you would on you own on-site lab.

After a lot of discussion, we all agree that we will choose Amazon EC2 as our cloud service provider for our software development. In a very broad term, Amazon EC2 continues to lead the way in terms of offering the widest range of functionality and maturity. Its expansive list of tools and services, along with its enterprise-friendly features make it a strong proposition for large organizations. Amazon EC2 has a rich collection tools and services with massive scales. Since we want to expand our market share, Amazon EC2 is the most suitable one. Amazon EC2 also offers an extensive range of cloud products and services at the cutting edge of technological advancement. Giving us significant benefits over an on-premises deployment when it comes to scalability, performance, security, and cost. It has the cheapest pricing model as for small instances only for \$69/ month and large instance \$3.97/hour. Amazon EC2 offers ephemeral storage. It is allocated as soon as an instance is started and destroyed when the instance terminates. It also offers block storage, which is equivalent to hard disks, and, hence, can be attached to any instance or used separately. Amazon EC2 offers a long-running storage services. For object service, it offers simple storage service.

## **6.0 Conclusion**

In our opinion, cloud computing providing a convenient and efficient way for users to access their data on different devices. There is a lot of types of cloud computing available in the market, for example, public cloud is more suitable for normal users because it is usually cheaper than a private cloud which is for single business entity. There is a hybrid cloud which involved features of private and public cloud, and is suitable for anyone but more recommended for enterprise or medium-sized business.

In this report, we had discussed 3 platforms of cloud service which are Google, Amazon, and Microsoft. We make a comparison of those 3 cloud service providers with a lot of elements such as service model, storage, security, OS environment offered, monitoring tools, VM instance types offered, performance and scalability, auto-scaling, and prices. To choose a cloud service, you might refer to those elements to make your decision.

In the future, we assume the cloud computing will provide larger storage capacity in their service. This is to increase the range of storage capacity selection for users. The performance of the Internet will be improved and we will much efficient on the Internet due to cloud computing and Internet of Things. The data we stored in cloud storage will be used for real-time data analysis and enhance performance. The speed of data transferring and service/application loading is important for users in daily use.

## **References**

1. Amazon EC2. Retrieved 12 January 2021, from <https://aws.amazon.com/ec2/?ec2-whats-new.sort-by=item.additionalFields.postDateTime&ec2-whats-new.sort-order=desc>
2. AWS Instance Types and Comparison. (2020). Retrieved 17 January 2021, from <https://www.cloudhealthtech.com/blog/aws-instance-types-and-comparison>
3. AWS vs Azure vs Google - Detailed Cloud Comparison. (2019). Retrieved 17 January 2021, from <https://intellipaat.com/blog/aws-vs-azure-vs-google-cloud/>
4. AWS—Difference between CloudWatch and CloudTrail. (2019). Retrieved 12 January 2021, from <https://medium.com/awesome-cloud/aws-difference-between-cloudwatch-and-cloudtrail-16a486f8bc95>
5. Cloud Computing Services | Microsoft Azure. (2021). Retrieved 17 January 2021, from <https://azure.microsoft.com/en-us/>
6. Cloud Storage | Google Cloud. Retrieved 12 January 2021, from <https://cloud.google.com/storage>
7. Future of Cloud Computing - 7 Trends & Prediction about Cloud - DataFlair. (2021). Retrieved 17 January 2021, from <https://data-flair.training/blogs/future-of-cloud-computing/>
8. Hamish Haldane (2015). What are the BENEFITS of Microsoft Azure? Retrieved from
9. <https://www.saasplaza.com/blog/what-are-benefits-microsoft-azure>
10. Harvey, C., & Patrizio, A. (2020). AWS vs. Azure vs. Google: Cloud Comparison. Retrieved 17 January 2021, from <https://www.datamation.com/cloud-computing/aws-vs-azure-vs-google-cloud-comparison.html>
11. iCorps Technologies (2017, December 06). The Pros and Cons of Microsoft Azure. Retrieved from <https://blog.icorps.com/pros-and-cons-microsoft-azure>
12. Knorr, E. (2018). What is cloud computing? Everything you need to know now. Retrieved 17 January 2021, from <https://www.infoworld.com/article/2683784/what-is-cloud-computing.html>
13. Machine types | Compute Engine Documentation | Google Cloud. (2021). Retrieved 17 January 2021, from <https://cloud.google.com/compute/docs/machine-types>
14. Mansa, J. (2020, July 28). Investopedia. Retrieved from Cyber Security: <https://www.investopedia.com/terms/c/cloud-computing.asp>
15. Nick Underwood (February 25). 3 Benefits of Amazon EC2 Virtual Server Hosting. Retrieved from <https://www.privoit.com/resources/3-benefits-of-amazon-ec2>
16. Reed, J. (2019). Microsoft Azure Instance Types: Comprehensive Comparison. Retrieved 17 January 2021, from <https://www.nakivo.com/blog/comparison-of-microsoft-azure-instance-types/>
17. Rikita Gupta (2018). Top 7 Advantages of Using Google Cloud Hosting. Retrieved from <https://www.whizlabs.com/blog/google-cloud-hosting/>