# Cloud Computing

Fauzan Yusuf (A20EC5004), Nabil Alkahar (A20EC0281), Arsyad Wiratama R (A20EC0290), Muhammad Afiq Zakwan Bin Anuar (A18KE0139), Reynard Andyti Putra K (A20EC0331)
Faculty of Engineering, School of Computing, Computer Network ,Universiti Teknologi Malaysia

**Abstract:** Cloud computing technology has been a new buzzword in the IT industry and expecting a new horizon for coming world. It is a style of computing which is having dynamically scalable virtualized resources provided as a service over the Internet. It reduces the time required to procure heavy resources and boot new server instances in minutes, allowing one to quickly scale capacity, both up and down, as ones requirement changes. With the rise of a ubiquitous provision of computing resources over the past years, cloud computing has been established as a prominent research topic. Many researchers, however, focus exclusively on the technical aspects of cloud computing, thereby neglecting the business opportunities and potentials cloud computing can offer. Enabled through this technology, new market players and business value networks arise and break up the traditional value chain of service provision. The focus of this paper lies on the real business aspects of cloud computing.

**Keywords:** Cloud computing, Business Model, Internet Computing, Cloud Programming Model, Sales Force Technology

## 1 Introduction

The Cloud of Computing is on high demand of computer system resources, especially on data storage(cloud storage) and computing power, without any direct active management. This term is generally used to describe data centers to the users over the internet.Large clouds,predominant today,sometime have function to distributed over multiple locations from central servers.If the connection to the user is relatively close.

Cloud computing was popularized by amazon.com releasing its Elastic Compute Cloud product in 2006.The references to the phrase "cloud computing" appeared as early as 1996, with the first known mention in a Compaq internal document.Term cloud has been used since as early as 1993,when apple spin-off general magic and AT&T used it describing their Telescript and PersonalLink technologies.

## 2 Comparison

To really appreciates the power of cloud computing, we need to really understand what is it. Cloud computing is relatively new technology, but over the years it has gotten quite a traction to the point that it is now the defacto standard of computing servers. Cloud computing heavily relies on the technology of virtualization, which make it possible for to have each node appears as a separate physical machines, this allows user to use and load custom software, operating system, set automated task and so on.

According to Forbes, 77% of enterprises have at least one application or a portion of their enterprise computing infrastructure in the cloud. Enterprises predict they'll invest on average $3.5M on cloud apps, platforms, and services this year. And more and more enterprises in the upcoming years targeting they infrastructure to be 100% in the cloud.

The benefits of doing this is absolutely huge, both for the end user consumer and the developers. Cloud computing allows developers to publish and start their company by eliminating the need to invest in expensive hardwares. A cloud computing services such as Amazon Web Services or better known as AWS, provides ease of use, scalable, and cheap solution for developers to host their back-end infrastructure online.

The most prominent companies that provides this type of services are, Amazon Web Services (AWS), Google Cloud Platform, and Microsoft Azure. In this article we are going to compare the three and figure out what benefits that they have from each other. To truly compare a cloud computing service, we need to set some points that we are going to score upon. We are going to decide by looking at the features, pricing and marketshare.

Let's first look at the number one cloud computing provider, AWS. The AWS ecosystem that amazon provides is truly remarkable, it offers almost every possible feature under the cloud computing industry. Their cloud computing allows easy access to computing power, data storage and other functionality that a developer will ever need. And as it stands, the chemistry when using their features are top-notch, this explains why AWS have the highest market share in the industry.

Price-wise, AWS provides very competitive fees for their services. They also provides free tiers for startups and individuals, it's an awesome way to try out before buying. And also a big plus, AWS provides the option to pay by the second. So you can save even more money by only paying for the services that you are actually using.

And on top of that, AWS is the longest standing cloud computing provider. They started back 15 years ago, and have came a long way. They provide state of the art technologies and top-notch support team. With reasonable price and advantages like this, you can never go wrong about going with AWS.

The second cloud computing service is Google Cloud. Google Cloud offers a myriad amount of services. And they especially shines for mobile app developers, a feature called App Engine eliminates the need of setting up your cloud computers and instead let you focus on developing your app. It is a fully managed solution to develop mobile app in a timely manner. Furthermore, you can also performs high demanding tasks, such as high level computing, storage solutions, networking, and databases.

Although in comparison Google Cloud Platform lacks features from AWS, it shines best in it's pricing. Cost efficiency is the key with GCP, it enables user to bill pay as you go, providing you with even more cost efficient fees. It also offers a long-term usage discount that starts after the first month.

GCP is very much a great choice for individuals and startups to start their project. Scaleablity is guaranteed and bills are also reasonable. Security-wise it is handled by Google, a state of the art company with dedicated enterprise level security, keeping your mind at ease.

And last but not least is Microsoft Azure, Azure also provides a complete set of features for a developer needs. The platform gives you the ability to manage and deploy virtual machines and scaling them as needed. The unique feature that Azure and AWS have over GCP is large-scale parallel batch computing, a feature that let's you solve high-demanding workloads easily.

When considering Azure, you will need to take into account that Azure calculates pricing based on the hourly rate. So essentially you are renting a sophisticated server that can do any task you need it to be by the hour. Prices can range from $0.099 per hour to $0.149 per hours. This might be the drawback for some companies, but Azure also has it's advantages. Speed is of the essence of Azure, they excels in speed of deployment, and operation or scalability. If your main focus is to look for this two key traits, Azure will be a great choice for you. They are the leader in speed when it comes to cloud computing solutions.

**Table 1.** Comparison between Cloud Computing providers

| **Cloud Computing Service Providers:** | **Amazon EC2** | **Google Cloud Platform** | **Microsoft Azure** |
|---|---|---|---|
| 1. Service model (IaaS, PaaS, SaaS) | PaaS: Elastic Beanstalk | PaaS: Cloud services | PaaS: App engine standard environment, App engine flexible environment |
| 2.Virtual Machine (VM) instance types offered | • EC2<br>• Elastic Container Service<br>• Elastic Container Service for Kubernetes<br>• Elastic Container Registry<br>• Lightsail<br>• Batch<br>• Elastic Beanstalk<br>• Fargate<br>• Auto Scaling<br>• Elastic Load Balancing<br>• VMware Cloud on AWS | • Compute Engine<br>• Kubernetes<br>• Functions<br>• Container Security<br>• Graphics Processing Unit (GPU)<br>• App Engine<br>• Knative | • Virtual Machines<br>• Virtual Machine Scale Sets<br>• Azure Container Service (AKS)<br>• Container Instances<br>• Batch<br>• Service Fabric<br>• Cloud Services |
| 3. Storage | • Simple Storage Service (S3)<br>• Elastic Block Storage (EBS)<br>• Elastic File System (EFS)<br>• Storage Gateway<br>• Snowball<br>• Snowball Edge<br>• Snowmobile | • Cloud Storage<br>• Persistent Disk<br>• Transfer Appliance<br>• Transfer Service | • Blob Storage<br>• Queue Storage<br>• File Storage<br>• Disk Storage<br>• Data Lake Store |
| 4 . OS environments offered | Core OS, Windows, SLES, Cloud Linux, Ubuntu, etc | Windows, SLES, CoreOS, FreeBSD, etc | SLES, Windows, CentOS, Oracle Linux, etc |
| 5. Security | AWS Security Hub | Azure Security Center | Cloud Security Command Center |

| | | | |
|---|---|---|---|
| 6.Performance and scalability | AWS supports all operating systems and generally ranks as the top IaaS platform for availabilityAltogether, AWS has 22 regions located around the world, 14 AZ's, and 114 edge locations this allows data delivery to deploy faster and on a global scale without affecting the availability of service or performance. | The strength of Azure is as a provider of IaaS, Azure also comes with built-in and ready to run server apps that support a range of languages, including .NET, Java, PHP, Node.js, and Python. The platform is available in 54 regions around the world. | Compared to the other 2, Google Cloud Platform is a newcomer. It supports Linux and also Windows server versions up to 2016. For 2018, it has expanded to 21 regions that are divided into a minimum of three zones each. This gives it a shorter reach than the other two providers. |
| 7. Pricing model | • Per hour- rounded up<br>• Lowest option: virtual CPUs and 8 GB of RAM costing US$69 per month<br>• Largest option: 3.84 TB of RAM and 128 virtual CPUs costing around US$3.97/hour | •Per minute- rounded up( minimum 10 minutes)<br>• Lowest option: 2 virtual CPUs and 8 GB of RAM at a 25 percent cheaper rate costing US$52/month<br>• Largest option: 3.75 TB of RAM and 160 virtual CPUs costing to US$5.32/hour | •Per minute- rounded up<br>• Lowest option: 2 virtual CPUs and 8 GB of RAM, in Azure, costing US$70/month<br>• Largest option: 3.89 TB of RAM and 128 virtual CPUs. It costing US$6.79/hour |
| 8. Auto-Scaling/Elasticity | -Auto Scaling | -Virtual Machines scale sets<br>-Auto scaling | -Instance groups |
| 9.Monitoring tools/service provided | -Cloud watch<br>-X ray<br>-Management Console | -Portal<br>-Monitor<br>-Application Insights | -Stackdriver Monitoring<br>-Cloudshell<br>-Debugger<br>-Trace<br>-Error Reporting |

## 3 Our Thoughts

Based on our literature review, we decided that Amazon EC2 is the best cloud service provider for our software development project. First of all, let us review each types of cloud platform.

Let us start with the advantages of Google Cloud Platform. First, Google Cloud Platform can handle traffic spike better than other cloud service provider. This is due to the Compute Engine load balancer. This kind of balancer did not require pre-warming and it would get activated instantly the moment it detects sudden traffic spike. This would prevent our process of software development from being interrupted.

Next advantage is because of the Google data centres that are spread globally and interconnected by Google's private fibre network. This would enable us to make our progress on

software development anywhere in the world, without worrying to get suddenly disconnected from the server.

For the disadvantage of Google Cloud Platform is the hefty fee for the support. It would be okay if we are developing our software from a big company. But, if we are developing our software either individually or in a small group, it would be quite a burden for us, financially.

Next disadvantage of Google Cloud Platform is expensive rate to download our software data from Google Cloud Software. It would be fine if we are developing our software fully online and intend to keep all of our software data online. But, we sometimes still want to keep some of our software data offline, in our hard disk, as we can do the review of the data while offline.

Now, how about the advantages and disadvantages of Microsoft Azure? Let start for the advantages of Azure for our software development. Firstly, Azure would allow us to use any framework, language and tools that available there. We just need the idea on how to develop our own software. Because we can access all frameworks, languages and tools on Azure, we can be more productive, by focusing more on our idea and coding, instead of worrying on how to manage them.

The other advantage of Azure is because of the its wide range of global data centres. This will enable us to develop our software continuously. If by any chances, nearest datacenter is down due to maintenance, we still can develop our software using other data centre. It definitely would prevent us from deviate from our software development schedule.

Disadvantage of Azure is, firstly, we need to have essential skills to manage our data, because Azure would not manage it for us. For users that are new to cloud computing like us, it definitely would hinder our software development. Without the proper data management, our software may face some unexpected problem and our documentation might get messy.

The other disadvantage of Azure is the speed issue. If we have to travel either because of business trip or vacation, during our software development, we may need to keep our attention on where we are staying. It is because some region may not have data centres. Even we get the data access, it would be slower than usual and may interrupt our software development stage.

The last cloud service provider we will talking about is Amazon EC2, which is the one that we chose to help us develop our software. For this cloud service provider, let us start from its disadvantage. One main disadvantage for AWS, or also called Amazon EC2 is the EC2 feature itself. EC2 have their own limitation which is based on region. The resources for AWS default limit would be vary from region to region. Even though user or organization may request to increase its limit, it would be resulting the extra fee.

Another disadvantage of AWS is the technical support fee. If we are developing our software as an individual, they fee can still be considered low. But if we are developing our software not as individual, let’s say as business or enterprise, the fee for technical support can be considerably high.

Now, for the reasons, that made we chose Amazon EC2 as our choice for us to develop our software. First advantage of Amazon EC2 is it is easy to use thanks to its AWS Management Console. AWS Management Console is a type of tool that enable us to control the cloud computer, cloud storage, and some other services that available in AWS infrastructure. Because of the design of this console, which is based on browser GUI, it would be make us feel more comfortable to develop our software.

Next advantage of AWS is the flexible capacity usage. AWS can help us to add the capacity for our project freely, does not matter which stage of software development we are in. One more great feature for AWS are they allow us to revert back our project capacity to the previous storage, thus we only have to pay for what we use only. It would definitely help us a lot, as a software developer.

# 4 Conclusion

In conclusion, cloud computing providers provide a mix-match solution for your needs. There's no need to stick to one company to provide all your needs. It is even very typical for a company to use different services from different providers, it all comes to down to how much you pay.

## References


1. *https://en.wikipedia.org/wiki/Cloud_computing*
2. Muhammad Ayoub Kamal, Hafiz Wahab Raza, Muhammad Alam, and M. S. Mazliham (2020). Highlight the features of AWS, GCP, and Microsoft Azure that have an impact when choosing a cloud service provider *https://www.researchgate.net/publication/340173446_Highlight_the_Features_of_AWS_GCP_and_Microsoft_Azure_that_Have_an_Impact_when_Choosing_a_Cloud_Service_Provider*
3. Krishnan S. P. T. & Jose L. Ugia Gonzalez (2015 January). The Google Cloud Platform Difference *https://www.researchgate.net/publication/300149280_The_Google_Cloud_Platform_Difference*
4. Pranay Dutta (2019 March). International *Journal of Trend* in Scientific Research and Development.
5. Pranay Dutta & Prashant Dutta (2019 April). Comparative Study of Cloud Services Offered by Amazon, Microsoft and Google *https://www.researchgate.net/publication/333696517_Comparative_Study_of_Cloud_Services_Offered_by_Amazon_Microsoft_and_Google*
6. Brandon Gaille,(2018, October 31). 15 Microsoft Azure Advantages and Disadvantages *https://brandongaille.com/15-microsoft-azure-advantages-and-disadvantages/*
7. Jose Vidal (2018, February 24). Google Storage: Pros/Cons and how to use it with JavaScript *https://medium.com/dailyjs/google-cloud-storage-pros-cons-and-how-to-use-it-with-javascript-ea9ce60a94c0*
8. Intellipaat (2019, June 25). AWS vs Azurae vs Google Cloud *https://medium.com/dailyjs/google-cloud-storage-pros-cons-and-how-to-use-it-with-javascript-ea9ce60a94c0*
9. Cynthia Harvey & Andy Patrizio (2020, October 22) AWS vs. Azure vs. Google: 2021 Cloud Comparison *https://www.datamation.com/cloud-computing/aws-vs-azure-vs-google-cloud-comparison.html*
10. Columbus, L (2018, August 30). State Of Enterprise Cloud Computing. *https://www.forbes.com/sites/louiscolumbus/2018/08/30/state-of-enterprise-cloud-computing-2018/?sh=31829ad2265e*
11. Jeff Peters (June 17,2020), Cloud Services Comparison. *https://www.varonis.com/blog/aws-vs-azure-vs-google/*
12. Syed Jaffar Abbas & Raju Manjhi (Not Listed). *https://www.iujharkhand.edu.in/Seminar_Proceedings/Abstracts-Seminar%20on%20Cloud%20Computing%20-22.11.12.pdf#:~:text=Abstract:%20Cloud%20computing%20is%20the%20means%20of%20accessing,on%20the%20part%20of%20users%20or%20service%20providers.*