Cloud Computing Fundamentals – Literature Review on Cloud Computing Service Providers

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1 Introduction

Cloud computing can be best described as "internet computing" where its main purpose is to deliver computer services including servers, storage, databases, networking, software, analytics and intelligence over the internet through the "the cloud". The cloud refers to the servers that are available on the internet and can be accessed using software and databases that run on those servers. There are many benefits of cloud computing, one of the examples are the users and companies or service providers are not required to have physical servers that they have to manage themselves or run software applications on their own machines but instead use a server that is already available on the cloud. Cloud computing can also give many benefits towards the quality of life in our workplace by enabling the users to have access to their files and applications from almost any device. This is only possible because the data is located on servers in data centers instead of locally storing the data on the user device. Aside from giving benefits to the users, cloud computing can also help businesses to control their costs. By using cloud computing, it will remove some of the IT costs that comes with providing internet services such as maintaining and updating their own servers.

In this paper we will discuss the primary Cloud Computing Service Providers that is available on the internet such as Amazon EC2, Google Cloud Platform and Microsoft Azure and compare the different services they provide.

2 Comparison

2.1 Service model

Cloud computing is offered in three different service models. The three models are Infrastructure as a Service(IaaS), Platform as a Service(PaaS) and Software as a Service(SaaS). Infrastructure as a Service(IaaS) is a vendor provides clients pay as-you-go access to resources such as storage facilities, processing power, networks and virtual private servers. Meanwhile, Platform as a Service(PaaS) is a service provider offers access to a cloud based environment in which users can build and deliver applications without the need of installing and working with IDEs. Software as a Service(SaaS) is a service provider delivers quick access to cloud based web applications which controlled by vendor APIs.

2.2 Virtual Machine

Cloud computing service provider offers special virtual machine(VM) instances that have both computational and memory advanced capabilities. Virtual Machine instances are same as the server within an organization except the location of the server is different. Rather than buying hardware to setup the server which is expensive, users can rent virtual machines which is connected to the internet and they can pay as they go when they wanted to use the software. The virtual machine instance types are general purpose, compute optimized, memory optimized, storage optimized and accelerator optimized.

2.3 Storage

Cloud computing has a great advantage which is capability to expand storage. The three most prominent cloud computing has different types of storage. There are various types of storage such as object storage, file storage, backup storage, data transfer storage and etc.

2.4 OS Environments Offered

Cloud computing software needs the specific type of operating system which supports the cloud features offered by the cloud computing service providers respectively. Google Cloud Platform has the highest supported OS compared to other two cloud providers.

2.5 Security

Rapid development of cloud computing has made the people to arise a question whether is cloud computing secure? Security has been the most considered when developing an online platform service because of the increase of threats on the internet. In cloud computing, data security has given a very big importance especially by the three prominent cloud services. Firstly, Amazon EC2 has AWS security that provides built-in firewalls, data encryption, multi factor authentication and many layers of protection against DDoS attacks. Secondly, Google Cloud Platform offers Google Cloud security which is an "end-to-end process" that have intrusion detection, network firewall, layered data center security, data encryption and secure global network. Thirdly, Microsoft Azure provides Microsoft Azure security which continuously monitor security health, VPN, complete data encryption control and HTTP load balancing.

2.6 Performance and scalability

Performance is defined as production of a system under a given workload for a specific time. There are several measurement to determine the performance and those are memory usage, response time of application, CPU load and disk I/O. Performance will vary based on the workloads and user requirements. Meanwhile, scalability is the capability of a system to handle the high demand without effecting the applications's performance. There are two types of scalability and those are horizontal(scale out or in) which add or remove systems and vertical(scale up or down) which add or remove resources such as storage, memory, CPU.

2.7 Pricing Model

Since there have been many huge cloud providers compete with each other and all of them have almost similar features, pricing can be an attraction for the people who wishes to change to cloud computing. The prices offered by the prominent cloud providers have reduced so that everyone can afford to use their service. Nowadays all cloud service providers offers free trial session which allows customers to try their services for certain period of time before they buy. Not only that, great discount also offered to attract big enterprises and customers. Amazon EC2, Google Cloud Platform and Microsoft Azure offers different pricing models, various discounts and price cuts.

2.8 Auto-Scaling/Elasticity

Autoscaling is a cloud computing feature that enables organizations to auto scale cloud services such as virtual machines scale up or down automatically based on the situations and demand of resources traffic. The three most prominent cloud providers too offer autoscaling tools. The benefit of auto-scaling is it eliminates the need for manual response in real time when there is any high traffic or demand.

2.9 Monitoring tools/service

Monitoring tools or service is very essential in cloud computing. Monitoring is the process of evaluation the condition of the cloud based infrastructures so that to prevent service disruption. Cloud providers provide monitoring tools for the organizations to monitor their performance, availability and security of their cloud. Benefit of monitoring is that the problems can be found and fix immediately before they impact any disruption for the customers experience.

Comparison of 3 Prominent Cloud Computing Service Providers

Comparison Points		**Google Cloud Platform**[3][4]	**Microsoft Azure**[3][5]	**Amazon EC2**[3][6]
Service model	IaaS	Google Compute Engine	Virtual Machine	Amazon EC2
	PaaS	Google App Engine	App and Cloud Services	AWS Elastic Beanstalk
	SaaS	Google Workspace	Microsoft Office 365	Amazon EC2
Virtual Machine (VM) Instances	General Purpose	E2, N2, 2D, N1	B, Dsv3, Dv3, Dv2, DC	A1, T2, T3, M4, M5, M6g
	Compute Optimized	C2	Fsv2	C4, C5, C5n, C6g
	Memory Optimized	M2, M1	Esv3, Ev3, Mv2, M, Dv2	R4, R5, R6g, X1, Z1d
Storage		Amazon Storage Gateway -hybrid cloud storage that provide unlimited space	Cloud Storage -Ultra-low-cost storage for media archives	Disk Storage -Scalable ultra-disk storage for virtual

			machines
	AWS Backup -Backup storage	Data Transfer Service -Enables offline and online data transfer	Archive Storage -Enables secure file shares across cloud network
OS Environment Offeres	- Windows Server 2016 - CentOS 7 - Debian 9 - Ubuntu 12.x	- Windows Server 2012 - Windows 10 - Oracle Linux - Red Hat Enterprise Linux	- Amazon Linux - Debian server - macOS - Raspbian
Security	- VPC Service Controls - Titan Security Key - Shielded VMs	- Azure Active Directory - Azure Key Vault - Azure Security Center	- AWS Shield - GuardDuty - CloudWatch
Performance and scalability	Can withstand traffic peaks and dips and provide excellent performance.	Auto-scale based on the application usage to provide the best performance for the situation.	Main feature is auto-scaling and has great performance and scalability
Pricing model	- Free but limited - "Pay-as-you-go"	- Free but limited - Azure Hybrid Benefit - "Pay-as-you-go"	- On-demand - Spot reserved - per-second instances
Auto-Scaling /Elasticity	Flexible at adjusting the capacity based on the demand	Built in and will automatically change the instances size running on the virtual machine.	Traffic will cause the computing capacity to be adjusted. It works by schedule and rule-based
Monitoring tools/service provided	- Computing - Networking - Machine Learning - Identity & Security	- Azure Cosmos DB - Azure Kubernetes Service (AKS) - Azure Cognitive Services	- Dynatrace - Amazon CloudWatch

3 Opinions

3.1 FAIZUL HAZWAN BIN ZULKEPLE

The introduction of cloud computing has drastically changed how we work on things. An example of a sector that benefits greatly from cloud computing is in software development since all of the work that is being done is saved digitally and stored locally. By having cloud computing, it enables them to share their work easily with other people by using google cloud platform such as google drive which can greatly improve their workflow. However, there are also disadvantages of relying on cloud computing which is not being in full control of the files that are saved on the cloud. This means that the security of the data is dependent on the service providers and not yourself which can be dangerous for companies with important private data.

3.2 SHUGENTRAN A/L VARATHAN

In my opinion, Amazon EC2 has advantage which is it has high security, configuration option and reliability meanwhile the disadvantage is it offers wide catalog which can be difficult for the users to navigate. Secondly, Google cloud platform's advantage is it has a great reputation among community, very flexible pricing model and the disadvantage is Google has not focus on provide support to large business projects. Thirdly, Microsoft Azure's advantages are it focuses more on enterprise community, flexible pricing and the disadvantage is its functions and supported OS are limited when compare to other service providers. I would choose Google Cloud Platform for my software development. It is because Google Cloud is supported by many operating system compared to other two cloud providers, it has multiple storages which is very needed to store the software and not only that it can provide high performance based on the demands to develop software.

3.3 IRSYAD ROS BIN HISYAM ROS

As a student who is starting to get into programming, I would love to pick Google Cloud Platform because it seems to be the most user-friendly service provider. Although it doesn't have as varied virtual machine instances as Amazon EC2 does, it has a ton of service models with different tools that I can choose to suit my needs. When working on a project, it would be great if the speeds are stable and Google Cloud Platform does that pretty well with

auto-scaling based on demand of my project. Lastly, the security aspect is great as I can share access of my work only to my colleagues that are related to the work via Granular IAM permission.

3.4 MUQRISYA BT MAT NOOR

Personally, I would choose Google Cloud because it has a better price. I think I do not need to overspend my budget on cloud computing service. Another reason is that Google Cloud is easy to learn and handle. For Amazon EC2, I need to learn first on how to use it and it is complicated as I might lack on something. Thus, I will choose the easiest one. Plus, Google Cloud computing provides the best security where I can let myself manage key profile on my own. I would definitely manage on my own as I can manage key permission, and dispose old keys. For Azure and Amazon EC2, they do not provide this sort of security service. Although Google Computing does not have an advanced features like Azure and Amazon EC2, it has already given enough service for me to use in developing software.

4 Conclusion

Cloud computing has been used widely around the world. It helps a lot of people or workers especially in business getting their company's data to be stored and secured. Although there are pros and cons using cloud computing. For example the pros of cloud computing is the flexibility to work. Cloud computing permits workers to be more adaptable in their work hones. For illustration, they have got the capacity to get to information from domestic, on occasion, or by means of the commute to and from work. On the off chance that they would like get to the information whereas they are off-site, they will be able interface to their virtual office easily. For the cons, receiving cloud arrangements on a little scale and for short-term ventures can be seen as being costly. However, at the very end, in this technology era, cloud computing service is still the most useful service given to the business out there as it also gives lots of benefits.

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