Cloud Computing: Software Development

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1 Introduction

Imagine you are the CEO of a large and informative logistic company. To manage and maintain all the data and information held, many IT experts is needed in position to do the job. However, hiring huge amount of IT experts for continuous task is not a wise choice. Hence, here comes the cloud computing.

Nowadays, cloud computing is widely use in most of the large company such as Vanguard, Fox News and United Airlines. Cloud computing allows convenient, on-demand access from anywhere to a shared pool of computing resources.

There are 5 essentials of cloud computing which are on-demand self-service, broad network access, resource pooling, rapid elasticity and metering. Firstly, on-demand self-service means users can access to the IT resource without requiring other human interaction. Secondly, broad network access means the ability to access service from any device connected to the network such as PCs, laptops, mobile phones and tablets. Thirdly, resource pooling mean computer networking and storage are pooled and shared across multiple customers. Fourthly, rapid elastic mean users can quickly scale or shrink the capabilities of cloud to match the level of user demand. Lastly, metering mean users are able to track and control the level of resource usage or cost of the usage.

Basically, there are 3 types of cloud deployments which are public cloud, private cloud and hybrid cloud. Public cloud allows host to access the systems and services to its clients and users easily; private cloud have the same function as public cloud, but it is available for only one specific company owns a private one and hybrid cloud allows user to access both private and public cloud resources from single management environment. Moreover, there are 3 types of IT service used in these cloud deployments which are Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS). SaaS allow user to access to the application and little or even no control over the delivery. PaaS allow users to access into a software development environment. Then, they can create their own cloud applications. The users have control all over these applications. IaaS allow users to quickly provision full computing resources including processing, storage and networks without the user having to manage the underlying cloud infrastructure.

Table 1: Platform types

Platform Type	**Examples**
SaaS	Gmail, Salesforce, Cisco WebEx, Google Cloud Platform
PaaS	Windows Azura, Heroku, OpenShift

IaaS	Amazon Web, Linode, Microsoft Azure, Amazon EC2

2 Comparative Evaluation

Cloud Computing is a system on an internet services offered on demand to a user who does not to worry with implementation or even maintenance. Cloud computing is not like an old time where the user must do a one-time purchase, after the payment, users are able to use the software purchase forever. Now, there are various company offer these services such as Google, Microsoft, and Amazon. Microsoft Azure, Amazon EC2, and Google Cloud Platform are the prominent service providers in this era.

2.1 Services Model

In business requirement, there are the service models are been provides such are Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS). IaaS is a service offered for requiring all computing capabilities on demand over the web. They include some facilities such storage, networks, processing power and private servers. IaaS is the platform "pay as you go" where you will consume timespan and storage with the amount you pay. This platform the company do not need to manage the infrastructure, all are prepared. PaaS is collaborating services between IaaS and SaaS. They offer accessing to cloud-based environment where company can build, deliver the applications without working with Integrated Development Environments which are super expensive. SaaS service offered as an application that can be accessed over the web and managed by software provider. SaaS is payed by the number of user use, time usage, amount data stored.

Table 2: Types of cloud computing services

Services Model:		
Amazon EC2	Microsoft Azure	Google Cloud Platform
• Amazon EC2 (IaaS) • AWS Elastic Beanstalk (PaaS)	• Azure Search (PaaS) • Office 365 (SaaS)	• Google Compute Engine (IaaS) • Google App Engine (PaaS) • Google Drive (Saas)

2.2 Virtual Machine and Cloud Storage

However, cloud computing service also provides best virtual machines. A virtual machine is like a computer file, also can runs in a window. Instead of having same experience with the host operation system itself the cloud computing provides that for users. It also produces an idealistic environment where can accessed to virus-infected-data, backups and running the applications. Virtual machine can be run side by side on same computer. Cloud Storage is a cloud computing that a third party provides to store any data anytime and anywhere as long the user has the access to the service. All the privacy data are encrypted, can be massive scale and all people around the world can be connected. If the connection is lost, we still get the backups and archives.

Table 3: Specifications for Virtual Machines and Storage

Virtual Machine	Amazon EC2 VMs scaling up to 256 vCPUs and 24,000 GB of RAM. 1. Shared core: • N/A 2. Storage-optimized: • d3. large • d3en.large • d3en.6xlarge	Microsoft Azure VMs scaling up to 416 vCPUs and 11,400 GB of RAM 1. Shared core: • N/A 2. Storage-optimized: • L8s v2 - L80s v2 • L4s – L32s	Google Compute Engine VMs scaling up to 416 vCPUs and 11,776 GB of RAM 1. Shared core: • f1-micro – g1-small • e2-micro – e2-medium 2. Storage-optimized: • N/A
Storage	• Unlimited • Worldwide accessibility • Backups and archives • High durability		

2.3 Operating System

Operating system is a platform for software hardware. Operating system can control and sub-coordinate the hardware among various running application. Windows Server in Amazon EC2 and Azure can manage upkeep server to a cloud computing, user get benefit of paying monthly based than larger fixed cost. Infrastructure tends to be easier to scale up, buying and running server in-house more cost effective.

However, Linux Kernel used in Amazon and Google Cloud such are CentOS provides free services for community supported computing platform Marketing Target for servers, desktop, and supercomputers. Second, Debian is a completely free piece of software supported by millions of programmers worldwide. Provides application

software where programs to help users get what they want to be done. Debian comes with over 50,000 packages all of it free.

2.4 Cloud Security

Cloud security is an element to protect the secrecy, integrity and availability of data, applications, services and infrastructures in cloud computing. Security in cloud computing is very important to protect personal data and business content. Table 4 shows the security of cloud computing services.

Table 4: Security of cloud computing services.

Security	• Use of shared security responsibility model. • Protected by Amazon Web Services (AWS) global network security.	• Use of shared security responsibility model. • Usage of physical, infrastructure and operational controls	• Many security layers • Apply encryption at rest and during transit in Google Cloud. • Apply Layer Transport Security to secure the data.

2.4 Performance, Scalability and Elasticity

Scalability and elasticity are very important in order to adjust the capacity according to the demands and the usage of the application to optimize costs and performance. Amazon EC2, Microsoft Azure and Google Cloud Platform are elastic and have auto-scale features.

2.4 Pricing and Service Provided

Price of cloud computing services depends on what service providers you are subscribed to and the purpose either for general purpose, compute optimized, GPU instances, memory optimized and many more. These service providers also have their own monitoring tools which monitor the data and analytics. Table 5 shows the pricing model and monitoring tools used.

Table 5: Pricing model and monitoring tools.

Pricing model	• On-Demand price range from $0.0255 - $10.848 per hour.	• On-Demandprice range from $0.02 - $4.608per hour.	• On-Demand price range from $0.002923 - $0.791488 per hour.
Monitoring tools/ Service provided	• Monitoring tools includes SolarWinds® AppOptics™,	• Monitoring tools includes Serverless360, Application Insights,	• Offer cloud monitoring.

	SolarWinds Papertrail™ and more.	Azure Monitorand more.	• Collect metrics in real time and visualize insights.

3 Opinion

There are three types of cloud platforms which are Software as a service (SaaS), Platform as a service (PaaS), and Infrastructure as a service (IaaS).
In short, difference exist between this three cloud computing platforms is within the layers of control. IaaS offers the most control to the users as they are responsible for their applications, middleware, operating system and etc. On the other hand, PaaS customers only manage their applications and data, while SaaS customers are only responsible for their own data within the software. Furthermore, they have their own advantages and disadvantages.

Advantages and disadvantages of cloud platform:

Advantages	Platform	Disadvantages
Accessibility -services provided can be access from any device	Software as a Service (SaaS)	Internet Connection -require stable internet connection
Cost -more cost-effective		Vendor's Control -lack of control by users
Updates -does not require continuous updating		Experience and Flexibilities -offer users with little customization only
Services -Provide various kind of service such as computing, memory, storage and other app development services	Platform as a Service (PaaS)	Security - Vendors are not responsible with the security of developer's application
Experience -excellent basic infrastructure (no need worries for building and maintaining it)		Capability -Users must accept the product customized by vendors, regardless the technological and operational incompatibilities
Virtual Infrastructure -provide infrastructure such as data center, servers and tools for app building		Hardware -require updated or high specification hardware
Flexibility -providing a general data center for storage	Infrastructure as a Service (IaaS)	Cost -Unexpected cause may appear in the bill due to users' control

Hardware -does not require high specification hardware		Experience - shortage of experienced service providers, guidance or ecosystem support since it has more complex integration and interaction with existing systems can be challenging.

After our discussion, we believe that Amazon EC2 is the ideal service provider for software development. It has service model Amazon Web Service (AWS) which provides secure and resizable compute cloud. AWS is the first cloud service provider that offers cloud computing infrastructure since 2008 and currently is the most popular cloud service provider in the world. AWS have large coverage in many country regions. Amazon EC2 also capable to obtain and boot new server instances within minutes, allowing us to adjust the capacity by using AWS auto scaling feature to optimize costs and performance as our computing requirements change. AWS auto scaling helps in maintaining a steady and predictable performance. In terms of security, Amazon EC2 is protected by AWS global network security. They provide security by working with Amazon Virtual Private Cloud (VPC) and our compute instances are in a (VPC). Furthermore, if we lost our data, Amazon VPC will be responsible for it. To prevent from losing data, it will also automatically back up the data to Amazon EC2 instances periodically. On-demand Data Transfer from Amazon EC2 lets us pay for data transfer by the GB with no long-term commitments. All data transfer in is either free or provided at a minimal cost.. Although Amazon EC2 is generally more expensive compare to other dedicated servers, we consider that Amazon EC2 offers the best cloud computing service in terms of performance, flexibility, resources and security.

4 Conclusion

In Industry Revolution 4.0, there are many technologies making our job easier and more convenience no matter in any industry such as business, health care and banking. However, the most considerable technology which can use in every industry is cloud computing. It is because cloud computing provides tools and solutions that are specifically designed for the industry including software development. While cloud computing is used, it promotes strong workflow. It is because users can access the data and information about an organization or ongoing projects from anywhere and anytime by using cloud computing. It is also much more cost-effective than any other computing solutions.

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