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

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1 Introduction

Cloud Computing is a network of remote servers hosted on the internet for storing and retrieving data.

Nowadays, humans need more advance ways today to store data and access it when needed. While valuable information was physically stored on paper in the pre-computer era, today, most of the data is stored on computer hard drives and servers. These hard drives and servers can store, process, and retrieve large amounts of data quickly and conveniently.

However, both hard drives and servers have limitations, and with today's pace of business and industry growth, the need for storage that can store and process an increasingly significant amount of data has become a priority. This is where Cloud Computing helps!

The cloud provides a number of IT services such as servers, databases, software, virtual storage, and networking, among others. In layman's terms, Cloud Computing is defined as a virtual platform that allows you to store and access your data via the internet without any restrictions.

2 Cloud Computing Service Providers

2.1 Amazon EC2

In 2006, Amazon Elastic Compute (EC2) was launched as a web service that supplies a virtual computing environment where they will take the responsibility of networking, storage, server, and virtualization while the user have access to manage the middleware, data, application, runtime, and Operating System. Amazon EC2 offers tremendous flexibility to their users on how they are configured, used, and purchased while provides a broad set of instance types, it makes them a really great infrastructure-as-a-service (IaaS) solution.

Amazon EC2 provides a lot of virtual machine instance types that are grouped into six families which are general purpose, compute optimized, memory optimized, accelerated computing, storage optimized, and micro instances [1].

Amazon EC2 offers four storage options for the user instances. Users can choose storage between Amazon EBS, Amazon EC2 instance store, Amazon EFS file system, and Amazon S3.

There are a variety of operating system (OS) environments that are being offered by Amazon EC2 which includes FreeBSD, Ubuntu, SUSE Linux Enterprise Server, Red Hat Enterprise Linux, Windows Server, Oracle Linux, Fedora, Fedora CoreOS, Gentoo Linux, CentOS, Debian, openSUSE Leap, and Amazon Linux.

Amazon Web Services (AWS) provides the security of the cloud where they are in charge of protecting the infrastructure that runs Amazon EC2. As part of AWS Compliance Programs, regular tests by third-party auditors are being done to verify the effectiveness of Amazon EC2 security. Other than that, Amazon EC2 is using AWS Nitro System which is enhanced security where virtualization resources are unloaded to exclusive hardware and software that can minimize the attack surface.

Amazon EC2 has almost 400 instances for virtually every business need. It is also the only cloud provider that supports macOS and have 24 regions and 77 availability zones globally. Amazon EC2 is scalable as it increases or decreases capacity only within minutes.

Moreover, there are five pricing models for Amazon EC2 which are On-Demand Instances, Reserved Instances, Spot Instances, Saving Plans, and Dedicated Hosts that users can choose according to their situation [2].

Other than that, to help users have the precise amount of instances available, Amazon EC2 Auto Scaling is developed to launch or terminate Amazon EC2 instances automatically to manage the load for your application.

Finally, AWS provides seven automated monitoring tools to monitor Amazon EC2 that users can use that includes system status checks, instance status checks, Amazon Cloudwatch alarms, Amazon Cloudwatch Events, Amazon Cloudwatch Logs, Cloudwatch Logs, and AWS Management Pack for Microsoft System Center Operations Manager [3]. Besides that, by using Amazon EC2 Dashboard and Amazon CloudWatch Dashboard users can do manual monitoring as well.

2.2 Google Cloud Platform

In the year 2008, Google released a platform for developing and hosting web applications called App Engine. It was PaaS modeled and launched initially as a beta with a limited number of developers having access to it, which they increased in a later version. It became generally available in 2011. In the beginning, it did not have support for many programming languages. Google gradually added support for various other languages.

Google Cloud Platform (GCP) is incorporated into Google Cloud. It includes the Google Cloud Platform public cloud infrastructure and Google Workspace [4].

Google Cloud's App Engine acts as Platform as a Service (PaaS) whereas, the Google Compute Engine acts as an Infrastructure as a Service (IaaS). Google Cloud Platform offers different services for computing, storage, networking, machine learning, cloud management, security, and developing tools. The main cloud computing products included in GCP are Google Compute Engine, Google App Engine, Google Cloud Storage, and Google Container Engine. It also provides various higher-level services.

Google Cloud Engine also offers usability for all micro, small, medium, or large Virtual Machines with up to 11.5 TB of RAM and 60 vCPUs [5].

Google Cloud Platform offers Cloud Storage which is a web administration for storing information on the platform. It has got great security and sharing capabilities and offers up to 5TB of storage to the users.

Numerous layers of security are implemented to ensure that the information in the database is safe. Google uses multiple layers of encryption to secure user data in the platform. GCP encrypts the user data stored without requiring any prompts to the customer using various encryption mechanisms [6].

Coming to performance, scalability, GCP users can create an auto-scaler having one or more auto-scaling commands which can be for utilizing the CPU, limiting to storage capacity, scheduled auto-scaling, etc.

To sum it up, Google cloud features a simple user interface, provides a large storage capacity at a lower price tag, great security, and numerous other cloud computing services. It can be said that, it is currently one of the best cloud computing services out there.

2.3 Microsoft Azure

In 2008, Ray Ozzie announces Windows Azure but renamed it to Microsoft Azure in 2014. Microsoft Azure is a cloud computing service created by Microsoft for building, testing, deploying, and managing applications and services through Microsoft-managed data centers. It provides software as a service (SaaS), platform as a service (PaaS), and infrastructure as a service (IaaS) and supports many different programming languages, tools, and frameworks, including both Microsoft-specific and third-party software and systems.

Microsoft Azure provides Azure Virtual Machine which is one of several types of on-demand, scalable computing resources that Azure offers. This virtual machine is instance type virtual machine that is grouped according to its size which are general purpose, compute optimized, memory optimized, storage optimized, GPU, and high-performance compute.

Microsoft Azure has a cloud storage solution for modern data storage scenarios named Azure Storage Platform. The Azure Storage platform includes several data services which are Azure Blobs, Azure Files, Azure Queues, Azure Tables, and Azure Disks. Each service is accessed through a storage account.

In Microsoft Azure, there are two main operating system environments being offered which are Windows Server and Linux Server. For Windows, Microsoft Azure provides many marketplace images to use with various versions and types of Windows Server operating systems. For Linux, Microsoft Azure supports running a number of popular Linux distributions provided and maintained by a number of partners like SUSE, Red Hat, Canonical, Debian, FreeBSD, FlatCar, RancherOS, Bitnami, Mesosphere, Docker, and Jenkins.

Azure provides you with a wide array of configurable security options and the ability to control them so that you can customize security to meet the unique requirements of your organization's deployments. Azure has many security operations like Security and Audit Dashboard, Azure Resource Manager, Application Insights, Azure Monitor, Azure Advisor, and Azure Security Center.

One of the great features of Azure service is its ability to auto scale according to the demands of the application usage. Scaling features depend on the app service plan you opt for in Azure. The scaling is done by creating more instances which is called scaling out. There are five app service plans in Azure which are free, shared, basic, standard, and premium plan.

Microsoft Azure has competitive and transparent pricing. We can pay direct and get the same price as you would through a Microsoft Enterprise Agreement. Microsoft Azure can match AWS pricing for comparable services and we can pay only for the resources you use and cancel anytime.

Azure Autoscale can scale automatically to match demand to accommodate the workload. They will scale out to ensure capacity during workload peaks and scaling will return to normal automatically when the peak drops. Azure Monitor helps maximize the availability and performance of your applications and services. It delivers a comprehensive solution for collecting, analyzing, and acting on telemetry from your cloud and on-premises environments. All data collected by Azure Monitor fits into one of two fundamental types, metrics and logs.

2.4 Comparison

Table 1: Comparison of Cloud Computing Service Providers

Cloud Computing Service Providers	Amazon EC2	Google Cloud Platform	Microsoft Azure
Service model	IaaS	Google Cloud's App Engine is PaaS, whereas Google Compute Engine is IaaS.	Provide IaaS, PaaS, and SaaS
Virtual Machine	Grouped into six families: general purpose, compute optimized, memory optimized, accelerated computing, storage optimized, and micro instances.	Offers usability for all micro, small, medium or large Virtual Machines with up to 11.5 TB of RAM and 60 vCPUs.	Grouped according to their size which are general purpose, compute optimized, memory optimized, storage optimized, GPU, and high-performance compute.
Storage	Provides Amazon EBS, Amazon EC2 instance store, Amazon EFS file system, and Amazon S3.	Offers Cloud Storage which is a web administration for storing information on the platform.	The Azure Storage platform includes several data services which are Azure Blobs, Azure Files, Azure Queues, Azure Tables and Azure Disks.
OS environments offered	FreeBSD, Ubuntu, SUSE Linux Enterprise Server, Red Hat Enterprise Linux, Windows Server, Oracle Linux, Fedora, Fedora CoreOS, Gentoo Linux, CentOS, Debian, openSUSE Leap, and Amazon Linux.	Google Cloud has CentOS. It's a free operating system platform powered by Linux	Windows Server and Linux Server (SUSE, Red Hat, Canonical, Debian, FreeBSD, FlatCar, RancherOS, Bitnami, Mesosphere, Docker and Jenkins)
Security	Provides AWS Nitro System and security of the cloud where they are in charge of protecting the infrastructure that runs Amazon.	Uses multiple layers of encryption to secure user data in the platform.	Provides many security operations like Security and Audit Dashboard, Azure Resource Manager, Application Insights, Azure Monitor, Azure Advisor and Azure Security Center.
Performance and scalability	Amazon EC2 is scalable as it increases or decreases capacity only within minutes.	Can create an auto-scaler that can utilize the CPU.	Able to auto scale according to the demands of the application usage

Pricing model	Provides 5 pricing models that suitable for different uses that gives different amount of discounts according to the chosen pricing models	Google Cloud Functions comes out as the cheapest provider for serverless computing due to its very low compute price.	Get the same price as you would through a Microsoft Enterprise Agreement and can match AWS pricing for comparable services
Auto-Scaling/Elasticity	Launch or terminate Amazon EC2 instances automatically to manage the load for your application	Can limit the storage capacity and scheduled auto-scaling.	Azure Autoscale can scale automatically to match demand to accommodate workload.
Monitoring tools/service provided	Provides 7 automated monitoring tools and 2 dashboards so that users can monitor the state of the Amazon EC2.	Google Cloud monitoring tools feature cloud monitoring systems such as- Artifact Registry, Cloud Core, Cloud SDK, Cloud Tasks etc.	Azure Monitor helps maximize the availability and performance of your applications and services.

3   Opinion

The opinion that we have concluded regarding the Cloud Computing Service Providers is that one of the efficient cloud platforms for our software development is Google Cloud Platform. One of the reasons being is because it is more affordable in long-term use. Unlike Amazon EC2 and Microsoft Azure, their pricing is significantly higher. Therefore, we think it is the best way to start off using the Google Cloud Platform as our first cloud service provider for our software development since it also provides myriad of same features as both other's cloud service. On top of that, Google Cloud Platform also provides a unique feature called redundancy where it backs up our data frequently across multiple storage devices globally. Thus, we do not have to worry anymore if some of our data gets corrupted or lost because we can recover it back in different storage.

4   Conclusion

In Conclusion, all of them are used for the same reason. AWS, Azure, and Google cloud. They have almost the same services. Both frameworks, operating systems, and structures are supported. Some only have name variations, but their characteristics are much the same. Therefore, when deciding which cloud product, you need to go with, the advice is to choose the free trial version and validate the one most successfully meets the customer specifications. It means making use of it and choosing it.

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