Most Prominent Cloud Computing Provider: Which One is The Most Relevant? Microsoft Azure vs Amazon EC2

Amirah Raihanah binti Abdul Rahim[1], Chloe Racquelmae Kennedy[1], Radin Dafina binti Radin Zulkar Nain[1], and Rasmin Kaur Sandhu[1]

1 Introduction

Cloud computing is one of the best inventions yet in the computing and IT industry, it makes everything easier, more accessible and attractive with all kinds of features offered by different providers. How do we define cloud computing? Cloud computing is one kind of service over the internet, requires no internal storage and everything relies on the internet only. In fact, the one who provides these services are from the hardware and software system in the data centre itself. Cloud computing has been giving people lots of advantages especially for those who have companies as it prevents them from using lots of cost and the software needs less maintenance as providers are the ones who maintain it. Hence, the number of workers can be deducted. On top of that, companies with huge amounts of data can get their result quickly as cloud computing is scalable. With all these advantages, that is why cloud computing is widely used these days whether it's in school, university and large companies. Since cloud computing is in demand, thus there are lots of providers that offer these services such as Google Cloud, Microsoft Azure and Amazon EC2. All of these providers offer different services and comparisons need to be made to choose the best cloud provider based on your needs.

2 Comparative Evaluations

2.1 Service model (IaaS, PaaS, SaaS)

- PaaS - Platform as a Service.
- IaaS - Infrastructure as a Service.
- Saas - SSoftware as a Service.

In conjunction to that, one of the famous cloud computing providers, Microsoft Azure uses all three types of service model that you can choose based on your needs. For example, Azure's IaaS provides customers with all the outsourcing and computing changes completely to Microsoft. This means that customers need to manage the infrastructure by themselves such as purchase, install and configure. On top of that, Azure's facilities are wide enough so that customers can choose according to their needs including Virtual Machines and Container Machines. Next, through PaaS services, customers can enjoy a complete cloud application from the smallest web apps to enterprise level software where they do not have to worry about scaling and server configuration because all of this is automatic and handled by Azure. Examples of Azure's PaaS are Azure CDN, Azure Search and app services. Moreover, Azure also has their SaaS which allows you to control what you created and use Microsoft's SaaS services that are already provided. For instance, Office 365 and Dynamic 365 where customers can experience the advantages of intelligent tools and amazing technology like machine learning.

In addition, Amazon EC2 is one of the cloud computing providers too and they use IaaS as the service provider. Amazon EC2 claims that their services are extremely secure, flexible, affordable and scalable cloud infrastructure and computing capacity. This has made cloud developers easier because they can make web-scale cloud computing and auto-scale resources. On the other hand, developers are also allowed to have full control over the instances anywhere including software stack while preserving the data. Lastly, they also

provide easy developing tools and applications which can save developers time and cost needed. All in all, Microsoft Azure offer more services compared to Amazon EC2.

2.2 Virtual Machine (VM) instance types offered

Combinations of virtual CPU, virtual memory, temporary storage, and networking capability are called instances or VMs and give a client the flexibility to choose the appropriate mix of workload resources. For the specifications of any target workload, both AWS EC2 and Azure provide instances on scale. The choice to store VM in persistent storage called EBS in Amazon terminology, or Blob Storage in Azure terminology, is offered by both EC2 and Azure. In a given case, whether it's cross-geo networking, you pay extra for storage usage and network use. There is a massive marketplace for both AWS and Azure from which you can collect and deploy any instance of your requirements at Scale. But with Microsoft, an upfront one- or three-year commitment to Azure Cloud, you can save up to 72 percent over pay-as-you-go pricing. At any moment, you may also swap or cancel the RI. Hybrid advantages are also provided by Microsoft. When migrating a few workloads or whole data centres to the cloud, you can use your on-premises Windows Server or SQL Server licenses with Software Assurance to make big savings. For your ongoing development and testing, you can get reduced rates on Azure, including no Microsoft software charges on Azure Virtual Machines and exclusive test pricing on other services.

2.3 Storage

Storage is the primary use of cloud computing that most people use these days as it is so much easier compared to bringing your external drive on hand everywhere. A lot of providers like Microsoft Azure, Amazon, Google Cloud provides all kinds of data storage for people to use. Talking about Microsoft Azure, they have offered a few types of cloud storage that have different uses and features according to its own pricing model. Firstly, general-purpose v2 accounts which are basic storage types for blobs, queues, files and tables and are recommended for any scenarios using Azure Storage. Next, general-purpose v1 accounts which are almost the same compared to v2 but it is a legacy account type and sometimes uses v2 if possible. In addition, BlockBlobStorage account which has a higher pricing model that includes premium features. This premium storage has excellent performance characteristics especially for append blobs and block blobs. This storage is recommended for anyone who encounters usage of smaller objects or requires low storage latency and high transaction rates. Other than that, Azure also offers File Storage accounts where it can only store files but with premium performance that is recommended for enterprise or any performance that has high scalability.

Moving on, Amazon EC2 has its own cloud storage range that users can choose from which are ABS, Amazon EC2 instance store, Amazon EFS and Amazon S3. . One of them is Amazon Elastic Block Store (EBS) that allows users to attach block-level storage volumes to a running instance and is also durable. Next, EBS can be used as a primary storage device for any data that needs frequent updates. If you are using databases as an instance, then EBS is the perfect choice for you. Next, instance stores are basically providing temporary block-level storage. If you stop the instance, any data from it will be lost. Lastly, Amazon S3 gives access to an affordable data storage infrastructure that allows you to store any data at any time. These are widely used to backup data safely.

2.4 OS environments offered

Operating system is an interface between PC user and hardware. It is a software that plays out all the essential tasks such as management of file, memory, process, devices and dealing with input and output (tutorials point, n.d.). Both Microsoft Azure and Amazon EC2 are composed of various OS that work together.

Feature	Microsoft Azure	Amazon EC2

Operating System Types	Linux Windows	Linux Windows macOS Raspbian
Supported Operating Systems	Cent OS FreeBSD openSUSE Linux Oracle Enterprise Linux SUSE Enterprise Linux Ubuntu Windows Server	Amazon Linux Ubuntu LTS CentOS Red Hat Enterprise Linux Windows Server Debian Server Oracle Linux

Table 1: OS environments offered

2.5 Security

Microsoft Azure provides security by utilizing roles with permission and authorization control features while Amazon EC2 gives security by offering authorizations on the whole account.

Feature	Microsoft Azure	Amazon EC2
Network	Virtual Network, ExpressRoute	Virtual Private Cloud (VPC) Network
Identity and Access Management	Azure Active Directory B2C	Cognito
Authentication and Authorization	Active Directory and Active Directory Premium	Identity and Access Management (IAM)
Storage Security	Blob	S3
Security Check	Security Centre	Trusted Advisor, AWS Inspector
Key Management	Key Vault	Key Management Service (KMS)
Logging	Log Analytics, Security Event Logs	CloudWatch Logs, CloudTrail
Compliance	TrustCenter	CloudHSM

Table 2: Security Microsoft Azure and Amazon EC2

2.6 Performance and scalability

Performance is the capacity of your task to scale and fulfil the needs positioned by the clients in a productive way. A significant consideration in accomplishing performance is to consider how your application scales. Scalability is the capacity of a framework to deal with expanded burden (Microsoft, 2020). Performance is tested by Phoronix Test Suite 3 and the results presented are Apache and Dbench benchmarks.

Test	*Azure (MB/s)*	*AWS (MB/s)*
Test 1	12.6516	12.6483
Test 2	12.6721	12.6642
Test 3	12.6319	12.6572
Average	12.65	12.66

Figure 1: Apache Benchmark

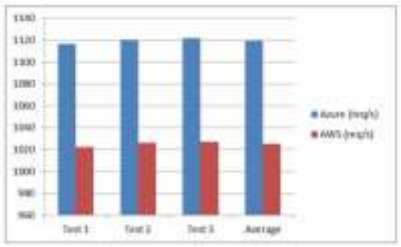

Figure 2 : Dbench Benchmark Results

From the results in figure 1, it shows the overall performance of the system and Microsoft Azure has a slight advantage over Amazon EC2 while the Dbench test which tests the disk performance in figure 2 shows that their results only have a little difference. In terms of server performance variability, Microsoft Azure and Amazon EC2 use virtualization and they are good enough to ensure good consistent performance. Besides, Microsoft Azure features multiple capabilities to scaling which are scaling up and down, scaling in and out and autoscaling while Amazon EC2 provides auto scaling. The autoscaling that both cloud computing provides allows us to scale the capacity up or down automatically and this could help us to scale up to maintain performance and scales down during low demand.

2.7 Pricing model

Comparing Azure vs AWS pricing has always been difficult due to the pace at which prices change. Azure and AWS are two excellent solutions for cloud service implementation, and many companies use both to enjoy the exclusive feature set of each cloud. However, before you decide on an AWS or Azure migration, it is important to compare pricing between clouds and then optimize the costs of deploying your services in the public cloud.

Instance Parameters	**Azure** **Per-Hour Price**	**AWS** **Per-Hour Price**
On-Demand / Linux / General Purpose / 4 CPUs / 16 GB Memory	$0.1670	$0.1856
On-Demand / Linux / Compute Optimized / 4 CPUs / 16 GB Memory	$0.1690	$0.1700

On-Demand / Linux / Memory Optimized / 4 CPUs / 16 GB Memory	$0.2660	$0.2660
On-Demand / Windows / General Purpose / 4 CPUs / 16 GB Memory	$0.5970	$0.8560
On-Demand / Windows / Compute Optimized / 4 CPUs / 16 GB Memory	$0.7260	$0.8340
On-Demand / Windows / Memory Optimized / 4 CPUs / 16 GB Memory	$0.8500	$0.9520

Table 3: On-Demand Azure VMs / Amazon EC2 Pricing

Instance Parameters	**Azure** **Per-Hour Price**

Reserved 3 Year / Linux / General Purpose / 4 CPUs / 16 GB Memory	$0.0701
Reserved 1 Year / Linux / General Purpose / 4 CPUs / 16 GB Memory	$0.1069
Reserved 3 Year / Windows / General Purpose / 4 CPUs / 16 GB Memory	$0.2507
Reserved 1 Year / Windows / General Purpose / 4 CPUs / 16 GB Memory	$0.3821

Table 4: Reserved Azure VMs / Amazon EC2 Pricing

2.8 Auto-Scaling/Elasticity

Azure elasticity as a service relates to a cloud service that allows Azure hosted services to be automatically scalable to meet demand and configured parameters. This gives Azure Administrators the ability to automatically scale the infrastructure and resources of Azure as and when required. With Amazon EC2, you can automate both volume-based and time-based elasticity, which can provide significant savings. Companies that shut down, for instance, Instances of EC2 outside a 10-hour workday will save 70% in comparison to running Instances like that 24 hours a day. Automation is becoming more and more relevant because environments are growing larger and becoming more complex, manually in which the quest for savings in elasticity is impractical.

2.9 Monitoring tools/service provided

Monitoring tools are used to monitor and track any software if there is any problem or failure so that the problem can be fixed before it gets worse. Different types of cloud computing providers require different monitoring tools. But there are some tools that can monitor both of the providers below. If there are not monitored, the system will experience failure and caused a huge mess to users. These are the examples of effective and widely used tools to monitor Microsoft Azure and Amazon EC2:

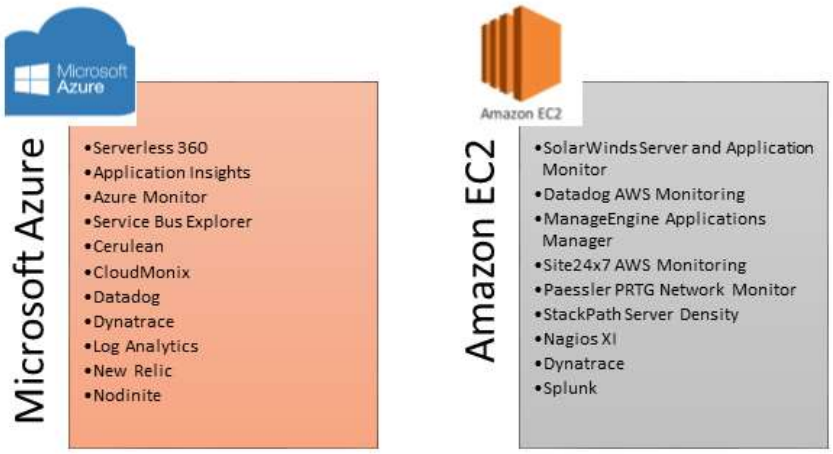

Figure 3: Monitoring tools/service provided

3 Opinions

3.1 Advantages and Disadvantages of Amazon EC2

ADVANTAGES	DISADVANTAGES
Wide variety of machine configurations	Complex to understand
Pay as you go	Security limitations
Excellent backup capabilities	User interface is hard to familiarized

Table 5: Advantages and Disadvantages of Amazon EC2

3.2 Advantages and Disadvantages of Microsoft Azure

ADVANTAGES	DISADVANTAGES
Highly secured	Requires management
Offers many scalability options	Lack of integrated backup
Have multiple global data centers	Requires platform expertise
Cost effective	Speed depends on location

Table 5: Advantages and Disadvantages of Microsoft Azure

3.3 Selected Cloud Service Providers

Based on the comparative evaluation and analysing the advantages and disadvantages of the two cloud service providers, we have made the decision to choose Microsoft Azure as our cloud service provider for our software development. There are few characteristics of why we chose Microsoft Azure with opinions supported and strong argument based on the Figure – above.

Microsoft Azure offers a strong security profile which follows the DADSC (detect, assess, diagnose, stabilize, close). This is very important to protect our data from information theft especially valuable information. There are also several features that help Microsoft Azure reduce the risk by using multi-factor authentication besides having built-in mechanisms to avoid distributed denial-of-service (DDoS) attacks. On top of that, Microsoft has over 3,500 cybersecurity experts who work to protect the infrastructures.

Microsoft Azure has multiple redundancies in place to maintain data access as they have access to a broader range of global data centres than any other cloud provider that eventually helps to access all of the data. The physical component of Azure consists of 160+ physical data centres that are arranged into regions. This is really helpful for us whenever one of the data centres are having problems or under maintenance, we don't have to worry because there are other data centres that are accessible at the fingertips.

Lastly, Microsoft Azure is highly known for their scalability options. They are designed to provide the best performance as they are massively scalable to meet the data storage from the end-user (Brandon Lee, 2019). Azure offers many great capabilities related to scaling such as scaling up and down, scaling in and out and autoscaling. We could benefit so much with the Azure cloud environment as they are not forced to purchase any data packets and just pay only for what we have used.

4 Conclusion

In conclusion, both cloud computing platforms have their pros and cons. It depends on the organization which platform suits their needs. Amazon Ec2 has a wide variety of machine configurations; you can pay as you go and has excellent backup capabilities. Azure on the other hand, is a zero-maintenance service, is highly secured, offer many scalability options and is cost effective. There is no— All the best when it comes to the Cloud Service Provider, all of it comes down to what suits your needs best.

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