Comparative Study of Cloud Services
Offered by Amazon, Microsoft & Google

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ABSTRACT

With the accelerated development in processing and storage technologies and the boom of the Internet, IT Hardware have become inexpensive, more potent and highly available than ever before. This has triggered the commencement of a new computing model called cloud computing, in which IT-Resources are catered as general utilities that can be hired and released by users through the Internet in an on-demand fashion. According to Gartner Survey Report, The marketplace for public-cloud is predicted to reach from '$260 billion' in 2017 to around '$411 billion in 2020'. As more and more IT systems are externalized, it is getting more imminent for us to choose the right cloud service provider for long term success. However, the challenge is to choose the best cloud service provider from the vast number of options like AWS, Azure and GCP to the smaller CSP's. As per Market share the Top 3 Global leaders are AWS, Azure and GCP1. In this paper, we will try to make analysis of between the three market leaders in cloud services namely Amazon, Microsoft & Google. We will also compare and contrast what AWS, Azure, and GCP offer in terms of storage, compute, management tools etc.

KEYWORDS: Cloud service Provider (CSP), Amazon Web Service (AWS), Microsoft Azure, Google Cloud Platform (GCP)

I. INTRODUCTION

Before an organization finds the best Cloud Service Provider, it should freeze its exact requirement. Sometimes organizations need Software as a Service and end up hiring Infrastructure as a Service. Hence an Organization should know its exact requirements with context to IaaS, SaaS & PaaS.

IaaS - In an IaaS model[2], a CSP hosts the hardware components originally present in an on-premises data center, including servers, storage and networking hardware, as well as the virtualization or hypervisor layer. The IaaS provider also provides a range of services to convoy those infrastructure components. These can include detailed-billing, monitoring, log-access, security, load-balancing and clustering, as well as storage-resiliency, such as backup, replication and recovery. IaaS customers access resources and services through a (WAN), such as the internet, and can use the cloud provider's services to install the remaining elements of an application stack.

SaaS - SaaS eliminates the need for organizations to install and run applications on their own servers or in their own data-centers[3]. This eliminates the expense of hardware procurement, provisioning and maintenance, as well as software-licensing, installation and support. Rather than procuring software to install, or additional hardware to support it, customers subscribe to a SaaS offering. Generally, they pay for this service on a monthly/hourly basis using a 'pay-as-you-go' model. Transitioning costs to a periodic operating expense allows many big-business to exercise better and more foreseeable budgeting. Users can also terminate SaaS offerings at any time to stop those periodic costs.

PaaS - PaaS does not normally replace a business's entire IT-Infra. Instead, a business trusts on PaaS providers for key-services, such as application hosting or Java development. A PaaS provider forms and supplies a strong and optimized environment on which users can install applications and data-sets. Users can emphasis on making and running applications rather than constructing and maintaining the underlying infrastructure and services. Many PaaS products are geared toward software-development. These platforms offer compute and storage infra, as well as text editing, version-management, compiling and testing services that help software-engineers create new software more quickly and efficiently. A PaaS product can also enable development teams to join forces and work together, regardless of their physical-work-location.

Finding a cloud service provider (CSP) has become an intricate judgement. Nowadays it's not a question of which

option we should work with, but rather, how to achieve the right performance and dispense risk across multiple vendors—while optimizing the cost.

In view of the above discussions, it can be envisaged that every organization should finalize CSP based on its Capabilities in IaaS, SaaS & PaaS. If any Organization is looking for Iaas then it should look for those CSP's which are having an edge on Iaas.

II. Major Cloud Computing Service-Providers
There are several cloud-computing service-providers available in industry. Few leading companies are listed below as per Gartner's Magic Quadrant[4]:-
1. Amazon Web Services – Launched in 2006
2. Microsoft Azure - Launched in 2010
3. Google Cloud Platform - Launched in 2008
4. Alibaba Cloud - Launched in 2009
5. Oracle Cloud- Launched in 2012
6. IBM Cloud- Launched in 2011

Figure-1: Gartner's Magic Quadrant
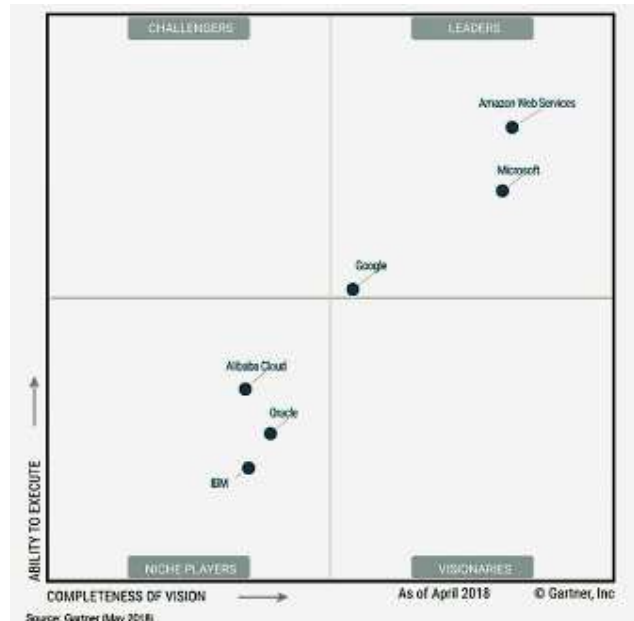
III. Comparison of Compute Services : AWS vs AZURE vs GCP

Service	Amazon Web Services	Google Cloud Platform	Microsoft Azure
Compute Services	Elastic Compute Cloud (EC2)	Compute Engine	Virtual Machines Virtual Machine Scale Sets
PaaS	Elastic Beanstalk	App Engine Standard Environment App Engine Flexible Environment	Cloud Services
VPS	Lightsail		Virtual Machine Images
Docker / Kubernetes containers	EC2 Container Service Kubernetes (EKS)	Kubernetes Engine Container Engine	Container Service Container Service (AKS)
Integrate systems and run backend logic processes	Lamda	Cloud Functions (Beta)	Functions Event Grid Virtual Machine Scale Sets
Automatically scale Instances	Auto Scaling	Instance Groups	AutoScaling

Table - 1

IV. Comparison of Storage Services: AWS vs AZURE vs GCP

Vendor	Storage Services	Database Services	Backup Services
AWS	• Simple Storage Service (S3) • Elastic Block Storage (EBS) • Elastic File System (EFS) • Storage Gateway • Snowball • Snowball Edge • Snowmobile	• Aurora • RDS • DynamoDB • ElastiCache • Redshift • Neptune • Database migration service	• Glacier
Azure	• Blob Storage • Queue Storage • File Storage • Disk Storage • Data Lake Store	• SQL Database • Database for MySQL • Database for PostgreSQL • Data Warehouse • Server Stretch Database • Cosmos DB • Table Storage • Redis Cache • Data Factory	• Archive Storage • Backup • Site Recovery
GCP	• Cloud Storage • Persistent Disk • Transfer Appliance • Transfer Service	• Cloud SQL • Cloud Bigtable • Cloud Spanner • Cloud Datastore	• None

Table -2

V. Key Cloud Tools

	Key Cloud Tools
AWS	Athena, QuickSight, SageMaker, Lex, Greengrass IoT, AWS Lambda & Deep Lens
Azure	HDInsight, Azure DataFactory, Azure ML Studio, Azure Boot Service, Cognitive Service, IoT Hub, Functions
GCP	BigQuery, Cloud DataFlow, Cloud ML Engine, Cloud IoT Core, Cloud Functions

Table – 3

VI. Comparison of Database Services : AWS vs AZURE vs GCP

Service	Amazon Web Services	Google Cloud Platform	Microsoft Azure
Managed relational database-as-a-service	RDS	Cloud SQL	SQL Database
			Database for MySQL
		Cloud Spanner	Database for PostgreSQL
NoSQL (Indexed)	DynamoDB	Cloud Datastore	Cosmos DB
		Cloud Bigtable	
NoSQL (Key-value)	DynamoDB SimpleDB	Cloud Datastore	Table Storage
Application or Memory Caching	ElastiCache	Mem Cache	Redis Cache
Database migration	Database Migration Service		Database Migration Service
Managed data warehouse	Redshift	Big Query	SQL Data Warehouse

Table – 4

VII. Comparison of Networking Services : AWS vs AZURE vs GCP

Service	Amazon Web Services	Google Cloud Platform	Microsoft Azure
Isolated, private cloud private networking	Virtual Private Cloud	Virtual Private Cloud	Virtual Network
Cross-premises connectivity	API Gateway	Cloud VPN	VPN Gateway
Manage DNS names and records	Route 53	Google Cloud DNS	Azure DNS Traffic Manager
Global content delivery networks	CloudFront	Cloud Interconnect Cloud CDN	Content Delivery Network
Dedicated, private network connection	Direct Connect	Cloud Interconnect	ExpressRoute
Load balancing configuration	Elastic Load Balancing	Cloud Load Balancing	Load Balancer Application Gateway

Table – 5

VIII. Comparison of Management Services : AWS vs AZURE vs GCP

Service	Amazon Web Services	Google Cloud Platform	Microsoft Azure
Cloud advisor	Trusted Advisor	Cloud Platform Security	Advisor
DevOps deployment	OpsWorks (Chef-based)	Cloud Deployment Manager	Automation
			Resource Manager
	CloudFormation		VM extensions
Management & monitoring	CloudWatch	Stackdriver Monitoring	Portal
	X-Ray	Cloud Shell	Monitor
		Debugger	Application Insights
		Trace	
	Management Console	Error Reporting	
Administration	Application Discovery Service		
	Systems Manager	Cloud Console	Log Analytics
			Operations Management Suite
	Personal Health Dashboard		Resource Health
			Storage Explorer
Billing	Billing API	Cloud Billing API	Billing API

Table – 6

IX.   Comparison of Security Services : AWS vs AZURE vs GCP

Service	Amazon Web Services	Google Cloud Platform	Microsoft Azure
Authentication and authorization	Identity and Access Management (IAM)	Cloud IAM	Active DirectoryActive Directory Premium
	Organizations	Cloud Identity-Aware Proxy	
Protect and safeguard with data encryption	Key Management Service		Storage Service Encryption
Hardware-based security modules	CloudHSM	Cloud Key Management Service	Key Vault
Firewall	Web Application Firewall		Application Gateway
Directory services	AWS Directory Service		Active Directory Domain Services
Identity management	Cognito		Active Directory B2C
Cloud services with protection	Shield		DDoS Protection Service

Table – 7

X.   Market Share and Usages

Amazon Web Services holds 33 percent of the cloud infrastructure market, according to data published by Synergy Research Group. Microsoft's stake of the market hopped to 13 percent from 10 percent a year before. Google improved to six percent from five percent. AWS market-share chopped by a percentage point[5]
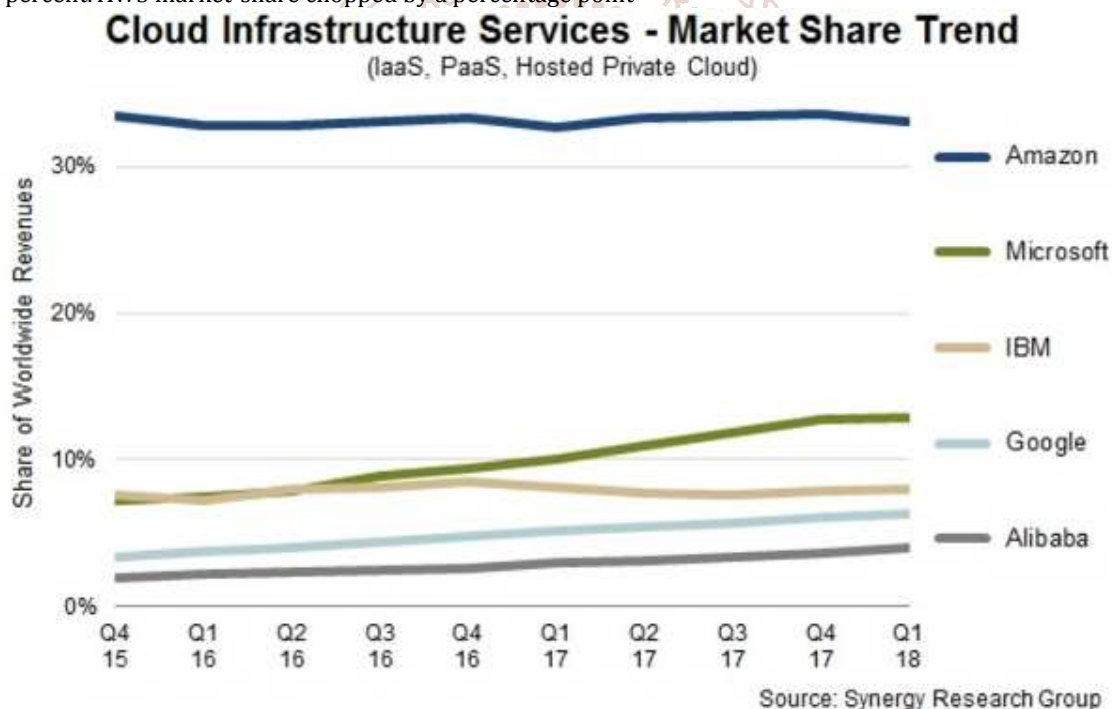
Figure- 2

XI.   Pricing Models : AWS vs AZURE vs GCP[6]

	Pricing	Models
AWS	Per hour – rounded up	On demand, reserved, spot
GCP	Per minute – rounded up (minimum 10 minutes)	On demand – sustained use
Azure	Per minute – rounded up commitments (pre-paid or monthly)	On demand – short term commitments (pre-paid or monthly)

Table – 8

XII. Key Benefits of AWS, AZURE & GCP

S. NO	AWS	AZURE	GCP
1	Dominates cloud domain with features such as configuration, monitoring, security, auto-scaling etc.	More reliable when comes to integrating with Microsoft tools	Expertise in DevOps
2	Better Offering	Better Development and testing tools	Flexible discounts & contracts
3	More Experience, enterprise friendly services	Also provide Hybrid cloud	Specifically designed for cloud-based businesses
4	More open source tools integration		
5	Global Reach		

Table – 9

XIII. Drawbacks of AWS, AZURE & GCP

S. NO	AWS	AZURE	GCP
1	The price structure is a bit intricate	Azure is lacking in the area of DevOps	GCP does not offer as many services as AWS or Azure.
2	AWS doesn't have a specific "hybrid cloud" solution	Azure's support for other operating-systems is very limited, only supporting a limited varieties of Linux.	GCP is the newest out of the three providers, that means it's the least mature in terms of variety of offerings

Table – 10

XIV. Conclusion

Although AWS leads in public cloud market share, but it would be incorrect to claim it provides the top solutions. Microsoft Azure and Google Cloud Platform sure have their added advantages if you're looking for easy business solutions or foolproof security. The idea is – there's no universal best when it comes to Cloud Service Provider, it all derives down to what best suits your requirements.

XV. Recommendations

In order to distribute Risk, the Organizations should go for Multi-Vendor CSPs. The SaaS should be delegated to the CSP having better SaaS features, similarly the PaaS should be delegated to the CSP having better PaaS features and The IaaS should be delegated to the CSP having better IaaS features. The Major role in this aspect will be of the Managed Service Provider (MSP) who will ensure to provide multiple CSPs.

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