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Study of Cloud Providers (Azure, Amazon, and Oracle) According To Service Availability and Price

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Abstract: Computing in the cloud refers to a model of providing computing and networking resources on a utility-based, pay-as-you-go basis, without the need for a dedicated server or network. Many aspects of life, from medicine and education to the arts and entertainment, and beyond, are increasingly reliant on technological advancements. Here, Technology corporations play a decisive role. Both large and small IT companies have seen tremendous growth in recent years. Due to Cloud-Computing and its wonderful services, this is now feasible. In the cloud, users have an unrealistic expectation of available resources yet only incur costs in proportion to what they actually use. With the development of new technologies, the quantity of cloud service suppliers has increased rapidly, and each one has expanded its range of services. Cloud users, however, may have trouble determining which service provider is ideal for their specific requirements. We'll be looking at Microsoft Azure, Oracle Cloud, and Amazon Web Services, all of which provide cloud computing services. In order to more accurately assess available cloud computing service providers, readers of this article may benefit from examining the data presented here. Comparisons are made on a wide range of criteria, including the services and tools offered by each provider, the platforms they run on, the languages they support, the level of security and scalability, and the amount of data that can be stored in the cloud.

Keywords: Cloud Computing, Cloud Service Providers, Amazon web services, Microsoft Azure, Oracle.

I. INTRODUCTION

Cloud Computing is recognized as a paradigm shift that integrates the internet with computing, enabling software, content, and data to be stored on distant systems that are accessible through the internet from any location in the world through computers, phones, and TVs, etc. Obviously, cloud computing is not a replacement concept. John Mc Carthy, a computing pioneer, prophesied in 1961 that Counts would one day be established as a public-service company, and subsequently invested in the means by which this would occur. In recent years, cloud technology has seen tremendous expansion, with several cloud providers emerging. Several service providers have focused on the computational aspects, providing end-users with solutions including Processor, store, databases, and networking. The price model for cloud computing is dependent on the amount and duration of utilized services or resources. Cloud computing

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provides an extensive selection of cloud-based services. Cloud service providers are companies that provide network services, infrastructures, platform, software, or business applications that are hosted in the cloud. Individuals and companies may access the cloud services via the data center of the provider of cloud services through an internet connection. Providers provide cloud solutions to customers in response to requests. Each cloud has unique features, storage capacity, billing systems, and production techniques for the services offered by other clouds. Supported service models include of Infrastructure-as-a-Service (IaaS), Platform-as-a-service (PaaS), and Software-as-a-service (SaaS) [1]. Below block diagram describe the fundamental cloud computing block and its component elements.

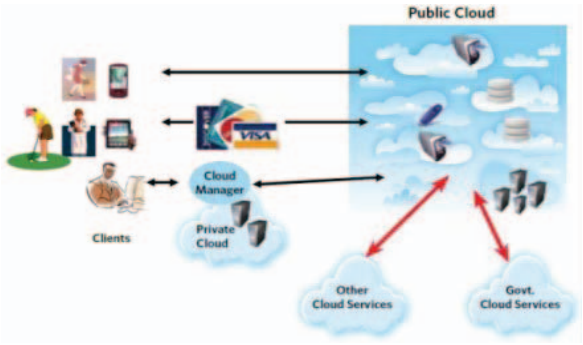

Figure 1: Basic model of cloud computing [5]

Figure 1 depicts the fundamental cloud computing block diagram and its component elements. The National Institute of Standards and Technology (NIST) describes the cloud computing paradigm as "a model for providing easy, on-demand network access to a shared pool of customizable computer resources (e.g. networks, computers, storage, applications, and services) that may be swiftly supplied and released with minimum administration effort or service provider contact" as the most generally used definition. Several intriguing aspects of cloud computing make it a plausible answer for numerous problems faced by people and corporations. These qualities include:

- Cloud service providers (CSPs) have the scalability to add more networks and systems to the cloud with little adjustments to the underlying infrastructure and software.
- The cloud separates resources from customers at the virtual level; hence, users may access any required resources without worrying about physical connectivity details.
- Utilizing redundant processing nodes (replication) enables the high service availability and makes cloud computing more trustworthy than local PCs.
- Cloud computing doesn't target specific applications. The cloud supports several simultaneous apps.
- Cloud resources are elastically provided and may be swiftly released depending on demand.
- Management of resources (such as hardware and software) is the duty of CSPs. This results in less difficulties for an organization's IT personnel.
- Cloud computing drastically reduces the IT expenditures. Expensive systems are unnecessary for occasional intensive computations. Such systems need far fewer personnel.
- Cloud services are now available anywhere and whenever there is a broadband network connection across several platforms (e.g., smart mobile, laptops, etc.).
- Outsourced backups assist in disaster recovery. Most organizations use cloud services to backup essential data. CSPs have disaster recovery systems as well.
- Cloud computing reduces e-waste and environmental impact. [1-6]

II. LITERATURE REVIEW

The Literature Review section provides an overview of comparative studies using cloud computing platforms. According to Fox, Armando, et al. [7], the cloud enables on-demand sharing, aggregation, and allotment of software, storage, and computing network resources. Complexity hiding and abstraction, virtualized resources, and effective utilization of dispersed resources are some of the most significant advantages of cloud computing.

Rajkumar Buyya et al. [8] presented a structure for the market-driven allocation of cloud resources. It provides a marketing-based comparison of many cloud service companies. Depending on their business needs, end customers may choose from a number of service providers.

Ang Li et al. [9] proposed assess of the performance and expenses of several cloud service providers. The outcome of the research was that cloud comparison is the first step in the rapid and accurate choosing of a provider of cloud services. It is a set of end-to-end benchmarks that serves as a scorecard for optimization providers.

Kharade et al. [10] proposed this research to evaluate Microsoft's Windows Azure technology and

commonplace servers. Azure servers allow for the dynamic change of services, while conventional servers need more costs and precise requirements in advance. This article provides a concise introduction to Microsoft Azure, its services, and its facilities.

Hofer et al. [11] provided a taxonomy structured as a tree based on the properties of several cloud systems. The cloud service providers were categorized according to the suggested taxonomy. The features studied were service offering, license type, pricing model, supporting language and operating systems, developer tools, and virtualization technique, among others. Likewise, Rimal et al. [12] created a taxonomy depending on provider characteristics and compared current providers using it. Comparative features included provider architecture, virtualization technique, services offered, methods for task scheduling, fault tolerance, compatibility and security, and compatibility for software and programming languages, among others. In several of the research, quantitative comparisons between various providers have been made. Cloud Comp, for example, is a suggested framework that compares the performance of multiple providers [9].

Shivangi Goel et al. [14] provided a comparison of several providers of cloud computing services, based on criteria such as cost, maximum, data protection, data backup, language supported, and platform support. It was determined that none of the providers are deficient, thus it is up to the user to choose service providers in accordance with the needs of their own businesses.

G. Tajadod et al. [15] examined two cloud infrastructure providers in terms of the security offered at both the architectural level and the application level. It was determined that Microsoft provides a higher degree of security than the competition.

Rajan et al. [16] authors hypothesized that cloud computing might save costs associated with software, hardware, licence renewal fees, and other expenses. Cloud computing eliminates the need to hire IT professionals and reduces the amount of energy used. Cloud computing is based on utilization, which means that users only pay the service provider for the resources that they really utilize and only when those resources are required.

Encalada et al. [17] proposed that cloud computing offers consumers' access to resources in a manner that is essentially identical to real time, without requiring them to commit to a lengthy period of time. Cloud computing enables organizations to expand their operations without incurring the high costs of modifying their already-in-place infrastructure. Companies are able to adjust the size of their operations to meet their requirements by using cloud platforms. Amazon Elastic Search (ES), which is both an open-source project and a service operated by Amazon Web Services, complies with real-time technological requirements and does log analysis and clickstream analysis on the AWS cloud. It supports Open Source Application Programming Interfaces and tools, among other things [18, 19], is easy to use, has a flexible cluster, is widely accessible, and has additional advantages.

Nagaprasad et al. [20] researchers presented cloud technology from several vantage points, including definitions, features, and technology. They have provided illustrations of a variety of platforms that are typical of cloud computing.

The advantages and disadvantages of cloud technology, cloud storage solutions, and infrastructure developed utilizing cloud services like Amazon Web Services were examined in Avinash Bandaru's [21] paper. James G. Bellingham [22] brought attention to the ongoing work being done on a heterogeneity ocean research platform that is built on contemporary decentralized networking and computer architecture.

Lipika Bose [25] suggested a few methods that may be used to build a selection process for picking the best possible service provider in accordance with the requirements of a company. A comparative analysis is provided based on the most recent information that can be found on the websites of cloud service providers. The findings of the research indicate that there is no "best" supplier and that all providers provide certain solutions that have these advantages.

M. Palankar et al. [26] conducted an analysis of Amazon S3 and analyzed its availability, performance, throughput, and the expenses associated with its utilization. When the expenses associated with offering high availability and durability of data are driven by specialized hardware and require nontrivial engineering effort, users are recommended to use S3 as a storage solution. This conclusion was reached after discussing certain security features of S3 and the support needed for storage services to meet the demands of the scientific community.

Noman I. et al. [27] proposed a comparison analysis on a variety of service providers and came to the conclusion that there are two routes that service providers might go in. One direction focuses on the

dependability of the service, while the other direction focuses on reducing costs.

According to Oldooz Dianat et al. [29] hypothesis, cloud computing has made hitherto unavailable low-Cost access to infrastructure possible. This was a significant finding. Operating and maintaining a data center that is owned and managed by a corporation is an expensive endeavor. The cloud provides an alternative way to get the required computing power, with the added benefit of being able to increase it as necessary.

Table 1. Comparative study on the basis of features

Study Title	Reference Citation	Method	Dataset	Features	Limitations	Future Scope
Comparative Study of Azure, Amazon, and Oracle Cloud Providers	[35]	Quantitative Analysis	Publicly available pricing information, service availability reports	Service availability, pricing	Limited to three cloud providers, data might not be up to date	Include more cloud providers, incorporate qualitative analysis
A Comparative Analysis of Cloud Service Providers: Amazon Web Services, Microsoft Azure, and Oracle Cloud	[36]	Qualitative Analysis	Online documentation, pricing information	Service features, scalability, security	Limited to three cloud providers, subjective analysis	Incorporate quantitative analysis, consider other cloud providers
Cloud Provider Comparison: Amazon Web Services vs. Microsoft Azure vs. Oracle Cloud	[37]	Mixed-Methods Analysis	Publicly available pricing information, customer reviews	Service features, pricing, customer satisfaction	Limited to three cloud providers, customer reviews might be biased	Conduct surveys to gather more objective customer feedback
Evaluation of Cloud Service Providers: Azure, Amazon Web Services, and Oracle Cloud	[38]	Quantitative Analysis	Service availability reports, pricing information	Service availability, pricing	Limited to three cloud providers, data might not be up to date	Include more cloud providers, incorporate qualitative analysis
A Comparative Study of Amazon Web Services, Microsoft Azure, and Oracle Cloud	[39]	Qualitative Analysis	Online documentation, pricing information	Service features, scalability, security	Limited to three cloud providers, subjective analysis	Incorporate quantitative analysis, consider other cloud providers
Cloud Provider Evaluation: Azure, Amazon Web Services, and Oracle Cloud	[40]	Mixed-Methods Analysis	Publicly available pricing information, customer reviews	Service features, pricing, customer satisfaction	Limited to three cloud providers, customer reviews might be biased	Conduct surveys to gather more objective customer feedback
Comparative Analysis of	[41]	Quantitative Analysis	Service availability	Service availability,	Limited to three cloud	Include more cloud

Cloud Providers: Amazon Web Services, Microsoft Azure, and Oracle Cloud			reports, pricing information	pricing	providers, data might not be up to date	providers, incorporate qualitative analysis
Cloud Provider Comparison: Azure, Amazon Web Services, and Oracle Cloud	[42]	Qualitative Analysis	Online documentation, pricing information	Service features, scalability, security	Limited to three cloud providers, subjective analysis	Incorporate quantitative analysis, consider other cloud providers
Comparative Evaluation of Amazon Web Services, Microsoft Azure, and Oracle Cloud	[43]	Mixed-Methods Analysis	Publicly available pricing information, customer reviews	Service features, pricing, customer satisfaction	Limited to three cloud providers, customer reviews might be biased	Conduct surveys to gather more objective customer feedback
Analysis of Cloud Providers: Azure, Amazon Web Services, and Oracle Cloud	[44]	Quantitative Analysis	Service availability reports, pricing information	Service availability, pricing	Limited to three cloud providers, data might not be up to date	Include more cloud providers, incorporate qualitative analysis
Cloud Provider Comparison: Amazon Web Services vs. Microsoft Azure vs. Oracle Cloud	[45]	Qualitative Analysis	Online documentation, pricing information	Service features, scalability, security	Limited to three cloud providers, subjective analysis	Incorporate quantitative analysis, consider other cloud providers

III. VARIOUS CLOUD COMPUTING SERVICE PROVIDERS

To analyses, contrast, and assess the various providers of cloud services in view of the many different research factors. In order to accomplish what needed to be done, we used both a conceptual and an empirical method. The evaluation of Amazon Web Services (AWS), Microsoft Azure, and Oracle as public cloud computing services is carried out by utilizing theoretical literature and basing the evaluation on cost, payment system, connectivity functionality, customer support, documentary evidence, programming, data protection, system software, Operating system support, free service, and geographical areas. Cloud Harmony, a supplier of benchmarking, is used in order to assess the level of service availability offered by cloud service providers.

3.1 Amazon Web Services (AWS)

Amazon.com started out as a retail company selling computer infrastructure when it was founded in 2003. Amazon was the first company to provide infrastructure-as-a-service, but it has now expanded its offerings to include platform-as-a-service [7]. In 2006, Amazon started providing IT infrastructure services to its customers in the form of web services, a technique that is now more commonly known as cloud computing. At the moment, AWS provides infrastructure that is scalable, trustworthy, and reasonably priced, and it does so in order to service hundreds and thousands of enterprises located in 190 countries across the globe [20]. Computation, space, databases, and networks are the four primary product categories that Amazon provides for its customers.

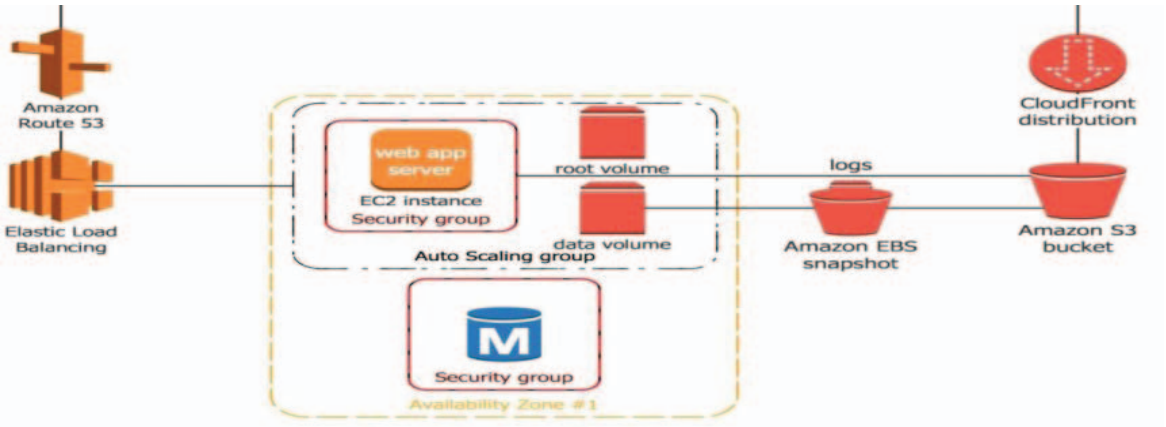

Figure 2. AWS cloud provider architecture [32]

3.1.1 **Compute**

A web service computing solution known as Amazon Elastic Compute Cloud (EC2) provides a computational capacity that is both secure and able to be dynamically increased. EC2 provides a web interface service that may be used to launch and manage instances that are based on servers running the Microsoft Operating System or the Linux Operating System [12]. Amazon Machine Images (AMI), which are crucial components of Amazon EC2 since they comprise an image of EC2 instances, the software running on those instances, and the settings needed to produce a boot disks for user instances [13], Because of EC2, new server instances may be obtained and booted in a matter of minutes rather than in the hours that would have been required before [12].

3.1.2 Storage

A storage facility called Amazon S3 offers two different forms of storage, namely objects and buckets. Data can be stored and retrieved as objects in buckets and can be retrieved in any quantity from anywhere. Objects can hold a minimum of 1 byte and a maximum of 5 GB of data.

3.1.3 **Database**

Amazon Aurora is a relational database that supports MySQL and PostgreSQL, and it provides high levels of both performance and availability, as stated by commercial databases. Amazon Aurora provides up to five times greater performance than MySQL does when it comes to multiple databases in regards to protection, availability, and reliability.

3.1.4 Network and content delivery

Using the Amazon VPC section of the AWS Cloud, a customer of Amazon Web Services (AWS) may install Amazon Web Services inside of a virtual private network (VPN). The client has total control over the whole of the virtual networking environment, including the selection of an IP address range, the generation of subnets, as well as the configuration of routing and network gateways. [13]

3.2 Microsoft Azure

Microsoft was an industry pioneer when it came to the provision of cloud services. The business now occupies the top spot in the SaaS market, with 17% of the market share, and the second spot in the PaaS and IaaS markets, with around 15.5% share of the market share, until the ending of 2019. The cloud services may be used by customers of Microsoft Azure either entirely inside the cloud or in conjunction with any other applications, data centers, or infrastructures that are already in place. It is the best provider for combination models that use hybrid clouds. In order to provide cloud services, Microsoft Azure adheres to the three criteria listed below.

• An environment based on Windows which is utilized to store information and operate programmers inside data centers

• SQL-Azure provides data services that are based upon SQL server and other platforms (iii). Internet services that provide distributed service provisioning as infrastructure for both locally hosted and cloud-based application environments.

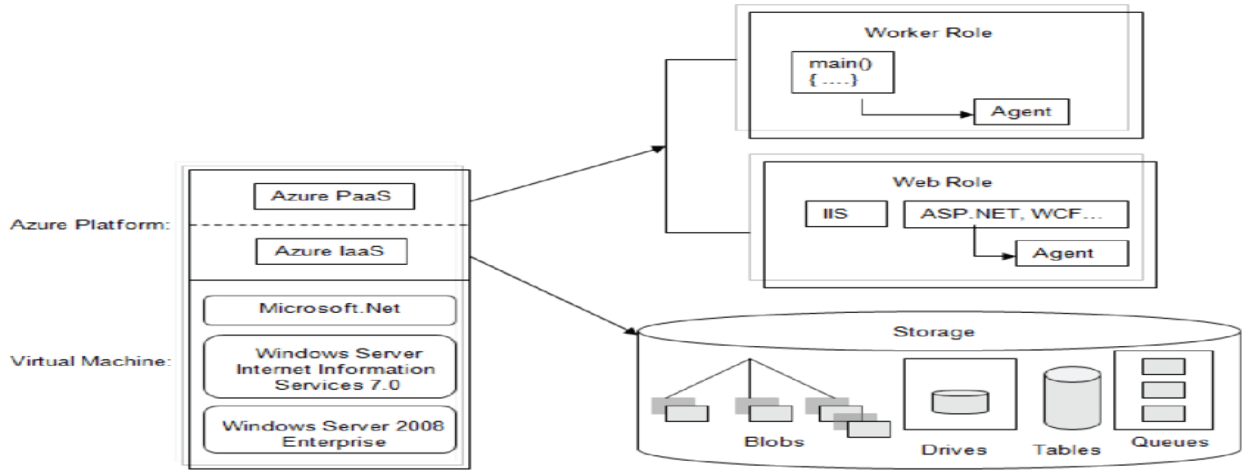

Figure 3. Architecture diagram of Azure

In June 2012, Microsoft launched Azure, their infrastructure-as-a-service platform. Hypervisors use Hyper-V. A programming approach for scalable apps and services is available on the Windows Azure Platform [28]. Microsoft Azure powers Azure Services Platform development, hosting, and administration. Windows Azure provides on-demand computation and storage for hosting, scaling, and managing online applications and services [6]. Connect, Storage, CDN, Fabric Controller, and Compute make up Microsoft.

3.2.1 Compute

Azure Computing Services runs the programmer. It runs apps on Microsoft data center Windows servers and in the cloud. Azure apps access computing resources using roles. Web, workers, and virtual machine roles comprise Windows Azure. These programmers were written in C#, Visual Basic, using the.NET framework [6].

3.2.2 Storage

Windows Azure storage is simple and scalable. They provide basic BLOB, queue, and table storage. We utilize a simple REST API based on HTTP requests to interface with these services to get and modify data in storage services using POST, PUT, and DELETE requests [14]. Storage supports organized and unstructured data. Storage components provide integrity because each storage account has two account keys that control access to its data. Data is fully controlled by storage keys. [6]

3.2.3 Content delivery network (CDN)

CDN delivers high-performance services by caching material near clients. Content delivery may distribute Windows and computer roles. CDN lets users worldwide rapidly access high-quality regularly accessed data [6].

3.2.4 Connect

With the user interface provided by Windows Azure Connect, it is possible to connect a computer and virtual machines on the network of an organization to IPsec.

3.3 Oracle

Oracle is not only one of the leading suppliers in the industry, but also the provider of the finest DBMS (Database management System) solutions for Object Relational DBMS. Besides the Database that comes packaged with Microsoft SQL Server, Oracle Database is another of the three business database technologies.

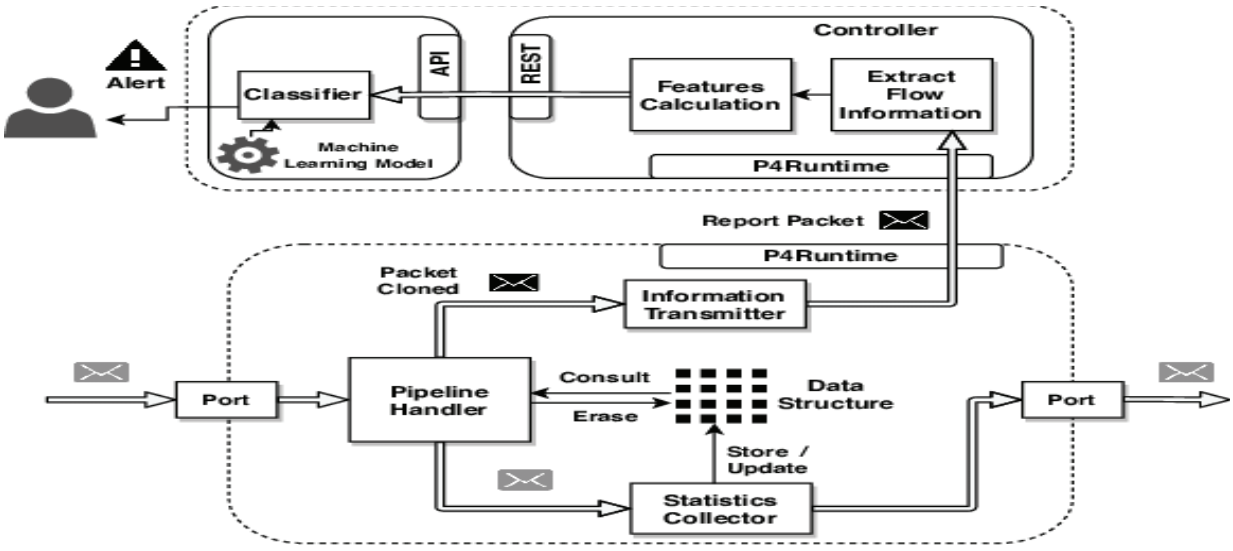

Figure 4.Architectural diagram of ORACLE

The practical watch out for protecting Accessing Remote Server as well as Preventative measures, Attempting to access Documents on Remote Cloud service, Retrieving Configuration Files, Permissions and Approvals, Connectivity Authority, writing security policy, Dbms Encryption, Oracle Mask, Standard built in Auditing, and Fine Grained Auditing (FGA) is demonstrated with SQL syntax and implemented with suitable real life examples, and its outcome is tested and verified. Additionally, the practical watch out for protecting attempting to access Remote Server and Prevention, Attempting to access Files on Remote this organized strategy shields the user's database from the assault by functioning as a Data Shield wall for the aggressor. [28]

3.3.1 Compute

The company offers Virtual Machine Instances, each of which comes in a variety of configurations (VM sizes) to accommodate a wide range of workloads and levels of performance requirements. Additionally, they provide bare metal servers on demand in addition to bare metal GPU servers. These servers do not have a hypervisor. Oracle Cloud Infrastructure was first made available in 2016 and included bare metal instances powered by Intel CPUs. These first base metal instances were powered by Intel servers when they were made available. [5] In the year 2018, Oracle Cloud began offering bare metal instances that were powered by AMD processors [6]. In the year 2021, Oracle Cloud will begin using Ampere Cloud-native CPUs. [7] In the year 2021, Oracle also made available its very first virtual machine (VM)-based compute instances that were powered by Arm processors. [7]

3.3.2 Storage

The platform offers block volumes, document storage, object storage spaces. And archives storage for databases, analytics platforms, content management systems, and other applications that use standard protocols and application programming interfaces (APIs).

3.3.3 Database Management

Oracle provides a platform for managing data that can handle database operations in addition to hyper-scale big data as well as streamed workloads. These workloads include online transaction processing (OLTP), data warehouses, Spark, machine learning, predictive text search, picture analytics, data catalog, as well as deep learning. The platform

Makes it possible to install MySQL, Oracle, and other relational and NoSQL databases as maintained cloud services

Whenever and wherever they are needed. Oracle Databases are distinguished by their provision of the Oracle Autonomous Database, which is tailored for data warehousing, transaction processing, or JSON; the Exadata form; and Real Application Clusters. (RAC).

3.3.4 Content Delivery Network (CDN) Service

Provides the capability for clients to offer electronic materials to end consumers from a place close by in a network that is geographically spread. Customers will see a reduction in origin-server-to-CDN egress expenses as a result of improved connections among OCI Object Storage, Compute, and CDN. Customers will additionally benefit from connected APIs, console, and UCM invoicing.

In order to make it easier to compare the many various cloud service providers, both functional as well as non-functional criteria were employed. The functional requirements of the cloud correctly represent the most fundamental and important core functions of the cloud. A requirement that, although not absolutely essential, is helpful in determining how efficiently a service is being operated.

IV. RESULT ANALYSIS

Table 2: General Characteristics of various Cloud Service Providers based on Non-Functional Requirements [6]

Cloud service providers	SLA	30-days SLA	Service locations
Amazon AWS	99.99%	99.9996	60
Microsoft Azure	99.95%	99.9923%	62
Oracle	99.9%	100%	41

Table 3: Comparison based on Non-Functional Requirement of Cloud Service Provider [6]

Parameters	Feature	Significance
Availability [4]	Up time and downtime	High
Free trial [3]	Months	High
Pricing plan [2]	Pay as you go , subscription	High
Operating System and Windows sup- ported [6]	Linux OS, windows OS	High
Regions [5]	Datacenter	High
Cost [7]	Virtual machines	High
Availability [4]	Up time and downtime	High
Free trial [3]	Months	High
Pricing plan [2]	Pay as you go , subscription	High
Operating System and Windows sup- ported [6]	Linux OS, windows OS	High
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Operating System and Windows sup- ported [6]	Linux OS, windows OS	High
Regions [5]	Datacenter	High
Cost [7]	Virtual machines	High

Depending on the price plan, users may either "pay as you go" or "subscribe" for resources. Subscribers may pay hourly or monthly. Regardless of use, clients must pay. However, a pay-as-you-go approach only charges consumers for resources they utilize [18]. Service companies who provide free trials to

test their products benefit customers. Depending on their country, carriers provide two-week to one-month free trials. Zettagrid, an Australian-only IaaS company, offers a 30-day free trial. Virtual-server.net, among others, offers free trials.

4.1 Service Availability

With the internet, accessibility refers to being ready to get to applications, services, and data anytime, anywhere. "Availability" means how much service can be accessible at once. If your service-level agreement (SLA) promises 99.99% availability, it will be offline for four minutes every month (30 days per month) and 50 minutes per year. The study evaluates service availability using Cloud Harmony.

Table 4: Comparison based on Service Availability

Parameters	Amazon AWS	Microsoft Azure	Oracle
Starting Year	2006	2010	1997
Types of Cloud Services Provided	IAAS, PAAS	PAAS, IAAS	PAAS, SAAS,IAAS
Free Trial	12 months	12 months	30 days
Pricing model	Pay as you go, Subscription	Pay as you go, Subscription	Pay as you go Subscription
Data Security	Encryption feature Such as SSL AWS, KMS (to manage your encryption keys) AWS cloud HSM (to generate, store, and manage cryptographic keys	Filtering routers Firewall Crypto-graphic Protection of messages. Soft- ware security patch management Cen-tralized,monitoring, Correlation, and analysis system	Oracle takes a layered approach to provide powerful data protection against a wide array of risks and threats

According to service availability, AWS provides 99.99% service availability [6]

4.2 Cost Comparison

Cloud providers charge per virtual machine count. A cloud service provider adds the virtual environment and storage device costs to calculate the monthly cost of each virtual machine.

Table 5. Cost Comparison of various cloud providers. [6]

Cloud service providers-	Small (2, 4GB, 100GB)	Medium (4, 8GB, 150 GB)	Large (8, 16GB, 200GB)	Extra-large (16, 32GB, 500 GB)
Amazon AWS	$83.00	$160.27	$310.54	$631.08
Microsoft Azure	$90.19	$163.92	$310.65	$652.02
Oracle	$62.24	$115.98	$214.96	$446.92

V. CONCLUSION

There is no way to determine which of the service providers the best is. This article compares Amazon Web Services, Microsoft Azure, and Oracle as cloud computing providers from the perspective of end users. Regarding the virtual computers and kinds of storage given as a service, it is fully up to the user to decide which of the three best matches their requirements. All three provide an extensive assortment of these equipment. [18]- [26]. In this post, we will compare and contrast some of the most prominent cloud computing service providers. Before migrating their activities to the new environment, this comparison will help individuals and businesses make crucial decisions on the benefits and drawbacks of cloud technology. To show which it is among the most intriguing in the cloud space, a number of important considerations have been made, including modifications to the cost policies, Interchangeability

operating Systems and language groups, supplementary services, and the aesthetic appeal of certain technological weights. As a result of the presence of a large number of providers, it is believed that the Service market would expand in several aspects. An assessment of cloud service providers, including Amazon Web Services (AWS), Windows Azure, and Oracle, has been compiled in order to serve as a starting point for anybody interested in transitioning to cloud computing.

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