International Journal for Multidisciplinary Research (IJFMR)
E-ISSN : 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Comparative Study of Top Cloud Providers on basis of Service Availability and Cost

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Abstract

The term "cloud computing" refers to a place where we can store our important data and use pay-as-you-go computing and networking services without a physical environment. Today's cloud computing provides us with robust computing and storage, high availability and security, rapid accessibility and adaption, ensured scalability and interoperability, and cost and time efficiency. Users in a cloud environment assume that there are endless resources accessible, and they only pay for the resources they really utilize. The number of cloud service providers is growing quickly and they are adding new capabilities as technology advances. However, a cloud consumer may find it challenging to identify the best service provider for their needs. Three cloud service providers—Amazon Web Services, Google and Microsoft Azure—are explored in this study, and a comparison of these cloud service providers is provided. On the basis of service availability, price, pricing structure, data security, operating system, Windows support, free trial, and geographies, the cloud service providers were compared.

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

1. Introduction

The National Institute of Standards and Technology (NIST) [16] defines the cloud computing model as "a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g. networks, servers, storage, applications, and services) that can be rapidly provisioned and released with little management effort or service provider interaction" as the most commonly used definition.

A distributed system, or cloud, is described as a collection of interconnected, virtualized computer systems that are introduced or dynamically provisioned in accordance with a larger pool of computing resources that are dependent on service level agreements [1].

Companies that offer network services, infrastructure, platforms, software, or business applications in the cloud are known as cloud service providers. Customers can access the cloud services through the data center of the cloud provider through an internet connection, whether they are individuals or businesses. Customers receive cloud solutions from providers in response to their requests [15].

2. Literature Review

An architecture for market-oriented resource distribution of resources within clouds was put forth by Rajkumar Buyya et al. [1]. It offers a comparison of several cloud service providers from a marketing standpoint. In light of their business requirements, end users can choose from a variety of service providers.

A systematic tool named "cloudcmp," created by Ang Li et al. [4], was created to compare the performance and costs of various cloud service providers. The study's conclusion was that cloudcmp is a first step toward the quick and correct selection of a cloud service provider. It is an end-to-end benchmark collection that acts as an optimization provider's scorecard.

According to criteria such as pricing, maximum limit, data security, data backup, supported languages, and platform support, Shivangi Goel [3] presented a comparative study of various cloud computing service providers. The user must select service providers in accordance with their business requirements because none of the service providers are weak, it was determined.

In terms of application-level security and architecture level security, G. Tajadod et al. [7] analyzed two public cloud service providers. It was determined that Microsoft provides a higher standard of security.

3. Need of Study

Offering affordable IT infrastructure and services is one of the main responsibilities of cloud service providers. Given the development of Cloud service providers are multiplying quickly as a result of the widespread use of cloud services by consumers. to pick the appropriate service a provider is challenging in light of a customer's business needs. Consequently, comparing several cloud service providers is crucial to both customers and rival businesses.

4. Objective of Study

- To research the various cloud service providers and the fundamentals of cloud computing.
- To compare the Cloud Harmony scores of various cloud service providers for service availability.
- To compare and evaluate the various cloud service providers in light of the various study parameters.

5. Research Methodology

Both a theoretical and an empirical approach were employed to attain the goals. The comparison of three public cloud service providers—Amazon AWS, Microsoft Azure, Google Cloud, is done using theoretical literature.
The analysis of books, journals, research papers, thesis, online studies, etc. that aid in the analysis of cloud service providers forms the basis of the literature survey. Comparison of various cloud service providers

based on price, pricing structure, access interface, customer service, documentation, programming languages, data security, operating system, Windows support, free trial, and geographical areas. Service availability of cloud service providers is evaluated using the Cloud Harmony benchmarking provider.

6. Different Cloud Computing Service Providers

AMAZON WEB SERVICES

In 2003, Amazon was established as a retailer offering computing infrastructure. Amazon originally provided Infrastructure-as-a-Service, but it now also offers Platform-as-a-Service [7]. Amazon begins offering IT infrastructure services in the form of web services in 2006—a practice now referred to as cloud computing. Currently, AWS offers scalable, dependable, and affordable infrastructure that supports hundreds of thousands of businesses in 190 nations worldwide [20]. The four main product categories offered by Amazon are computing, storage, databases, and networking.

Compute
A web service computing tool called Amazon Elastic Compute Cloud (EC2) offers safe, dynamically scaled compute capacity. To deploy and administer instances based on Microsoft and Linux Operating System servers, EC2 offers a web service interface [12]. Amazon Machine Images (AMI), which include an image of EC2 instances, their software, and configuration to create a boot disc for user instances [13], are essential elements of Amazon EC2. New server instances can be acquired and booted in minutes rather than hours thanks to EC2 [12].

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 5GB of data.

Database
According to commercial databases, Amazon Aurora is a MySQL and PostgreSQL relational database that offers excellent speed and availability. When it comes to commercial databases, Amazon Aurora offers up to five times more performance than MySQL in terms of security, availability, and dependability.

Network and content delivery
A user of AWS can deploy AWS resources in a virtual private network using the Amazon VPC area of the AWS Cloud.
The entire virtual networking environment is completely in the control of the customer, including the choice of an IP address range, the creation of subnets, and the setup of routing tables and network gateways [21], [7], [17].

MICROSOFT AZURE

The primary element of Microsoft's infrastructure-as-a-service concept, Microsoft Azure, was introduced in June 2012. It leverages Hyper-V as a tool for hypervisors. The Windows Azure Platform offers means to raise and reduce the computing capacity of apps and services, as well as a programming model created to construct scalable applications [21]. The Azure Services Platform's development, hosting, and management environments are all powered by Microsoft Azure, the cloud services operating system. In Microsoft data centers, Windows Azure offers developers on-demand compute and storage for hosting, scaling, and managing web applications and services on the internet [22]. Microsoft is made up of five parts: Connect, Storage, Content Delivery Network, Fabric Controller, and Compute.

Compute

The programme is run in the cloud via Microsoft Azure Compute Services. It offers a mechanism to run applications both on Windows servers running in Microsoft data centers and on the cloud [22]. Roles are compute containers that Azure applications employ to access computing resources [21]. Windows Azure uses three main sorts of roles: web, worker, and virtual machine.

These programmes were developed with the help of the.NET framework, as well as in other programming languages, including C# and Visual Basic [21].

Storage

The storage capabilities offered by Windows Azure are made to be incredibly straightforward and scalable. They offer the basic BLOB storage, queue storage, and simple table storage services. We use a straightforward REST API based on HTTP requests to communicate with these services, and we alter data in the storage services using conventional POST, PUT, and DELETE requests as well as retrieving data from the storage services using straightforward GET requests [14]. Both structured and unstructured data are supported by storage services. Because each storage account contains two account keys that are used to govern access to all of the data in that storage account, storage components guarantee integrity [21]. Access to the storage keys gives full control over the associated data.

Content delivery network

By caching content at locations close to customers, CDN ensures good performance and high bandwidth for service delivery.

Windows software and compute roles are among the resources that can be delivered via content delivery. Users anywhere in the world can quickly access high-quality commonly visited data thanks to CDN [5].

Connect

An organization network's computer and virtual machines can be connected via IPsec using Windows Azure Connect's user interface [21], [22].

GOOGLE CLOUD

The Google App Engine platform is a fully integrated offering from Google. Developers utilise the complete package to create, link, and run code for both standard web applications and mobile applications. This includes services, SDKs, development environments, and other components. As a PaaS solution with high availability, Google App Engine is furthermore accessible online. This approach reduces the

management burden brought on by virtual machines during peak usage. Later, Google made the decision to enter the IaaS market and provided all cloud customers with a variety of cloud solutions. The Google Cloud gives users access to hardware-based control over virtual machines that are running in the cloud. Google also provides discounts and flexible pricing alternatives. With all these features, Google's Compute Engine has an advantage over the other cloud providers in terms of price/performance [10].

7. Result Analysis

Comparing cloud services using a wide range of metrics

In order to compare various cloud service providers, two requirements—functional and non-functional—were used.
The fundamental core functions of the cloud are described by functional requirements. Non-functional requirement that evaluates the efficiency of a service's operation.

Table 1: General Characteristics of various Cloud Service Providers based on Non-Functional Requirements

Parameters	Feature	Significance	Type
Availability [4]	Up time and down-time	High	Non functional
Free trial [3]	Months	High	Non functional
Pricing plan [2]	Pay as you go , sub-scription	High	Non functional
Operating System and Windows sup-ported [6]	Linux OS, windows OS	High	Functional
Regions [5]	Datacentre	High	Functional
Cost [7]	Virtual machines	High	Functional

The end user interface for access, configuration, and deployment is known as the access interface. While Amazon AWS offers a command line interface, Windows Azure, Rackspace, and Rackspace provide control panels online. Some services, such as Google App Engine, merely offer developers an application programming interface.
In terms of data, infrastructure, and virtualization, security is the primary concern. Cloud service providers need to make sure the applications and customer data are secure. Providers who offer only the most fundamental security capabilities (such a simple firewall) or none at all are seen as poor, whereas those that include security automation are regarded as good [29]. How frequently the services will be available is referred to as availability [22].

Table 2: Comparison based on Non-Functional Requirement of Cloud Service Provider

Parameters	Amazon AWS	Microsoft Azure	Google cloud
Starting date [21] [9]	2006	2010	2011
Types of Cloud Services [14] [23] [9]	IAAS, PAAS	PAAS, IAAS	PAAS, SAAS
Free Trial [17] [9] [10]	12 months	12 months	12 months
Pricing model [2]	Pay as you go, Subscription	Pay as you go, Subscription	Pay as you go
Data Security [8, 3, 9, 25]	• 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 • Cryptographic • Protection of messages. • Software security patch management • Centralized, monitoring, Correlation, and analysis system	Google 2 step verification

Customers have two options for paying for the resources they use in a pricing plan: pay as you go or on a subscription basis. Customers that subscribe on a subscription basis might do so hourly or monthly. Customers must pay whether they use the resources or not. However, with a pay-as-you-go model, customers only pay for the resources they really utilise [18]. Some service providers offer a free trial to try out their products, which is quite beneficial for customers. There is a two-week to one-month free trial period. Some

Depending on their country, suppliers offer users free trials. For instance, the IaaS service Zettagrid exclusively accepts Australian customers and offers a 30-day free trial. Free trials are a request-only service offered by some companies, such as virtual-server.net [19].

8. Service Availability

With the aid of the internet, availability refers to having access to tools, services, and data from any location at any time. How frequently the services will be available is referred to as availability. With a 99.99% SLA (service-level agreement), the service will be unavailable for approximately 4 minutes every month (30 days per month) and for approximately 50 minutes annually [11], [22]. The study measures service availability using benchmark provider Cloud Harmony.

Table 3: Comparison based on Service Availability

Cloud service providers	SLA	30-days SLA	Service locations
Amazon AWS	99.99%	99.9996	60
Microsoft Azure	99.95%	99.9923%	62
Google Cloud platform	99.95%	100%	61

According to service availability, AWS provides 99.99% service availability

9. Cost Comparison

Each cloud provider's costs are determined by the amount of virtual machines used. The cost of the virtual machine and the cost of the block storage are combined to get the monthly cost for each category of virtual machines for each cloud service provider.

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
Google cloud platform	$62.24	$115.98	$214.96	$446.92

References

1. R. Buyya, Chee Shin Yeo, SriKumar, James Broberg, and Ivona Brandic. “cloud computing and emerging IT platforms: “Vision, hype, and reality for delivering computing as the 5th utility.” Future Generation Computer Systems 25 (2009) 599_616.
2. C.N. Hofer and G. Karagiannis, “Cloud Computing Services: Taxonomy and Comparison” Volume 2, Issue 2, September 2011, Journal of Internet Services and Applications. (S I: Future Net Service Models &Designs), pp. 81-94.
3. Shivangi Goyal, “A comparative study of cloud service providers”, International Journal of Advance Research in Computer Science and Software Engineering.Volume 2, issue 2, February 2012
4. A. Li, X. Yang, S. Kandula, and M. Zhang, “Cloudcmp: comparing public cloud providers,” in Proceedings of the 10th annual conferenceon Internet measurement. ACM, 2010, pp. 1–14.
5. AlexandruIosup, Simon Ostermann, D.H.J Epema, “C-meter: A framework for performance analysis of computing clouds”, Conference Paper · January 2009 DOI:10.1109/CCGRID. 2009.40. Source: DBLP
6. B.P. Rimal, E. Choi and I. Lumb, “A Taxonomy and Survey of Cloud Computing Systems” presented at Fifth International Conference on INC, IMS and IDC, Seoul, Korea, 2009, pp. 44-51.
7. G.Tajadod, L.Batten, K.Govinda, “Microsoft and Amazon: A comparison of approaches to cloud security”, 978-1-4673- 4510-1/12/$31.00 ©2012 IEEE.

8. Lipika Bose "A Comparative study of the various cloud service providers along with the focus on various techniques for optimal service selection" Volume 1, No. 6, 2012.
9. http://www.rackspace.com [Accessed 11 Nov. 2018]
10. https://cloud.google.com [Accessed 15 Nov. 2018]
11. Cloud spectator, "top 10 cloud IaaS providers benchmark", 2017 American report price performance analysis of the top 10 public IaaS providers.
12. Overview of Amazon Web Services, Amazon Web Services, Inc, April 2017.
13. http://calculator.s3.amazonaws.com [Accessed 20 Oct. 2018]
14. https://www.rackspace.com/calculator [Accessed 11 Nov. 2018]
15. Mrs. Akanksha kherdikar, "A comparative study of traditional cloud service providers and cloud service broker", sinhgad institute of management and computer application (SIMCA), NCI2TM: 2014, ISBN: 978-81-927230-0-6.
16. Mell, Peter, and Tim Grance. "The NIST definition of cloud computing." (2011).
17. http://aws.amazon.com/ [Accessed 20 Oct. 2018]
18. Y.W. Liu et al., "Evaluation of parameters importance in cloud service selection using rough sets", Copyright © 2016 by authors and Scientific Research Publishing Inc. 7, 527-541 (2016).
19. Viji Rajendran V, Swamynathan S, "Parameters for comparing a cloud service providers: A comprehensive analysis"
20. Overview of Amazon web services, Amazon web services Inc. April 2017.
21. Rawan Aljamal, Ali El-Mousa, FahedJubair, "A comparative review of high-performance computing major cloud service providers", 978-1-5386-4366-2/18/$31.00 ©2018 IEEE.
22. Ignatiuz Technologies LLC, "Windows Azure", 201 Exton commons, Exton PA 19341, 6 JAN 2012.
23. Preemsheela gupta, Neelam sahu, "An overview of cloud computing with various applications", International research journal of Engineering and Technology, 05 03, 2018
24. Thoran Rodrigues, "Comparing cloud infrastructure-as-a-service providers", (2012).
25. https://www.digitalocean.com/legal/data-security