International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2022): 7.942

Cloud Computing and Overview of Different Platforms

Dr. Md Dilshad Ghani[1], Dr. Md. Jawed Ikbal Khan[2]

Email: *dislhadghani[at]hotmail.com*

HOD, P.G. Department Mathematics, Mirza Ghalib College Gaya
Email: jawedikbalkhan[at]gmail.com

Abstract: ***The expectations for how and when networking, storage, and computer resources should be distributed, managed, and used are being radically changed by cloud computing, which also enables users to access services anywhere in the world. Cloud computing is essential for today's rapidly expanding corporate world because of its strong computing and storage capabilities, high availability and security, quick accessibility and adaptability, dependable scalability, and interoperability. It is also very cost-effective. A customer, company, or trade that uses a developing cloud environment can select a platform, software, network resource, and infrastructure that works well for their business. Each of these options offers unique benefits and features. First, the authors create a thorough taxonomy to explain the architecture of cloud computing. The authors used the classification to help with a survey of several cloud computing services that are currently in use and have been developed by numerous projects worldwide, including Amazon, Google, Microsoft, Sun, and Force.com. Using the findings from the survey, the authors were able to identify similarities as well as differences in the architecture approaches used in cloud computing.***

Keywords: Amazon, Microsoft Azure, Google, Force.com

1. Introduction

The on-demand, internet-based, pay-as-you-go availability of computer power, databases, storage space, application software, and other IT resources are commonly referred to as "cloud computing"[1]. Instantaneous access to adaptable and affordable IT resources is made possible by a cloud services platform. These resources can be utilized for everything from managing essential organizational tasks to implementing apps that distribute images to millions of mobile users. We might be able to avoid spending a lot of money on hardware purchases and time on administrative tasks by using cloud computing. Alternatively, we can maintain current IT infrastructure or provide the precise quantity and configuration of computer resources required to power your next big idea. Everything we need is at our fingertips in an instant, and we will only be charged for what we actually use. Cloud computing streamlines the process of acquiring network access to numerous servers, storage, databases, and application services. [1]

Figure 1: Cloud Computing resources delivered via internal

2. Different Types of Computing Models

Infrastructure as a service (IaaS) provides access to networking capabilities, computers (virtual or on dedicated hardware), and data storage space. These are the core elements of cloud IT. In terms of customized your configuration and having the most administrative control over your IT assets, infrastructure as a service offers the greatest flexibility when compared to other forms of cloud computing.[2]

Platform as a Service (PaaS): It frees up resources that would be used for managing enterprises to concentrate on the implementation and administration of apps instead of the infrastructure that supports them (usually operating systems and hardware). Instead of wasting time worrying about menial but important chores like capacity planning, software maintenance and patching, resource procurement, and software upkeep, organizations can concentrate on what they do best. [2]

SaaS (Software as a Service) The service provider delivers your finished product while also operating and maintaining it for you. When customers or businesses SaaS typically refers to consumer-facing software. Businesses should focus on how to use a software as a service (SaaS) solution, rather than how to keep it operational.[2]

AWS (Amazon Web Service): In 2006 [3]. Amazon Online Services (AWS) began providing enterprise IT infrastructure services as online services, now known as cloud computing. Cloud technology eliminates the need for businesses to plan and purchase IT infrastructure ahead of time. Instead, they can instantly spin up hundreds of thousands of servers in a matter of minutes, resulting in faster delivery of results.

Amazon Web Services (AWS) is the world's most complete and widely utilized cloud provider, with 200 fully featured services available from data centers across the world. Millions

of customers use AWS to save money, increase flexibility, and swiftly launch new products and services. [4]

Figure 2: Leading Cloud Share Market of the world [5]

Introduction of AWS services into a user-created custom virtual network on Amazon Virtual Private Cloud (Amazon VPC). [6] Users can manage all aspects of their network, including resources, connections, and security. It also outlines the protocols that a network must follow when exchanging data across different regions or Availability Zones. Use AWS assets such as EC2 and RDS for data storage. With Amazon Web Services VPC, users can limit access to only those who need it. Users can quickly change their Amazon Virtual Private Cloud (VPC) network settings. You have complete control over your virtual private network, from setup to deletion. [7,8]

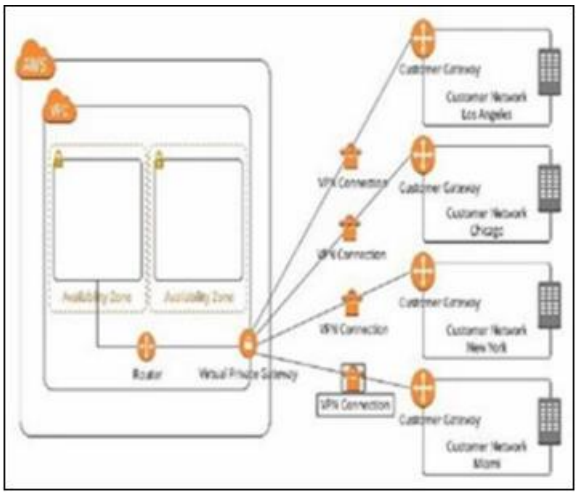

Figure 3: Virtual Private Cloud's (VPC) [9]

a) **Google application engine:** Google App Engine offers an extendable runtime environment for web-based apps written in Java or Python that take advantage of Google's massive IT infrastructure. Google App Engine is provided by Google Inc. Its main advantage is that developers can quickly create small web-based applications on their machines and deploy them to the cloud. One important feature is that Google App Engine provides developers with a simulated environment in which to build and test applications locally on any operating system or system running a sufficient version of Python and Java language environments. Google makes use of the Java Virtual Machine in conjunction with the Jetty Servlet engine and Java Data Objects.

b) **Windows Azure: - SQL** Azure and.NET services make up the Windows Azure Platform [9]. The.NET services include Access Control services and the.NET service bus. Microsoft's Windows Azure platform uses shared multitenant hardware. SQL Azure is the only coexisting DBMS functionality that is accessible in the same hardware context as the apps, hence Windows Azure application development requires it.

c) **Force.com:** Force.com is a development and execution environment that exists independently of Salesforce.com. Force.com is the greatest Platform as-a-Service (PaaS) solution for developing CRM-based applications, and its platform and runtime environment are built on Java technology. The platform makes use of a proprietary programming language and environment known as Apex code, which is known for its ease of use and speed of development and execution.

3. Performance Variable Between Public Cloud and Virtual Private Cloud (VPC)

There are several factors that can influence the degree to which a public cloud and a VPC environment differ in performance. Let's take a closer look at these elements to make a more informed comparison:

Changes in performance may occur during peak hours since resources in the public cloud are shared by multiple users. A Virtual Private Cloud (VPC) offers specialized resources, resulting in more reliable operation.

a) **Latency:** Can be worsened in public clouds since data must travel over the public internet. As private networks, VPCs have the ability to give speedier access to on-premises resources.[12]

b) **Scalability:** It is frequently given via public clouds, allowing you to quickly deploy additional resources when needed. Virtual private clouds are scalable, but they may require more hands-on management and configuration. VPCs offer better control over network configuration, security measures, and resource allocation. In public cloud systems, certain elements are often abstracted away.

c) **Security:** Virtual private clouds (VPCs) are more secure than traditional networks since they are not connected to the outside world. Public cloud providers prioritize security, and with appropriate setup, users can use the cloud without anxiety.

d) **Cost:** Public cloud price may vary depending on how much space and bandwidth you really utilize. Although VPC expenses are more predictable in the long run, they may require significant initial capital outlays.

Data center and region performance can be influenced by their geographical location. Because several public clouds provide facilities all around the world, you can select the one with the lowest latency and other performance indicators.

Virtual private clouds can only be used in specific locations.[11]

Depending on the usage case, different performance

requirements will apply. While public clouds provide scalability, certain applications may benefit from the isolation and low latency of a virtual private cloud (VPC).

Network design and VPC setup have a big impact on performance. Optimizing subnets, load balancers, and routing can improve VPC performance. Public clouds and VPCs require ongoing monitoring and adjusting for optimal performance. Regularly assess and adjust resource allocation and network configuration.

4. Procedures for the Experiment

This section describes the experimental setup in great detail, as it was used to measure performance. Settings for Computer Hardware and Programs:
We used the following combinations of hardware and software to conduct our performance analysis:

a) Hardware:
- Servers: Dell PowerEdge R740 with dual Intel Xeon Gold 6254 processors (3.1 GHz, 18 cores each)
- Memory: 256 GB DDR4 RAM
- Storage: RAID 10-configured enterprise-grade NVMe SSDs

b) Software:
- Operating System: Ubuntu Server 20.04 LTS
- Web Server: Nginx 1.20.1
- Database: MySQL 8.0.26
- Application Framework: Node.js 14.17.5
- Load Balancer: HAProxy 2.4.2
- Monitoring and Metrics: Prometheus 2.30.1 and Grafana 8.1.2
- Load Testing Tool: Apache JMeter 5.4.1

We chose AWS and Azure, two of the most well-known and widely utilized cloud service providers, for our performance investigation due to their stable systems and comprehensive suites of services. Both service providers offer VPC solutions, allowing for direct comparisons inside the same cloud environment.

Detailed Services and Locations: Amazon Web Service (AWS): We tested in the incredibly popular and accessible Region of the US East (North Virginia) (us-east-1). We used Amazon EC2 instances to host our web applications and Amazon Relational Database Service for MySQL to administer our databases. Elastic Load Balancing (ELB) was implemented to balance loads.

We conducted our Azure testing in the East US region, which is a well visited and reputable section of Azure.

We hosted the web app on Azure VMs, maintained the database with Azure Database for MySQL, and balanced traffic with an Azure Load Balancer.[13]. We adopted a common deployment approach for both public cloud and VPC environments to ensure scientific rigor and uniform evaluation of web applications and workloads.[17]

Table I: Performance Evaluation between Public Clod and Virtual Private Cloud's (VPC)

S. No	Matric	Public Cloud	VPC
1	CPU Utilization (%)	70	50
2	Memory Utilization (%)	**80**	**60**
3	Network Latency (ms)	**20ms**	**5ms**
4	Response Time (ms)	**300ms**	**150ms**
5	Bandwidth Usage (%)	80% of allocation	60% of allocation
6	Scaling Efficiency (Scaling Events)	10 times	5 times
7	Uptime Percentage (%)	99.95%	99.99%
8	Error Rate (%)	2%	1%
9	Cost per Transaction ($)	$0.10	$0.08
	Security Incidents (Count)	5 incidents	2 incidents

5. Conclusion and Future Work

AWS provides fast and secure solutions to connect off-site networks to Amazon Virtual Private Cloud (VPC), allowing for optimal use. We examined the AWS VPC components and explained how they interacted. To provide cloud computing services to consumers, organizations should set up a private virtual private cloud (VPC). The table displays statistics on the performance and costs of different cloud environments. Differences between a Virtual Private Cloud and the Public Cloud various measures have shed light on the effectiveness, efficiency, and safety of various setups. Efforts going forward should improve and optimize these settings to accommodate changing business requirements and security standards.

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Author Profile

Dr. Dilshad Ghani received the Ph.D Magadh University Bodh-Gaya Bihar India in 2024. **Certified MCSE, CCNA, ITILV3, Microsoft Certified Azure Administrator Associate Certified and Certified AWS Solutions Architect** with more than 15 years of IT experience in IT infrastructure and Networking. Expertise in Network, Windows, Cloud computing and Linux systems.

Dr. Md. Jawed Ikbal Khan, HOD, P.G. Department Mathematics, Mirza Ghalib College Gaya