C-Research-Report

*Note: Lab should be marked for Credit

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***Abstract*—This paper's purpose is to provide the reader with an overview of cloud computing. The paper outlines what is Cloud operating system is and why Linux is a good Cloud operating system. A discussion on different aspects of integrating Unix-based networking services on the cloud. The paper also aims to provide a comparison between Platform as a Service and infrastructure as a Service.**

I. Introduction

Cloud computing is the delivery of computing resources as a service. As more businesses start to integrate more cloud services, most people will be using this cloud with little knowledge about them. In this paper, I report back on what I learned about Cloud Computing and its different aspects. The paper aims to answer

1) Provide a brief description of the advantages and disadvantages of using Unix on the Cloud compared to other operating systems.
2) Discuss different aspects of integrating Unix-based networking services on the cloud
3) Compare Cloud Unix-based products discuss the pros and cons between Platform/Container as a Service and Infrastructure as a Service,

The rest of the paper is organised as follows. Section 2 contains information about the Cloud operation system (Cloud OS) and why Linux is a good/bad Cloud OS. Section 3 outlines the minimum requirement for setting up a cloud service. This includes a discussion on web and database servers. Section 4 explore monitoring tools for the cloud, and compare monitoring tool in the Unix-base system environment. Section 5 is a discussion of what Infrastructure as a Service (IaaS) and Platform as a Service (PaaS) are. Additionally, it compares Amazon's IaaS vs. Amazon's PaSS and their relative strengths and weaknesses. Section 6 concludes by summarising the paper's main points.

II. Cloud operating system

Every cloud technology will have a cloud operating system (Cloud OS) to allow virtualization. H. M. Musse and L. A. Alamro (2016) defined a Cloud OS as "an additional set of services to the traditional operating systems that offer administrative access to resources in the cloud including allocating and deallocating virtual machines, dispatching and migrating processes, setting up inter-process communication, etc." [1] They also stated Cloud OS has a management system to control cloud resources and deploy multiple virtual machines.

A. The Cloud OS Requirements

H. M. Musse and L. A. Alamro (2016) outlined the requirements of an efficient and reliable Cloud OS. The requirements are:

1) Cloud OS should have backup mechanisms to detect system failure and provide alternative connectivity to maintain Cloud OS operations. [1]
2) Cloud OS should have an abstraction of the cloud as a logical system that hides any low-level operation from cloud users. [1]
3) Cloud OS management systems should automate any decentralized and scalable operations to provide cost and computer resource efficiency. [1]
4) Cloud OS provides systems like virtual machine monitoring, scheduling, security measures, power and memory management without external applications. [1]
5) Cloud OS should able to manage and control virtualized physical servers and virtualized resources such as memory, networks, storage and software. [1]

B. Advantages having Linux as Cloud OS

Linux is an open-source operating system (OS) created from UNIX's principles and design. [2] Linux has several advantages in a cloud environment:

1) Linux adaptability to different machines' hardware and application is advantageous. Cloud service providers can modify their Linux to meet their specifications. [1]
2) Linux provides commercial and non-commercial license options when helping with deploying multiple systems. [1]
3) Linux provides more power efficiency compared to other operating system. [1]
4) Linux has a variety of virtualization technologies that enable virtualization and manage virtualized resources. Linux can host and be a guest to virtual machines. [1]
5) Linux is an open-source operating system which makes it less vulnerable to viruses. [3]

C. Disadvantages having Linux as Cloud OS

Although Linux has convincing reasons why it is an excellent Cloud OS, it has drawbacks.

1) Learning how to use Linux can be difficult for users. [2]
2) Requires an expert due to lack of customer support. [2]
3) Small amount of applications that support Linux when compared to Windows. [2]
4) Linux lack of a comprehensive GUI like Windows. [3]
5) Requires an expert due to lack of customer support. [3]

III. Deploying Cloud server

To deploy a cloud server, the bare minimums are [4]:

1) Operating systems.
2) Server-side software.
3) Web server.
4) API servers.
5) Database server.

Only database and web servers are discussed further because they are a type of API server and operating system previously discussed.

A. Web server

W. M. C. J. T. Kithulwatta et al.(2022) identify that the two most popular web servers were "Nginx web server was used by 33.4% in all net-centric applications. Apache web server was used by 31.4% in all net-centric applications." [5]

A. Garnett states (2022) that "Apache is chosen for its flexibility, power, and near-universal support" [6]. It's a dynamically loadable module system and can directly serve many scripting languages without requiring additional software. On the other hand, Nigix is chosen for its resource efficiency and responsiveness under load. Nigix's advantageous resource efficiency can be proven with W. M. C. J. T. Kithulwatta et al.'s experiment. W. M. C. J. T. Kithulwatta et al.'s experiment (2022) looked at the availability, performance and stability of Apache and Nigix in Docker-based infrastructure [5]. They discovered Apache can handle single requests better than Nigix. However, Nigix performs better than Apache when it handles 50 or more requests at once. At 500 requests, Nigix's overall response timer was 14% faster than Apache's.

B. Database Servers

A database in the Cloud is a mixture of nodes. Each node is connected collectively in its database via a communications network. Due to databases existing on a virtual platform, businesses can have more flexibility and save money by not having on-site database servers [7]. There are two different categories of databases, SQL(rational) and NoSQL(non-relational). T. Shareef et al. (2022) mention that NoSQL databases have proven better than SQL due to being fast and reliable." [7] T. Shareef et al. can be supported by an experiment. R. Pandey (2020) compared MongoDB (NoSQL) and MySQL (rational) in their performance [8]. MongoDB performed better than MySQL especially in terms of of latency and throughput for a large number of operations. In 200,00 database operations, MongoDB was faster than MySQL roughly 26.7%. R. Pandey (2022) also found that "NoSQL databases are a better choice for large applications that run on the cloud" while he was researching.

IV. Monitoring tools for Cloud

Y. Verginadis (2023) defined the responsibility of monitoring tools are "collection, propagation, processing, storage, and visualization of monitoring data." [9] Y. Verginadis also provided a table with monitoring tools for comparative analysis. However, it doesn't give strong evidence of whether performance metrics are accurate or not. M. Grosmann and C. Schenk (2018) did a performance investigation on Monit and Prometheus [10]. Monit and Prometheus are Unix-based monitoring tools for computer and network resources. In terms of these tools' computation resource consumption when monitoring, Prometheus has low CPU consumption and Monit has low RAM usage. While in the network category, Prometheus can handle lots of incoming traffic and Monit can monitor more outgoing traffic. With these results, M. Grosmann and C. Schenk (2018) conclude that Prometheus should be a recommended monitor tool for cloud services due to its overall resource efficiency and adaptability to different software components.

V. Cloud Delivery Models

A. Infrastructure as a Service (IaaS)

IaaS provides a dynamic solution for accessing operating systems, networking, storage, and other infrastructural components [11]. IaaS remove the obligation from cloud users to purchase and maintain physical server hardware. This allows cloud user to pay what they need based on their circumstances. IaaS is a popular option due to its flexibility. Developer and researchers can customise their computer environment for any situation. This solution is not for people who want to manage system operations.

B. Platform as a Service (PaaS)

Within the framework of PaaS, cloud providers offer customers a comprehensive computing platform that contains the operating system, execution environments, databases, and web servers [1]. Customers do not have to worry about managing the operating system and networks at the cost of more restrictions due to the cloud host.PaaS intend to allow developers can create and operate their software solutions within a cloud environment without incurring the expenses and complexity of managing hardware and software components. PaaS monitors and allocates resources based on the application's demands, hence, no manual control of computer resources for PaaS users.

C. Amazon's IaaS vs. Amazon's PaaS

For companies like Amazon which have multiple cloud solutions, it will be hard to determine what services are suitable for a project. Table I outlines the difference between Amazon's IaaS vs. Amazon's PaaS. This table information is

TABLE I: Comparison between AWS EC2 and AWS Lambda [12]

Features	***AWS EC2***	***AWS Lambda***
Performance	AWS EC2 instance is suitable for latency-sensitive or complex applications.	AWS Lambda is unsuitable for latency-sensitive or complex applications.
Availability	AWS EC2 is optimal for running long-running tasks or apps with varying execution times.	AWS Lambda is optimal for tasks that last no more than 15 minutes. AWS Lambda also limits how much memory and instances
Security	EEC2 allows you to implement security best practices at the instance level but time-consuming	AWS Lambda consistently monitor, patch, and maintain infrastructure security
Scalability	EC2 requires you to define the minimum, desired, and maximum capacities you need manually.	Lambda automates their capacities to conserve resources
Pricing	EC2 charges by the second and increases depending which hardware is running	Lambda charges by the number of requests served, and by the length of time it takes to execute code

based on C. Slingerland's (2022) article. In summary, AWS's IasS product allows longer update time and AWS's PaaS has better monitor computer resource efficiency. In terms of performance, it is up to the user to determine what is suitable for them. Long-execution projects should use the AWS's IaSS.

VI. Conclusion

With the market growth of cloud computing, technology will be more likely to operate more on cloud service than on-premise services. This research paper allows me to explore Cloud operation systems, diving into deploying and monitoring the cloud and understanding the advantages and disadvantages of IaaS and PaaS through Amazon Unix-based platforms.

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