Integration of UNIX-based Network Services on Cloud

Hadi Rezay
101604801@student.swin.edu.au

***Abstract*—The purpose of this research report is to explore the Unix architecture and the network services it provides for cloud providers, customers and integration services. It outlines the advantages, disadvantages and integration tools in the Unix environment. While also researching the cloud vendors and their service models, how they have implemented their products encompassing Unix at its core.**

I. Introduction

Cloud-based solutions have become the norm for business and government agencies to choose from, with the key factors of minimizing business expense, improving performance and security. Cloud solutions appeal to customers as customers do not have to understand the underlying infrastructure. However, whether it is infrastructure as a service, platform as a service or software as a service, the choice of the operating system becomes an important decision for customers, cloud providers and cloud integration service providers [1]. Cloud customers look for high availability, scalability, cost-efficiency, flexibility, reliability, and security when implementing their cloud solutions. Among operating systems, Unix meets the above demands due to its long history of being open-source and tested at every stage of its development.

II. UNIX and Unix-like systems

There are popular variants of Unix-like operating systems such as Linux distributions systems which are derived from Unix architecture which makes them modular, simple and included with the basic functionalities of command-line interpreter, pipes and hierarchical file system.
At the heart of the Unix OS is the kernel which has complete access to hardware resources, system programs and virtual memory. ”It has subsystems that offer services to file system handling, resource handling, memory management, start and stop programs, and a few other low-level core tasks” (Software Testing Help, 2023 [2]). The kernel acts as the middle man between the user and the hardware resources, it also provides many features such as paging, concurrency and especially networking capabilities which are essential on the Cloud.
Fig1 is an example of the Unix Kernel demonstrating the kernel space and user space.

A. Advantages of Unix on the cloud

As discussed before, Unix/Linux offers many features that makes it a go to operating system. The following factors are key features of Unix:

- High availability

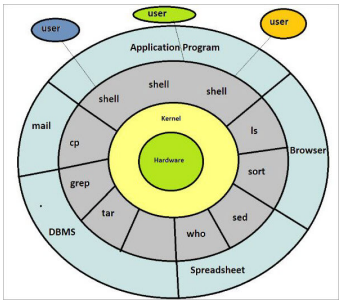

Fig. 1. Unix Kernel [2]

- Reliability
- Scalability
- Flexibility
- Security

Unix achieves the above performance metrics due to its many characteristics. Cloud providers and customers choose an operating system which provides a high level of operational performance than normal. An operating system’s operation performance is measured by its up-time. During which failures, errors, system crashes and hardware failures must be kept at minimum. According to (The Open Group, 2016 [4]), Unix has been regarded as the always on OS. The Unix Standard provides guidelines of building application and APIs to ensure a reliable software is developed to achieve high level of availability, therefore, Unix provides a strong foundation for platform/software as a service [4]. There are also many documentations for the command-line and utilities for administrators to leverage from. ”Collectively, all of these features and technical documentation creates a great foundation within a UNIX operating system” (The Open Group, 2016, [4]).
The following will discuss the features that makes Unix/Linux achieve the above performance metrics. Unix is written in C programming language which makes it a portable operating system and allows programmers to communicate with the hardware. Memory usage is another great aspect of Unix as it uses less memory to execute programs, handle virtual memory in a better manner. The most prominent part of Unix/Linux is the command-line interpreter and less dependent on GUI which uses less resources. Many hosting companies rely on Unix for hosting on cloud as it is considered the ideal OS for hosting [5]. When it comes to security, Unix’s long history becomes an important factor as it has been well tested thus providing a safe and secure environment on the cloud.

B. Disadvantages of Unix on the cloud

Unix also comes with its disadvantages and challenges despite being the ideal operating system for the cloud. The following are they key disadvantages:

- learning curve
- Vendor lock-in
- cost management
- management concerns
- security concerns

The biggest challenge of Unix/Linux is amount of time it takes a beginner to master it. As simple as Unix seems, it can be very challenging for administrators to learn full capabilities of command-line interpreter [5]. Most day-to-day to operations are executed using commands, therefore, Unix lacks a friendly user-interface.

The learning curve can also lead to high cost, poor management, poor performance and most importantly security breaches. As a cloud administrator, poor management of Unix machines can lead to high cost if resources are not managed in an efficient manner. Lack of Unix knowledge can cause misconfiguration, poorly defined security policies and remote access on the cloud. This can lead to major security breaches both for cloud providers and customers.

III. Integration of Unix-Based Networking Services on the Cloud

To leverage Unix/Linux benefits, various network services can be deployed on the cloud. Below are some key services. Apache and Nginx are some examples of Unix-based web servers that can be deployed on the cloud. As for deployment this can be done by IaaS or CaaS.

Email Servers can be deployed on Unix systems for receiving and sending emails on the cloud using IaaS model.

Virtual private network servers can be implemented on Unix using IaaS cloud model.

Linux kernel Netfilter can be used to migrate the user's virtual machine in the cloud while keeping the connection alive and ensuring a secure connection and prevention from DDoS attacks [7].

IV. Basic Tools for Integration

There are many Unix-based integration tools, the following are a list of different tools:

1) SSH can be used to establish a secure connection to Cloud Unix VMs.
   Pros: provides strong encryption and multiple authentication methods, e.g. public/private keys.
   Cons: only has access to Unix's terminal.

2) Configuration management tools such as Ansible and Puppet are popular for automation the process of provisioning resources and instances.
   Pros: automates management of resources.
   Cons: requires a deep knowledge of infrastructure.

3) Containers and orchestration such as Docker and Kubernetes can be used to compile programs and their dependencies.
   Pros: provides scalability and portability.
   Cons: requires a deep learning curve.

V. Platform/Container as a Service vs. Infrastructure as a Service

All cloud providers offering Infrastructure as a Service model include Unix/Linux operating systems when deploying virtual machines. Amazon offers standard Linux distributions such as RedHat, CentOS, SUSE and Ubuntu as well as specialized Amazon Linux distributions [9]. As for Containerised/Platform as a Service, Amazon's App Runner and Fargate services allow the customers to select their choice of Linux operating system.

Microsoft Azure's Infrastructure as a Service model offers a ranges of Unix and Linux operating systems to be deployed as a VM [10].

Unix/Linux::

- FreeBSD
- AIX
- HP-UX
- Ubuntu
- RedHat

As for Microsoft's Containerisation/Platform as a Service model, Microsoft offers Azure Kubernetes Service which is a containerisation service. Customers have the choice of using Linux-based distribution [11].

There are also other PaaS services such as Azure App Service which is a development environment offering multiple programming languages. The choice of operating system will depend on the selection of programming language [**?**].

Below is an table showing each cloud provider's IaaS and PaaS offerings.

TABLE I
IaaS and PaaS Unix/Linux offerings

	IaaS	C/PaaS	Linux/Unix
Amazon	EC2,	Elastic, Lamda	Yes
Azure	VM	App Service, Functions	Yes

VI. Conclusion

In summary, Unix/Linux distributions offer many benefits when it comes to different cloud model deployments. Both cloud and integration providers can leverage from the many features of Unix and its sub-systems. The modular operating system provides customers and cloud developers the ability to customize Unix to suit any environment. While keeping in mind both the advantages and disadvantages of Unix. It is conclusive by this report that all cloud vendors and customers understand the importance of Unix when implementing their solutions.

REFERENCES

[1] ”UNIX - Robust Platform for Cloud”, Software Testing Help. 2023, Accessed on Sep. 08, 2023. [Online]. Available: https://blog.opengroup.org/2016/07/06/unix-robust-platform-for-cloud/.

[2] ”UNIX The Always On OS ”, Software Testing Help. 2023, Accessed on Sep. 08. [Online]. Available: https://blog.opengroup.org/2016/04/18/unix-the-always-on-os/.

[3] ”The UNIX based Cloud ”, Software Testing Help. 2023, Accessed on Sep. 08. [Online]. Available: https://blog.opengroup.org/2016/02/03/unix-based-cloud/.

[4] ”UNIX The Always On OS ”, Software Testing Help. 2023, Accessed on Sep. 08. [Online]. Available: https://blog.opengroup.org/2016/04/18/unix-the-always-on-os/

[5] J. Rehman, ”What are advantages and disadvantages of UNIX operating system,” itrelease, Accessed on: Sep. 08, 2023. [Online]. Available: https://www.itrelease.com/2021/03/what-are-advantages-and-disadvantages-of-unix-operating-system.

[6] O. Holovnia, ”Selecting cloud computing software”, in CTE Workshop, 2022, Accessed on: Sep. 08, 2023. [Online]. Available: https://acnsci.org/journal/index.php/cte/article/view/116/115

[7] J. Available: https://acnsci.org/journal/index.php/cte/article/view/116/115 oll=top.

[8] https://dl.acm.org/doi/pdf/10.1145/2756594.2756598

[9] https://aws.amazon.com/mp/linux/

[10] https://azure.microsoft.com/en-au/solutions/linux-on-azure/

[11] https://learn.microsoft.com/en-us/azure/aks/use-azure-linux