VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

Internship Report

on

"CLOUD COMPUTING AND NETWORKING WITH OPENSTACK"

A report submitted in partial fulfilment of the requirements for the award a degree of

BACHELOR OF ENGINEERING

in

COMPUTER SCIENCE AND ENGINEERING

Submitted by

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Under Supervision of

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Associate Professor

Computer Science and Engineering

ALVA'S
Education Foundation®

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

ALVA'S INSTITUTE OF ENGINEERING AND TECHNOLOGY

MOODBIDRI-574225, KARNATAKA

2023 – 2024

ALVA'S INSTITUTE OF ENGINEERING AND TECHNOLOGY
MOODBIDRI-574225, KARNATAKA

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

CERTIFICATE

This is to certify that the Internship report on **"Cloud Computing and Networking using Openstack"** submitted by **JAMES JOSEPH (4AL20CS052)** is work done by him and submitted during the academic year 2023–24, in partial fulfilment of the requirements for the award of the degree of **BACHELOR OF ENGINEERING** in **COMPUTER SCIENCE AND ENGINEERING**

Internship Mentor
Department of CSE

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Internship Coordinator
Department of CSE

Head of the Department
Department of CSE

Examiners

Name   **Signature**

1)

2)

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Acknowledgment

First, I would like to thank **CITSA Technologies PVT LTD** for giving me the opportunity to do an internship within the organization.

I also would like all the people that worked along with me in **CITSA Technologies PVT LTD** with their patience and openness they created an enjoyable working environment.

It is indeed with a great sense of pleasure and immense sense of gratitude that I acknowledge the help of these individuals.

I am highly indebted to Managing Trustee Mr. Vivek Alva and Principal **Dr. Peter Fernandes, Alva's Institute of Engineering and Technology, Mijar** for the facilities provided to accomplish this internship.

I would like to thank my Head of the Department **Dr. Manjunath Kotari, Professor, Department of Computer Science and Engineering** for his constructive criticism throughout my internship.

I would like to thank my internship Coordinator **Dr. Bramha Prakash H P, Associate Professor, Department of Computer Science and Engineering** for his guidance throughout my internship.

I am extremely grateful to my department staff members and friends who helped me in successful completion of this internship.

<div align="right">

JAMES JOSEPH　　　**4AL20CS052**

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INTERNSHIP CERTIFICATE

CITSA TECHNOLOGIES PVT LTD

Certificate of Internship Completion

This is to certify that James Joseph has successfully completed an internship program at CITSA Technologies Pvt Ltd as a Cloud Engineer focusing on OpenStack, from February 12, 2024, to April 12, 2024.

During his tenure, James demonstrated a keen understanding of cloud computing fundamentals, OpenStack architecture, and deployment. He actively contributed to designing, deploying, and managing cloud environments, showcasing exceptional skills in:

- Infrastructure as a Service (IaaS) setup using OpenStack
- Automating cloud operations and ensuring high availability of services
- Implementing and managing virtual networks, storage, and compute resources
- Collaborating with the development and operations team to optimize cloud solutions

His ability to tackle complex challenges with innovative solutions has significantly benefited our projects and team dynamics. James's dedication, technical expertise, and collaborative spirit have been exemplary.

We commend James for his hard work, professionalism, and contributions to our cloud engineering projects. He has shown great potential for a successful career in cloud computing and technology.

We wish him all the best in his future endeavors.

For CITSA Technologies Pvt Ltd

Sheeba P
Manager HR
9745022265
12-04-2024

ABSTRACT

CITSA Technologies Pvt Ltd is a multi crore IT solution provider Company focusing on providing user-friendly and cost -effective solutions to customers to enhance their productivity. The Unit is registered as a Start-up. They offer dedicated and innovative solutions for Govt. Departments through GeM portal, Tender & Limited Tender. They have completed our 5 Years heritage leadership in IT products and services and also deliver Premium Technology support to Value Added customers, and institutions all over India. The organization is headquartered in Kerala's capital city, Thiruvananthapuram. They provide a wide range of products in the area of networking and security. From its humble beginnings, CITSA Technologies has exponentially grown to be one of the best provider of networking and hardware solutions among the government enterprises in Kerala. They provide services and facility-related components or activities that support the implementation, maintenance, operation, and enhancement of a data centre. It is always challenging to manage sophisticated threats, but CITSA Technologies provide the best solution related to the complex problems. The company also manage the operations and maintenance of Web-based applications. Including development and customization of open source application.

DAILY LOGS

DAY	DATE	TOPICS COVERED
Day 1-Day 6	12/02/2024 – 17/02/2024	Linux commands and bash scripting
Day 7-Day 12	19/02/2024 – 24/02/2023	Introduction to openstack systems and components
Day 13-Day 22	26/02/2024 – 07/03/2024	Manual installation and configuration of key components in bare metal servers.
Day 23-Day 28	11/03/2024 – 16/03/2024	Installation and configuration in virtual machine
Day 29-Day 33	18/03/2024 – 22/10/2024	Deployment of cloud instances and network configurations
Day 34-Day 36	25/03/2024 – 27/03/2024	Web development tools c-panel and wordpress
Day 40-Day 45	01/03/2024 - 10/04/2024	Networks and firewall using OPNsense and FreeBSD

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INTERNSHIP OBJECTIVES

To gain practical experience and deepen understanding in the development and implementation of cloud system and instances using openstack and devstack and also to gain an understanding of development of web application and firewall systems in a router. Through this internship, I aim to apply theoretical and practical knowledge in instance deployment and router configurations to real-world scenarios, enhancing my skills in cloud systems, networking and web design. I seek to contribute to the creation of an efficient and user-friendly instances that optimizes hardware and security. Furthermore, I aspire to learn about industry standards, regulatory compliance, and best practices in cloud computing web development and networking thereby preparing myself for a career at the intersection of technology.

CHAPTER 1

INTRODUCTION

CITSA Technologies Pvt Ltd is a multi crore IT solution provider Company focusing on providing user-friendly and cost -effective solutions to customers to enhance their productivity. The Unit is registered as a Start-up. They offer dedicated and innovative solutions for Govt. Departments through GeM portal, Tender & Limited Tender. They have completed our 5 Years heritage leadership in IT products and services and also deliver Premium Technology support to Value Added customers, and institutions all over India. The organization is headquartered in Kerala's capital city, Thiruvananthapuram. They provide a wide range of products in the area of networking and security.

Fig 1.1 Logo of CITSA Technologies

CONTACT DETAILS:

Websites: https://citsat.com/

Headquarters: Thiruvananthapuram

Year Founded: 2007

Company Type:

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From its humble beginnings, CITSA Technologies has exponentially grown to be one of the best provider of networking and hardware solutions among the government enterprises in Kerala. They provide services and facility-related components or activities that support the implementation, maintenance, operation, and enhancement of a data centre.

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CHAPTER 2

PROJECT DETAILS

2.1 PROJECT AREA/DOMAIN:

Cloud computing has revolutionized the way businesses and individuals access and utilize computing resources. It involves the delivery of computing services—including servers, storage, databases, networking, software, and more—over the internet on a pay-as-you-go basis. OpenStack, an open-source cloud computing platform, encompasses various project areas, with networking being a critical component. Networking in OpenStack refers to the management and orchestration of networking resources within the cloud environment. Networking and security play pivotal roles in ensuring the reliability, performance, and integrity of modern IT infrastructures. Networking encompasses the design, implementation, and management of communication networks that connect devices and systems within an organization. It involves technologies such as routers, switches, firewalls, and protocols like TCP/IP, DNS, and DHCP. Security, on the other hand, involves protecting networks, systems, and data from unauthorized access, breaches, and cyber threats. OPNsense is an open-source, easy-to-use firewall and routing platform based on the FreeBSD operating system. It offers a rich set of features for network security and management, making it suitable for both home and business use. OPNsense provides a web-based graphical user interface (GUI) for configuring and monitoring firewall rules, virtual private networks (VPNs), intrusion detection and prevention systems (IDS/IPS), traffic shaping, and more.

2.2 PROBLEM STATEMENT:

Open source platforms play a crucial role in fostering innovation, collaboration, and accessibility in the realm of technology. By providing access to source code, open source platforms empower developers to customize, modify, and extend software according to their specific needs, accelerating the pace of development and innovation. Our problem statement is to develop instances using openstack and to create an iso for firewall using opnsense firewalls systems. We are also tasked with the proper understanding of the above mentioned systems which then can be commercialized.

2.3 EXPLANATION OF WORKING OF PROPOSED IDEA:

The proposed idea makes use of two major open source tools. They work along with linux and unix based systems such as Ubuntu and FreeBSD. The description of the tools are:

1. **OpenStack:** OpenStack operates as a comprehensive cloud computing platform designed to manage and orchestrate large pools of compute, storage, and networking resources within a data center environment. Its architecture consists of several core components, including Nova for compute, Swift for object storage, Cinder for block storage, and Neutron for networking. OpenStack employs a modular architecture, allowing users to scale and customize their cloud infrastructure according to their specific requirements. It leverages APIs to facilitate automation and integration with other systems, enabling seamless provisioning and management of virtualized resources.

2. **OPNSense:** OPNsense is an open-source, easy-to-use firewall and routing platform based on the FreeBSD operating system. It offers a rich set of features for network security and management, making it suitable for both home and business use. OPNsense provides a web-based graphical user interface (GUI) for configuring and monitoring firewall rules, virtual private networks (VPNs), intrusion detection and prevention systems (IDS/IPS), traffic shaping, and more. It incorporates advanced security technologies such as stateful packet filtering, VPN support (including OpenVPN and IPSec), and plugin-based extensibility to enhance its functionality.

CHAPTER 3

METHODOLOGY

3.1 Keystone

Keystone is organized as a group of internal services exposed on one or many endpoints. Many of these services are used in a combined fashion by the frontend. For example, an authenticate call will validate user/project credentials with the Identity service and, upon success, create and return a token with the Token service. The Identity service provides auth credential validation and data about *users* and *groups*. In the basic case, this data is managed by the Identity service, allowing it to also handle all CRUD operations associated with this data. In more complex cases, the data is instead managed by an authoritative backend service. An example of this would be when the Identity service acts as a frontend for LDAP.

3.2 Neutron

OpenStack Networking (neutron) allows you to create and attach interface devices managed by other OpenStack services to networks. Plug-ins can be implemented to accommodate different networking equipment and software, providing flexibility to OpenStack architecture and deployment.

Neutron-server: Accepts and routes API requests to the appropriate OpenStack Networking plug-in for action.

OpenStack Networking plug-ins and agents: Plug and unplug ports, create networks or subnets, and provide IP addressing. These plug-ins and agents differ depending on the vendor and technologies used in the particular cloud.

Messaging queue: Used by most OpenStack Networking installations to route information between the neutron-server and various agents. Also acts as a database to store networking state for particular plug-ins.OpenStack Networking mainly interacts with OpenStack Compute to provide networks and connectivity for its instances.

3.3 Glance

The Image service (glance) project provides a service where users can upload and discover data assets that are meant to be used with other services. This currently includes *images* and *metadata definitions*. Glance image services include discovering, registering, and retrieving virtual machine (VM) images. Glance has a RESTful API that allows querying of VM image metadata as well as retrieval of the actual image. VM images made available through Glance can be stored in a variety of locations from simple filesystems to object-storage systems like the OpenStack Swift project.

3.4 Placement

The placement API service was introduced in the 14.0.0 Newton release within the nova repository and extracted to the placement repository in the 19.0.0 Stein release. This is a REST API stack and data model used to track resource provider inventories and usages, along with different classes of resources. For example, a resource provider can be a compute node, a shared storage pool, or an IP allocation pool. The placement service tracks the inventory and usage of each provider. For ex...mple, an instance created on a compute node may be a consumer of resources such as RAM and CPU from a compute node resource provider, disk from an external shared storage pool resource provider and IP addresses from an external IP pool resource provider.The types of resources consumed are tracked as **classes**. The service provides a set of standard resource classes (for example DISK_GB, MEMORY_MB, and VCPU) and provides the ability to define custom resource classes as needed. Each resource provider may also have a set of traits which describe qualitative aspects of the resource provider. Traits describe an aspect of a resource provider that cannot itself be consumed but a workload may wish to specify. For example, available disk may be solid state drives (SSD).

CHAPTER 4

IMPLEMENTATION

4.1 INSTALLATION OF DEPENDENCIES:

```
sudo apt update
sudo apt install -y python3 python3-pip
```

4.2 DATABASE INSTALLATION AND CONFIGURATION

```
sudo apt install -y mariadb-server python3-mysqldb
sudo mysql_secure_installation
```

4.3 MESSAGE QUEUE INSTALLATION AND CONFIGURATION

```
sudo apt install -y rabbitmq-server
sudo rabbitmqctl add_user openstack RABBIT_PASS
sudo rabbitmqctl set_permissions openstack ".*" ".*" ".*"
```

4.4 KEYSTONE INSTALLATION AND CONFIGURATION

```
sudo pip3 install keystoneauth1 keystonemiddleware
sudo apt install -y keystone
sudo su -s /bin/bash -c "keystone-manage db_sync" keystone
sudo keystone-manage bootstrap --bootstrap-password ADMIN_PASS
\
    --bootstrap-admin-url http://controller:5000/v3/ \
    --bootstrap-internal-url http://controller:5000/v3/ \
    --bootstrap-public-url http://controller:5000/v3/ \
    --bootstrap-region-id RegionOne
```

4.5 GLANCE INSTALLATION AND CONFIGURATION

```
sudo pip3 install glance
sudo apt install -y glance


sudo su -s /bin/bash -c "glance-manage db_sync" glance
```

4.6 NOVA INSTALLATION AND CONFIGURATION

```
sudo pip3 install nova
sudo apt install -y nova-api nova-conductor nova-novncproxy nova-scheduler
sudo su -s /bin/bash -c "nova-manage api_db sync" nova
sudo su -s /bin/bash -c "nova-manage cell_v2 map_cell0" nova
sudo su -s /bin/bash -c "nova-manage cell_v2 create_cell --name=cell1 --verbose" nova
sudo su -s /bin/bash -c "nova-manage db sync" nova
```

4.7 NEUTRON INSTALLATION AND CONFIGURATION

```
sudo pip3 install neutron

sudo apt install -y neutron-server neutron-plugin-ml2 neutron-
linuxbridge-agent neutron-dhcp-agent neutron-metadata-agent

sudo su -s /bin/bash -c "neutron-db-manage --config-file
/etc/neutron/neutron.conf --config-file
/etc/neutron/plugins/ml2/ml2_conf.ini upgrade head" neutron
```

4.8 BLOCK STORAGE(CINDER) INSTALLATION AND CONFIGURATION

```
sudo pip3 install cinder

sudo apt install -y cinder-api cinder-scheduler

sudo su -s /bin/bash -c "cinder-manage db sync" cinder
```

4.9 HORIZON DASHBOARD INSTALLATION

```
sudo pip3 install horizon

sudo apt install -y openstack-dashboard
```

4.10 FINALIZE CONFIGURATIONS

```
sudo systemctl restart apache2.service

sudo systemctl restart glance-api.service glance-registry.service

sudo systemctl restart nova-api.service nova-scheduler.service nova-
conductor.service nova-novncproxy.service

sudo systemctl restart neutron-server.service neutron-linuxbridge-
agent.service neutron-dhcp-agent.service neutron-metadata-
agent.service

sudo systemctl restart cinder-api.service cinder-scheduler.service

sudo systemctl restart apache2.service
```
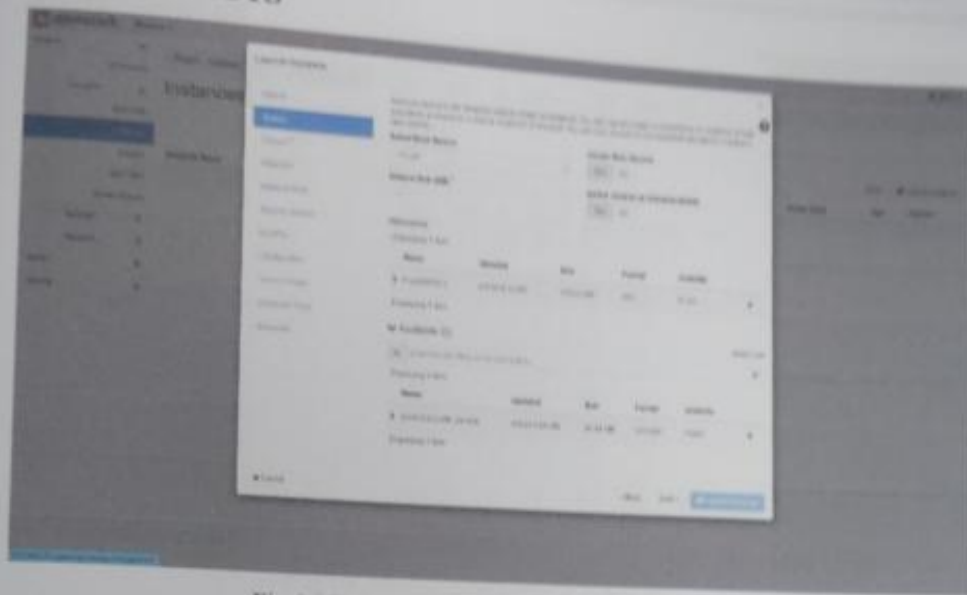
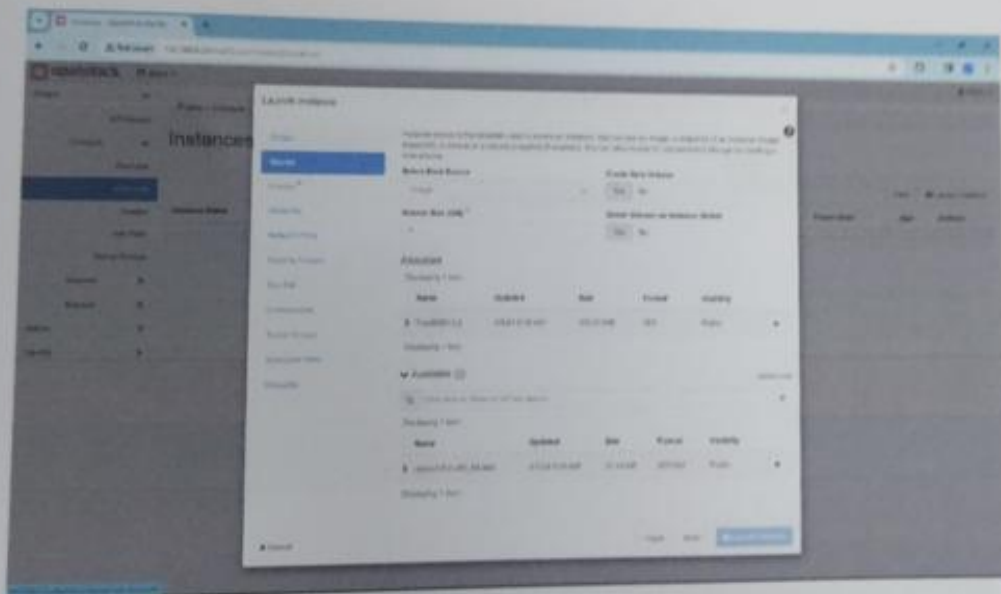# 4.11 SNAPSHOTS

Fig 4.1 Horizon dashboard for instance launch
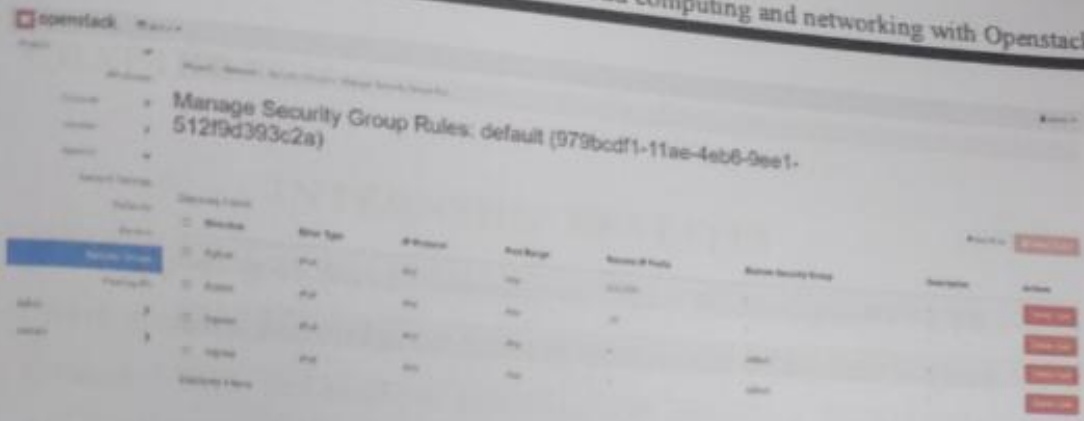

Fig 4.2 Image selection for instance

Fig 4.3 Allocating resources to instance

Fig 4.4 Public and private key generation

Fig 4.5 Security Groups allocation and creation

Fig 4.6 Launching a FreeBSD based cloud instance

CHAPTER 5

INTERNSHIP BENEFITS

After completing 45 days of internship in CITSA Technologies PVT LTD, I have acquired knowledge on instance creation and deployment in cloud systems. I have had ahnds on experience with networking which includes concepts on routing, IP addressing and subnet creation. I have also acquired a chance to experiment with different network protocols that includes SSH, TCP/UDP and ICMP. Along with this I have also learned how to host a web system using C-panel and wordpress and also how to create a firewall using OPNsense and freeBSD unix system.

CHAPTER 6

CONCLUSION

In conclusion, the adoption of OpenStack for our cloud computing project has proven to be a strategic decision, offering unparalleled flexibility, scalability, and control over our infrastructure. Leveraging OpenStack's robust suite of services, we have successfully built a dynamic and resilient cloud environment that meets the diverse needs of our organization. Throughout the project, we have witnessed the tangible benefits of utilizing OpenStack, including seamless resource orchestration, simplified management workflows, and cost-effective scalability. Looking ahead, the foundation laid by our OpenStack implementation positions us well to adapt to future technological advancements and evolving business requirements, ensuring that our cloud infrastructure remains agile, reliable, and future-proof. The implementation of OPNsense in our project centered on firewalls has proven to be an effective and reliable solution. Through meticulous configuration and customization, we have successfully fortified our network infrastructure against unauthorized access, malicious attacks, and potential security breaches. OPNsense's intuitive interface and robust feature set have empowered us to tailor our firewall rules, monitor network traffic, and enforce stringent security policies with ease.

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