

**Data Center Service Implementation  
Using Docker Container and FortiGate Network**

**BY**

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This Report Presented in Partial Fulfillment of the Requirements for the  
Degree of Bachelor of Science in Computer Science and Engineering

Supervised By

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**DAFFODIL INTERNATIONAL UNIVERSITY**

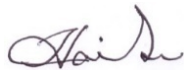
**DHAKA, BANGLADESH**

**JANUARY 2022**

## APPROVAL

This Project titled “**Data Center Service Implementation Using Docker Container and FortiGate Network**” submitted by Saddman Zahin Himel, 163-15-8371 and Nazmul Ahammad Arman, 163-15-8369 to the Department of Computer Science and Engineering, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on 06-1-2022.

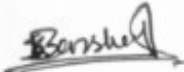
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## DECLARATION

We hereby declare that, this project has been done by us under the supervision of **Refath Ara Hossain, Lecturer, Department of CSE** Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

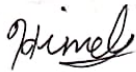
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## **ABSTRACT**

This project is replication of a concept that how can we utilize our minimum hardware resources at maximum output performance by using Docker container virtualization and also, we can secure our network by using security firewall and monitor our data center monitoring system for vulnerability. We can further develop this system as a VPS server that people can use as their personal computer this is how we can utilize at full performance this system. For this project we are using GNS3 simulation software, VMWARE WORKSTATION. We are replicating an office setup how office network setup work. Head office and branch office network connectivity via VPN and office application configuration and usable for users.

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# CHAPTER 1

## Introduction

### 1.1 Introduction

The data center is a facility where data or information store in vast majority in server storage device it could be NAS (network area storage) or SAN (Storage area network) depend on data center designer and data center infrastructure. all data is connected via servers through switches routers, lot, ONU and powered via UPS (uninterrupted power supply) or backup power generator. data center plays most important role in our real life, by the data center we cannot imagine our modern life, it runs our social media platforms, our data privacy, our office work, our financial records etc. [1] [2]

### 1.2 Specifies a Modern Data Center

Today's server farms are vastly different from what they were only a few years ago. Foundation has transitioned from traditional on-premises physical to virtual organization that assist apps and Jobs across pools of physical framework in a multi-cloud environment. Informational exist and is linked across multiple server farms, the edge, and public and private mists throughout this time. The server farm should be able to share data between these several locations, both services run on the cloud server. Even the public cloud is made up of several farms. When applications services are installed in the cloud server services, the cloud provider's server farm. [3] [4]

### 1.3 Server Farm Office

To support the middle's equipment and programming, server farm parts necessitate a massive foundation. Power substations, uninterruptible power supply (UPS), ventilation, cooling system, fire protection, independent power generators, and connections to outside networks are among them.

## 1.4 The Principles for Server Farm Foundation

ANSI/TIA-942 is the most widely accepted standard for server farm plans and frameworks. It integrates ANSI/TIA-942 accreditation criteria, consistency with one of four server farm levels examined for degrees of repetition and internal failure adaption.

- The fundamentals of a website. A Tier 1 server farm provides only little protection against actual events. It features a single, non-redundant dispersion method and Part site foundation with redundancy. This server farm provides enhanced protection against genuine events. It features extra limit pieces and a single, non-redundant delivery path.
- Site framework that is concurrently feasible. This server farm protects against almost all real-world events by providing repeating limit portions and a variety of free conveyance options. Every component can be removed or replaced without disrupting end- user administrations.
- Site framework that is fault tolerant. The higher levels of adaptation to internal failure and excess are provided by this server farm. Simultaneous practicality and one issue anywhere in the establishment without generating vacation is enabled by repetitive limit parts and diverse autonomous dispersion ways.

## 1.5 Motivation

Server farms are the foundation of the computerized economy and the inescapable reception of cloud administrations, business examination and large information will keep on speeding up their interest. Since server farms burn-through a lot of energy, research endeavors are expected to distinguish what works with activities to carry out practices and innovations to one or the other retrofit to or design green server farms. This paper addresses this issue drawing from institutional, anticipation and inspiration capacity hypotheses and in view of study information gathered from 96 server farms. The discoveries demonstrate that presentation and exertion hope structure the solid request

drivers and along with capacity will prompt the execution of practices and innovations that further develop the energy proficiency of server farms.

- Resource Sharing
- Virtualization
- Host your website
- Data connectivity with wire and wireless
- Communicate system with (e-mail, VoIP, messaging)
- Keep information record (data storage)
- Exploring for new ideas (research and development for new technologies)
- Running simulation for different purpose (space research, flight control, missile testing, virtual system testing).

## **1.6 Aims and Objectives**

- a. Create and carry out an enterprise server farm for getting and delivering basic data resources.
- b. Adoptive hearty and assessable administrations that help the requirements of enterprise partners.
- c. Make a solid and effective assistance for facilitating and delivering basic data resources and different information to its clients.
- d. Carry out security approaches and specialized apparatuses to shield information from disaster, risk, compromise of other improper use.
- e. Decrease costs related with the security and keep of basic data resources.
- f. Offer quality support levels that meet or better client assumptions.
- g. Improvement on efficiencies through essential execution of standard platforms.
- h. Provide improved information security in consistence with administration and other administrative bodies.

## 1.7 Expected Outcome

Were all technologists, or in any event, clients of innovation. In the server farm space, we are continually utilizing new frameworks, strategies for correspondence, and cutting-edge innovations intended to make life easier.

Yearly worldwide IP traffic will reach 3.3 zettabytes by 2021. In 2016, worldwide IP traffic was 1.2 ZB each year or 96 exabytes (one billion gigabytes) each month.

Worldwide IP traffic will increment almost triple over the course of the following five years and will have increment 127-fold from 2005 to 2021.

- a. previous data center system and device was power hungry but new system of data center device is more efficient and less power consumption device. power of data center is reduced via 40% across the globe and recently all data center company shifting their premises is south and north area of earth because of weather condition. North pole and south pole are cold, and it help data center to cool down and work more effectively. it reduces power consumption and burn fossil fuel.
- b. data center can help our country economy growth.it can help our county economy via monitoring all financial system and software algorithm. We can implement more data center infrastructure in our country and provide cloud base, and data storage services to other countries to earn remittance for our country When we asked respondents about data center growth, we found that ownership, renovations, and building were on the upswing.
- c. How much change innovation and additions are being made in the data center industry in any given year. Such as the public cloud, private cloud and traditional IT.

Figure 1.7 Shows Growth and expansion of data center industry

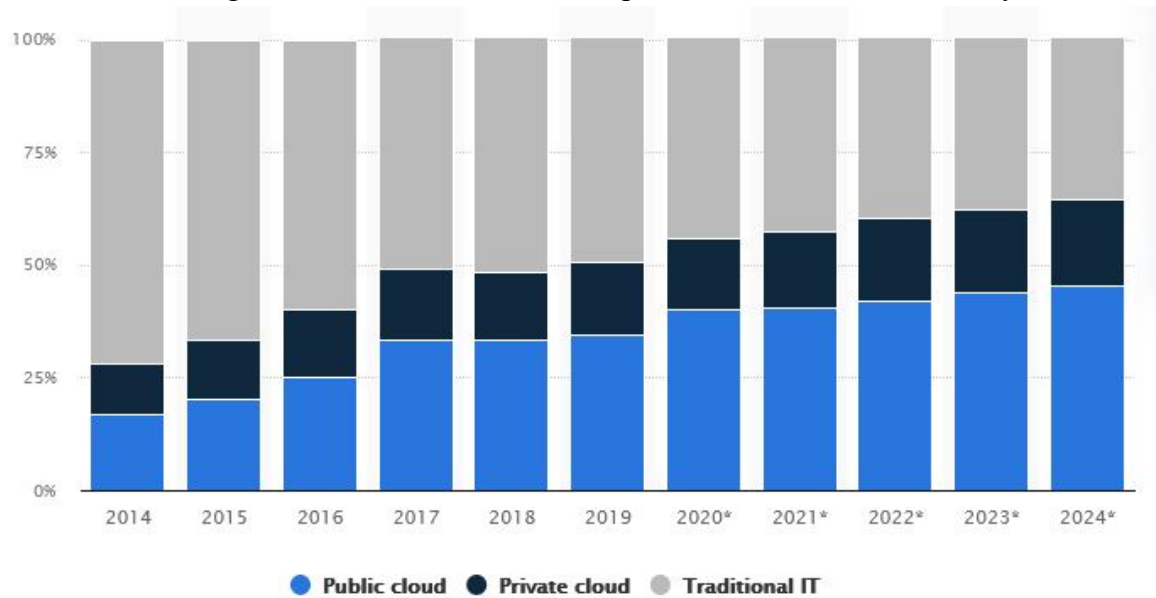


Figure 1.7: Growth and expansion of data center industry

## 1.8 Layout of The Report

- a. The introductory chapter gives the background leading of our project about data center and network security.
- b. The chapter Design model of the Project.
- c. This chapter is about Requirement Specification Network project with GNS3 and VMware.
- d. This chapter is about the overview of the project. In this chapter we discuss about FortiGate Brand VLAN, IPsec VPN, Firewall, IDS, IPS, Web Server, FTP Server, NAS Server with Automatic Backup, Mail server with configuration and screenshots.
- e. Demo (Simulation and result) of the project.
- f. We turn into the conclusion and future Scope of the Networking security system of Organizations.

## CHAPTER 2

### Background

#### 2.1 Firewall

The firewall is a security device which monitor all the traffic activities in the network. the firewall checks each incoming and outgoing packet thought network for malicious packet or information to prevent any cyber-attack like DDOS, MITM (man in the middle) packet sniffing, ransomware attack, BOT etc. Firewall types that United Threat Management Firewall (UTMFW), Next-generation Firewall (NGFW), Threat-focused (TFFW). [5]

#### 2.2 Network Switch

A network switch is a device that works on networking data link layer.it help data or packet to transmit device to device like computer to computer, computer to laptop or mobile or outside through router or firewall. Network switch has its own mac table, and it stores these device macs address each packet contain header destination mac address to reach on destination location. Layer 3 switch is available, and this kind of switch can work route level but can-do NAT (network address translation). [6]

#### 2.3 Network Switch Works

##### 2.3.1 Deployed in The Following Ways

- Edge or access switches: this type of switch is installed in server racks where server is installed. This method can help us to separate the Ares and help us to find network error problem easily. This type of switches directly handles end devices like computer, access control, Ip cameras, access point, printers, scanner, and aggregation switches.
- Aggregation or distribution switches: this switch is installed in middle point where all edge switch uplink cable relates to aggregation switches,



this type must have redundancy and link fault tolerant system to prevent any kind of link breakdown like multiple cores switch a downlink line, two power supply and two or more power incoming system for nonstop performance.

- Core switches: these switches also have redundancy link, but these switches are directly connected under firewall or routers. This switched distribute data or packet and sometime provide Ip address, depend on data center configuration. This switches downlink is aggregation switches and uplink are firewall and routers sometimes both can be connected to prevent link down error.

## **2.4 VLAN**

VLAN (virtual LAN) is a technology that works inside Lan port. multiple data can be sent in one port in different network.it reduce the Lan port to use individual port by port. Each VLAN has its own network and subnets, and gateway Lan can work in multiple switches though VLAN ID and its smooth the internal network architecture and data flow inside network. [7]

## **2.5 IPsec VPN**

VPN is virtual private network connections forwarded (tunneled) through public-to-public Ip networks. IPsec VPN Is s protocol, secure the network connection in standards way to create a VPN (virtual private connection). IPsec is a group of protocols that work together to set up encrypted connection between two or more router and firewall devices. IPsec VPN system used to set up VPNs and it works by encrypting IP packets. Within the team “IPsec” “IP” stands for “Internet Protocol” and “sec” for secure. [8] [9]

## **2.6 IDS**

An intrusion detection system (IDS) is a system and work as a software application that monitors all the packets in the network for malicious activity or policy breaches via monitoring time any kind of malicious activity or violation

can scan via IDS it is reported and stored centrally using a security data and event management system. Some IDS's can detected intrusion via network scanning. [10]

These are classified as intrusion prevention systems (IPS), IDS detection types:

- NIDS – Network Intrusion Detection System
- HIDS – Host-based Intrusion Detection System
- HIDS – Host Intrusion Detection System

## **2.7 IPS**

IPS (intrusion prevention system) is a system that can detect and prevent any kind of cyber security like DDOS (distributed denial of service) Bot attack, brute force entry, email bombing, network vulnerabilities, exploits, and hackers, MITM (man in the middle) IPS (intrusion prevent system) can quickly block ports and prevent the attack. [11] [12]

## **2.8 Web Server**

A web server is use in store information and spread the information everyone. like online newspaper. but now a day webserver is very necessary to everyone. web servers contain information, this information cloud be person information, social media platform information, online job circular based information by the webserver we can collect information though public example online vote, online public opinion, online store for place order any product, curriculum vita collection, and many more. web servers need a hosting pc to host the site and domain server for its identity to identify in public itself. websites need HTTP (hypertext transfer protocol) SMTP (simple mail transfer protocol).

## 2.9 DMZ

In cyber security, a demilitarized zone (DMZ) is a subnetwork which separates the internal local area network (LAN) external networks. The external-facing server, resources and services sit in the DMZ, meaning that they have accessible from and have access to the internet in addition to the other parts of the internal LAN. This means there is no direct access between the internet and the internal LAN cannot be reached. Examples of services that might be in the DMZ. [13]

## 2.10 VMware Workstation

VMware Workstation is a virtual machine software that is used for x86-64 based computer operating system to run multiple operating systems over a single physical computer. Each virtual machine can run a single any operating system (Microsoft, Linux etc.). VMware Workstation Strongly supports hardware compatibility and works as a bridge or as a NAT and host mood network between physical machine for all kinds of hardware sources with hard disk, USB tool. All drives are installed via the host physical machine. [14] [15]

## 2.11 GNS-3 (Graphical Network Simulation)

GNS3 is used by hundreds of thousands of network engineers worldwide to emulated, configure, test and troubleshoot virtual and real network. GNS3 allows you to run a small topology consisting of only a few devices on your laptop, to those that have many devices hosted on multiple servers or even hosted in the cloud. [16] [17]

At first, we will install VMware software on our main host laptop after that we will install VM pc (windows 10 user pc) follow the step following figures.

- Click on create new virtual machine
- Select typical then click on next
- Elect I will install the operating system latter
- Select Microsoft windows and windows vision which windows you want to install
- Give a virtual machine and virtual machine install location

- Give the virtual machine install size and select virtual store type
- Now select virtual machine setting and select cd/DVD and use iso file and give the iso file location.

Let's install VM ware in windows 10. After finishing install VM ware, then the open VM ware we will see on display like the picture below.

Figure 2.11 – 1 Shows windows 10 in VM

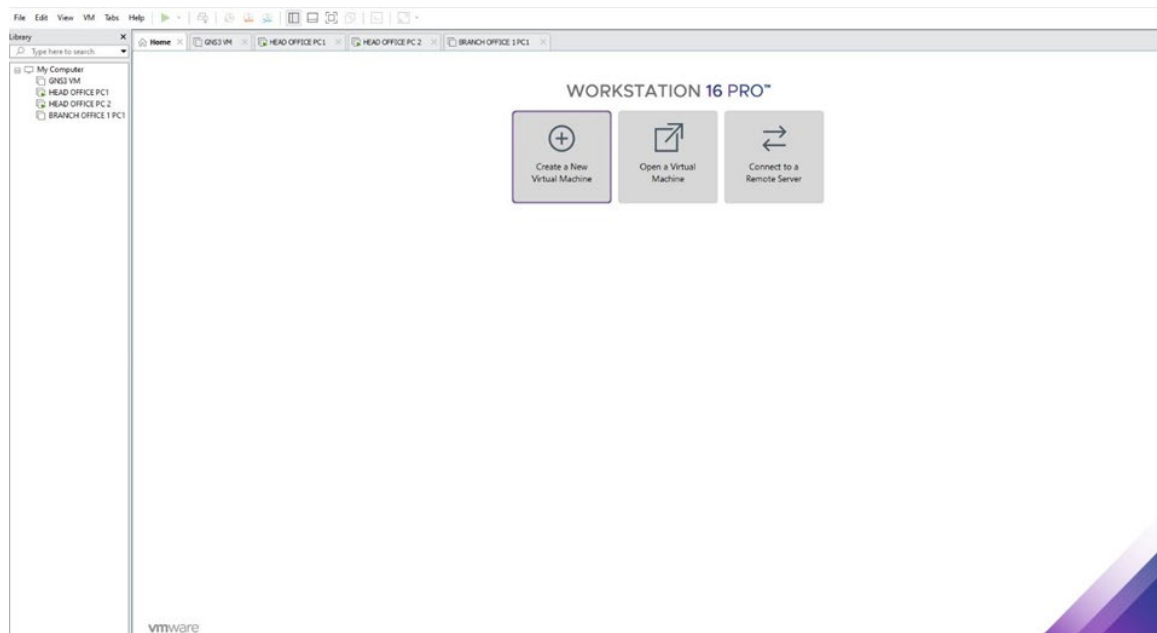


Figure 2.11 – 1: windows 10 in VM

VM ware it will be seen on the display in the next step. Figure 2.11 – 2 shows windows 10 in VM

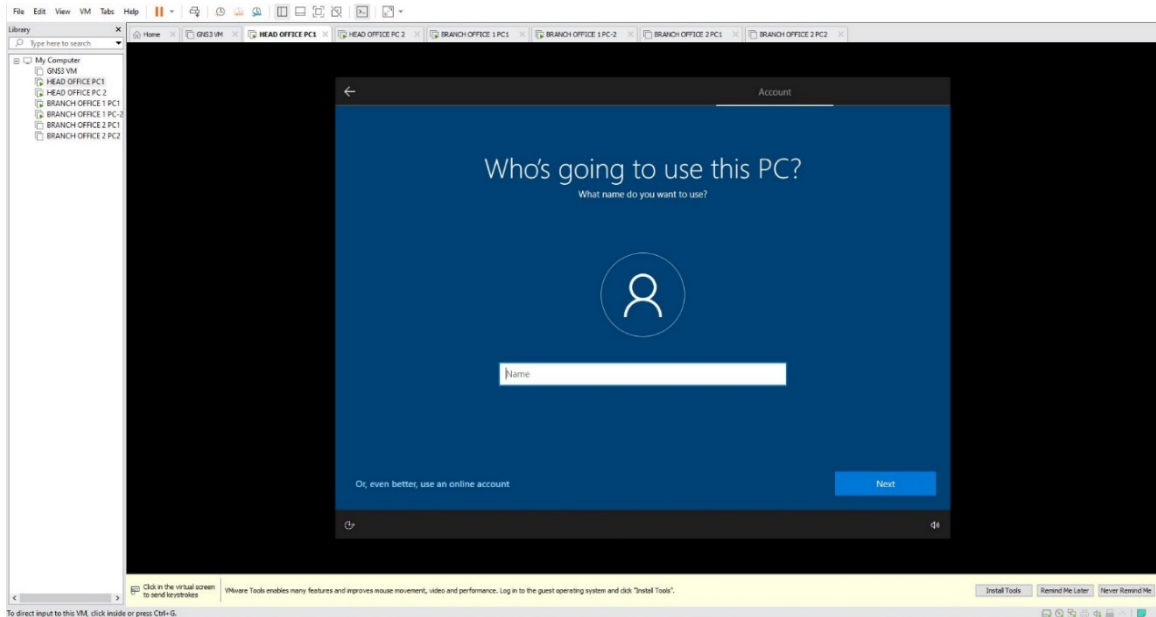


Figure 2.11 – 2: windows 10 in VM

VM ware it will be seen on the display in the next step. Figure 2.11 – 3 shows windows 10 in VM

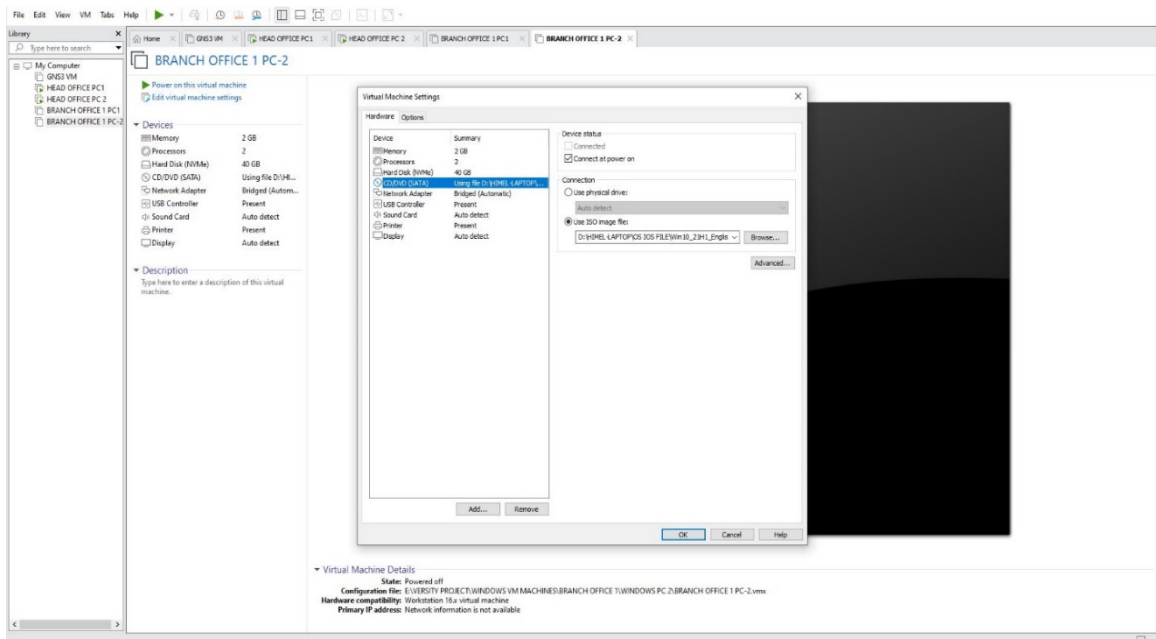


Figure 2.11 – 3: windows 10 in VM

Our window 10 user end pc is ready to use we will add 5 more pc as user pc now we will install ubuntu server on our VM machine.

- Create a new virtual machine
- Select language (English) then install ubuntu
- From update and install select normal install and download Ubuntu while installing.
- Installation type select erase and install Ubuntu
- Select time zone and create username password on VM Ubuntu server

Now, we will set up ubuntu in VM ware, this is one part of Linux. After finishing install Ubuntu, then the open Ubuntu we will see on display like the picture below.

Figure 2.11 – 4 shows Ubuntu Server setup

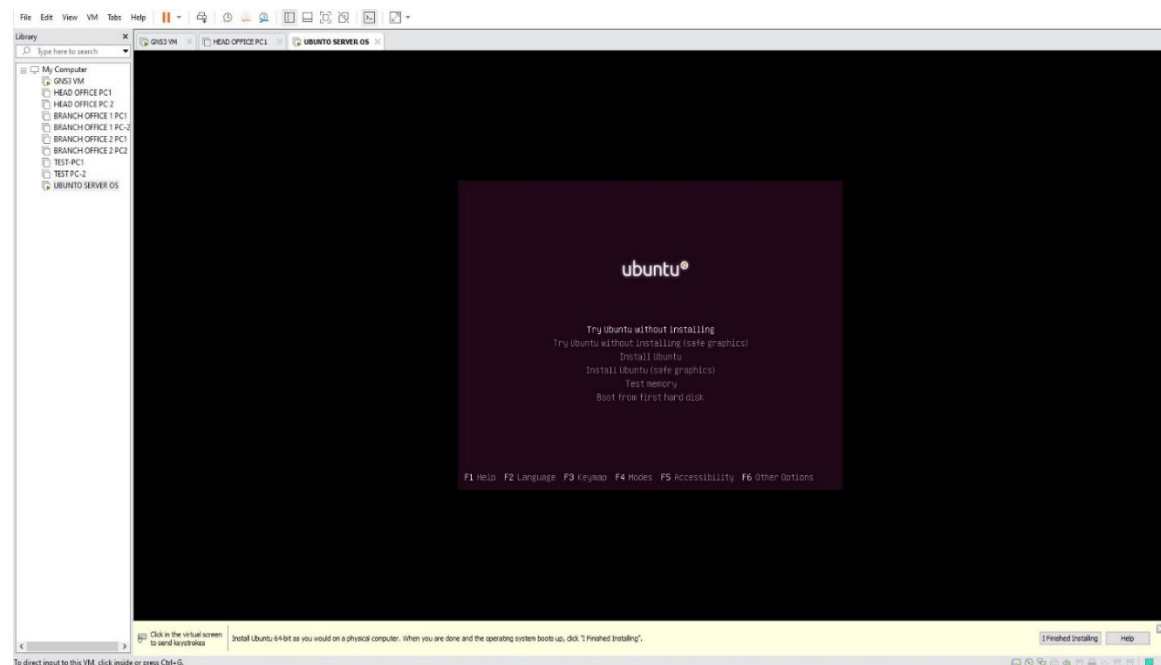


Figure 2.11 - 4: Ubuntu Server setup

VM ware it will be seen on the display in the next step. Figure 2.11 – 5 shows Ubuntu Server Setup

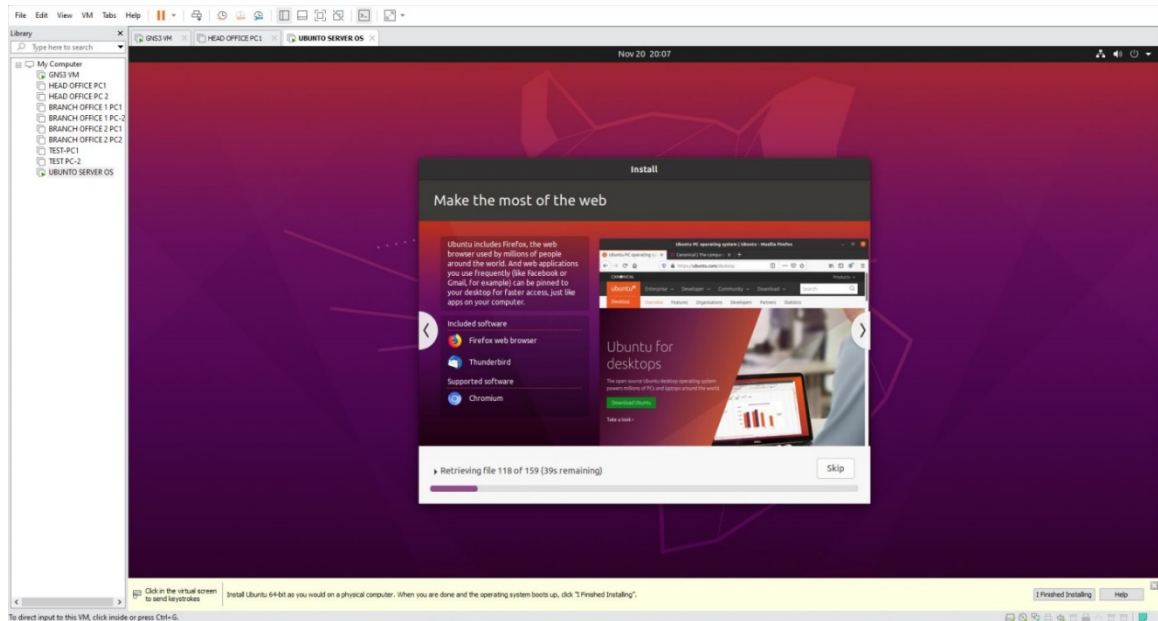


Figure 2.11 - 5: Ubuntu Server setup

### 2.11.1 Install GNS-3 and insert GNS-VM and Fortinet 64vm Version 7.0.1

Let's install GNS3 in VM ware. After finishing install GNS3, then the open GNS3 we will see on display like the picture below. Figure 2.11.1 – 1 shows Installed Gns3vm and Fortinet 64vm



Figure 2.11.1 – 1: Installed Gns3vm and Fominet 64vm

Gns3vm and Fortinet 64vm it will be seen on display in the next step.

Figure 2.11.1 – 2 shows Installed Gns3vm and Fortinet 64vm

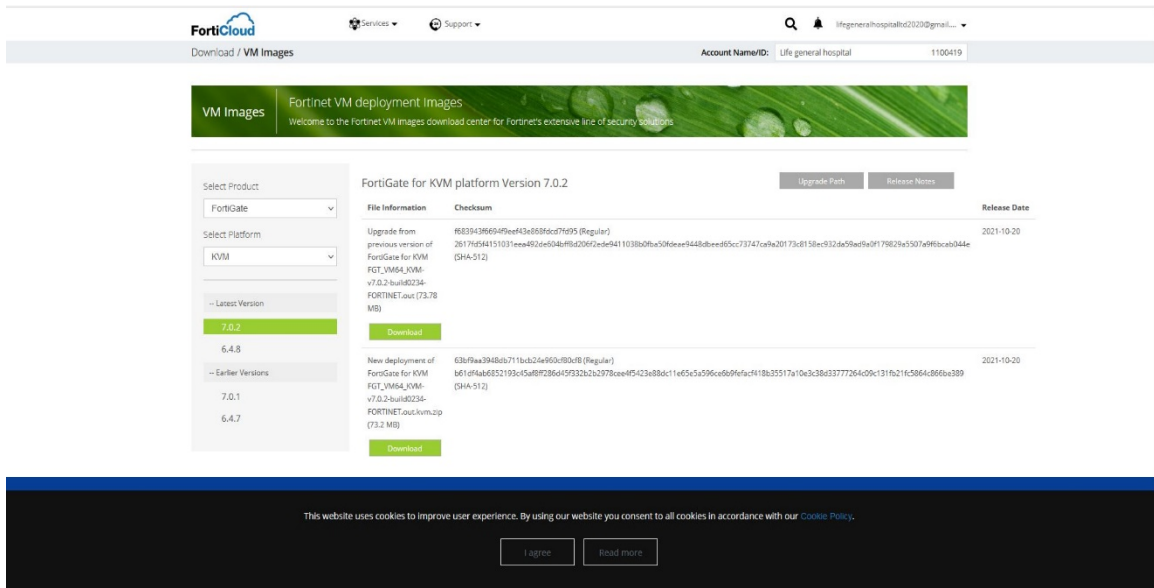


Figure 2.11.1 – 2: installed Gns3vm and Forninet 64vm

Gns3vm and Fortinet 64vm it will be seen on display in the next step.

Figure 2.11.1 – 3 shows Installed Gns3vm and Fortinet 64vm

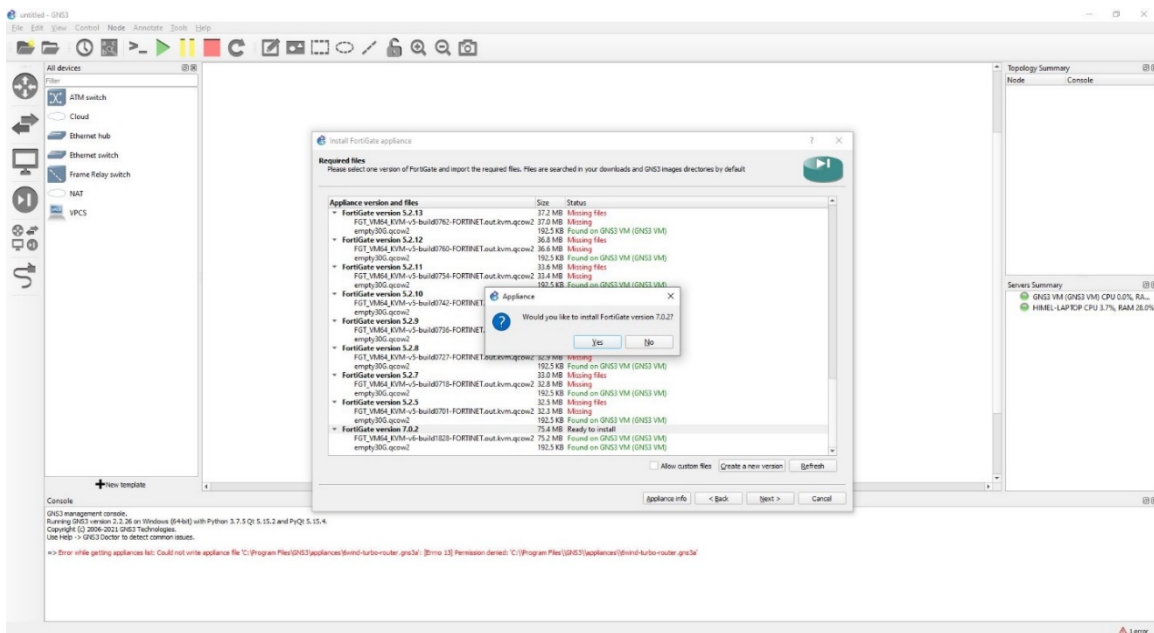


Figure 2.11.1 – 3: Installed Gns3 VM and Fortinet 64vm



Gns3vm and Fortinet 64vm it will be seen on display in the next step.

Figure 2.11.1 – 4 shows Installed Gns3vm and Fortinet 64vm

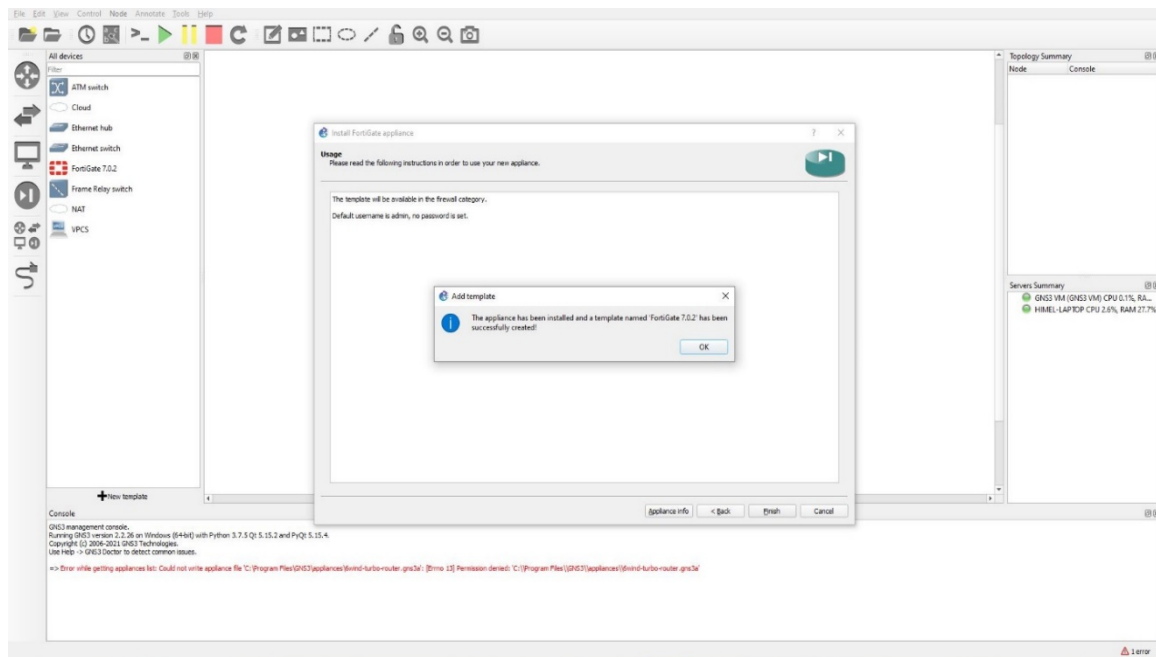


Figure 2.11.1 – 4: Installed Gns3vm and Fortinet 64vm

## 2.11.2 Configure our Fortinet head office firewall wan port, LAN port, IP address, DNS configure security policies, Firewall policies, Static route and VPN IPsec.

We need to enable our wan port on cli (command line interface) mode

### ■ WAN Port

```
FortiGate-VM64-KVM # config system interface
FortiGate-VM64-KVM (interface) # edit port1
FortiGate-VM64-KVM (port1) # set mode static
FortiGate-VM64-KVM (port1) # set ip 192.168.122.89 255.255.255.0
FortiGate-VM64-KVM (port1) # set allowaccess https http ping telnet ssh
FortiGate-VM64-KVM (port1) # set role wan
FortiGate-VM64-KVM (port1) # set alias WAN-port
FortiGate-VM64-KVM (port1) # end
```

## LAN Port

This is our firewall Lan port dashboard in this panel we can configure our Lan port as our requirement. Figure 2.11.2 – 1 Shows LAN Port

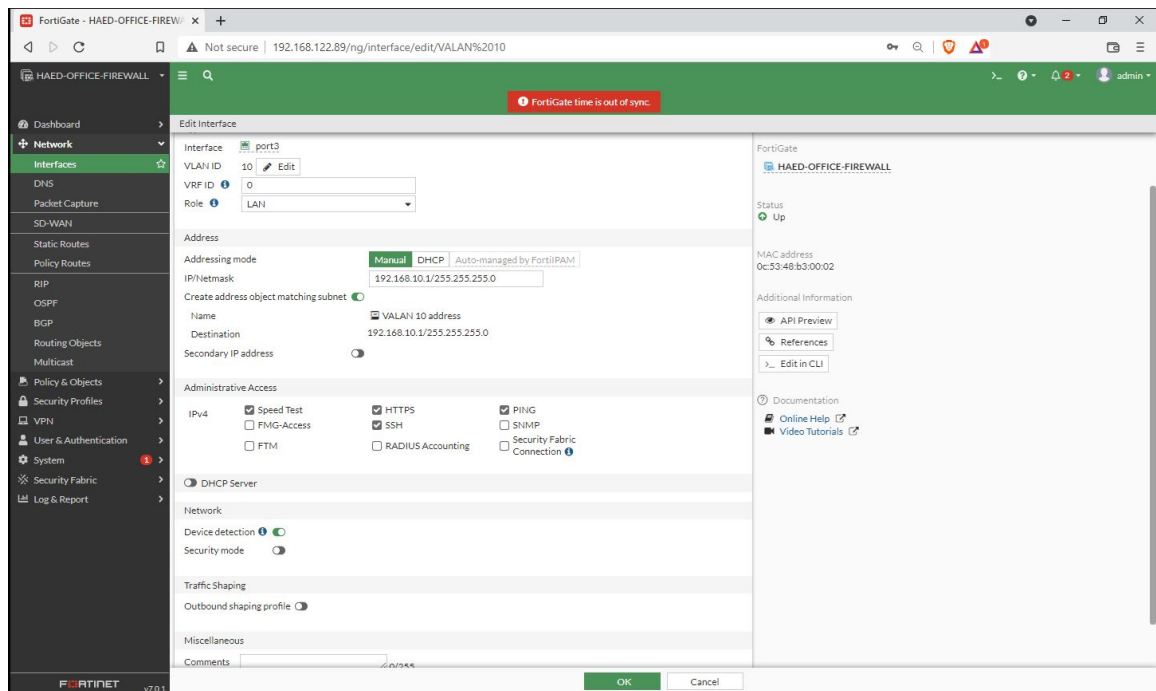


Figure 2.11.2 – 1: LAN Port

## Security Policies

This figure shows us firewall web filter (websites) security polices where we can customize out polices as our requirement. Figure 2.11.2 – 2 Shows Security Policies

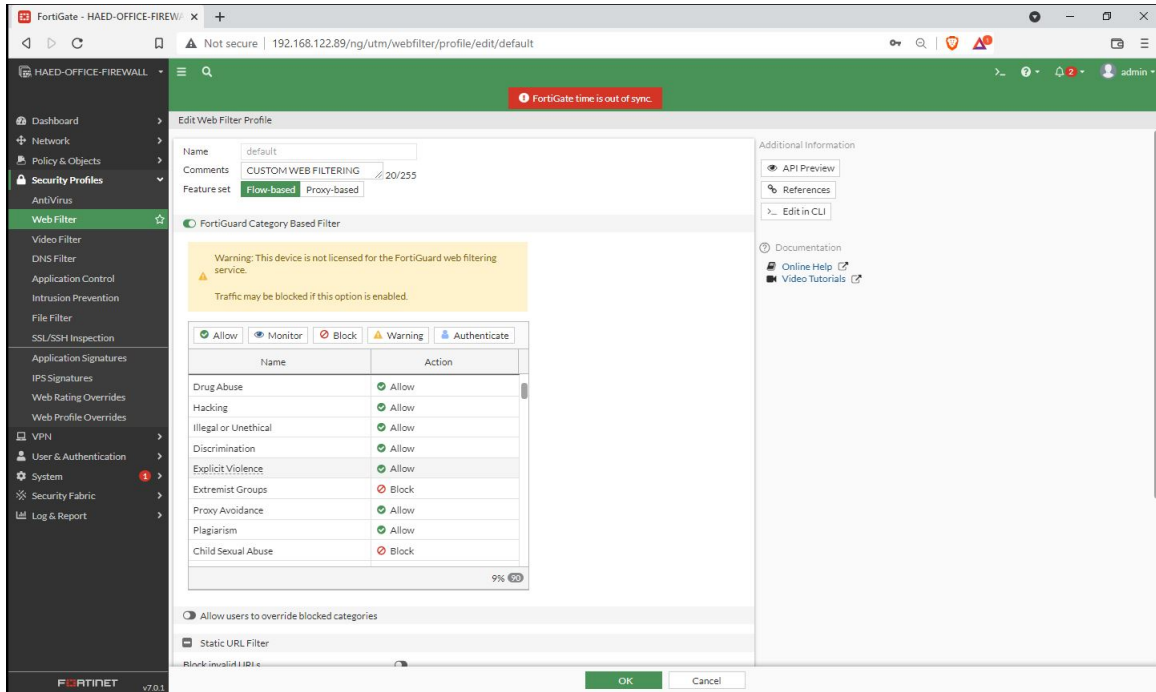


Figure 2.11.2 – 2: Security Policies

## IPS Policies

This is firewall IPS (intrusion prevention system) where we can configure our IPS and prevent cyber-attack. Figure 2.11.2 – 3 Shows IPS Policies

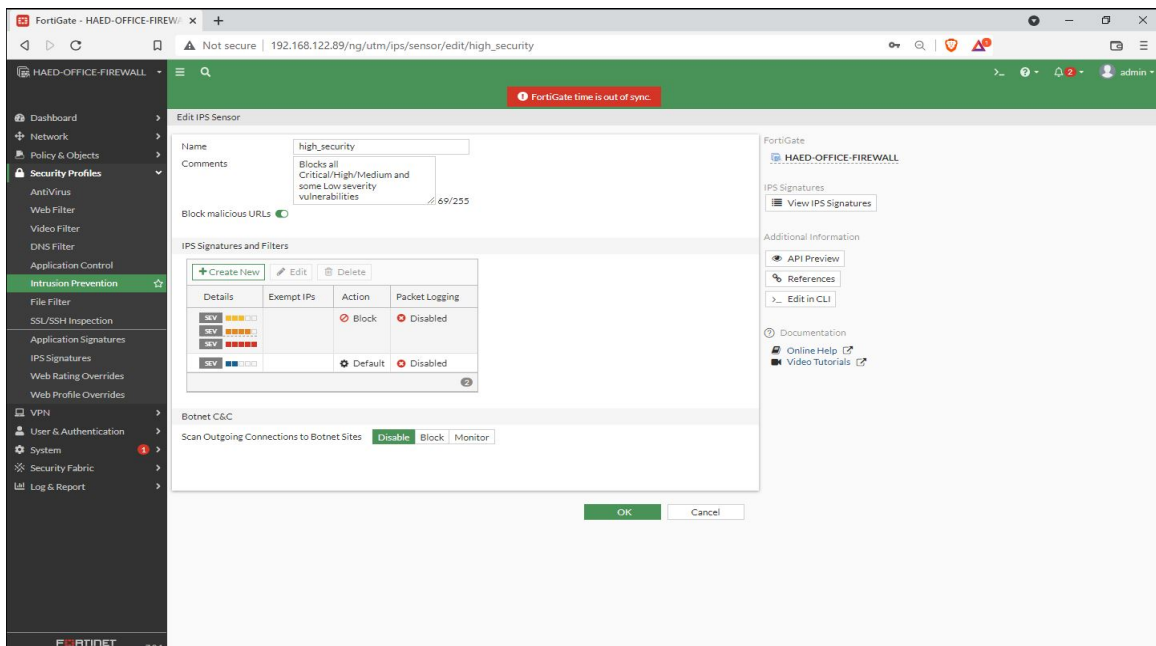


Figure 2.11.2 – 3: IPS Policies

## Static Route

This is static route configuration. Figure 2.11.2 – 4 Shows Static Policies

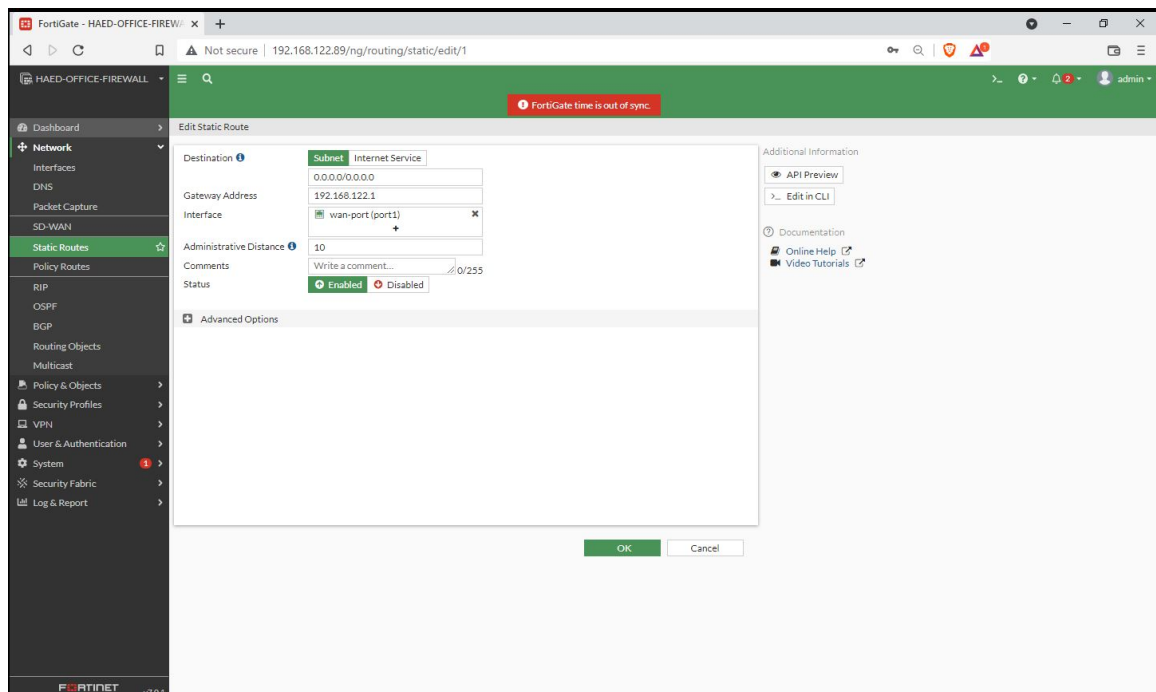


Figure 2.11.2 – 4: Static Route

## VPN Setup for Two Branches

This is site to site VPN setup and configuration. Figure 2.11.2 – 5 Shows VPN setup for two branches

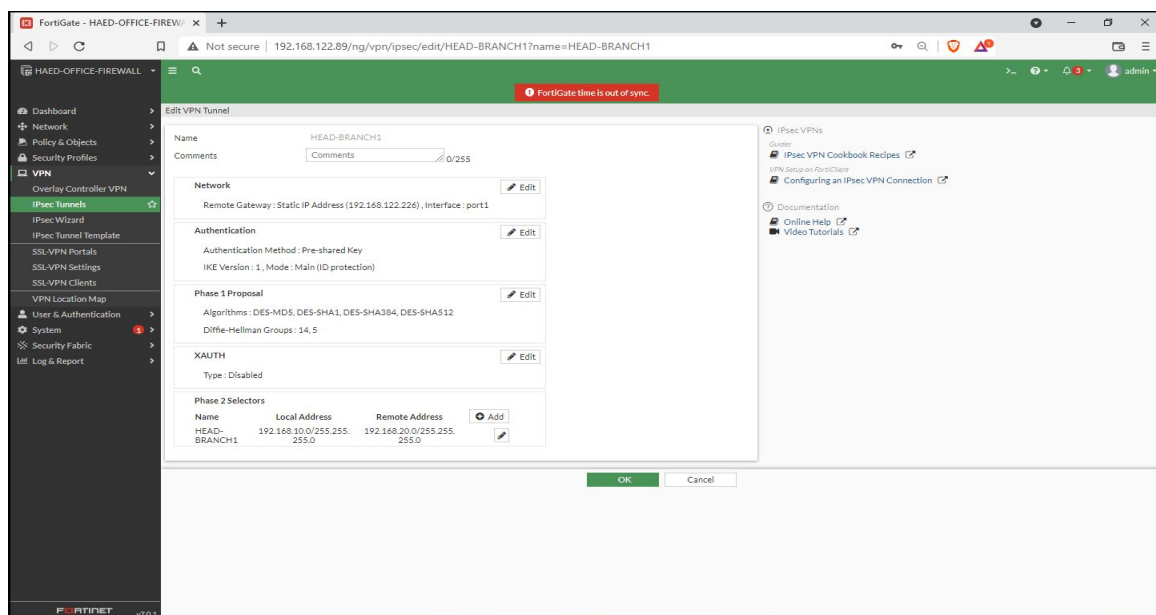


Figure 2.11.2 – 5: VPN Setup for Two Branches

This is site to site VPN setup and configuration. Figure 2.11.2 – 6 Shows VPN setup for two branches

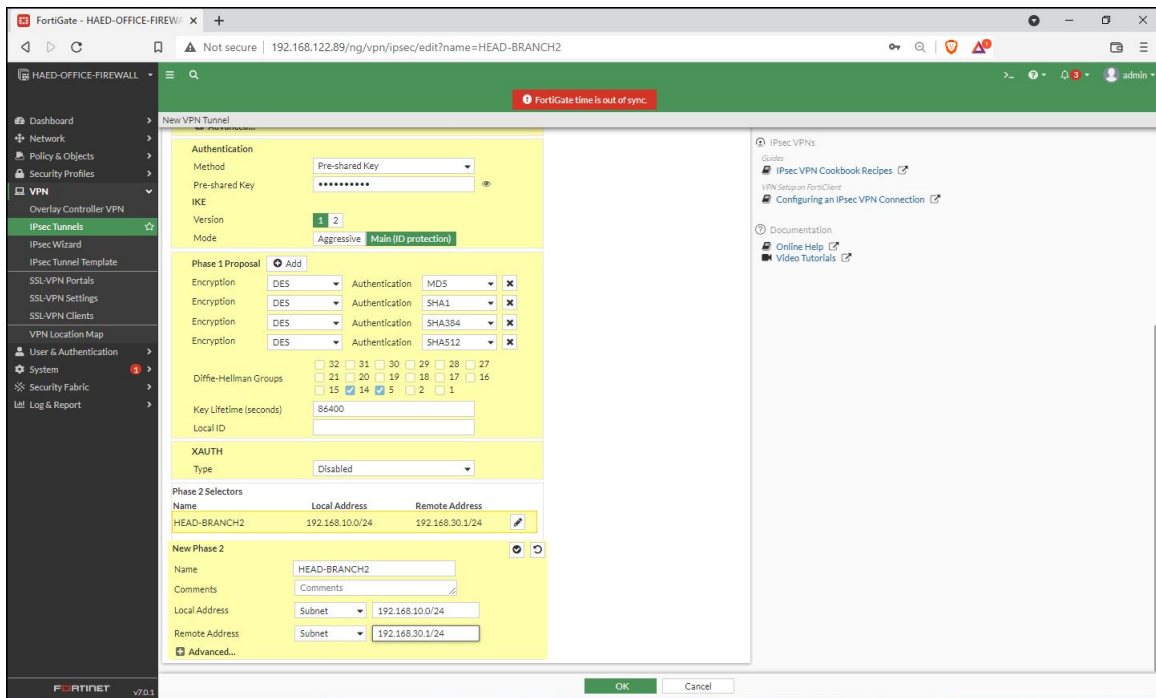


Figure 2.11.2 – 6: VPN Setup For Two Branches

## Firewall Policies

This is firewall access policies for VPN, wan and Lan connectivity in firewall policies. Figure 2.11.2 – 7 Shows Firewall Policies

The screenshot shows the FortiGate web interface for Firewall Policies. The 'Policy & Objects' menu is selected, and the 'Firewall Policy' list is displayed. The table below shows the configuration for several policies.

Name	From	To	Source	Destination	Schedule	Service	Action	NAT	Security Profiles
local lan to internet	LOCAL-LAN (port3)	wan-port (port1)	all	all	always	ALL	ACCEPT	Enabled	certificate-inspection
vpn_head to branch1_local_0	LOCAL-LAN (port3)	head to branch1	head to branch1_local	head to branch1_remote	always	ALL	ACCEPT	Disabled	no-inspection
vpn_head to branch1_remote_0	head to branch1	LOCAL-LAN (port3)	head to branch1_remote	head to branch1_local	always	ALL	ACCEPT	Disabled	no-inspection
vpn_head-branch2_local_0	LOCAL-LAN (port3)	head-branch2	head-branch2_local	head-branch2_remote	always	ALL	ACCEPT	Disabled	no-inspection
vpn_head-branch2_remote_0	head-branch2	LOCAL-LAN (port3)	head-branch2_remote	head-branch2_local	always	ALL	ACCEPT	Disabled	no-inspection
Implicit Deny	any	any	all	all	always	ALL	DENY		

Figure 2.11.2 – 7: Firewall Policies

### 2.11.3 Branch Office 1

Now we will configure our Fortinet branch office 1 firewall wan port, LAN port, IP address, DNS configure, security policies, firewall policies, static route and VPN IP-sec. We need to enable our wan port on cli (command line interface) mode.

#### WAN Port

```
FortiGate-VM64-KVM # config system interface
FortiGate-VM64-KVM (interface) # edit port1
FortiGate-VM64-KVM (port1) # set mode static
FortiGate-VM64-KVM (port1) # set ip 192.168.122.226 255.255.255.0
FortiGate-VM64-KVM (port1) # set allowaccess https http ping telnet ssh
FortiGate-VM64-KVM (port1) # set role wan
FortiGate-VM64-KVM (port1) # set alias WAN-port
FortiGate-VM64-KVM (port1) # end
```

Configuration for wan port of firewall via FortiGate VM64 KVM.

Figure 2.11.3 – 1 Shows WAN Port

```
FortiGate-VM64-KVM (port1) # set mode static
FortiGate-VM64-KVM (port1) # set ip 192.168.122.226 255.255.255.0
FortiGate-VM64-KVM (port1) # set allowaccess https http ping ssh
FortiGate-VM64-KVM (port1) # set role wan
FortiGate-VM64-KVM (port1) # set alias wan-port
FortiGate-VM64-KVM (port1) # end

FortiGate-VM64-KVM # config system global
FortiGate-VM64-KVM (global) # set hostname BRANCH-OFFICE-1
FortiGate-VM64-KVM (global) # END
Unknown action 0

FortiGate-VM64-KVM (global) # end

BRANCH-OFFICE-1 # █
```

Figure 2.11.3 – 1: WAN Port

## LAN Port

Branch office 1 LAN dashboard, where we can configure Lan interfaces and service as our requirement. Figure 2.11.3 – 2 Shows LAN Port

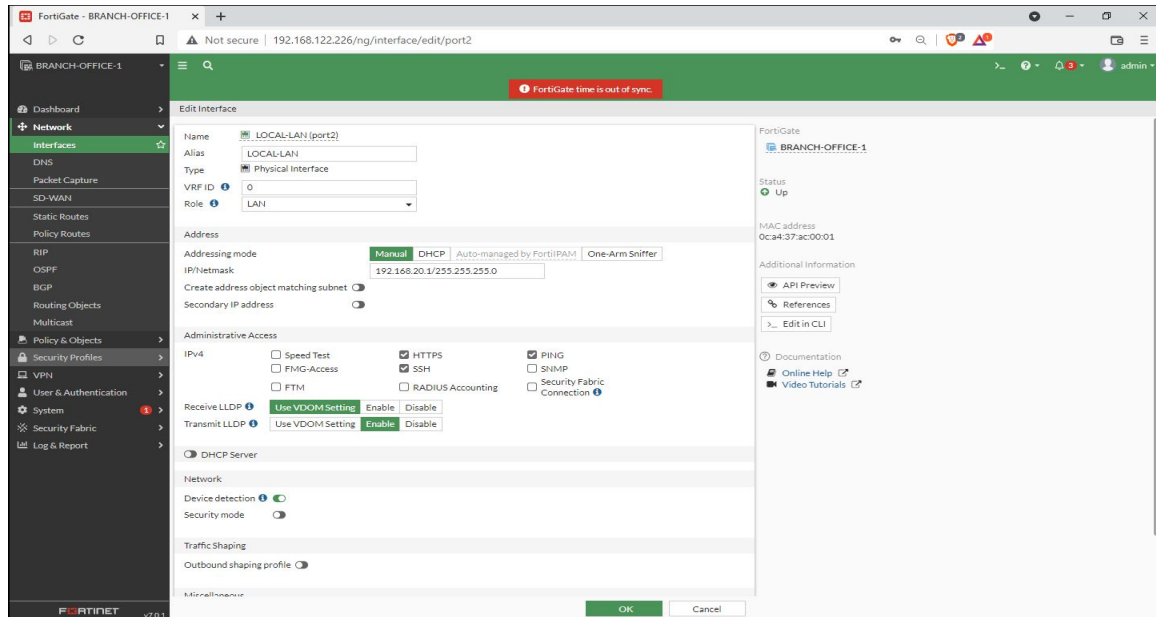


Figure 2.11.3 – 2: LAN Port

## This is DNS (domain name server) we are using google DNS. DNS Configure

DNS dashboard, where we can configure DNS are using google DNS as our requirement. Figure 2.11.3 – 3 Shows DNS (Domain name server)

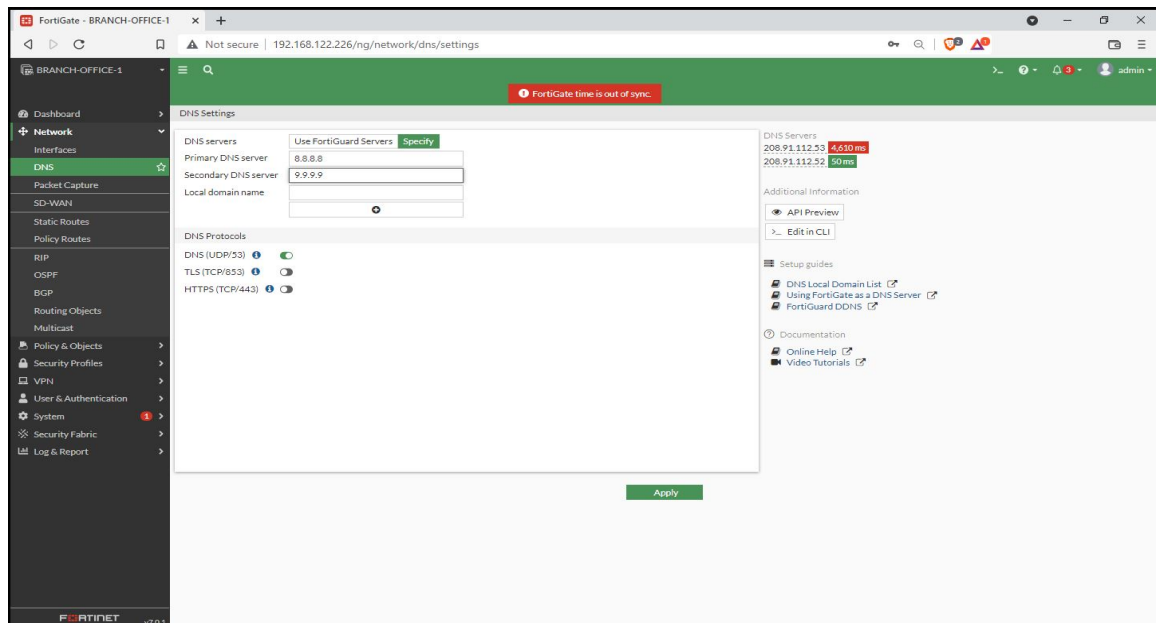


Figure 2.11.3 – 3: DNS Configure

## VPN IP-sec configure with head office

VPN IP-sec dashboard, where we can configure VPN IP-sec configure with head office as our requirement. Figure 2.11.3 – 4 Shows VPN IP-sec configure with head office

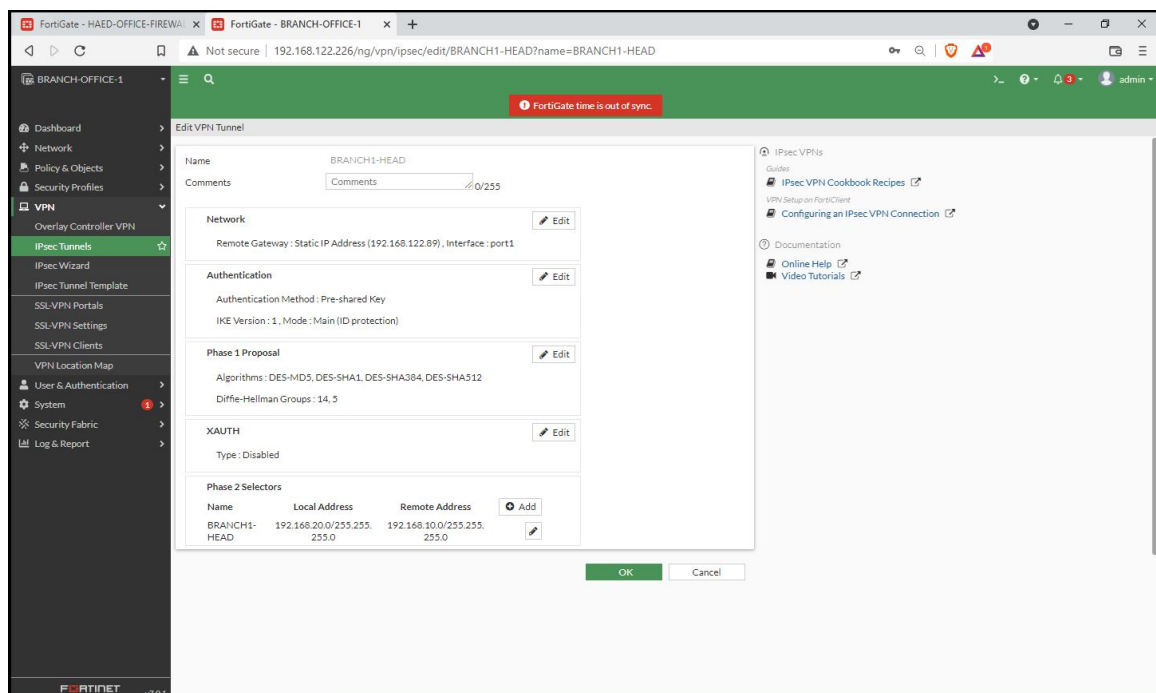


Figure 2.11.3 – 4: VPN IP- sec configure with head office



## Firewall Policies

This is firewall access policies for VPN, wan and Lan connectivity in firewall policies.

Figure 2.11.3 – 5 Shows Firewall Policies

Name	From	To	Source	Destination	Schedule	Service	Action	NAT	Security Profiles
LOCAL-LAN TO INTERNET	LOCAL-LAN (port2)	WAN-POR (port1)	all	all	always	ALL	ACCEPT	Enabled	default, block-high-risk, high_security, certificate-inspect
vpn_branch2-head_local_0	LOCAL-LAN (port2)	branch2-head	branch2-head_local	branch2-head_remote	always	ALL	ACCEPT	Disabled	no-inspection
vpn_branch2-head_remote_0	branch2-head	LOCAL-LAN (port2)	branch2-head_remote	branch2-head_local	always	ALL	ACCEPT	Disabled	no-inspection
vpn_branch2-branch1_local_0	LOCAL-LAN (port2)	branch2-branch1	branch2-branch1_local	branch2-branch1_remote	always	ALL	ACCEPT	Disabled	no-inspection
vpn_branch2-branch1_remote_0	branch2-branch1	LOCAL-LAN (port2)	branch2-branch1_remote	branch2-branch1_local	always	ALL	ACCEPT	Disabled	no-inspection
Implicit Deny	any	any	all	all	always	ALL	DENY		

Figure 2.11.3 – 5: Firewall Policies

The same configure we will follow in fortinet branch office 2 only the wan port lan port and firewall polices will be change.

### 2.11.4 Configure our main ubuntu server

- First, we will install docker on ubuntu server
- `$ sudo apt-get update`
- `$ sudo apt install apt-transport-https ca-certificates curl software-properties-common`
- `$ curl -fsSL https://download.docker.com/linux/ubuntu/gpg | sudo apt-key add`
- `$ sudo add-apt-repository "deb [arch=amd64] https://download.docker.com/linux/ubuntu focal stable"`
- `$ sudo apt install docker-ce`

## 2.11.4.a Next Cloud

- docker pull nextcloud
- docker run -d -p 8080:80 --name = clouds service nextcloud

Docker and Ubuntu server dashboard, where we can configure docker and ubuntu server as our requirement. Figure 2.11.4.a – 1 Shows Docker and Ubuntu server

```
ubuntu@ubuntu-virtual-machine:~/Desktop$ sudo docker ps
CONTAINER ID   IMAGE     COMMAND   CREATED   STATUS    PORTS   NAMES
ubuntu@ubuntu-virtual-machine:~/Desktop$ sudo docker ps -a
CONTAINER ID   IMAGE     COMMAND   CREATED   STATUS    PORTS   NAMES
ubuntu@ubuntu-virtual-machine:~/Desktop$ sudo docker image

Usage: docker image COMMAND

Manage images

Commands:
  build      Build an image from a Dockerfile
  history    Show the history of an image
  import     Import the contents from a tarball to create a filesystem image
  inspect    Display detailed information on one or more images
  load       Load an image from a tar archive or STDIN
  ls         List images
  prune      Remove unused images
  pull       Pull an image or a repository from a registry
  push       Push an image or a repository to a registry
  rm         Remove one or more images
  save       Save one or more images to a tar archive (streamed to STDOUT by default)
  tag        Create a tag TARGET_IMAGE that refers to SOURCE_IMAGE

Run 'docker image COMMAND --help' for more information on a command.
ubuntu@ubuntu-virtual-machine:~/Desktop$ sudo docker images
REPOSITORY    TAG       IMAGE ID       CREATED        SIZE
nextcloud     latest   1d418eb70dce   7 days ago    937MB
ubuntu@ubuntu-virtual-machine:~/Desktop$ sudo docker run -d -p 8080:80 --name cloud-service nextcloud
b055dcf3e9f432184327d5d92a79e1929f3895539662b5eeed756d91741c774
ubuntu@ubuntu-virtual-machine:~/Desktop$ sudo docker ps
CONTAINER ID   IMAGE     COMMAND   CREATED   STATUS    PORTS   NAMES
b055dcf3e9f4   nextcloud "/entrypoint.sh apac..." 15 seconds ago   Up 14 seconds   0.0.0.0:8080->80/tcp, :::8080->80/tcp   cloud-service
ubuntu@ubuntu-virtual-machine:~/Desktop$
```

Figure 2.11.4.a - 1: docker and ubuntu server

Then Docker and Ubuntu server will show dashboard for log in. Figure 2.11.4.a – 2 Shows docker and ubuntu server log in

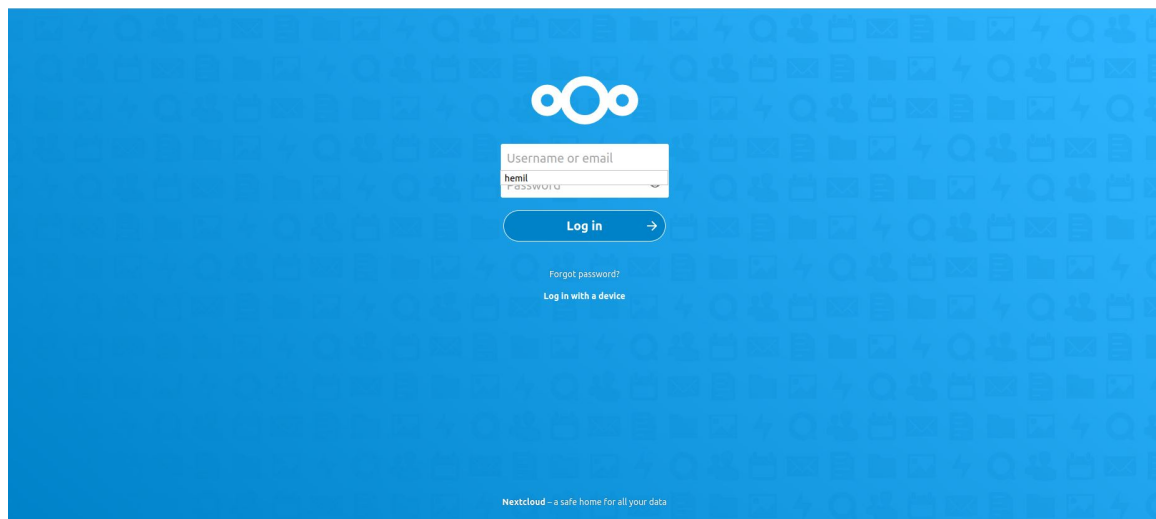


Figure 2.11.4.a – 2: docker and ubuntu server login

### 2.11.4.b Web Server

- `sudo docker run -d --name web-server -p 801:80 -v /home/ubuntu/web-server:/usr/share/nginx/html nginx`

Figure 2.11.4.b – 3 Shows web server

```
ubuntu@ubuntu-virtual-machine:~$ ls
Desktop Documents Downloads Music Pictures Public Templates Videos
ubuntu@ubuntu-virtual-machine:~$ sudo docker ps
CONTAINER ID   IMAGE     COMMAND                  CREATED        STATUS        PORTS                               NAMES
b055dcf3e9f4   nextcloud "/entrypoint.sh apac..." 7 minutes ago Up 7 minutes  0.0.0.0:8080->80/tcp, :::8080->80/tcp cloud-service
ubuntu@ubuntu-virtual-machine:~$ sudo docker run -d --name web-server -p 801:80 -v /home/ubuntu/web-server:/usr/share/nginx/html nginx
Unable to find image 'nginx:latest' locally
latest: Pulling from library/nginx
eff15d958d66: Already exists
1e5351450a59: Pull complete
2df63e6ce2be: Pull complete
9171c7ae368c: Pull complete
820f975acd28: Pull complete
266f639b35ad: Pull complete
Digest: sha256:097c3a0913d7e3a5b01b6c685a60c03632fc7a2b50bc8e35bcaa3691d788226e
Status: Downloaded newer image for nginx:latest
b0dbfbed58ef0ce9fe0947bae6b15e795a26cd1ef99909b5f21109ea4ee9a6fb
ubuntu@ubuntu-virtual-machine:~$ sudo docker ps
CONTAINER ID   IMAGE     COMMAND                  CREATED        STATUS        PORTS                               NAMES
b0dbfbed58ef   nginx     "/docker-entrypoint..." 8 seconds ago Up 8 seconds  0.0.0.0:801->80/tcp, :::801->80/tcp web-server
b055dcf3e9f4   nextcloud "/entrypoint.sh apac..." 13 minutes ago Up 13 minutes  0.0.0.0:8080->80/tcp, :::8080->80/tcp cloud-service
ubuntu@ubuntu-virtual-machine:~$
```

Figure 2.11.4.b – 3: web server

### 2.11.4.c FTP Server

- `$ sudo docker run -d -v /home/ftpserver:/home/vsftpd -p 20:20 -p 21:21 -p 47400-47470:47400-47470 -e FTP_USER=Zenith -e FTP_PASS=Zenith -e PASV_ADDRESS=127.0.0.1 --name ftp --restart=always bogem/ftp`
- `$ sudo apt-get update`
- `$ sudo apt-get install filezilla`

Figure 2.11.4.c – 4 Show Ftp Directory

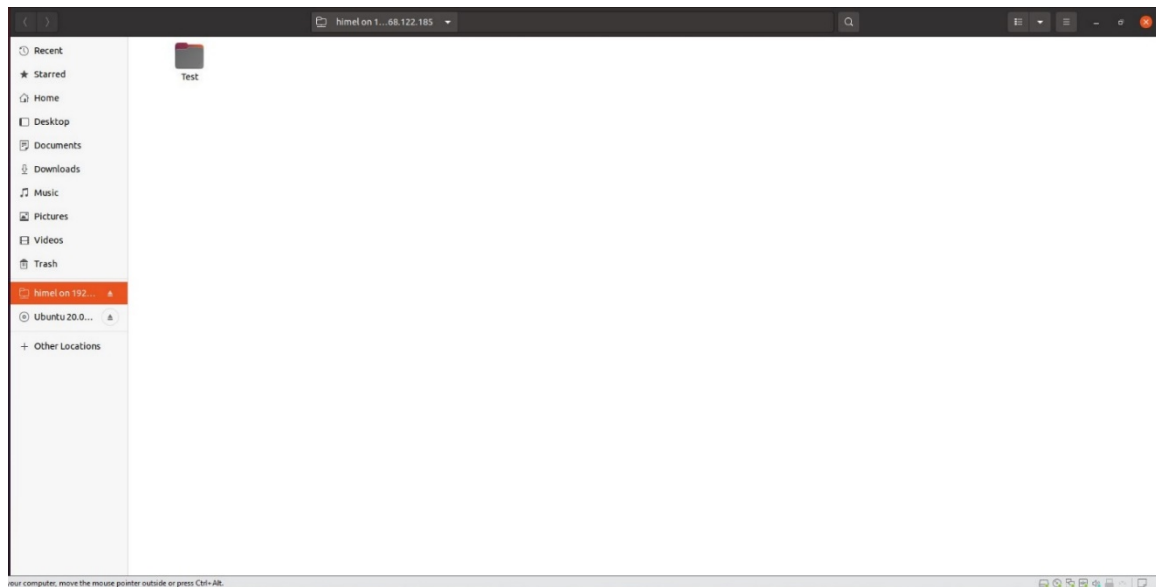


Figure 2.11.4.c – 4: Ftp Directory

#### 2.11.4.d Mail Server

To configure our mail server, we need specific requirements to our mail server which we will take it as our VM machine.

processor: 4vCPU, Ram: 8GB, disk space: 50GB

- `$ sudo vim /etc/dnsexample.com.conf`
- `$ sudo hostnamectl set-hostname client.exmample.com`
- `$ sudo vim/etc/hosts`
- `$ sudo systemctl restart`
- `$ wget https://files.zimbra.com/downloads/8.8.15_GA/zcs-8.8.15_GA_3869.UBUNTU18_64.20190918004220.tgz`
- `$ tar -xvf zcs-8.8.15_GA_3869.UBUNTU18_64.20190918004220.tgz`
- `$ cd zcs-8.8.15_GA_3869.UBUNTU18_64.20190918004220.tgz`
- `$ sudo ./install.sh`
- `$ sudo apt-get install update`
- `$ nslookup server.example.com`
- `$ sudo vim/etc/resolv.conf`
- `$ sudo nano /etc/resolv.conf`

## CHAPTER 3

### Requirement Specifications

#### 3.1 Element

- a. VMware Software
- b. Gns3 (Graphical Network Simulator)
- c. Operating system Image file (windows 10 and Ubuntu server OS)
- d. Computer
- e. Switch
- f. Firewall
- g. Host Computer
- h. IP Address
- i. Subnet Mask
- j. Default Gateway
- k. Domain Name
- l. Domain Server
- m. NTP Server
- n. FTP Server
- o. Web Server
- p. Mail server
- q. DMZ

#### 3.2 Internal and External Requirements

##### 3.2.1 Firewall Overview

As we know it very well that Fortinet (cyber security) company is one of the leading network security devices manufactures, Next-Generation Firewall (NGFW). [18] [19]

- Ultra-fast security, end to end
- Consistent real-time defense with FortiGate Services

- Excellent user experience with security processing units
- Operational efficiency and automated workflows

### **3.2.2 Windows 10 Overview**

Windows 10 is a major release of the Windows NT operating system developed by Microsoft. It is the successor to Windows 8.1, which was released nearly two years earlier and it self was released to manufacturing on July 15, 2015 and broadly released for the general public on July 29, 2015.

### **3.2.3 Ubuntu Overview**

Ubuntu is a complete Linux operating system, freely available with both communication and professional support. The Ubuntu community is built on the ideas protected in the Ubuntu Platform: that software should be obtainable free of charge, that software program tools should be serviceable by people in their local language and despite any incapacities and that people should have the freedom to modify and change their software program in whatever way they see suitable.

### **3.2.4 Docker Overview**

Docker is an open platform for developed, supply and running application. Docker enables you to separate your application from your infrastructure so you can deliver software quickly. With docker you can manage your infrastructure in the same ways you handle your applications. By taking benefit of docker's systems for delivery, analysis and deploying code quickly, you can significantly reduce the interruption between composing code and running it in production.  
[20] [21]

# CHAPTER 4

## Data Center Design and Diagram

### 4.1 Design and Diagram

For this project we are using GNS3 simulation software, VMware Workstation. We are replicating an office setup how office network setup work. Head office and branch office network connectivity via VPN and office application configuration and usable for users.

Figure 4.1 Shows Data Center Design

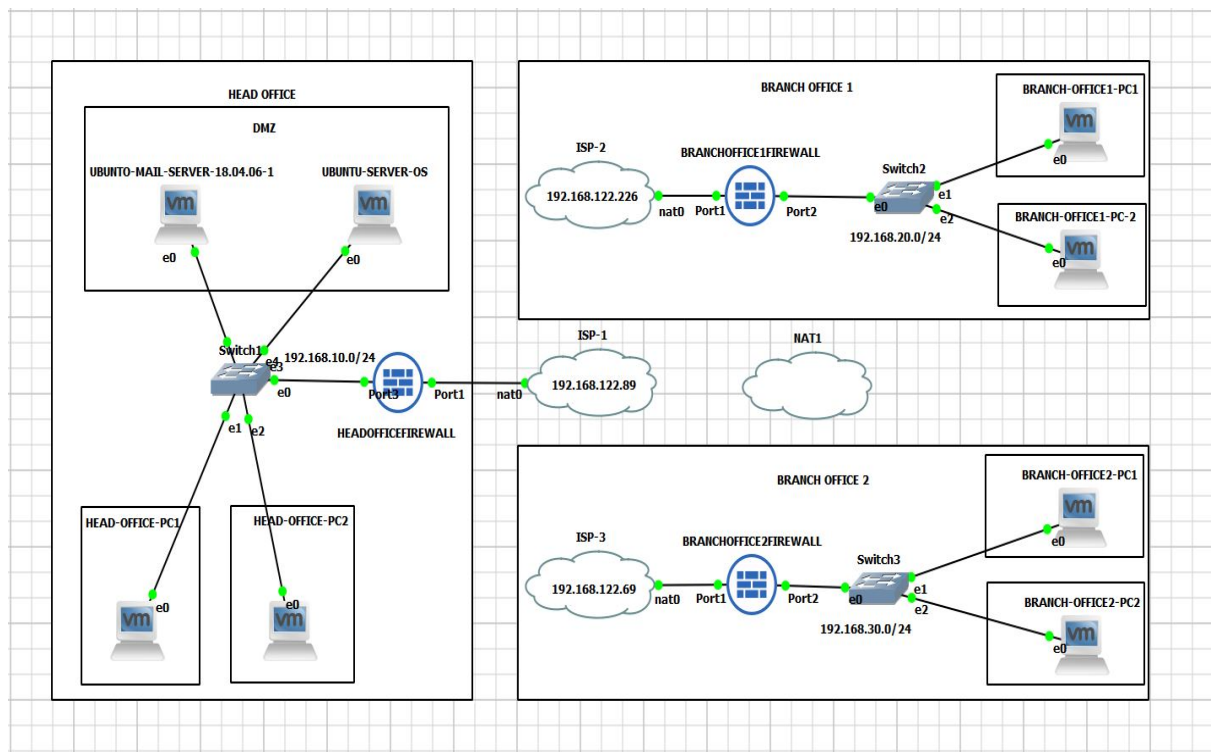


Figure 4.1: Data Center Design

## **CHAPTER 5**

### **Impact on Society, Environment and Sustainability**

#### **5.1 Impact on Society**

As we mention before in data center facility there are lot of server and NAS (network attached storage) remain on this kind of facility and gathers data from everywhere and people buy space package or use some free space offer package as they like, but in backend system strong AI system run on server system and monitor everything and social media platform is rub by this server.so we all relay on this backend data center system to run our own social platform.

#### **5.2 Impact on Environment**

In the world all big data center data mining company and bitcoin miners, data storage companies are trying to reduce their electricity cost by transferring their farms in north pole and south pole location for cold area and it also reduce energy cost by burning fossil fuel and trying to reduce environment temperature naturally.

#### **5.3 Ethical Aspects**

It is most important thing in data center to keep everyone data privately. data center company should not look for any type of information and sale data to other companies. Every company of this system should use firewall for prevent cyber-attack from black hat hackers or stolen information from any intruders.



## **5.4 Sustainability Plan**

For future upgrade and expansion data center should chose those type of place when data center can be expended if needed and from prevent environment type disaster like cyclone flood, earthquake, and most important load shedding. And rooftop we can use solar panel to create electricity from the sun and use this power energy in night this is how we can sustain our system properly.

## CHAPTER 6

### Conclusion and Further Development

#### 6.1 Conclusion

The main reason behind the developing this project because we want to show that we can improve our server services with minimum hardware requirement by Docker container virtualization. This project is just a concept for future virtualization system. This virtualization can help to improve our environment by low energy consumption.

#### 6.2 Scope for Further Developments

- a. We can add more server services as we need for future development.
- b. We can Improve firewall security policies for more secure network.
- c. All the server services should run on real server machines.
- d. We will improve our web server and next cloud server services as future requirement.

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