



Research on hypervisors

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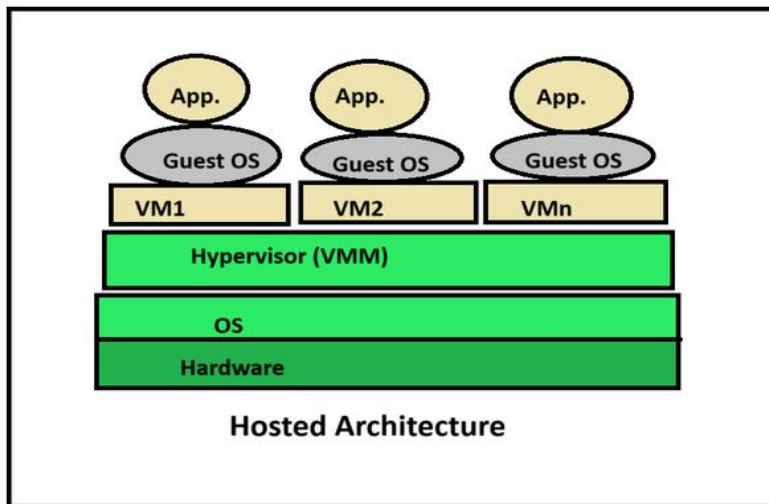
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Introduction

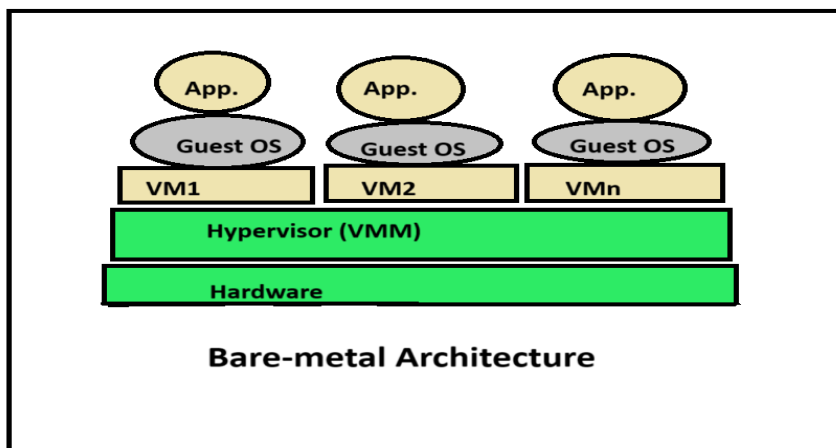
In this research paper, I aim to research hypervisors and their respective types, discuss advantages and how they are structures, and I will also create a virtual topology given in the task.

Task 1

A hypervisor is software that makes virtualization possible by creating virtual computers and able to run such virtual computers on a single physical computer, ensuring that each virtual system has its own operating system and applications. There are 2 types of hypervisors namely; TYPE 1 hypervisor and TYPE 2 hypervisor. TYPE 1 hypervisors run directly on the host system and employ bare metal architecture, which does not require an operating system. While TYPE 2 hypervisors run on an application installed on the host system and adopt an architecture type called the hosted architecture. The hypervisor allows the physical system to allocate computer resources such as the CPU and memory to each virtual system as required. The two types of architecture in a hypervisor are hosted and bare metal. The hosted architecture requires the operating system to be installed on the hardware which then allows the hypervisor to be installed which consists of a hypervisor layer, partitions, and virtualization stacks as shown in fig.1



In the bare metal architecture, no operating system is required in installation only the physical system is required as shown in fig.2



There are many features of hypervisors, such as-

- Partitioning – hypervisor can use the computer hardware efficiently and allows multiple independent software to run in the hardware concurrently.
- Resource distribution – hypervisor can find the best way to distribute limited resources between multiple applications.

- Isolation – hypervisor makes sure all the virtual machines are independent of each other which prevents the problem of one virtual machine from infecting another virtual machine.
- Communication – hypervisor handles all communications between each virtual machine
- Scalability – hypervisors allow easier management of resources like adding or removing.

Using a hypervisor requires your hardware to have some baseline requirements, such as

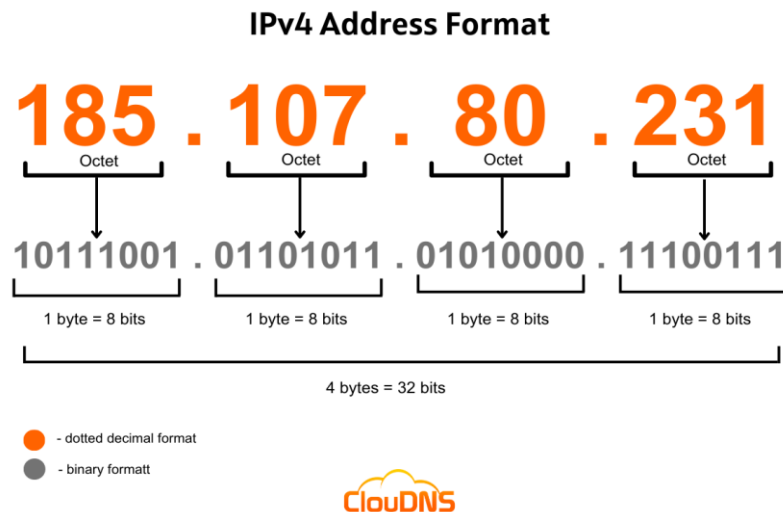
- A 64-bit processor with a with a second level address translation (SLAT) capability
- 4GB RAM minimum processor
- Virtualization support enabled in BIOS
- A CPU with multiple cores like AMD for optimal performance
- Gigabit ethernet network
- A fast storage like SSDs

Benefits of hypervisors -

- Improved security – since hypervisors use virtual machines that run independently on the hardware any crashes or virus attacks are isolated and have no hope of affecting other virtual machines like a sand box.
- Improved flexibility – the use of VMs makes it easier to manage resources
- Cost reduction – hypervisors eliminate the need of more physical hardware with the use of VMs

The IP address is a unique sequence of numbers or letters that is specific to a computer on the network and acts as the device's identifier. It is normally in an octet form. The IP stands for Internet Protocol. In terms of the functionality of the network, the IP address acts as a unique postal code address. Like in the sense that if packets of data need to be sent to a computer would need its correct IP address to receive the correct information. The IP address also manages traffic on

the network by creating subnets of itself, allowing communication between devices on different networks through switches and routers. There are 2 types of formats regarding IP address, the IPv4 and IPv6. The IPv4 address structure is in the form of a numerical string divided into octets like (192.0.2.1) where each part of the octet has a specific function for the network. The IPv4 format explains that the first octet (192) identifies the network ID and the remaining octets identify the host ID as shown in fig3.



The IP address also had a subnet mask which acts as an identifier that tells network specialist which part of the IP address belongs to the network. IPv4 addresses also have various classes like class A, class B, class C, class D (multicast addresses) and class E. IPv6 addresses are in a 128-bit format divided into eight 16-bit blocks (or hextets) divided by colons as shown in fig 3.2

IPv6 address

2001 : 0DC8 : E004 : 0001 : 0000 : 0000 : 0000 : F00A

16 bits : 16 bits : 16 bits : 16 bits : 16 bits : 16 bits : 16 bits : 16 bits

128 Bits



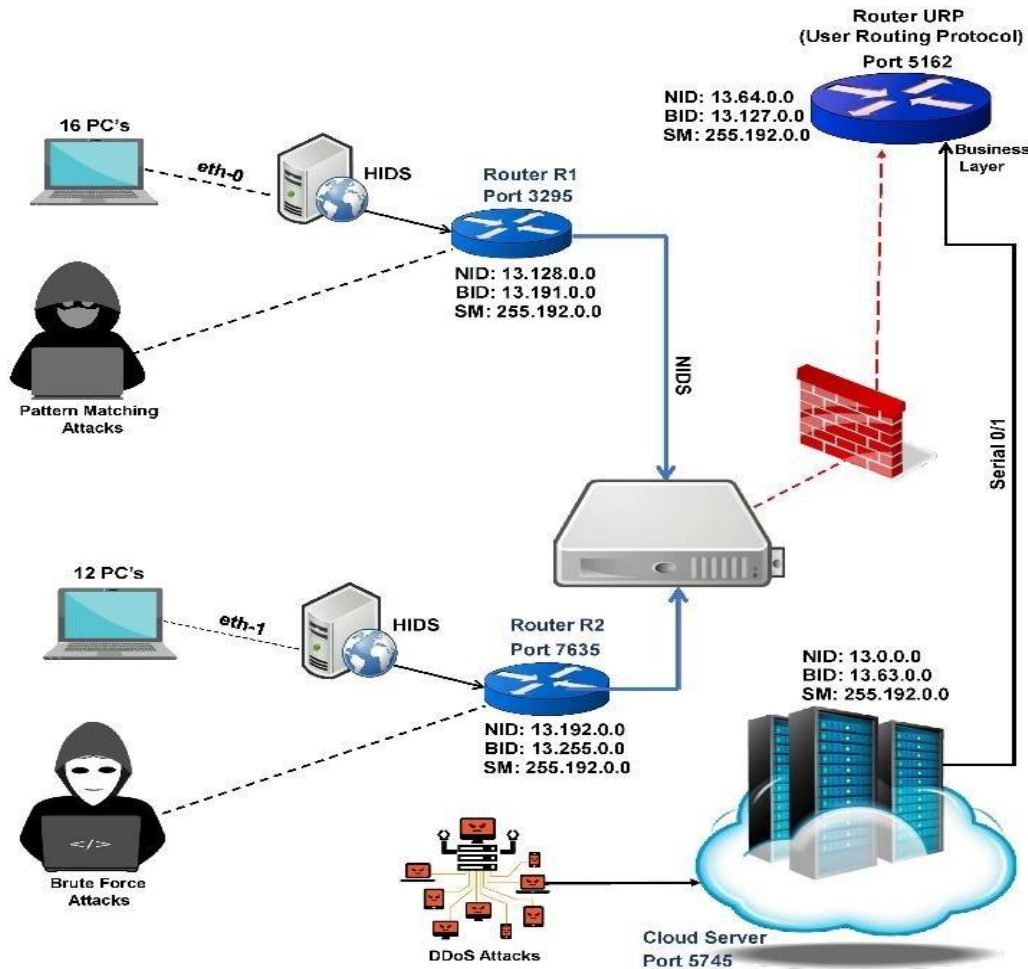
The IPv6 format is the newer format which was made 20 years ago and was meant to replace the old IPv4 format because as the years go by the number of computers connecting to the internet has increased and the IPv4 format is not able to satisfy the needs of all the devices which the IPv6 is able to.

Difference between IPv4 and IPv6

IPv4	IPv6
32-bit address	128-bit address
Allows fragmentation	No fragmentation
Network address translation	No network address translation needed
Address config. Manually or with DHCP	Automatically configured

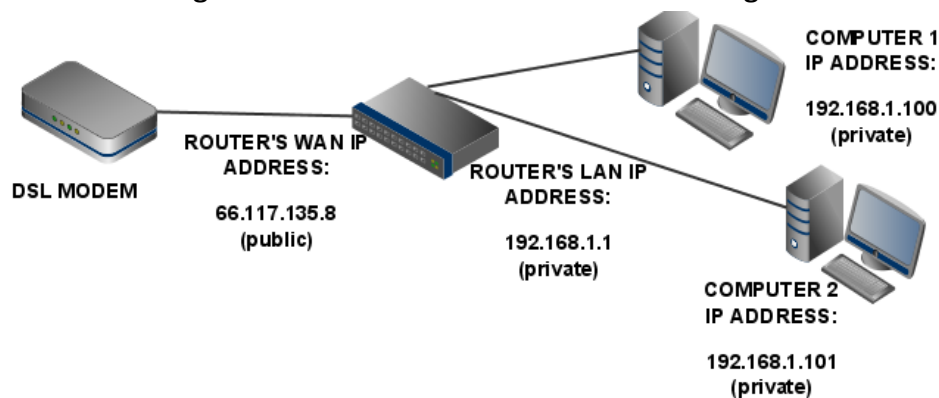
There are many applications of IP addressing mainly -

- Cloud computing – this is used to manage and provide services to companies or homes that desire to keep secure data in a cloud, only allowing IP addresses familiar to the company or home, shown in fig4.



- Online gaming – IP addresses are used in online games to connect various accounts to a local server or a session.
- Local area networks – the management of devices and communication of devices connected to the same router by a LAN cable is done with all

devices having the same IP address as shown in fig 5.



Routing is a process in which a network path is selected for communication between each computer on the network. Routing protocols are a set of rules designed to find the best pathway possible for forwarding data and ensuring routing information is sent between routers regularly allowing routers to build up network topologies. There are many types of routing protocols namely; static routing, dynamic routing, distance-vector routing, and link-state routing.

Static routing also called non-adaptive routing is a type of routing that the network administrator needs to manually configure the routing for example if we have 3 different paths the network administrator needs to pick a certain path for the nodes to transmit data from one to the other. The network administrator is InCharge of routing data packets to their destination.

Dynamic routing- in this process the routing of pathways is automatic because the pathways chosen are the shortest route due to various shortest path algorithms and pre-determined metrics. This routing process is also called adaptive routing, and the router makes changes to the routing table when new paths are taken.

Distance-vector routing – this method routers use by finding the best path for data to travel across a network. Each router keeps a router table with the number of hops used to get the data to its destination which will then show the shortest distance each router took and shares the information with its neighbors to update their tables and find the most efficient route.

Link-state routing- this routing method is like the opposite of distance-vector routing because instead of using an algorithm, link-state routing uses link-state

routers to exchange information amongst each router allowing them to learn the entire network topology.

Difference between static routing and dynamic routing.

STATIC ROUTING	DYNAMIC ROUTING
The routing is manually configured	The routing is automatically configured
Does not adapt to changes in the network topology.	Adapts to changes in the network topology.
Requires manual updates	Updates routing routes automatically
This routing is less scalable as it is mostly used for small and simple networks	This routing is more scalable as it is mostly used for large and complex networks

A VPN is an application that makes a secure network when using public networks by encrypting online traffic and hiding your online identity. Making it more difficult for third parties to steal information. A VPN has many key features and concepts

Concepts and features of a VPN

CONCEPTS	FEATURES
Creates a secure and encrypted connection between two parties over the internet	VPNs mask the IP address and location of users
Encapsulates data packets within another protocol to create a secure connection	VPNs enable remote access to networks and resources
Can verify and identify users and devices	VPNs enables firewall protections to block unauthorized access

The DHCP (dynamic host configuration protocol) is a protocol used to assign IP addresses automatically. It is also the main protocol where users on an enterprise network communicate.

Concepts and features of a DHCP

CONCEPTS	FEATURES
Automatically assigns IP addresses and other network settings to devices on a network	Provides options for configuring additional network settings like a DNS server and subnet masks
Assigns IP addresses from a pool of available addresses	DHCP is scalable and able to support substantial number of resources
Able to temporarily assign IP addresses to devices and able to renew or release it	Manages a pool of IP addresses, ensuring they are not duplicated.

Active directory domain services are the core functions in active directory which manage users and devices to arrange them in a hierarchical order. It allows companies to customize data to suit their own needs, managing AD DS can be done from any computer, to be able to use AD DS there are some key terms you need to understand like; schema, replication service, global catalog, and sites.

Certificate authorities – this is a trusted organization that issues certificates to businesses, websites, and individuals. This is done as a form of encryption because attackers could make fake websites with stolen information from other verified websites.

Task 2

I chose a type 2 hypervisor as I found it easier to use and manage compared to a type 1 hypervisor. In terms of installation time and use compared to type 1 as well as the fact that most type 2 are free of cost. The type 2 hypervisor I used is called virtual box but at first that was not my decision as shown below in fig6. I had downloaded QUMU which is also a type 2 hypervisor, but it required a

The screenshot shows the Chrome browser's 'Download history' page. The address bar shows 'chrome://downloads'. The page has a search bar at the top with the text 'Search download history'. Below this, the downloads are organized by date. The 'Today' section is empty. The 'December 12, 2024' section contains three items: 'qemu-w64-setup-20250210.exe' (downloaded from 'https://qemu.weibnetz.de'), '1-x86-S3210670718318881-main.pdf', and 'ACCA5034_Sem1_CW_2024_2025_Data_Security_and_Compliance.docx'. The 'December 2, 2024' section contains one item: 'EAppInstaller.exe'. The 'November 18, 2024' section contains three items: 'Network_programmability_task.docx', 'yfc-3.0.21-win64.exe', and 'DEVASC_VM.exe'. At the bottom, a notification bar states: 'Deleted A_Systematic_Review_of_Information_S... from download history, but it's still on your device'. The taskbar at the bottom shows various application icons and the system clock.

The screenshot displays the MSYS2 website interface and two terminal windows. The website shows the 'Getting Started' section, which includes links for installation, sponsors, and documentation. The terminal windows show the execution of the following commands:

```
pacman -S mingw-w64-ucrt-x86_64-gcc
```

```
pacman -S mingw-w64-ucrt-x86_64-gcc
```

```
pacman -S mingw-w64-ucrt-x86_64-gcc
```

The terminal output shows the installation progress, including the total download size (49.38 MiB) and total installed size (416.82 MiB). The installation is completed successfully, and the user is prompted to proceed with installation.

Using the virtual box, I used a Linux ios operating system called Ubuntu. I picked Ubuntu because it was easier to download and get used to deploying networks as well as configuring the virtual machines. I also tried a windows iOS operating system but found challenges as a product key was required as shown in fig 9, then I settled on using Linux for both VMs shown in fig 10.

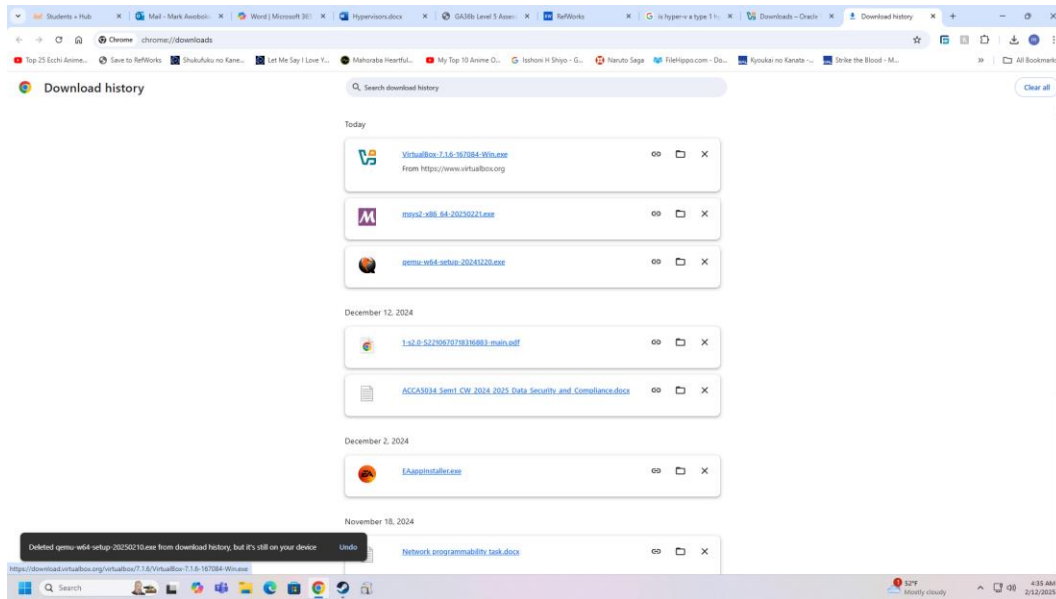


Fig 8

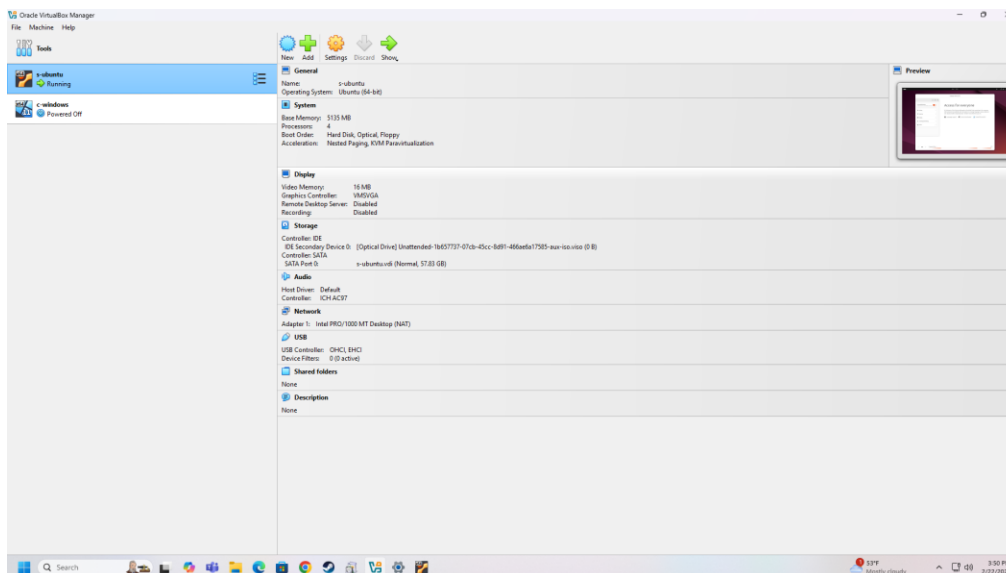


Fig 9

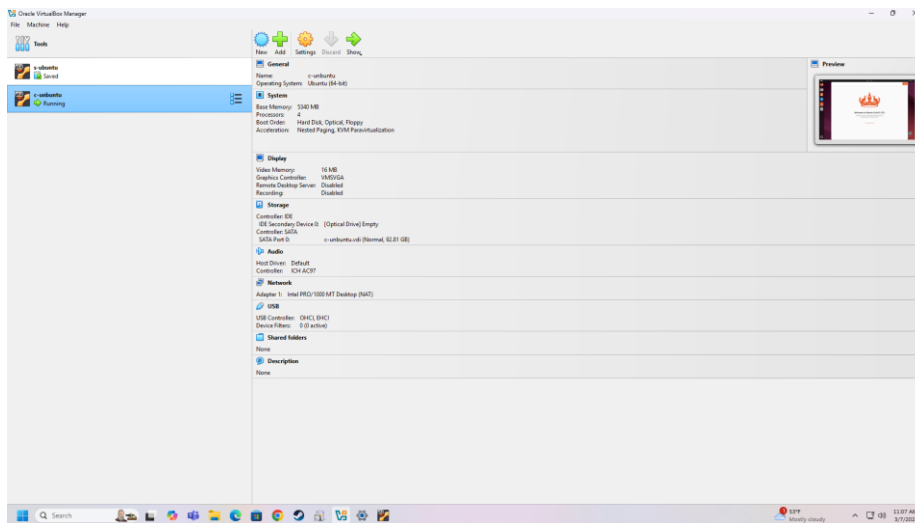


Fig 10

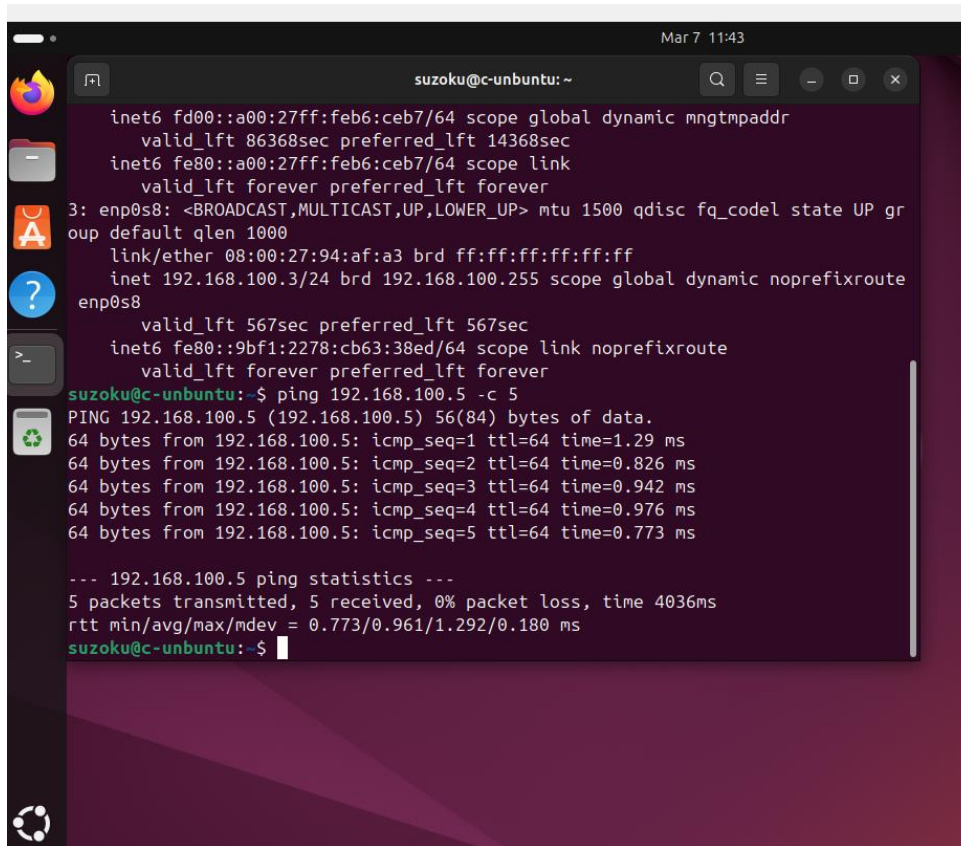
After configuring both VMs I then set the network IP Address and Subnet masks and ran both the VMs to make sure they both worked, then used a code “IP addr show.” This code is a Linux code which shows the IP address of the virtual machine, and it worked.

```

Mar 7 11:45
suzoku@s-ubuntu: ~
inet 127.0.0.1/8 scope host lo
    valid_lft forever preferred_lft forever
inet6 ::1/128 scope host noprefixroute
    valid_lft forever preferred_lft forever
2: enp0s3: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP gr
oup default qlen 1000
    link/ether 08:00:27:73:bd:9e brd ff:ff:ff:ff:ff:ff
    inet 10.0.2.15/24 brd 10.0.2.255 scope global dynamic noprefixroute enp0s3
        valid_lft 86367sec preferred_lft 86367sec
    inet6 fd00::7d75:b5dd:fec4:f809/64 scope global temporary dynamic
        valid_lft 86368sec preferred_lft 14368sec
    inet6 fd00::a00:27ff:fe73:bd9e/64 scope global dynamic mngtmpaddr
        valid_lft 86368sec preferred_lft 14368sec
    inet6 fe80::a00:27ff:fe73:bd9e/64 scope link
        valid_lft forever preferred_lft forever
3: enp0s8: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP gr
oup default qlen 1000
    link/ether 08:00:27:cf:5d:84 brd ff:ff:ff:ff:ff:ff
    inet 192.168.100.5/24 brd 192.168.100.255 scope global dynamic noprefixroute
    enp0s8
        valid_lft 567sec preferred_lft 567sec
    inet6 fe80::5fdb:f92c:aa2b:7a67/64 scope link noprefixroute
        valid_lft forever preferred_lft forever
suzoku@s-ubuntu:~$

```

Then to show if both virtual machines could send messages between each other I use code “ping IP address -c 5” this code shows how many messages I wanted to send in ping format to the other virtual machine and it went successfully as there was no packet loss between each VM over the network.



```

suzoku@c-ubuntu: ~
inet6 fd00::a00:27ff:feb6:ceb7/64 scope global dynamic mngtmpaddr
    valid_lft 86368sec preferred_lft 14368sec
inet6 fe80::a00:27ff:feb6:ceb7/64 scope link
    valid_lft forever preferred_lft forever
3: enp0s8: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000
    link/ether 08:00:27:94:af:a3 brd ff:ff:ff:ff:ff:ff
    inet 192.168.100.3/24 brd 192.168.100.255 scope global dynamic noprefixroute
        enp0s8
            valid_lft 567sec preferred_lft 567sec
            inet6 fe80::9bf1:2278:cb63:38ed/64 scope link noprefixroute
                valid_lft forever preferred_lft forever
suzoku@c-ubuntu:~$ ping 192.168.100.5 -c 5
PING 192.168.100.5 (192.168.100.5) 56(84) bytes of data:
64 bytes from 192.168.100.5: icmp_seq=1 ttl=64 time=1.29 ms
64 bytes from 192.168.100.5: icmp_seq=2 ttl=64 time=0.826 ms
64 bytes from 192.168.100.5: icmp_seq=3 ttl=64 time=0.942 ms
64 bytes from 192.168.100.5: icmp_seq=4 ttl=64 time=0.976 ms
64 bytes from 192.168.100.5: icmp_seq=5 ttl=64 time=0.773 ms

--- 192.168.100.5 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4036ms
rtt min/avg/max/mdev = 0.773/0.961/1.292/0.180 ms
suzoku@c-ubuntu:~$

```

Conclusion

Hypervisor type 2 is better than hypervisor type 1 because of the ease of use, availability, and ease of leaning.

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