

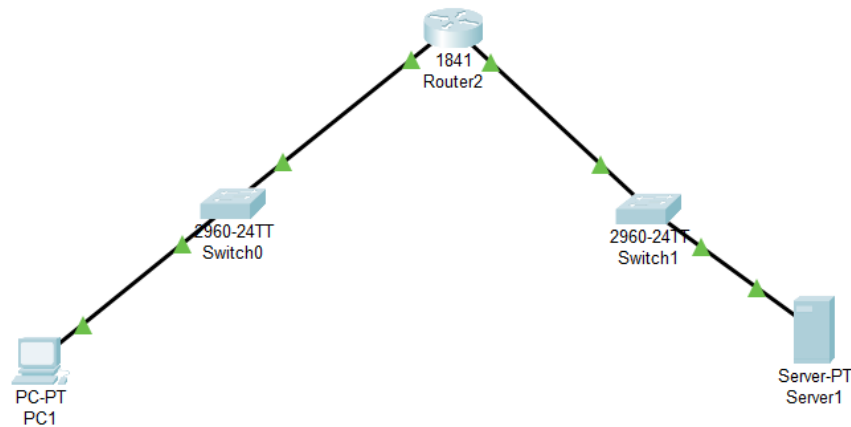
Coursework Portfolio 2

Building a Virtual Sandboxed network
using , Operating systems i.e. Ubuntu gateway, Ubuntu desktop and Ubuntu server .

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1. Network Diagram



Configuring the Gateway Router (Router1)

To configure Router1 as a gateway router with two interfaces (one for the local network and one for the serial connection), follow the steps below:

❖ Enter Privileged EXEC Mode:

- From the router's console, enter privileged EXEC mode by typing:

Router1> enable

❖ Enter Global Configuration Mode:

- Enter global configuration mode to make configuration changes:

❖ Router1#configureterminal

Configure FastEthernet Interface (Local Network):

- Configure the **FastEthernet 0/0** interface, which connects to your local network:

Router1(config)# interface fastethernet 0/0

```
Router1(config-if)# ip address 192.168.38.1 255.0.0.0
```

```
Router1(config-if)# no shutdown
```

```
Router1(config-if)# exit
```

❖ Configure Serial Interface (Connection to Another Router or WAN):

- Configure the **Serial 0/1** interface, which connects to another router or WAN network:

```
Router1(config)# interface serial 0/1
```

```
Router1(config-if)# ip address 192.168.138.1 255.0.0.0
```

```
Router1(config-if)# no shutdown
```

```
Router1(config-if)# exit
```

2.IP Address Table:

Devices	IP Addresses	Subnet mask
Gateway Router VM (enp0s3) , i.e. Ubuntu server	10.0.2.16	255.255.255.0
Gateway Router VM (enp0s8) ,i.e. Ubuntu server	192.168.38.1	255.255.255.0
Gateway Router VM (enp0s9), i.e. Ubuntu server	192.168.138.1	255.255.255.0
Ubuntu Desktop VM	192.168.38.2	255.255.255.0
Application server VM Bitnami	192.168.138.2	255.255.255.0

3.Git Pages Lab Report

<https://github.com/Vaish30v/sandbox>

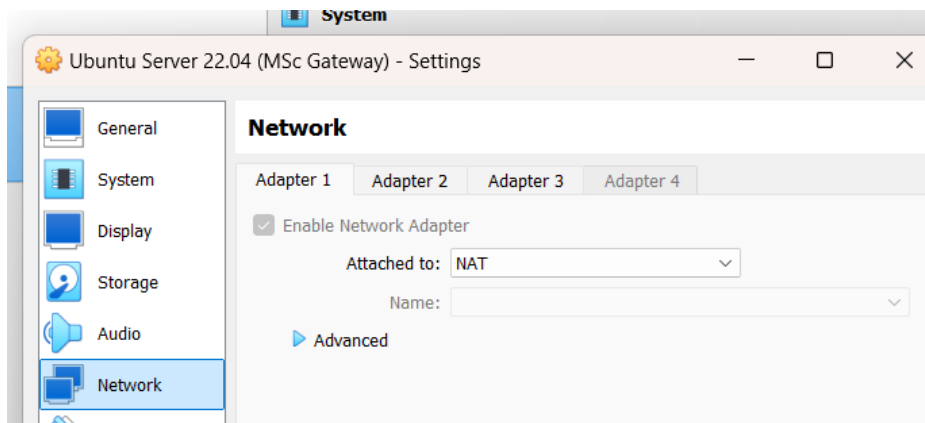
Configuration Steps:

For this project we need to download three Operating Systems in VM virtual box.

1. Ubuntu gateway (iso)
2. Ubuntu Desktop (iso)
3. Ubuntu Server , Bitnami wordpress(ova)

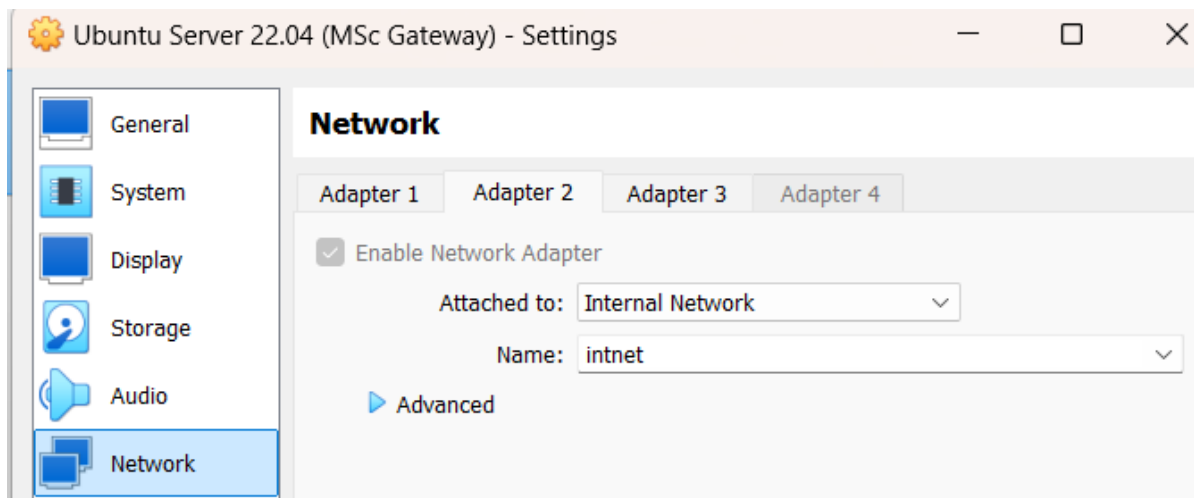
1. Ubuntu Gateway Router:

- Creating a new virtual machine.
- Configuring network adapters [opening setting then network in that we will find the interphases like adapter 1, adapter 2, adapter 3] So in that,
- ✓ Adapter 1: setting to NAT (enp0s3) ip addresses here will be assigned via dhcp4, and this is used to provide access to the internet via the host computer.



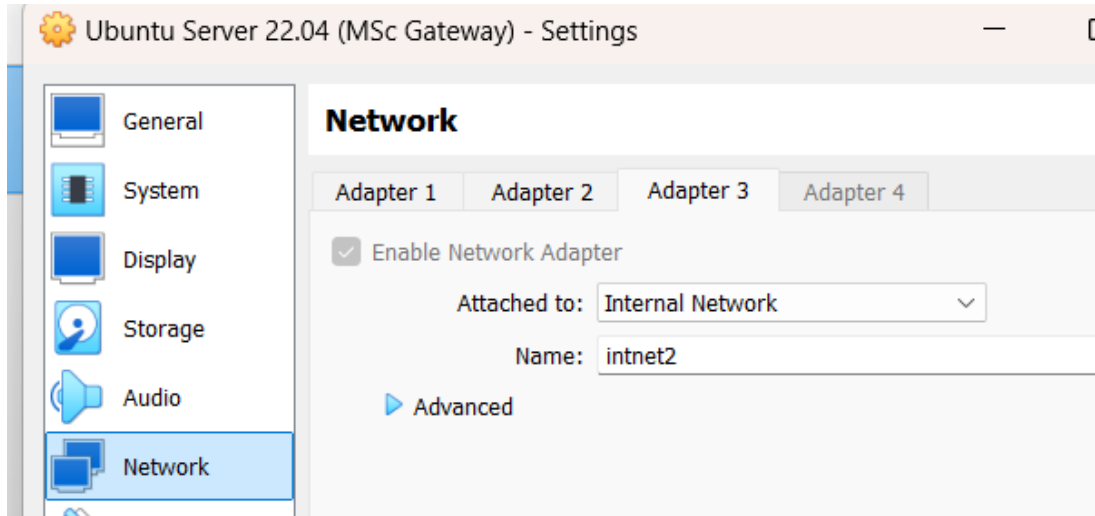
This image above represent Adapter 1 and its network configuration.

- ✓ Adapter 2: setting it to Internal Network(enp0s8) and subnet Intnet then in advances tab setting it to PCnet-Fast III.



This image represent Adapter 2 and its Network Configurations .

- ✓ 3.Adapter 3: setting it to Internal Network (enp0s9) , subnet to Intnet2



This image represent Adapter 3 and its Network Configures.

Configuring static IPs on the Network

Now we need to assign the Static IPs , for this

- Editing network configuration files:

```
sudo nano /etc/netplan/00-installer-config.yaml
```

after running this command, we will see the screen like this here we have to add our IPs

```
File Machine View Input Devices Help
GNU nano 6.2 /etc/netplan/00-installer-config
# This is the network config written by 'subiquity'
network:
  ethernets:

    enp0s3:
      dhcp4: true
    nameservers:
      addresses: [8.8.8.8/24]
      addresses: [1.1.1.1/24]

    enp0s8:
      dhcp4: false
      addresses: [192.168.38.1/24]

    enp0s9:
      dhcp4: false
      addresses: [192.168.138.1/24]

  version: 2
```

Then for saving it (CTRL X) then type Y (yes) and Enter.

- Now for applying changes,
Sudo netplan apply
- For checking applied changes worked well, we use
ip a

```

student@router:~$ ip a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
        valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host
        valid_lft forever preferred_lft forever
2: enp0s8: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP
    link/ether 08:00:27:47:32:dc brd ff:ff:ff:ff:ff:ff
    inet 192.168.38.1/24 brd 192.168.38.255 scope global enp0s8
        valid_lft forever preferred_lft forever
    inet6 fe80::a00:27ff:fe47:32dc/64 scope link
        valid_lft forever preferred_lft forever
3: enp0s3: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP
    link/ether 08:00:27:17:36:79 brd ff:ff:ff:ff:ff:ff
    inet 10.0.2.15/24 metric 100 brd 10.0.2.255 scope global dynamic enp0s3
        valid_lft 86270sec preferred_lft 86270sec
    inet6 fe80::a00:27ff:fe17:3679/64 scope link
        valid_lft forever preferred_lft forever
4: enp0s9: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP
    link/ether 08:00:27:80:ed:23 brd ff:ff:ff:ff:ff:ff
    inet 192.168.138.1/24 brd 192.168.138.255 scope global enp0s9
        valid_lft forever preferred_lft forever
    inet6 fe80::a00:27ff:fe80:ed23/64 scope link
        valid_lft forever preferred_lft forever

```

Now this images shows IPs addresses applied successfully.

- Enabling IP Forwarding:

To allowing Routing between two subnets , we have to enable ip forwarding

Open the sysctl configuration file:

```
sudo nano /etc/sysctl.conf
```

- Uncommenting the line (removing #)

```
Net.ipv4.ip_forward=1
```

- Apply the changes

```
sudo sysctl -p
```

- Set Up IPTables for routing

Configuring iptables to ensure packets are forwarded between the subnets,

Configuring iptables to allow Forwarding ,

```
sudo iptables -A FORWARD -i enp0s8 -o enp0s9 -j ACCEPT
```

```
sudo iptables -A FORWARD -i enp0s9 -o enp0s8 -j ACCEPT
```

```
sudo iptables -A FORWARD -i enp0s3 -o enp0s8 -j ACCEPT
```

```
sudo iptables -A FORWARD -i enp0s8 -o enp0s3 -j ACCEPT
```

```
sudo iptables -A FORWARD -i enp0s3 -o enp0s9 -j ACCEPT
```

```
sudo iptables -A FORWARD -i enp0s9 -o enp0s3 -j ACCEPT
```

Between enp0s8 and enp0s9

Between enp0s3 and internal networks

Enabling NAT on enp0s3 for internet access,

```
sudo iptables -t nat -A POSTROUTING -o enp0s3 -j MASQUERADE
```

To make the changes permanent, can save the iptables rules:

```
sudo apt install iptables-persistent
```

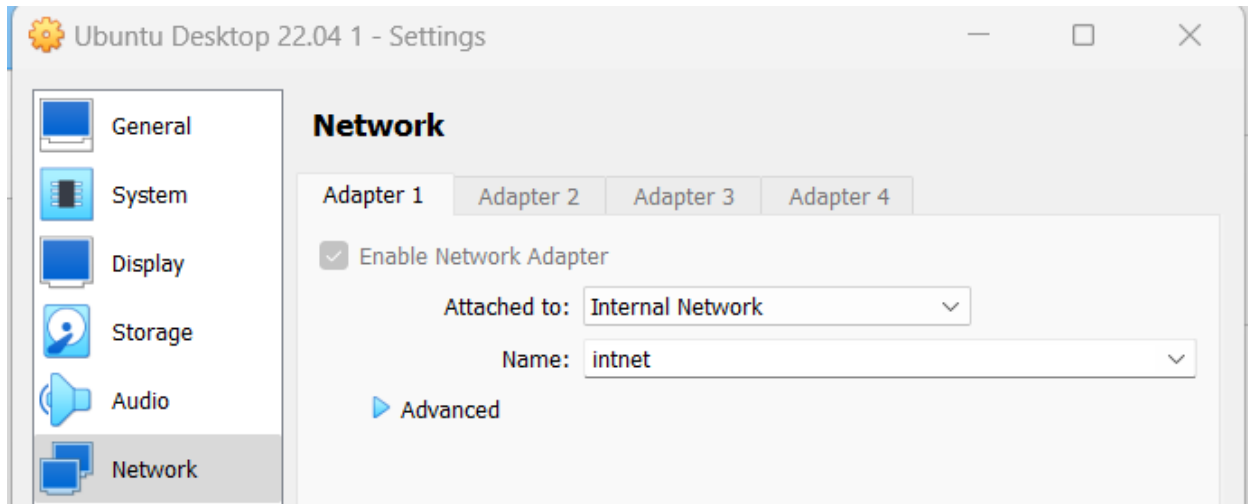
```
sudo netfilter-persistent save
```

```
sudo netfilter-persistent reload
```

2. Ubuntu Desktop OS configuration Steps:

Configuring the network interfaces,

Selecting Adapter 1 and subnet (intnet)



In the setting , go the network then select IPv4

In that select IPv4 method to manual then adding address IP addresses.

Then apply and disconnect it for one more time and on .

Wired

Cancel Apply

Details Identity **IPv4** IPv6 Security

IPv4 Method

- ☐ Automatic (DHCP)
- ☒ Manual
- ☐ Shared to other computers
- ☐ Link-Local Only
- ☐ Disable

Addresses

Address	Netmask	Gateway	
192.168.38.2	255.255.255.0	192.168.38.1	

DNS Automatic ☒

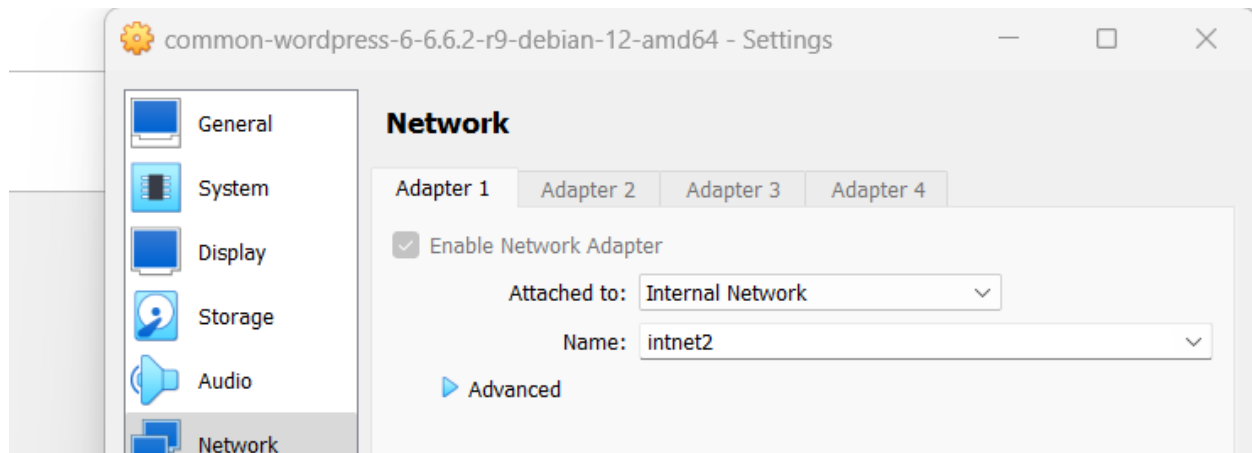
8.8.8.8, 1.1.1.1

Separate IP addresses with commas

```
student@ubdesktop: ~  
student@ubdesktop:~$ ip a  
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000  
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00  
    inet 127.0.0.1/8 scope host lo  
        valid_lft forever preferred_lft forever  
    inet6 ::1/128 scope host  
        valid_lft forever preferred_lft forever  
2: enp0s3: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000  
    link/ether 08:00:27:97:75:31 brd ff:ff:ff:ff:ff:ff  
    inet 192.168.38.2/24 brd 192.168.38.255 scope global noprefixroute enp0s3  
        valid_lft forever preferred_lft forever  
    inet6 fe80::ccb2:c136:6dee:5645/64 scope link noprefixroute  
        valid_lft forever preferred_lft forever  
3: virbr0: <NO-CARRIER,BROADCAST,MULTICAST,UP> mtu 1500 qdisc noqueue state DOWN group default qlen 1000  
    link/ether 52:54:00:71:a8:06 brd ff:ff:ff:ff:ff:ff  
    inet 192.168.122.1/24 brd 192.168.122.255 scope global virbr0  
        valid_lft forever preferred_lft forever  
student@ubdesktop:~$  
student@ubdesktop:~$
```

3.Bitnami Wordpress application configuration steps:

Go the setting then , select network configuration like Internal network and subnet intnet2.



Then check overall connectivity if it is running or not that it.

4.Functional test Results:

Ubuntu Gateway :

1. Pinging from Ubuntu gateway to Ubuntu desktop [ping 192.168.38.2]

```
student@router:~$ ping 192.168.38.2
PING 192.168.38.2 (192.168.38.2) 56(84) bytes of data:
64 bytes from 192.168.38.2: icmp_seq=1 ttl=64 time=68.9 ms
64 bytes from 192.168.38.2: icmp_seq=2 ttl=64 time=32.0 ms
64 bytes from 192.168.38.2: icmp_seq=3 ttl=64 time=2.70 ms
64 bytes from 192.168.38.2: icmp_seq=4 ttl=64 time=2.03 ms
64 bytes from 192.168.38.2: icmp_seq=5 ttl=64 time=3.71 ms
64 bytes from 192.168.38.2: icmp_seq=6 ttl=64 time=1.81 ms
64 bytes from 192.168.38.2: icmp_seq=7 ttl=64 time=1.92 ms
64 bytes from 192.168.38.2: icmp_seq=8 ttl=64 time=1.36 ms
64 bytes from 192.168.38.2: icmp_seq=9 ttl=64 time=0.529 ms
64 bytes from 192.168.38.2: icmp_seq=10 ttl=64 time=0.907 ms
64 bytes from 192.168.38.2: icmp_seq=11 ttl=64 time=1.87 ms
^C
```

2. Pinging from Ubuntu gateway to bitnami wordpress (server) [ping 192.168.138.2]

```
student@router:~$ ping 192.168.138.2
PING 192.168.138.2 (192.168.138.2) 56(84) bytes of data.
64 bytes from 192.168.138.2: icmp_seq=1 ttl=64 time=60.1 ms
64 bytes from 192.168.138.2: icmp_seq=2 ttl=64 time=1.28 ms
64 bytes from 192.168.138.2: icmp_seq=3 ttl=64 time=5.45 ms
64 bytes from 192.168.138.2: icmp_seq=4 ttl=64 time=1.83 ms
64 bytes from 192.168.138.2: icmp_seq=5 ttl=64 time=2.15 ms
64 bytes from 192.168.138.2: icmp_seq=6 ttl=64 time=2.68 ms
64 bytes from 192.168.138.2: icmp_seq=7 ttl=64 time=2.97 ms
64 bytes from 192.168.138.2: icmp_seq=8 ttl=64 time=2.77 ms
64 bytes from 192.168.138.2: icmp_seq=9 ttl=64 time=1.49 ms
64 bytes from 192.168.138.2: icmp_seq=10 ttl=64 time=2.66 ms
64 bytes from 192.168.138.2: icmp_seq=11 ttl=64 time=2.09 ms
64 bytes from 192.168.138.2: icmp_seq=12 ttl=64 time=2.92 ms
^C
```

3. Pinging the DNS server

```
student@router:~$ ping 8.8.8.8
PING 8.8.8.8 (8.8.8.8) 56(84) bytes of data.
64 bytes from 8.8.8.8: icmp_seq=1 ttl=114 time=393 ms
64 bytes from 8.8.8.8: icmp_seq=2 ttl=114 time=113 ms
64 bytes from 8.8.8.8: icmp_seq=3 ttl=114 time=16.2 ms
64 bytes from 8.8.8.8: icmp_seq=4 ttl=114 time=15.7 ms
64 bytes from 8.8.8.8: icmp_seq=5 ttl=114 time=16.9 ms
64 bytes from 8.8.8.8: icmp_seq=6 ttl=114 time=17.0 ms
64 bytes from 8.8.8.8: icmp_seq=7 ttl=114 time=21.4 ms
64 bytes from 8.8.8.8: icmp_seq=8 ttl=114 time=20.1 ms
64 bytes from 8.8.8.8: icmp_seq=9 ttl=114 time=22.3 ms
64 bytes from 8.8.8.8: icmp_seq=10 ttl=114 time=17.5 ms
64 bytes from 8.8.8.8: icmp_seq=11 ttl=114 time=15.5 ms
64 bytes from 8.8.8.8: icmp_seq=12 ttl=114 time=15.2 ms
```

Ubuntu Desktop:

1. Pinging from Ubuntu Desktop to Ubuntu Gateway r1 [ping 192.168.38.1]

```

student@ubdesktop:~$ ping 192.16.38.1
PING 192.16.38.1 (192.16.38.1) 56(84) bytes of data.
64 bytes from 192.16.38.1: icmp_seq=1 ttl=53 time=213 ms
64 bytes from 192.16.38.1: icmp_seq=2 ttl=53 time=62.0 ms
64 bytes from 192.16.38.1: icmp_seq=3 ttl=53 time=19.2 ms
64 bytes from 192.16.38.1: icmp_seq=4 ttl=53 time=18.6 ms
64 bytes from 192.16.38.1: icmp_seq=5 ttl=53 time=20.7 ms
64 bytes from 192.16.38.1: icmp_seq=6 ttl=53 time=54.1 ms
64 bytes from 192.16.38.1: icmp_seq=7 ttl=53 time=50.6 ms
64 bytes from 192.16.38.1: icmp_seq=8 ttl=53 time=21.4 ms
64 bytes from 192.16.38.1: icmp_seq=9 ttl=53 time=18.6 ms
64 bytes from 192.16.38.1: icmp_seq=10 ttl=53 time=20.4 ms
^C
--- 192.16.38.1 ping statistics ---
10 packets transmitted, 10 received, 0% packet loss, time 90

```

2. Pinging from Ubuntu Desktop to Ubuntu server(bitnami wordpress) [ping 192.168.138.2]

```

student@ubdesktop:~$ ping 192.168.138.2
PING 192.168.138.2 (192.168.138.2) 56(84) bytes of data.
64 bytes from 192.168.138.2: icmp_seq=1 ttl=63 time=49.3 ms
64 bytes from 192.168.138.2: icmp_seq=2 ttl=63 time=3.76 ms
64 bytes from 192.168.138.2: icmp_seq=3 ttl=63 time=3.91 ms
64 bytes from 192.168.138.2: icmp_seq=4 ttl=63 time=17.0 ms
64 bytes from 192.168.138.2: icmp_seq=5 ttl=63 time=38.2 ms
64 bytes from 192.168.138.2: icmp_seq=6 ttl=63 time=38.4 ms
64 bytes from 192.168.138.2: icmp_seq=7 ttl=63 time=23.3 ms
64 bytes from 192.168.138.2: icmp_seq=8 ttl=63 time=4.38 ms
64 bytes from 192.168.138.2: icmp_seq=9 ttl=63 time=3.21 ms
64 bytes from 192.168.138.2: icmp_seq=10 ttl=63 time=3.96 ms
64 bytes from 192.168.138.2: icmp_seq=11 ttl=63 time=2.45 ms
64 bytes from 192.168.138.2: icmp_seq=12 ttl=63 time=20.0 ms
64 bytes from 192.168.138.2: icmp_seq=13 ttl=63 time=5.30 ms
^C

```

3. Pinging from Ubuntu Desktop to Ubuntu Gateway r2 [ping 192.168.138.1]

```

student@ubdesktop:~$ ping 192.168.138.1
PING 192.168.138.1 (192.168.138.1) 56(84) bytes of data.
64 bytes from 192.168.138.1: icmp_seq=1 ttl=64 time=40.4 ms
64 bytes from 192.168.138.1: icmp_seq=2 ttl=64 time=3.22 ms
64 bytes from 192.168.138.1: icmp_seq=3 ttl=64 time=2.78 ms
64 bytes from 192.168.138.1: icmp_seq=4 ttl=64 time=1.10 ms
64 bytes from 192.168.138.1: icmp_seq=5 ttl=64 time=1.81 ms
64 bytes from 192.168.138.1: icmp_seq=6 ttl=64 time=1.67 ms
64 bytes from 192.168.138.1: icmp_seq=7 ttl=64 time=1.46 ms
64 bytes from 192.168.138.1: icmp_seq=8 ttl=64 time=2.09 ms
64 bytes from 192.168.138.1: icmp_seq=9 ttl=64 time=2.02 ms
64 bytes from 192.168.138.1: icmp_seq=10 ttl=64 time=2.19 ms
64 bytes from 192.168.138.1: icmp_seq=11 ttl=64 time=2.56 ms
^C

```

Ubuntu Server (Bitnami Wordpress)

1. Pinging from Ubuntu server to Ubuntu Gateway r1 [ping 192.168.38.1]

```
bitnami@debian:~$ ping 192.168.38.1
PING 192.168.38.1 (192.168.38.1) 56(84) bytes of data.
64 bytes from 192.168.38.1: icmp_seq=1 ttl=64 time=2.96 ms
64 bytes from 192.168.38.1: icmp_seq=2 ttl=64 time=41.6 ms
64 bytes from 192.168.38.1: icmp_seq=3 ttl=64 time=1.67 ms
64 bytes from 192.168.38.1: icmp_seq=4 ttl=64 time=0.995 ms
64 bytes from 192.168.38.1: icmp_seq=5 ttl=64 time=2.11 ms
64 bytes from 192.168.38.1: icmp_seq=6 ttl=64 time=0.703 ms
64 bytes from 192.168.38.1: icmp_seq=7 ttl=64 time=2.12 ms
64 bytes from 192.168.38.1: icmp_seq=8 ttl=64 time=1.63 ms
64 bytes from 192.168.38.1: icmp_seq=9 ttl=64 time=1.22 ms
^C
--- 192.168.38.1 ping statistics ---
9 packets transmitted, 9 received, 0% packet loss, time 8019ms
```

2. Pinging from Ubuntu server to Ubuntu Desktop [ping 192.168.38.2]

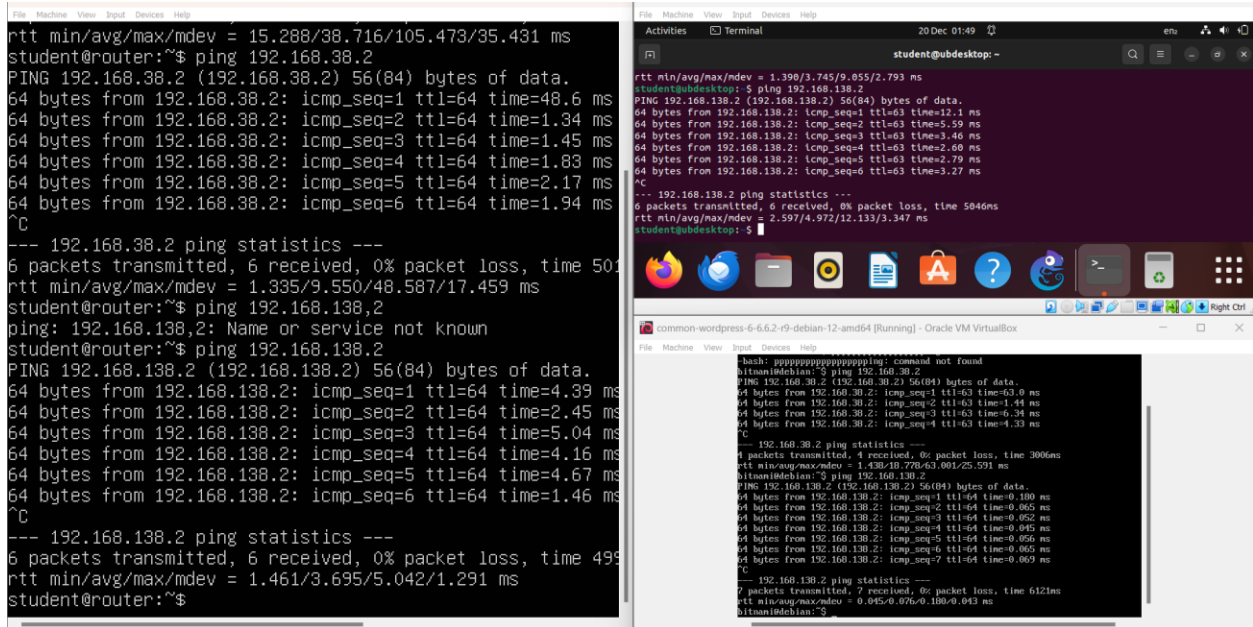
```
bitnami@debian:~$ ping 192.168.38.2
PING 192.168.38.2 (192.168.38.2) 56(84) bytes of data.
64 bytes from 192.168.38.2: icmp_seq=1 ttl=63 time=49.9 ms
64 bytes from 192.168.38.2: icmp_seq=2 ttl=63 time=4.24 ms
64 bytes from 192.168.38.2: icmp_seq=3 ttl=63 time=21.9 ms
64 bytes from 192.168.38.2: icmp_seq=4 ttl=63 time=3.23 ms
64 bytes from 192.168.38.2: icmp_seq=5 ttl=63 time=3.99 ms
64 bytes from 192.168.38.2: icmp_seq=6 ttl=63 time=3.63 ms
64 bytes from 192.168.38.2: icmp_seq=7 ttl=63 time=16.4 ms
64 bytes from 192.168.38.2: icmp_seq=8 ttl=63 time=4.38 ms
64 bytes from 192.168.38.2: icmp_seq=9 ttl=63 time=23.5 ms
^C
--- 192.168.38.2 ping statistics ---
```

3. Pinging from Ubuntu server to Ubuntu Gateway r2 [ping 192.168.138.1]

```
PING 192.168.138.1 (192.168.138.1) 56(84) bytes of data.
64 bytes from 192.168.138.1: icmp_seq=1 ttl=64 time=4.30 ms
64 bytes from 192.168.138.1: icmp_seq=2 ttl=64 time=2.42 ms
64 bytes from 192.168.138.1: icmp_seq=3 ttl=64 time=3.85 ms
64 bytes from 192.168.138.1: icmp_seq=4 ttl=64 time=2.39 ms
64 bytes from 192.168.138.1: icmp_seq=5 ttl=64 time=1.99 ms
64 bytes from 192.168.138.1: icmp_seq=6 ttl=64 time=2.26 ms
64 bytes from 192.168.138.1: icmp_seq=7 ttl=64 time=3.22 ms
64 bytes from 192.168.138.1: icmp_seq=8 ttl=64 time=2.87 ms
64 bytes from 192.168.138.1: icmp_seq=9 ttl=64 time=1.25 ms
64 bytes from 192.168.138.1: icmp_seq=10 ttl=64 time=3.38 ms
^C
```

Screen recording: for all 3 OS .

Coursework Portfolio 2



The image displays two terminal windows side-by-side, showing network connectivity tests. The left window is a terminal on a router, and the right window is a terminal on a desktop machine.

Left Terminal (Router):

```
rtt min/avg/max/mdev = 15.288/38.716/105.473/35.431 ms
student@router:~$ ping 192.168.38.2
PING 192.168.38.2 (192.168.38.2) 56(84) bytes of data.
64 bytes from 192.168.38.2: icmp_seq=1 ttl=64 time=48.6 ms
64 bytes from 192.168.38.2: icmp_seq=2 ttl=64 time=1.34 ms
64 bytes from 192.168.38.2: icmp_seq=3 ttl=64 time=1.45 ms
64 bytes from 192.168.38.2: icmp_seq=4 ttl=64 time=1.83 ms
64 bytes from 192.168.38.2: icmp_seq=5 ttl=64 time=2.17 ms
64 bytes from 192.168.38.2: icmp_seq=6 ttl=64 time=1.94 ms
^C
--- 192.168.38.2 ping statistics ---
6 packets transmitted, 6 received, 0% packet loss, time 504ms
rtt min/avg/max/mdev = 1.335/9.550/48.587/17.459 ms
student@router:~$ ping 192.168.138.2
ping: 192.168.138.2: Name or service not known
student@router:~$ ping 192.168.138.2
PING 192.168.138.2 (192.168.138.2) 56(84) bytes of data.
64 bytes from 192.168.138.2: icmp_seq=1 ttl=64 time=4.39 ms
64 bytes from 192.168.138.2: icmp_seq=2 ttl=64 time=2.45 ms
64 bytes from 192.168.138.2: icmp_seq=3 ttl=64 time=5.04 ms
64 bytes from 192.168.138.2: icmp_seq=4 ttl=64 time=4.16 ms
64 bytes from 192.168.138.2: icmp_seq=5 ttl=64 time=4.67 ms
64 bytes from 192.168.138.2: icmp_seq=6 ttl=64 time=1.46 ms
^C
--- 192.168.138.2 ping statistics ---
6 packets transmitted, 6 received, 0% packet loss, time 499ms
rtt min/avg/max/mdev = 1.461/3.695/5.042/1.291 ms
student@router:~$
```

Right Terminal (Desktop):

```
rtt min/avg/max/mdev = 1.390/3.745/9.055/2.793 ms
student@ubdesktop:~$ ping 192.168.138.2
PING 192.168.138.2 (192.168.138.2) 56(84) bytes of data.
64 bytes from 192.168.138.2: icmp_seq=1 ttl=63 time=2.1 ms
64 bytes from 192.168.138.2: icmp_seq=2 ttl=63 time=5.59 ms
64 bytes from 192.168.138.2: icmp_seq=3 ttl=63 time=3.46 ms
64 bytes from 192.168.138.2: icmp_seq=4 ttl=63 time=2.68 ms
64 bytes from 192.168.138.2: icmp_seq=5 ttl=63 time=2.79 ms
64 bytes from 192.168.138.2: icmp_seq=6 ttl=63 time=3.27 ms
^C
--- 192.168.138.2 ping statistics ---
6 packets transmitted, 6 received, 0% packet loss, time 504ms
rtt min/avg/max/mdev = 2.597/4.972/12.133/3.347 ms
student@ubdesktop:~$
```

The right terminal window also shows a second ping test to 192.168.38.2, which is successful. The desktop terminal window has a taskbar at the bottom with various application icons.

Here's the link for my onedrive video

https://drive.google.com/drive/u/2/folders/1uq_VxJR4vi5qu9IY9fkrZawUvfaEGHAG