BUILDING A VIRTUAL SANDBOXED NETWORK USING VIRTUALBOX

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INTRODUCTION

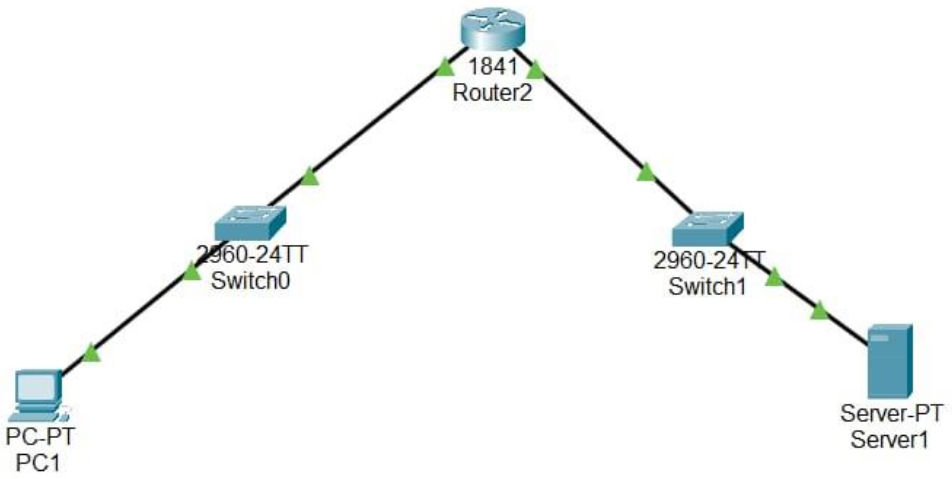
A sandboxed network is a virtual environment that provides a safe and isolated space where you can experiment with network configurations, protocols, and systems without the risk of disrupting live or production environments. Think of it as a digital playground where you can safely learn and test out networking concepts, troubleshoot issues, and simulate various network scenarios. By creating a sandboxed network, you gain the freedom to explore and practice without worrying about causing harm to critical systems or data.

For this project, you will set up your own private sandboxed virtual network using VirtualBox, a popular and user-friendly virtualization platform. In this network, you'll create multiple virtual machines (VMs), each configured with unique private IP addresses to mimic how real-world networks operate. These VMs will be interconnected, allowing you to simulate a functional network with diverse roles, such as web servers, application servers, and client machines.

The purpose of this exercise is to deepen your understanding of essential networking concepts. You will gain practical experience in IP subnetting, learning how to divide networks into smaller, manageable segments. You'll also dive into network interface configuration, where you'll learn how to assign IP addresses, set up routing, and ensure secure communication between machines. Additionally, you will work on basic server setups, where you'll configure virtual machines to act as servers, running services like web hosting or file sharing.

By the end of this project, you'll not only have a hands-on understanding of how networks function but also acquire skills in network design, planning, and organization. These skills are foundational for anyone aspiring to work in network administration, IT support, or any other field that involves managing and securing network infrastructures. This sandboxed network will serve as your training ground, giving you the confidence to apply what you've learned in real-world situations, all while keeping your experiments safe from impacting actual systems.

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# configure terminal

- 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 192.168.0.1 255.0.0.0
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 192.168.100.1 255.0.0.0
  - Router1(config-if)# no shutdown
  - Router1(config-if)# exit

Verification

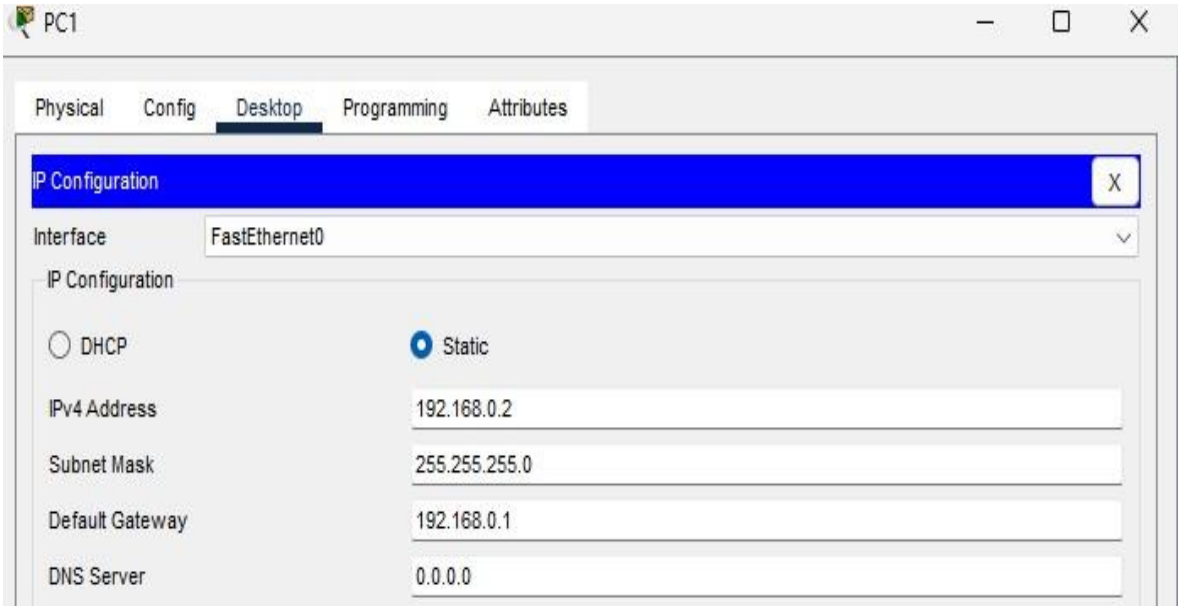
To ensure your interfaces are correctly configured and active, use the following commands:

1. Verify Interface Status:
   - Router1# show ip interface brief

2. Ping Test: You can also test connectivity by pinging the configured interfaces:
   - Router1# ping 192.168.0.1
   - Router1# ping 192.168.100.1

Desktop (PC):

- Click the pc and open it go to the desktop >IP Configuration >change to static >Set IP address.



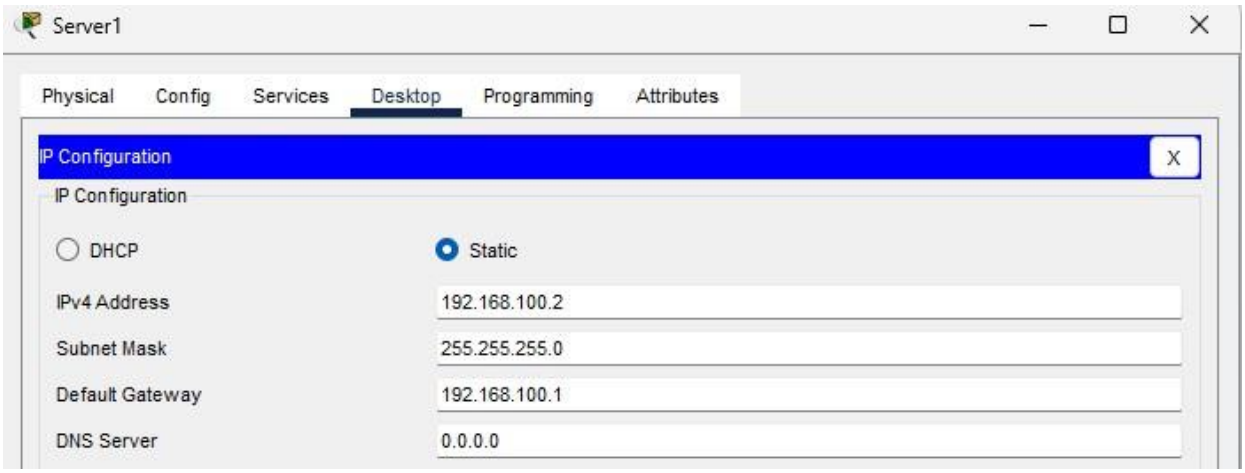
- Set all PC for this.
- And ping 192.168.0.2

```
Cisco Packet Tracer SERVER Command Line 1.0
C:\>ping 192.168.0.2

Pinging 192.168.0.2 with 32 bytes of data:

Reply from 192.168.0.2: bytes=32 time<1ms TTL=127
Reply from 192.168.0.2: bytes=32 time<1ms TTL=127
Reply from 192.168.0.2: bytes=32 time<1ms TTL=127
Reply from 192.168.0.2: bytes=32 time<1ms TTL=127

Ping statistics for 192.168.0.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Screenshot For ping PC to Gateway

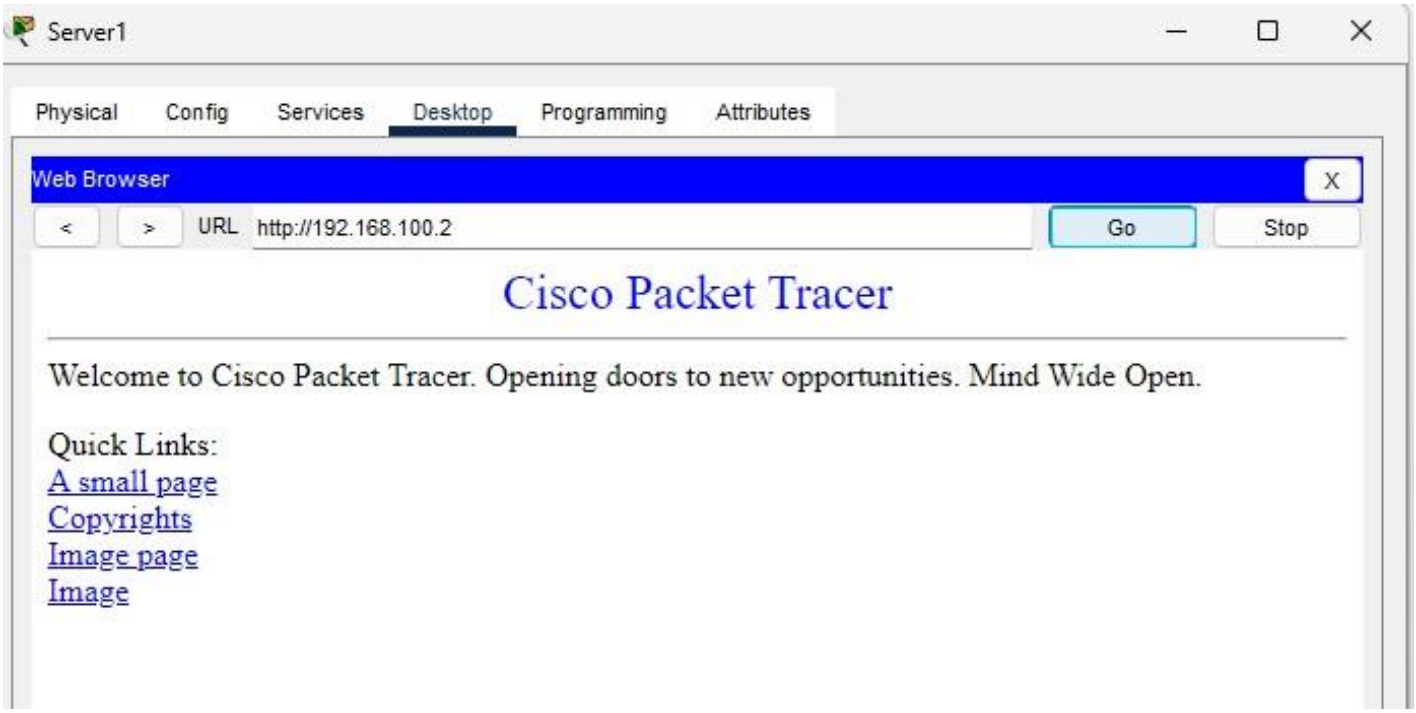
Application Server:

- Click the Application Server and open it go to the desktop >IP Configuration >change to static >Set IP address.



- Click the Application Server and open it go to the service> Click HTTP> Turn ON HTTP and HTTPS> add HTML page in Application Server.

- Click the Application Server and open it go to the desktop >Web Browser >Type the IP address 192.168.100.2.



Screenshot for web server showing a web site in web browser.

2. IP ADDRESS TABLE

Device	Role	IP Address	Subnet Mask
Desktop VM **(Ubuntu Desktop)**	Management	192.168.0.2	255.255.255.0
Gateway Router VM (enp0s3) **(Ubuntu Server)**	Internet Access	192.168.0.1	255.255.255.0
Gateway Router VM (enp0s8) **(Ubuntu Server)**	Subnet 01 - Internal Network	192.168.100.1	255.255.255.0
Gateway Router VM (enp0s9) **(Ubuntu Server)**	Subnet 02 - Internal Network	10.0.2.15	255.255.255.0
Application Server VM **(Wordpress)**	Server	192.168.100.2	255.255.255.0

3. Git Pages Lab Report

Configuration Guide for Virtual Machines and Operating Systems

To proceed with this project, you are required to set up three distinct virtual machines (VMs). Below are the detailed steps to guide you through the process.

Step 1: Prepare Your Virtual Environment

Before starting the configuration of individual VMs, ensure that the following prerequisites are completed:

1. **Install VirtualBox**:
    - Download and install the latest version of Oracle VirtualBox on your system.
2. **Download the Necessary Operating Systems (OS)**:
    - **Ubuntu Desktop OS** (ISO format) or another desktop OS such as Kali Linux, Windows, etc.
    - **Ubuntu Server OS** (ISO format).
    - **Bitnami WordPress Application Server** (OVA format).
3. **Import the Operating Systems into VirtualBox**:
    - Create three VMs within VirtualBox, each allocated for one of the above operating systems.

Ubuntu Server OS Configuration:

Step 1: Create a New Virtual Machine for Ubuntu Server

1. Launch **VirtualBox**.
2. Click **New** to create a new VM.
3. Name the VM (e.g., "Ubuntu Server").
4. Set the **Type** to **Linux** and the **Version** to **Ubuntu (64-bit)**.
5. Allocate **memory** (e.g., 2048 MB or higher depending on your system capacity).
6. Opt to **Create a virtual hard disk now** and specify a disk size (e.g., 10 GB or more).
7. Click **Create**.

Step 2: Configure Network Interfaces

To enable the Ubuntu Server to function as a router between two subnets, configure the following network interfaces:

1. Access the VM's **Settings**.
2. Select the **Network** tab.
3. **Adapter 1**:
    - Set to **Internal Network** (e.g., "intnet").
    - Set the **Adapter Type** to **PCnet-FAST III** or any supported type.
    - In Ubuntu, this adapter will usually be named **enp0s8**.
4. **Adapter 2**:
    - Enable the second adapter and set it to another **Internal Network** (e.g., "intnet1").
    - In Ubuntu, this adapter will be identified as **enp0s9**.
5. **Adapter 3**:
    - Set to **NAT** (Network Address Translation).
    - In Ubuntu, this will be named **enp0s3** and its IP address will be assigned automatically via DHCP.

Step 3: Install Ubuntu Server

1. Boot the VM and select the **Ubuntu Server ISO** as the installation disk.
2. Follow the on-screen prompts:
    - Set your **time zone** and **keyboard layout**.
    - Create a user account and assign a strong password.
    - When prompted, select the option to install **OpenSSH Server** for remote access.
3. Complete the installation process and **reboot** the VM once done.

Step 4: Configure Static IPs on the Network Interfaces

After installation, assign static IP addresses to the two internal network interfaces:

1. Log in to your **Ubuntu Server**.
2. Edit the network configuration file:

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

3. Insert the appropriate configuration for your interfaces (replace with actual IP addresses for each subnet):

```
# This is the network config written by 'subiquity'
network:
  ethernets:

    enp0s3:
      addresses: [192.168.0.1/24]
      dhcp4: false

    enp0s8:
      addresses: [192.168.100.1/24]
      dhcp4: false
    enp0s9:
      dhcp4: true

  version: 2
```

4. Save and exit (Ctrl + X, then confirm with 'Yes').
5. Apply the network changes:
   - sudo netplan apply
   - ip a

Step 5: Enable IP Forwarding

To allow the Ubuntu Server to route traffic between the subnets:

1. Open the sysctl configuration file:

- **sudo nano /etc/sysctl.conf**

2. Uncomment (or add if missing) the line:

- **net.ipv4.ip_forward=1**

3. Apply the changes:

- **sudo sysctl -p**

Step 6: Set Up IPTables for Routing

For the server to properly route packets between the two subnets, configure

iptables:

1. Allow packet forwarding between interfaces:

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

2. To persist these rules across reboots:

- **sudo apt install iptables-persistent**
- **sudo netfilter-persistent save**
- **sudo netfilter-persistent reload**

Ubuntu Desktop OS Configuration:

Step: Install Ubuntu Desktop in a Virtual Machine

To create a VM with a GUI-based operating system, follow these steps:

1. Open **VirtualBox**.
2. Click **New** to initiate the VM creation process.
3. Specify the following details:
    - **Name**: Ubuntu Desktop.
    - **ISO**: Select the ubuntu-24.04.1-desktop-amd64.iso.
    - **Unattended Installation**: Ensure the box for "Skip Unattended Installation" is checked.
4. Click **Next** and assign the following resources:
    - **Base Memory**: 2048 MB.
    - **Processors**: 2 (adjust based on your system's performance).
5. Create a **Virtual Hard Disk** with a minimum size of **25 GB**.
6. Click **Next**, verify the settings, and then click **Finish**.
7. Start the VM and select **Try or Install Ubuntu**.
8. Once booted, click **Install Ubuntu**.
9. Create a user account, complete the installation process, and restart the VM when prompted.

Step 2: Configure the Network Interfaces for Ubuntu Desktop VM

To configure the network interface for the **Ubuntu Desktop VM**:

1. **Access VM Settings**:
    - Go to the **Settings** of your Ubuntu Desktop VM within **VirtualBox**.
    - Select the **Network** tab.
2. **Network Adapter Configuration**:
    - Set **Adapter 1** to **Internal Network** (you can name it, e.g., intnet).
3. **Configure Network Interface on Ubuntu Desktop**:
    - Launch the **Ubuntu Desktop** VM and log in.
    - Navigate to **Settings** > **Network**.
    - Select **enp0s3** (your primary network interface) and click the settings gear.
    - In the **IPv4** tab, change the **IPv4 Method** to **Manual**.
    - Set the following:
        - **Address**: 192.168.0.2
        - **Netmask**: 255.255.255.0 or 24
        - **Gateway**: 192.168.0.1
    - Click **Apply** to save the changes.
4. **Reconnect the Network**:
    - Disconnect the network and then reconnect to apply the new settings.

Bitnami Web Application Configuration

Step 1: Install Bitnami Application in the VM

1. **Import Bitnami OVA File**:
    - In **VirtualBox**, go to **File** > **Import Appliance**.

- Browse to the file **bitnami-wordpress-6.3.1-r0-debian-11-amd64.ova** and select **Open**.
- Click **Next** and then **Finish** to complete the import process.

2. **Start the Virtual Machine**:
   - Once the appliance is imported, click **Start** to launch the Bitnami WordPress VM.
3. **Initial Login**:
   - Upon first boot, the login credentials will be displayed on the screen.
   - You will need to reset the password the first time you log in.
4. **Close the VM**:
   - Once the setup is complete, close the Bitnami application.

Step 2: Configure the Network Interfaces for Bitnami VM

1. **Access the VM Settings**:
   - Go to the **Settings** of your Bitnami WordPress VM.
   - Select the **Network** tab.
2. **Configure Network Adapter**:
   - Set **Adapter 1** to **Internal Network** (you can name it, e.g., intnet1).
3. **Configure Network Settings on Bitnami VM**:
   - Open the **Bitnami WordPress VM** and log in.
   - Run the following command to edit the network interfaces file:

sudo nano /etc/network/interfaces

- Add the following configuration for **eth1**:

auto eth1

iface eth1 inet static

address 192.168.100.2

netmask 255.255.255.0

gateway 192.168.100.1

- Save the file by pressing **CTRL + X**, then type **Y** to confirm, and hit **Enter**.

4. **Apply Network Configuration**:
   - Run the following commands to apply the changes:

- **sudo ifdown eth1 && sudo ifup eth1**
- **sudo systemctl restart networking**

   - Verify the IP address configuration:

- **ip a**

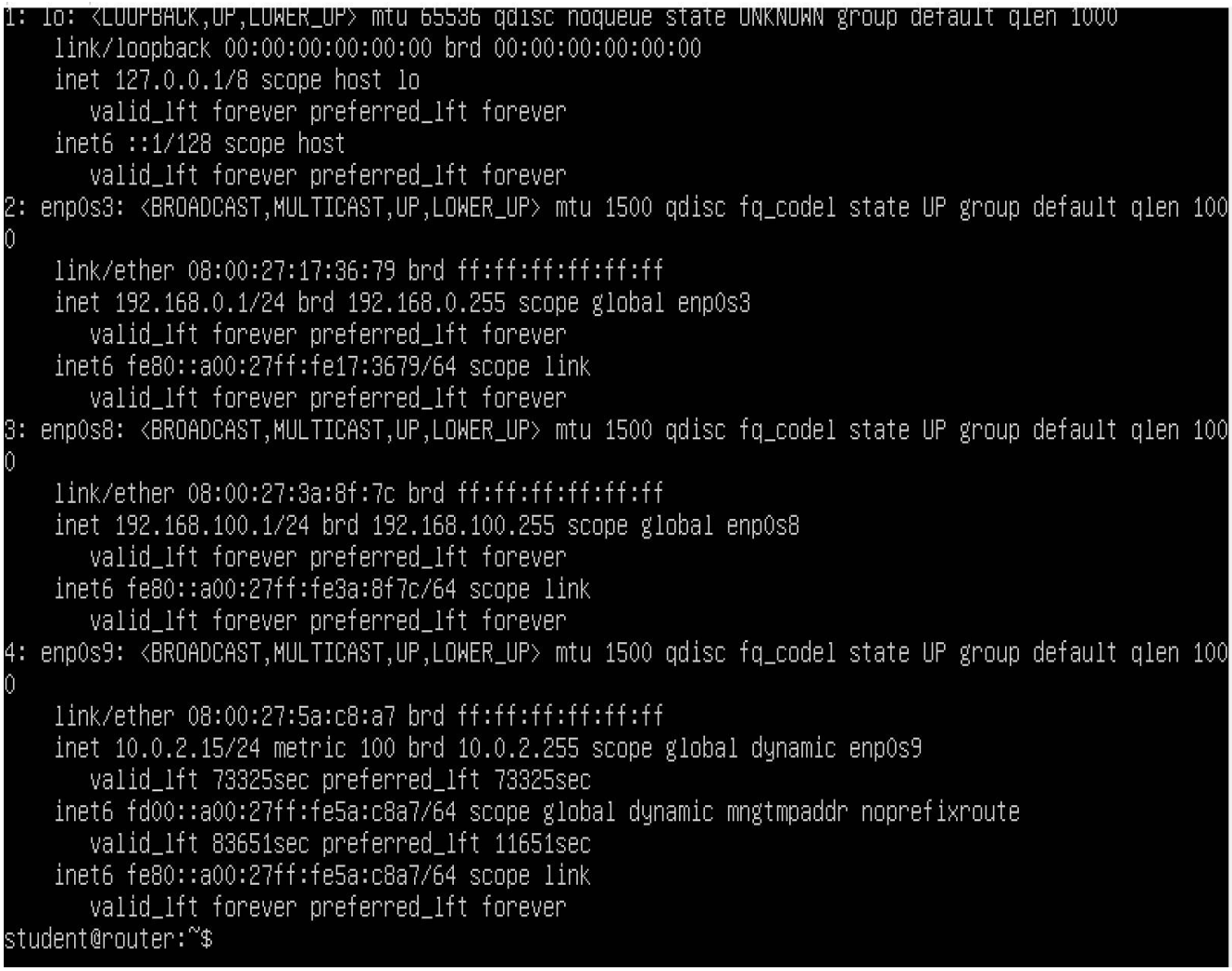
4. Functional Test Results

Evidence that all VMs can communicate as per the design (e.g., ping results, screenshots of application access).

Screenshots for Functional Test Results:

Ubuntu Server OS:

- ✓ Network IP configuration For Ubuntu Server.



- ✓ Ping Ubuntu Server to Ubuntu Desktop Using IP address 192.168.0.2.

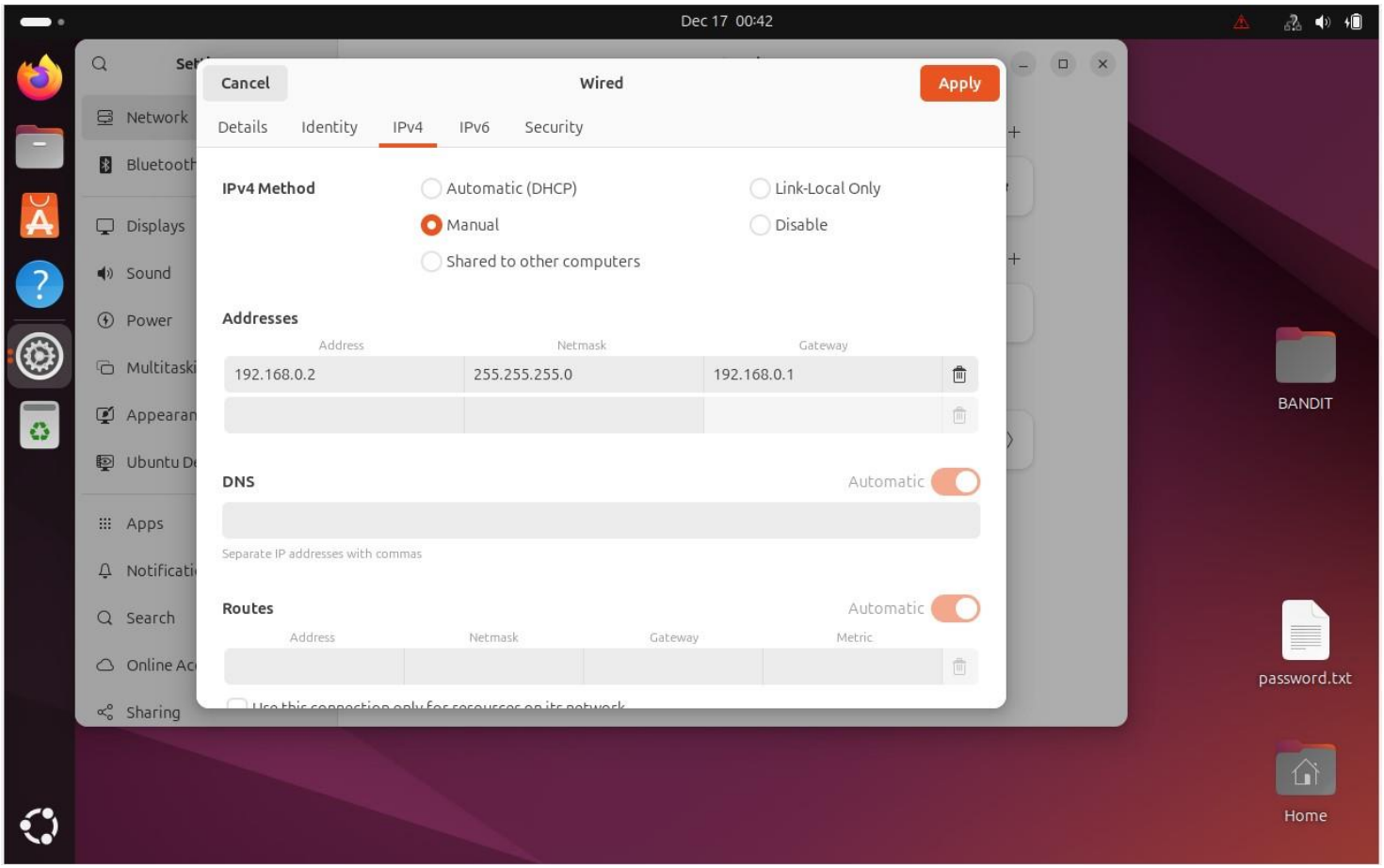
```
student@router:~$ ping 192.168.0.2
PING 192.168.0.2 (192.168.0.2) 56(84) bytes of data.
64 bytes from 192.168.0.2: icmp_seq=1 ttl=64 time=0.917 ms
64 bytes from 192.168.0.2: icmp_seq=2 ttl=64 time=0.926 ms
64 bytes from 192.168.0.2: icmp_seq=3 ttl=64 time=0.802 ms
64 bytes from 192.168.0.2: icmp_seq=4 ttl=64 time=0.800 ms
64 bytes from 192.168.0.2: icmp_seq=5 ttl=64 time=0.791 ms
64 bytes from 192.168.0.2: icmp_seq=6 ttl=64 time=0.750 ms
64 bytes from 192.168.0.2: icmp_seq=7 ttl=64 time=0.821 ms
64 bytes from 192.168.0.2: icmp_seq=8 ttl=64 time=0.826 ms
64 bytes from 192.168.0.2: icmp_seq=9 ttl=64 time=0.825 ms
64 bytes from 192.168.0.2: icmp_seq=10 ttl=64 time=0.838 ms
64 bytes from 192.168.0.2: icmp_seq=11 ttl=64 time=0.753 ms
64 bytes from 192.168.0.2: icmp_seq=12 ttl=64 time=0.770 ms
64 bytes from 192.168.0.2: icmp_seq=13 ttl=64 time=0.787 ms
64 bytes from 192.168.0.2: icmp_seq=14 ttl=64 time=0.735 ms
64 bytes from 192.168.0.2: icmp_seq=15 ttl=64 time=0.771 ms
64 bytes from 192.168.0.2: icmp_seq=16 ttl=64 time=0.718 ms
64 bytes from 192.168.0.2: icmp_seq=17 ttl=64 time=0.762 ms
64 bytes from 192.168.0.2: icmp_seq=18 ttl=64 time=0.666 ms
^C
--- 192.168.0.2 ping statistics ---
18 packets transmitted, 18 received, 0% packet loss, time 17026ms
rtt min/avg/max/mdev = 0.666/0.792/0.926/0.061 ms
student@router:~$
```

- ✓ Ping Ubuntu Server to Bitnami Application Server Using IP address 192.168.100.2.

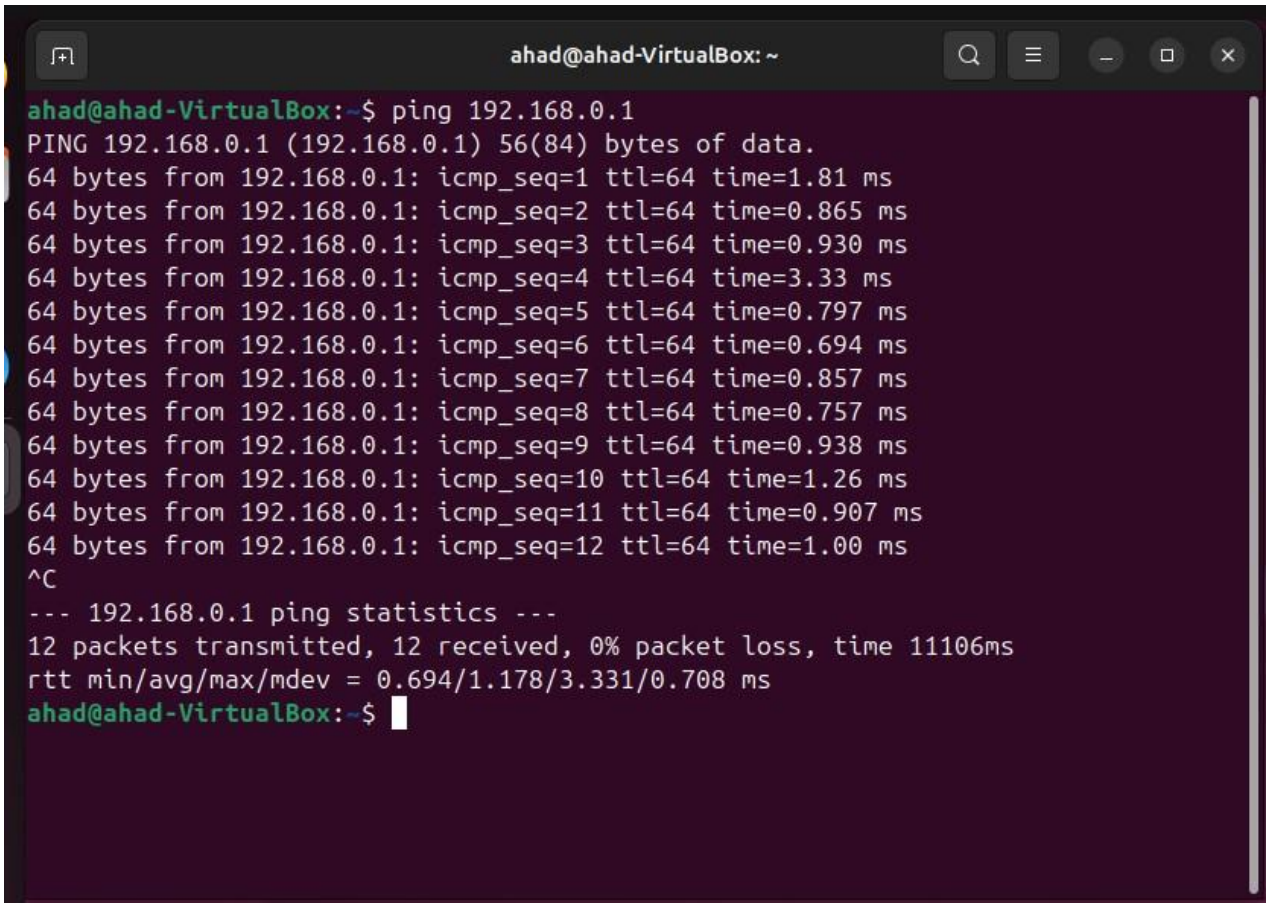
```
student@student:~$ ping 192.168.100.2
PING 192.168.100.2 (192.168.100.2) 56(84) bytes of data.
64 bytes from 192.168.100.2: icmp_seq=1 ttl=64 time=0.053 ms
64 bytes from 192.168.100.2: icmp_seq=2 ttl=64 time=0.020 ms
64 bytes from 192.168.100.2: icmp_seq=3 ttl=64 time=0.020 ms
64 bytes from 192.168.100.2: icmp_seq=4 ttl=64 time=0.025 ms
64 bytes from 192.168.100.2: icmp_seq=5 ttl=64 time=0.024 ms
64 bytes from 192.168.100.2: icmp_seq=6 ttl=64 time=0.025 ms
64 bytes from 192.168.100.2: icmp_seq=7 ttl=64 time=0.023 ms
64 bytes from 192.168.100.2: icmp_seq=8 ttl=64 time=0.024 ms
64 bytes from 192.168.100.2: icmp_seq=9 ttl=64 time=0.025 ms
64 bytes from 192.168.100.2: icmp_seq=10 ttl=64 time=0.025 ms
64 bytes from 192.168.100.2: icmp_seq=11 ttl=64 time=0.025 ms
64 bytes from 192.168.100.2: icmp_seq=12 ttl=64 time=0.026 ms
64 bytes from 192.168.100.2: icmp_seq=13 ttl=64 time=0.025 ms
64 bytes from 192.168.100.2: icmp_seq=14 ttl=64 time=0.024 ms
64 bytes from 192.168.100.2: icmp_seq=15 ttl=64 time=0.025 ms
64 bytes from 192.168.100.2: icmp_seq=16 ttl=64 time=0.024 ms
64 bytes from 192.168.100.2: icmp_seq=17 ttl=64 time=0.025 ms
64 bytes from 192.168.100.2: icmp_seq=18 ttl=64 time=0.025 ms
64 bytes from 192.168.100.2: icmp_seq=19 ttl=64 time=0.023 ms
64 bytes from 192.168.100.2: icmp_seq=20 ttl=64 time=0.024 ms
64 bytes from 192.168.100.2: icmp_seq=21 ttl=64 time=0.025 ms
64 bytes from 192.168.100.2: icmp_seq=22 ttl=64 time=0.025 ms
64 bytes from 192.168.100.2: icmp_seq=23 ttl=64 time=0.024 ms
^C
--- 192.168.100.2 ping statistics ---
23 packets transmitted, 23 received, 0% packet loss, time 22045ms
rtt min/avg/max/mdev = 0.020/0.025/0.053/0.007 ms
student@student:~$
```

Ubuntu Desktop OS:

- ✓ Network IP configuration For Ubuntu Desktop.



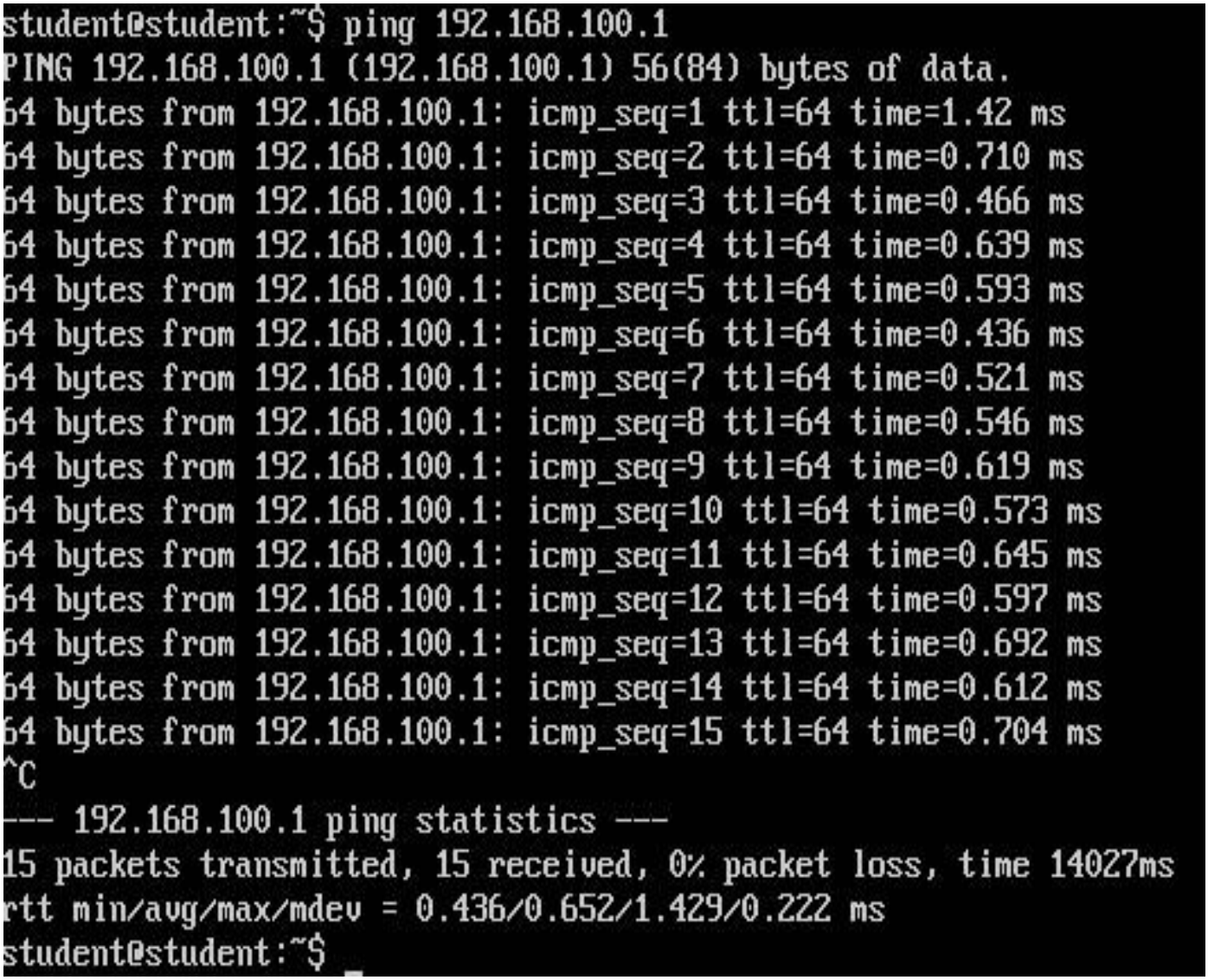
✓ Ping Ubuntu Desktop to Ubuntu Server Using IP address 192.168.0.1.



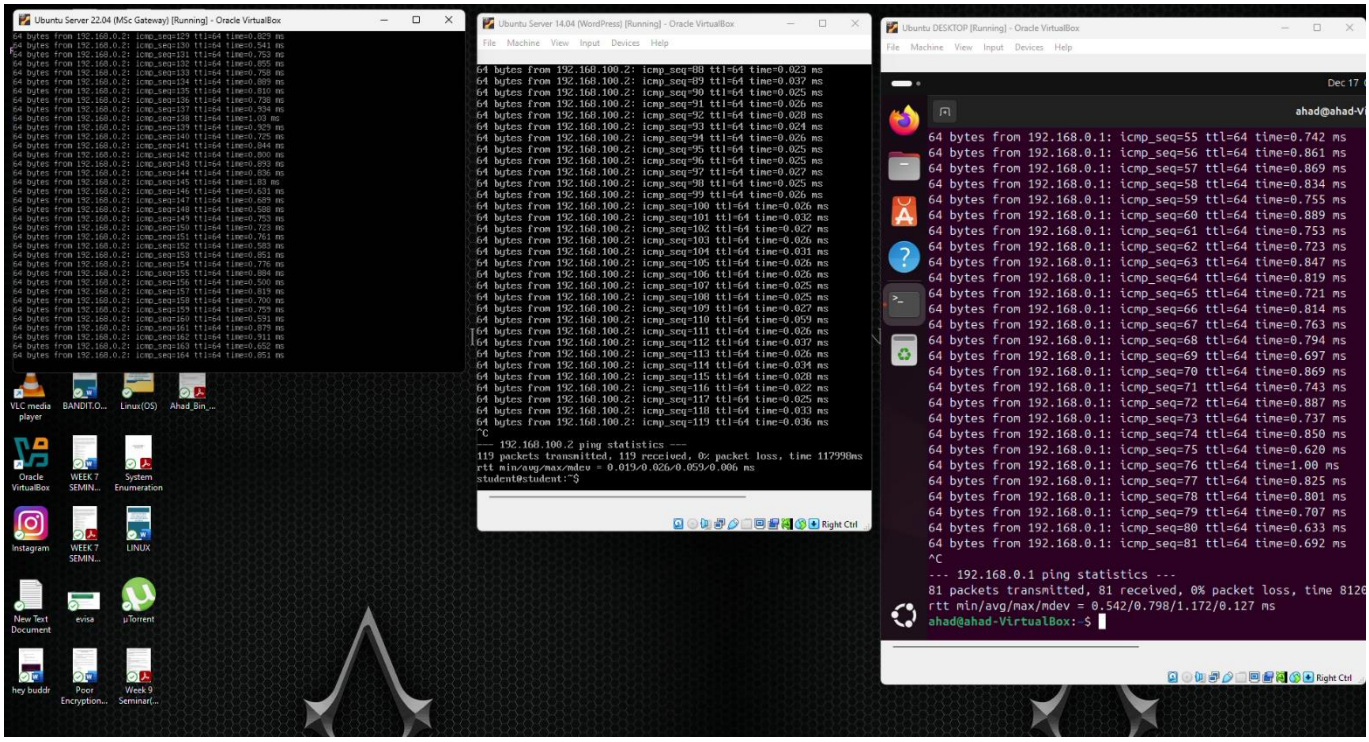
Bitnami Application Server:

✓ Network IP configuration For Bitnami Application Server.

- ✓ Ping Bitnami Application Server to Ubuntu Server Using IP address 192.168.100.1.



PING OF ALL MACHINE



One drive link for the video demonstration of machine pings

ALL TOGETHER PING.mp4