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Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA
FACULTY OF COMPUTER SCIENCE AND INFORMATION TECHNOLOGY
(FSKTM)
SEMESTER I 2023/2024

OPERATING SYSTEM
BIC 20803
SECTION 04

GROUP ASSIGNMENT 1 (GROUP 29)

TITLE
NETWORK SETTING IN VIRTUAL MACHINE (VM)

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DATE SUBMISSION: 28th OCTOBER 2023

 <p>UTHM Universiti Tun Hussein Onn Malaysia</p> <p>FACULTY OF COMPUTER SCIENCE AND INFORMATION TECHNOLOGY</p>	Course Code	BIC20803	Item	ASSIGNMENT 1
	Course	OPERATING SYSTEM	Date Release	OCT 2023
Title	Network Setting in Virtual Machine (VM)			
Objectives	At the end of this task, student should be able to: i. Understand the configuration of virtual machine. ii. Apply the concept of operating system structures. iii. Demonstrate key skills for virtual machine services.			
Method	<ul style="list-style-type: none"> • VM installation and configuration • Observation • Books/Journals; Internet 			
Mode	<input type="checkbox"/> Group (2 persons only)			
Submission	<ul style="list-style-type: none"> • Report Week 4 (29/10/2023 – 02/11/2023) • Author - Group Activities tab 			

TASK 1: Choose and install one of the following **hypervisors / virtual machine monitors (VMM)** in the host machine (Host OS)

- VMware Workstation Player /Oracle VirtualBox / Xvisor / Lguest or others



TASK 2: Install ONE virtual machine (Guest OS) in the installed hypervisor / virtual machine monitor (VMM)

- Using Linux Distro (e.g., CentOS, Ubuntu, Debian, Fedora)



TASK 3 (REPORT-WEEK 3):

Prepare a report containing the following information:

a. CHAPTER 1: Network configuration

- i. Explain **ALL** types of network connection in the VM.

There are five types of network connections that we can use for our Virtual Machine (VM) (Heddings, A., 2020). One of them is Network Address Translation (NAT). NAT enables the virtual machine to share the IP address of the host computer. This helps the virtual machine (VM) to connect to the internet by using the host's network connection. It frequently serves as VMs' default option.

Next, NAT Network. Every virtual machine in NAT Network mode has an internal router configuration unique to it. One virtual machine (VM) cannot access services on another VM with this configuration. Since everything is ultimately translated, each virtual machine (VM) might really have the same private IP address. While NAT Network operates on the same idea as NAT, it employs a single network for every virtual machine that is set on the same NAT Network. Similar to how a computer connected to one of your router's many Ethernet ports may talk with other devices on the network, this enables guest-to-guest communication via a virtual switch.

Other than that, Bridged mode is another network option in VMs. It does not isolate virtual machines like other modes do. When in bridged mode, virtual machines (VMs) use the host's network interface to connect directly with outside services. Because of this, even though virtual machines (VMs) are still linked to the same computer, they appear to your router as different IP addresses. With bridged mode, you have a great deal of freedom in hosting services on virtual machines (VMs) and accessing them locally on your network by using an address and port number. It's especially helpful if your server has several physical interfaces and Ethernet ports since it lets you operate virtual machines (VMs) on different networks depending on your actual wiring.

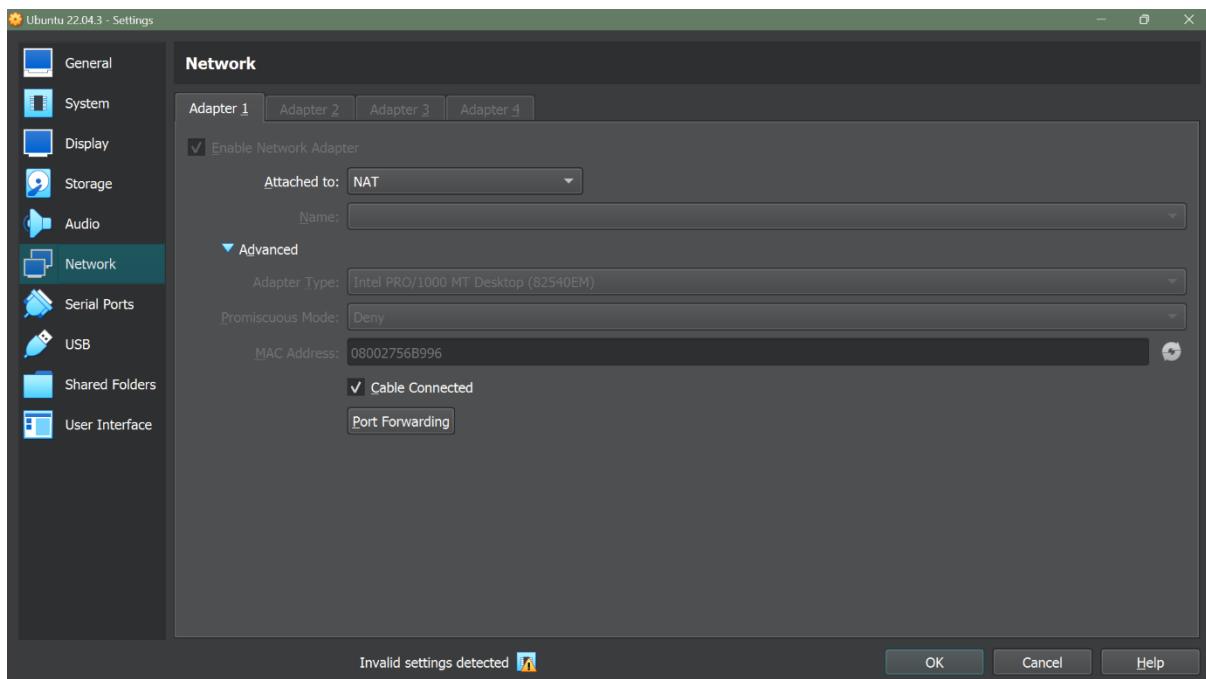
Apart from that, the fourth VM network option is Host-Only Adapter. Virtual machines are cut off from the internet in this mode, but they are still able to communicate with each other and with the host. Guests are usually assigned IP addresses by DHCP servers, which facilitates easy communication amongst guests. When considerable two-way communication between the host and guest is needed but the host does not have internet connection, the Host-Only mode is the best option. Bridged mode, which offers complete network access, may be used to accomplish both two-way communication and external access.

Last but not least, the Internal Network is a network option used to mimic real networks. It is by default closed off from the outside world, enabling communication amongst guests on the network but not with the host or the internet. This helps to simulate completely isolated networks, but it may also be set up to provide the private computers

access to the internet. Internal Network is a good option if you need the freedom to set up everything on your own or if you want to mimic or imitate a virtual network. Because it allows users to establish their network without requiring real gear, it's extremely helpful for training.

- ii. Which connection should you use to enable the Internet connection in the Guest OS? Provide screenshot of the connection setup.

I believe by using the NAT (Network Address Translation) connection will enable the internet access for the Guest OS in a VM (Virtual Machine). That was because this option allows the VM to share the host's network connection, enabling it to access the internet.

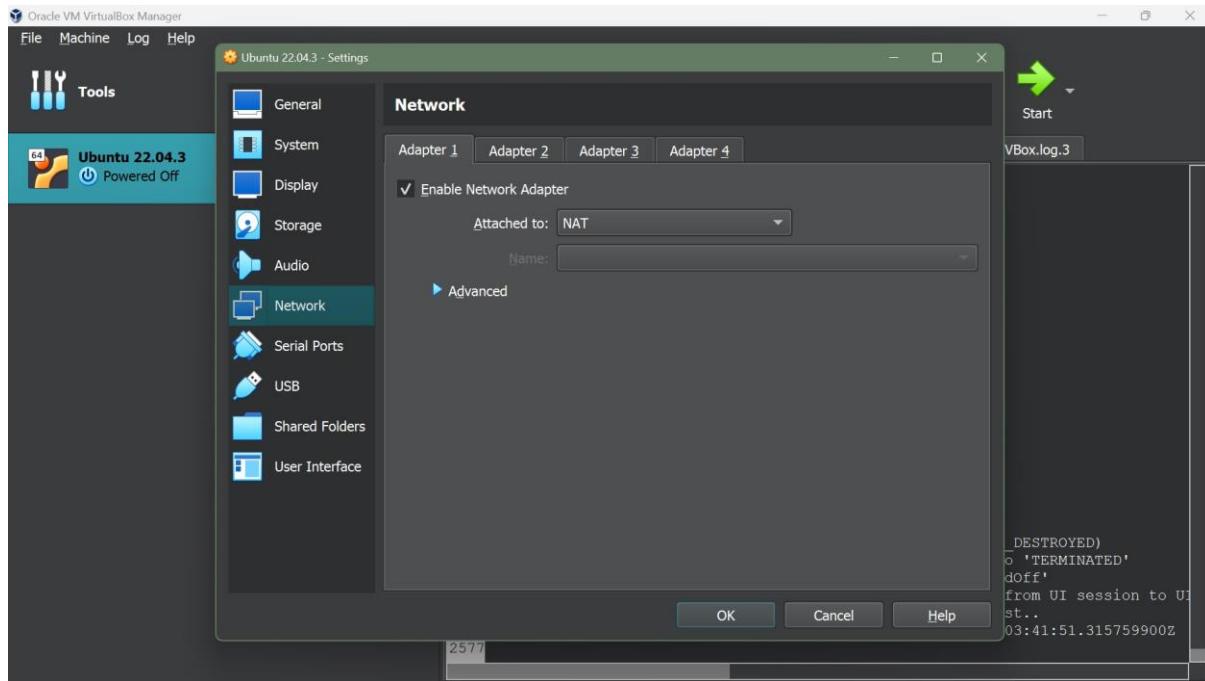


b. **CHAPTER 2: Experiment Observation & Explanation**

- i. Setup network using the following experiment:

1. **Experiment 1: NAT**

- a. Provide screenshot of the network setup (Network Setting for the specific experiment).



- b. Execute experiment for each question in the following table and state the result.
c. Provide the result screenshot for each of the question in the table.

Network Setting: NAT	
Questions	Result (Yes/No)
A. Can VM ping to host?	Yes
B. Can host ping to VM?	No
C. Can VM access to external network? E.g., Browse the Internet or ping www.google.com	Yes
D. Can another computer on the same host network ping to VM?	Yes

EXPERIMENT RESULT

A)

```
wana@wana-VirtualBox:~$ ping 192.168.56.1
PING 192.168.56.1 (192.168.56.1) 56(84) bytes of data.
64 bytes from 192.168.56.1: icmp_seq=1 ttl=127 time=35.6 ms
64 bytes from 192.168.56.1: icmp_seq=2 ttl=127 time=1.83 ms
64 bytes from 192.168.56.1: icmp_seq=3 ttl=127 time=1.42 ms
64 bytes from 192.168.56.1: icmp_seq=4 ttl=127 time=1.36 ms
64 bytes from 192.168.56.1: icmp_seq=5 ttl=127 time=4.60 ms
64 bytes from 192.168.56.1: icmp_seq=6 ttl=127 time=1.08 ms
64 bytes from 192.168.56.1: icmp_seq=7 ttl=127 time=1.10 ms
64 bytes from 192.168.56.1: icmp_seq=8 ttl=127 time=1.03 ms
64 bytes from 192.168.56.1: icmp_seq=9 ttl=127 time=2.71 ms
64 bytes from 192.168.56.1: icmp_seq=10 ttl=127 time=1.13 ms
64 bytes from 192.168.56.1: icmp_seq=11 ttl=127 time=2.08 ms
64 bytes from 192.168.56.1: icmp_seq=12 ttl=127 time=49.8 ms
64 bytes from 192.168.56.1: icmp_seq=13 ttl=127 time=2.10 ms
64 bytes from 192.168.56.1: icmp_seq=14 ttl=127 time=1.23 ms
64 bytes from 192.168.56.1: icmp_seq=15 ttl=127 time=1.38 ms
64 bytes from 192.168.56.1: icmp_seq=16 ttl=127 time=3.78 ms
64 bytes from 192.168.56.1: icmp_seq=17 ttl=127 time=5.12 ms
64 bytes from 192.168.56.1: icmp_seq=18 ttl=127 time=2.57 ms
64 bytes from 192.168.56.1: icmp_seq=19 ttl=127 time=1.32 ms
64 bytes from 192.168.56.1: icmp_seq=20 ttl=127 time=1.01 ms
64 bytes from 192.168.56.1: icmp_seq=21 ttl=127 time=1.21 ms
64 bytes from 192.168.56.1: icmp_seq=22 ttl=127 time=1.43 ms
64 bytes from 192.168.56.1: icmp_seq=23 ttl=127 time=1.35 ms
64 bytes from 192.168.56.1: icmp_seq=24 ttl=127 time=78.0 ms
64 bytes from 192.168.56.1: icmp_seq=25 ttl=127 time=450 ms
64 bytes from 192.168.56.1: icmp_seq=26 ttl=127 time=1.19 ms
64 bytes from 192.168.56.1: icmp_seq=27 ttl=127 time=1.89 ms
64 bytes from 192.168.56.1: icmp_seq=28 ttl=127 time=1.10 ms
64 bytes from 192.168.56.1: icmp_seq=29 ttl=127 time=2.33 ms
64 bytes from 192.168.56.1: icmp_seq=30 ttl=127 time=1.18 ms
64 bytes from 192.168.56.1: icmp_seq=31 ttl=127 time=2.34 ms
64 bytes from 192.168.56.1: icmp_seq=32 ttl=127 time=1.11 ms
64 bytes from 192.168.56.1: icmp_seq=33 ttl=127 time=1.16 ms
64 bytes from 192.168.56.1: icmp_seq=34 ttl=127 time=1.30 ms
64 bytes from 192.168.56.1: icmp_seq=35 ttl=127 time=2.99 ms
64 bytes from 192.168.56.1: icmp_seq=36 ttl=127 time=1.77 ms
64 bytes from 192.168.56.1: icmp_seq=37 ttl=127 time=6.67 ms
64 bytes from 192.168.56.1: icmp_seq=38 ttl=127 time=3.98 ms

Microsoft Windows [Version 10.0.22621.2428]
(c) Microsoft Corporation. All rights reserved.

C:\Users\user>ipconfig

Windows IP Configuration

Ethernet adapter Ethernet 2:

Connection-specific DNS Suffix . :
Link-local IPv6 Address . . . . . : fe80::9199:4b30:ae71:ea8e%9
IPv4 Address . . . . . : 192.168.56.1
Subnet Mask . . . . . : 255.255.255.0
Default Gateway . . . . . :

Wireless LAN adapter Local Area Connection* 3:

Media State . . . . . : Media disconnected
Connection-specific DNS Suffix . :

Wireless LAN adapter Local Area Connection* 4:

Media State . . . . . : Media disconnected
Connection-specific DNS Suffix . :

Ethernet adapter McAfee VPN:

Media State . . . . . : Media disconnected
Connection-specific DNS Suffix . :

Ethernet adapter Wi-Fi:

Connection-specific DNS Suffix . :
IPv6 Address . . . . . : 2001:d08:e1:983c:926d:75dd:b86c:7aea
Temporary IPv6 Address. . . . . : 2001:d08:e1:983c:d069:827e:7bd2:b579
Link-local IPv6 Address . . . . . : fe80::14d2:2e59:e1b:2a9c%22
IPv4 Address . . . . . : 192.168.1.187
Subnet Mask . . . . . : 255.255.255.0
Default Gateway . . . . . : fe80::1%22
192.168.1.254
```

B)

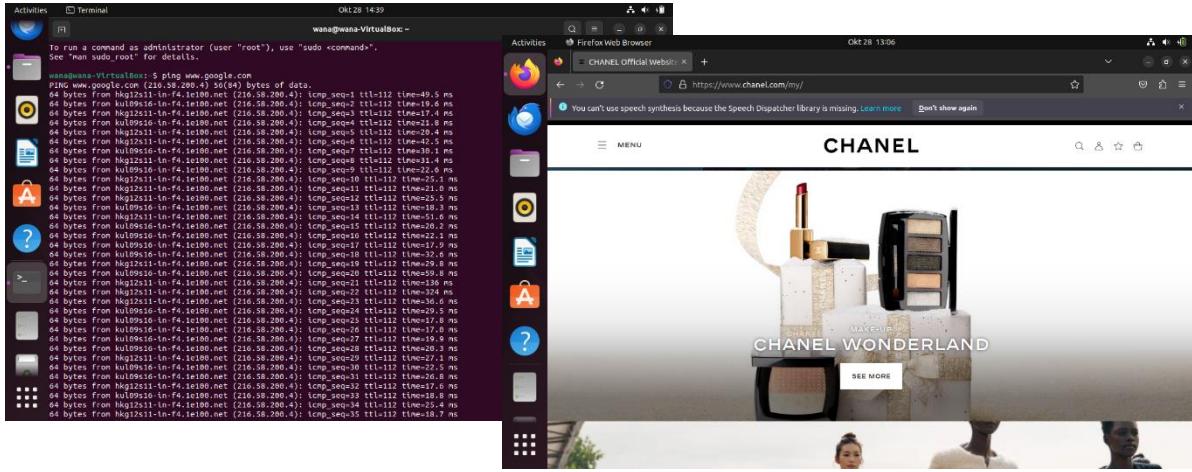
```
wana@wana-VirtualBox:~$ ifconfig
enp0s3: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 10.0.2.15  netmask 255.255.255.0  broadcast 10.0.2.255
                inet6 fe80::3076:1583:4119:150  prefixlen 64  scopeid 0x20<link>
        ether 08:00:27:56:b9:96  txqueuelen 1000  (Ethernet)
        RX packets 2644  bytes 2738798 (2.7 MB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 1007  bytes 166166 (166.1 KB)
        TX errors 0  dropped 0  overruns 0  carrier 0  collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536
        inet 127.0.0.1  netmask 255.0.0.0
                inet6 ::1  prefixlen 128  scopeid 0x10<host>
        loop  txqueuelen 1000  (Local Loopback)
        RX packets 335  bytes 37199 (37.1 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 335  bytes 37199 (37.1 KB)
        TX errors 0  dropped 0  overruns 0  carrier 0  collisions 0

wana@wana-VirtualBox:~$ ping 10.0.2.15
Pinging 10.0.2.15 with 32 bytes of data:
Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 10.0.2.15:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
    C:\Users\user>
```

C)



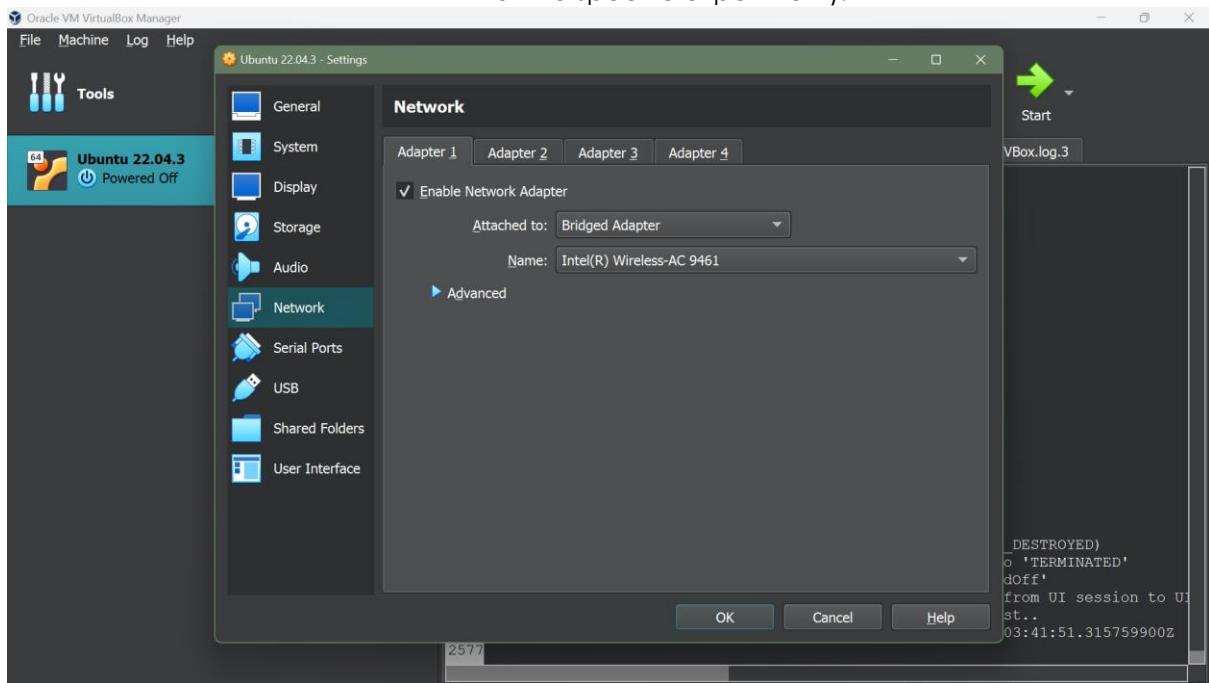
D)

A screenshot of a terminal window titled "codebind@codebind-VirtualBox: ~". It shows the command "ping 10.0.2.15" being run, resulting in a series of ICMP echo reply messages. The terminal interface includes standard Linux window controls at the top.

```
To run a command as administrator (user "root"), use "sudo <command>".  
See "man sudo_root" for details.  
  
codebind@codebind-VirtualBox:~$ ping 10.0.2.15  
PING 10.0.2.15 (10.0.2.15) 56(84) bytes of data.  
64 bytes from 10.0.2.15: icmp_seq=1 ttl=64 time=0.028 ms  
64 bytes from 10.0.2.15: icmp_seq=2 ttl=64 time=0.038 ms  
64 bytes from 10.0.2.15: icmp_seq=3 ttl=64 time=0.039 ms  
64 bytes from 10.0.2.15: icmp_seq=4 ttl=64 time=0.039 ms  
64 bytes from 10.0.2.15: icmp_seq=5 ttl=64 time=0.037 ms  
64 bytes from 10.0.2.15: icmp_seq=6 ttl=64 time=0.037 ms  
64 bytes from 10.0.2.15: icmp_seq=7 ttl=64 time=0.038 ms  
64 bytes from 10.0.2.15: icmp_seq=8 ttl=64 time=0.037 ms  
64 bytes from 10.0.2.15: icmp_seq=9 ttl=64 time=0.039 ms  
64 bytes from 10.0.2.15: icmp_seq=10 ttl=64 time=0.038 ms  
64 bytes from 10.0.2.15: icmp_seq=11 ttl=64 time=0.037 ms  
64 bytes from 10.0.2.15: icmp_seq=12 ttl=64 time=0.036 ms  
64 bytes from 10.0.2.15: icmp_seq=13 ttl=64 time=0.033 ms  
64 bytes from 10.0.2.15: icmp_seq=14 ttl=64 time=0.039 ms  
64 bytes from 10.0.2.15: icmp_seq=15 ttl=64 time=0.038 ms  
64 bytes from 10.0.2.15: icmp_seq=16 ttl=64 time=0.039 ms  
64 bytes from 10.0.2.15: icmp_seq=17 ttl=64 time=0.037 ms  
64 bytes from 10.0.2.15: icmp_seq=18 ttl=64 time=0.036 ms  
64 bytes from 10.0.2.15: icmp_seq=19 ttl=64 time=0.037 ms
```

2. Experiment 2: Bridge Adapter

- a. Provide screenshot of the network setup (Network Setting for the specific experiment).



- b. Execute experiment for each question in the following table and state the result.
c. Provide the result screenshot for each of the question in the table.

Network Setting: Bridge Adapter	
Questions	Result (Yes/No)
A. Can VM ping to host?	No
B. Can host ping to VM?	No
C. Can VM access to external network? E.g., Browse the Internet or ping www.google.com	Yes
D. Can another computer on the same host network ping to VM?	No

EXPERIMENT RESULT

A)

```
wana@wana-VirtualBox:~$ ping 192.168.56.1
PING 192.168.56.1 (192.168.56.1) 56(84) bytes of data.

From 203.78.193.237 icmp_seq=20 Destination Net Unreachable

From 203.78.193.237 icmp_seq=103 Destination Net Unreachable
From 203.78.193.237 icmp_seq=175 Destination Net Unreachable
From 203.78.193.237 icmp_seq=208 Destination Net Unreachable
From 203.78.193.237 icmp_seq=304 Destination Net Unreachable
From 203.78.193.237 icmp_seq=337 Destination Net Unreachable
From 203.78.193.237 icmp_seq=401 Destination Net Unreachable
From 203.78.193.237 icmp_seq=411 Destination Net Unreachable
From 203.78.193.237 icmp_seq=414 Destination Net Unreachable
```

B)

```
wana@wana-VirtualBox:~$ ifconfig
enp0s3: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 192.168.1.207  netmask 255.255.255.0  broadcast 192.168.1.255
                inet0 2001:db8:e1:983c:9e0b:87cf:575d:d3bd  prefixlen 64  scopeid 0x0<global>
                inet6 fe80::3076:1583:4119:e150  prefixlen 64  scopeid 0x20<link>
                inet6 2001:db8:e1:983c:afed:92e4:92a6:5b28  prefixlen 64  scopeid 0x0<global>
        ether 08:00:27:56:b9:96  txqueuelen 1000  (Ethernet)
        RX packets 2803  bytes 2776622 (2.7 MB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 1172  bytes 189424 (189.4 KB)
        TX errors 0  dropped 0  overruns 0  carrier 0  collisions 0

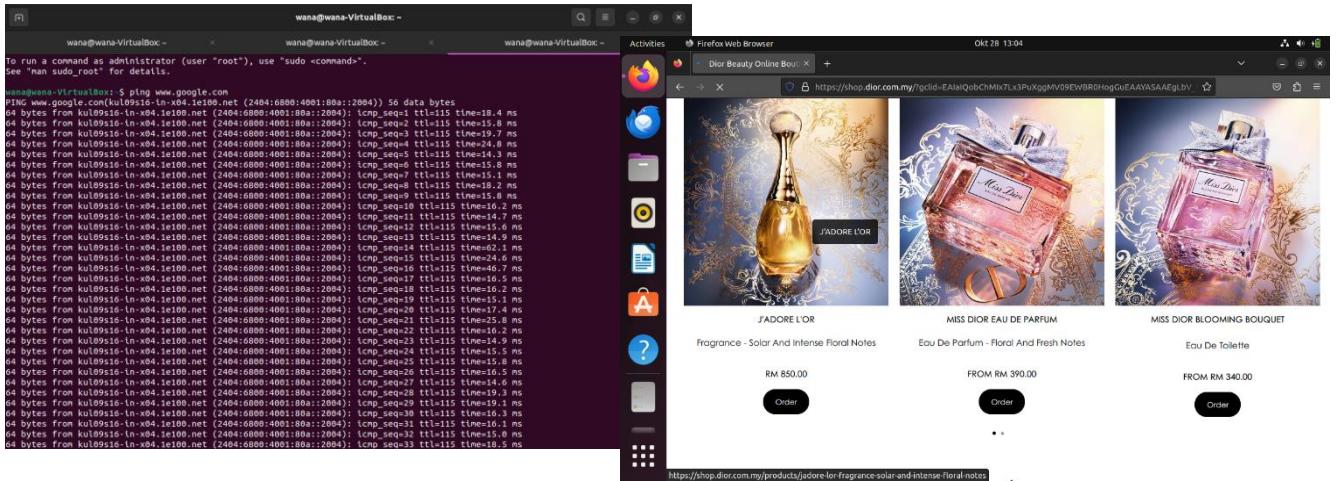
lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536
        inet 127.0.0.1  netmask 255.0.0.0
        inet6 ::1  prefixlen 128  scopeid 0x10<host>
        loop  txqueuelen 1000  (Local Loopback)
        RX packets 399  bytes 44245 (44.2 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 399  bytes 44245 (44.2 KB)
        TX errors 0  dropped 0  overruns 0  carrier 0  collisions 0

wana@wana-VirtualBox:~$ C:\Users\user>ping 10.0.2.15

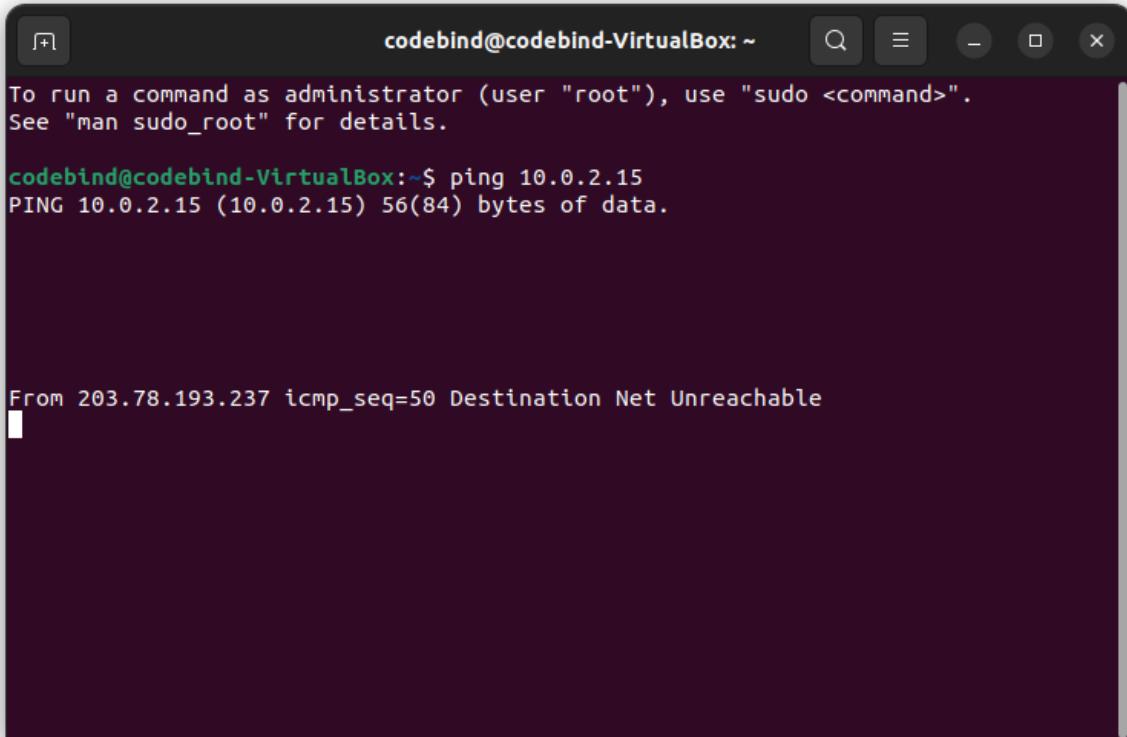
Pinging 10.0.2.15 with 32 bytes of data:
Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 10.0.2.15:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
C:\Users\user>
```

C)

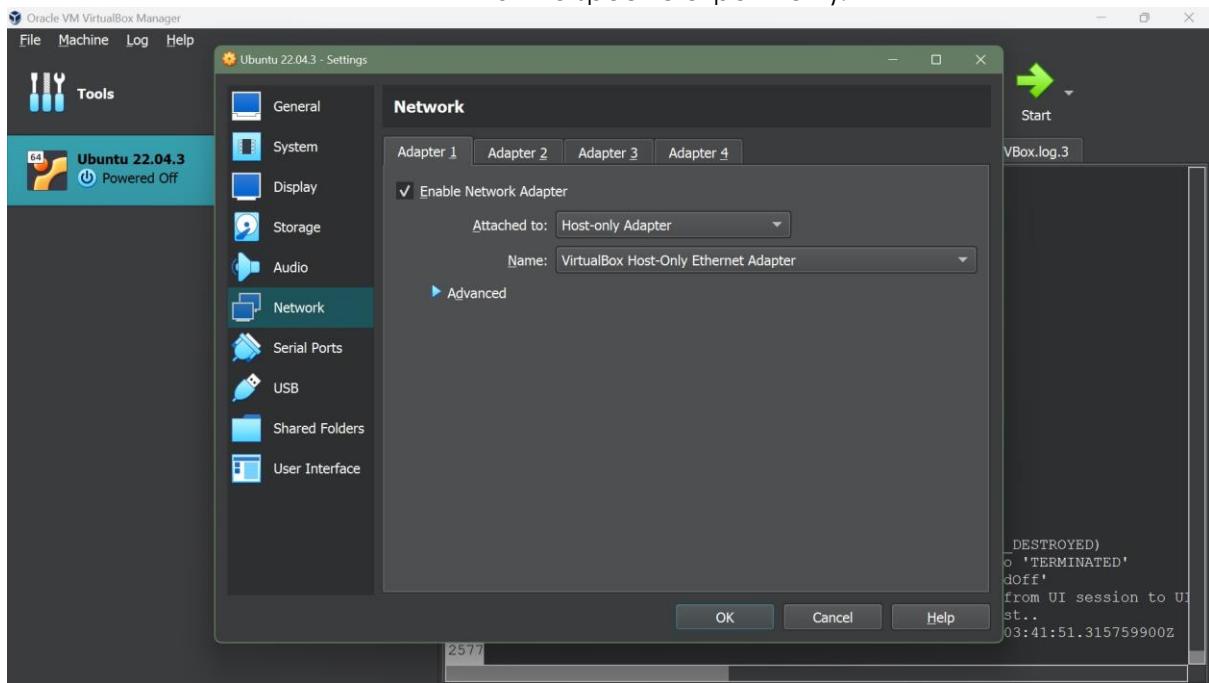


D)



3. Experiment 3: Host-only Adapter

- Provide screenshot of the network setup (Network Setting for the specific experiment).



- Execute experiment for each question in the following table and state the result.
- Provide the result screenshot for each of the question in the table.

Network Setting: Host-only Adapter	
Questions	Result (Yes/No)
A. Can VM ping to host?	Yes
B. Can host ping to VM?	No
C. Can VM access to external network? E.g., Browse the Internet or ping www.google.com	No
D. Can another computer on the same host network ping to VM?	No

EXPERIMENT RESULT

A)

```
wana@wana-VirtualBox: ~
```

To run a command as administrator (user "root"), use "sudo <command>"
See "man sudo_root" for details.

```
wana@wana-VirtualBox:~$ ping 192.168.56.1
PING 192.168.56.1 (192.168.56.1) 56(84) bytes of data.
64 bytes from 192.168.56.1: icmp_seq=1 ttl=128 time=0.912 ms
64 bytes from 192.168.56.1: icmp_seq=2 ttl=128 time=0.989 ms
64 bytes from 192.168.56.1: icmp_seq=3 ttl=128 time=0.555 ms
64 bytes from 192.168.56.1: icmp_seq=4 ttl=128 time=0.538 ms
64 bytes from 192.168.56.1: icmp_seq=5 ttl=128 time=0.481 ms
64 bytes from 192.168.56.1: icmp_seq=6 ttl=128 time=0.584 ms
64 bytes from 192.168.56.1: icmp_seq=7 ttl=128 time=0.523 ms
64 bytes from 192.168.56.1: icmp_seq=8 ttl=128 time=0.573 ms
64 bytes from 192.168.56.1: icmp_seq=9 ttl=128 time=0.101 ms
64 bytes from 192.168.56.1: icmp_seq=10 ttl=128 time=1.37 ms
64 bytes from 192.168.56.1: icmp_seq=11 ttl=128 time=0.652 ms
64 bytes from 192.168.56.1: icmp_seq=12 ttl=128 time=1.55 ms
64 bytes from 192.168.56.1: icmp_seq=13 ttl=128 time=1.78 ms
64 bytes from 192.168.56.1: icmp_seq=14 ttl=128 time=0.667 ms
64 bytes from 192.168.56.1: icmp_seq=15 ttl=128 time=1.06 ms
64 bytes from 192.168.56.1: icmp_seq=16 ttl=128 time=0.618 ms
64 bytes from 192.168.56.1: icmp_seq=17 ttl=128 time=1.16 ms
64 bytes from 192.168.56.1: icmp_seq=18 ttl=128 time=1.11 ms
64 bytes from 192.168.56.1: icmp_seq=19 ttl=128 time=1.02 ms
64 bytes from 192.168.56.1: icmp_seq=20 ttl=128 time=1.11 ms
64 bytes from 192.168.56.1: icmp_seq=21 ttl=128 time=1.71 ms
64 bytes from 192.168.56.1: icmp_seq=22 ttl=128 time=1.41 ms
64 bytes from 192.168.56.1: icmp_seq=23 ttl=128 time=0.629 ms
64 bytes from 192.168.56.1: icmp_seq=24 ttl=128 time=0.854 ms
64 bytes from 192.168.56.1: icmp_seq=25 ttl=128 time=0.726 ms
64 bytes from 192.168.56.1: icmp_seq=26 ttl=128 time=1.96 ms
64 bytes from 192.168.56.1: icmp_seq=27 ttl=128 time=1.25 ms
64 bytes from 192.168.56.1: icmp_seq=28 ttl=128 time=1.25 ms
64 bytes from 192.168.56.1: icmp_seq=29 ttl=128 time=0.844 ms
64 bytes from 192.168.56.1: icmp_seq=30 ttl=128 time=3.28 ms
64 bytes from 192.168.56.1: icmp_seq=31 ttl=128 time=0.771 ms
64 bytes from 192.168.56.1: icmp_seq=32 ttl=128 time=0.637 ms
64 bytes from 192.168.56.1: icmp_seq=33 ttl=128 time=15.3 ms
```

```
C:\Users\user>ipconfig
```

Windows IP Configuration

Ethernet adapter Ethernet 2:

```
Connection-specific DNS Suffix . :
Link-local IPv6 Address . . . . . : fe80::9199:4b30:ae71:ea8e%9
IPv4 Address . . . . . : 192.168.56.1
Subnet Mask . . . . . : 255.255.255.0
Default Gateway . . . . . :
```

Wireless LAN adapter Local Area Connection* 3:

```
Media State . . . . . : Media disconnected
Connection-specific DNS Suffix . :
```

Wireless LAN adapter Local Area Connection* 4:

```
Media State . . . . . : Media disconnected
Connection-specific DNS Suffix . :
```

Ethernet adapter McAfee VPN:

```
Media State . . . . . : Media disconnected
Connection-specific DNS Suffix . :
```

Wireless LAN adapter Wi-Fi:

```
Connection-specific DNS Suffix . :
IPv6 Address . . . . . : 2001:d08:e1:983c:926d:75dd:8b6c:7aea
Temporary IPv6 Address . . . . . : 2001:d08:e1:983c:d069:827e:7bd2:b579
Link-local IPv6 Address . . . . . : fe80:14d2:2e59:e1b:2a9c%22
IPv4 Address . . . . . : 192.168.1.187
Subnet Mask . . . . . : 255.255.255.0
Default Gateway . . . . . : fe80:1%22
                                         192.168.1.254
```

```
C:\Users\user>_
```

B)

```
wana@wana-VirtualBox: ~
```

```
wana@wana-VirtualBox:~$ ifconfig
enp0s3: flags=4163<UP,BROADCAST,RUNNING,MULTICAST  mtu 1500
        inet 192.168.56.101  netmask 255.255.255.0  broadcast 192.168.56.255
        inet6 fe80::3076:1583:4119:e150  prefixlen 64  scopeid 0x20<link>
          ether 08:00:27:56:b9:96  txqueuelen 1000  (Ethernet)
            RX packets 3036  bytes 2805055 (2.8 MB)
            RX errors 0  dropped 0  overruns 0  frame 0
            TX packets 1227  bytes 196380 (196.3 KB)
            TX errors 0  dropped 0  overruns 0  carrier 0  collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING  mtu 65536
        inet 127.0.0.1  netmask 255.0.0.0
        inet6 ::1  prefixlen 128  scopeid 0x10<host>
          loop  txqueuelen 1000  (Local Loopback)
            RX packets 471  bytes 50093 (50.0 KB)
            RX errors 0  dropped 0  overruns 0  frame 0
            TX packets 471  bytes 50093 (50.0 KB)
            TX errors 0  dropped 0  overruns 0  carrier 0  collisions 0
```

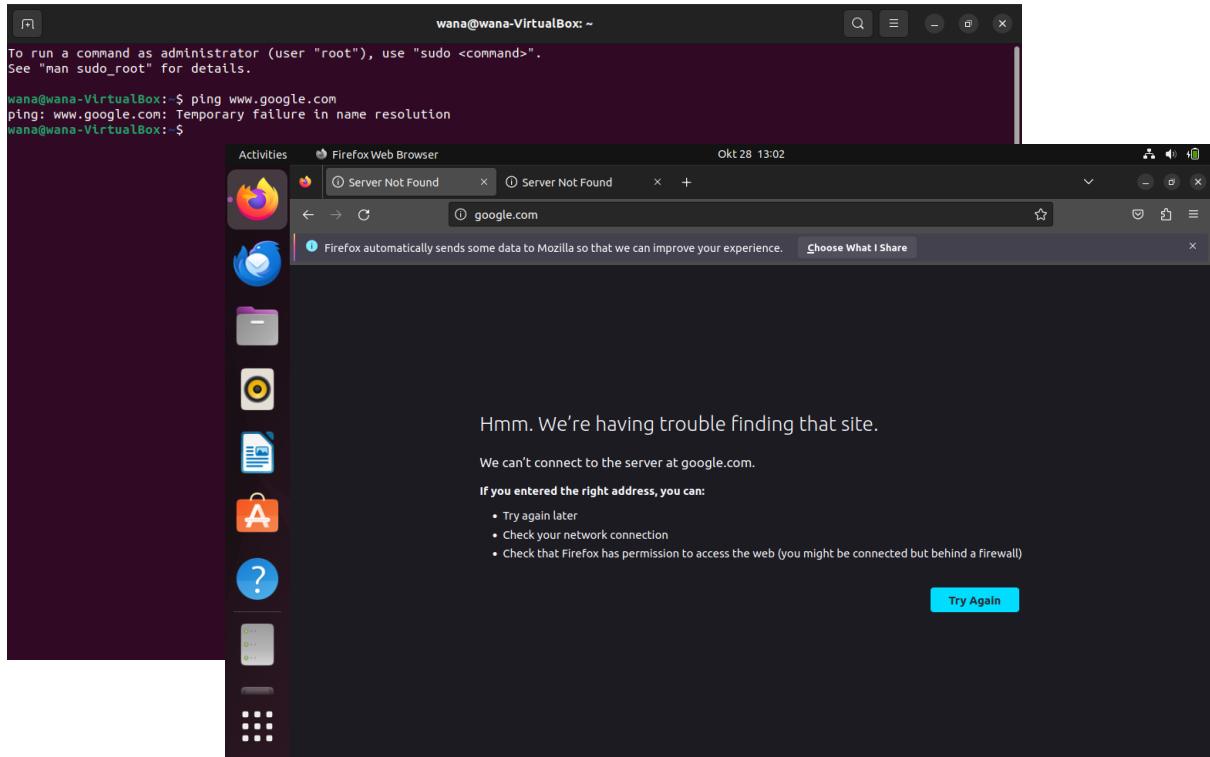
```
wana@wana-VirtualBox:~$
```

```
C:\Users\user>ping 10.0.2.15

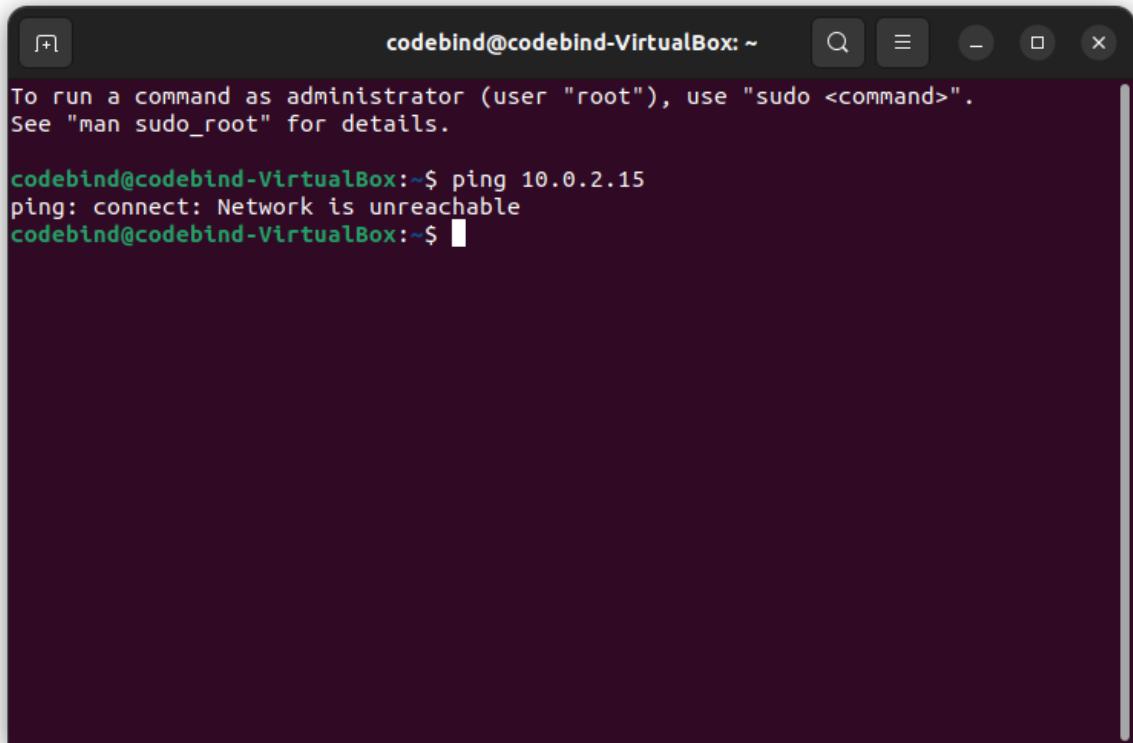
Pinging 10.0.2.15 with 32 bytes of data:
Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 10.0.2.15:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
C:\Users\user>
```

C)



D)



- ii. Observe the differences of the above three settings (Experiment 1, 2 & 3). Elaborate your observation and make a short conclusion.

In Experiment 1, the VM may reach the external network via the host, but it may not be immediately available from other machines on the same network unless port forwarding is used. While by using Bridged in Experiment 2, the VM acts as an independent machine on the same network as the host, making it immediately reachable by other machines on the same network. Last but not least, in Experiment 3, the VM can connect with the host and other VMs on the same host-only network but cannot likely access the external network directly.

To conclude, the network configuration, such as NAT, Bridged, or Host-only, is specified by the demands of the computer. NAT is appropriate for the majority of internet-connected contexts, Bridged allows VMs to function as independent machines on the network, and Host-only excludes VMs from the external network while providing connectivity between them and the host.

**** Note:** You may need to execute command 'ipconfig' in command prompt (if using Windows) and 'ifconfig' in terminal (if using Linux) to get the IP information for executing the above-mentioned experiments.

REFERENCES

1. Heddings, A. (2020, July 23). Which Type of Networking Should You Use for Your Virtual Machine? How-to Geek.
<https://www.howtogeek.com/devops/which-type-of-networking-should-you-use-for-your-virtual-machine/>

** Sample of experiment results:

hazalila@hazalila-VirtualBoxUbuntu:~

```

TX packets 2199 bytes 152519 (152.5 KB)
TX errors 0 dropped 0 overruns 0 carrier 0 collisio
lo: flags=73<UP,LOOPBACK,RUNNING> mtu 65536
    inet 127.0.0.1 netmask 255.0.0.0
    inet6 ::1 prefixlen 128 scopeid 0x10<host>
        loop txqueuelen 1000 (Local Loopback)
        RX packets 163 bytes 14108 (14.1 KB)
        RX errors 0 dropped 0 overruns 0 frame 0
        TX packets 163 bytes 14108 (14.1 KB)
        TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

hazalila@hazalila-VirtualBoxUbuntu:~$ ping 10.65.60.93
PING 10.65.60.93 (10.65.60.93) 56(84) bytes of data.
64 bytes from 10.65.60.93: icmp_seq=1 ttl=127 time=0.831 ms
64 bytes from 10.65.60.93: icmp_seq=2 ttl=127 time=1.59 ms
64 bytes from 10.65.60.93: icmp_seq=3 ttl=127 time=1.07 ms
64 bytes from 10.65.60.93: icmp_seq=4 ttl=127 time=1.65 ms
64 bytes from 10.65.60.93: icmp_seq=5 ttl=127 time=1.68 ms
^C
--- 10.65.60.93 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 401ms
rtt min/avg/max/mdev = 0.831/1.363/1.682/0.348 ms
hazalila@hazalila-VirtualBoxUbuntu:~$ 
```

Command Prompt

```

Wireless LAN adapter Wi-Fi:
    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix . .
Wireless LAN adapter Local Area Connection* 3:
    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix . .
Wireless LAN adapter Local Area Connection* 12:
    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix . .
Ethernet adapter Ethernet:
    Connection-specific DNS Suffix . : lan
    Link-local IPv6 Address . . . . . : fe80::c824:11b2:2920:d18a%2
    IPv4 Address . . . . . : 10.65.60.93
    Subnet Mask . . . . . : 255.255.252.0
    Default Gateway . . . . . : 10.65.63.254
Ethernet adapter Bluetooth Network Connection:
    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix . .

C:\Users\User>
```

hazalila@hazalila-VirtualBoxUbuntu:~

```

hazalila@hazalila-VirtualBoxUbuntu:~$ ifconfig
enp0s3: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 10.0.2.15 netmask 255.255.255.0 broadcast 10.0.2.255
        inet6 fe80::e63f:5b:sa41:6a7f prefixlen 64 scopeid 0x10<host>
            ether 08:00:27:5a:86:31 txqueuelen 1000 (Ethernet)
            RX packets 5233 bytes 4804180 (4.8 MB)
            RX errors 0 dropped 0 overruns 0 frame 0
            TX packets 2199 bytes 152519 (152.5 KB)
            TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING> mtu 65536
    inet 127.0.0.1 netmask 255.0.0.0
    inet6 ::1 prefixlen 128 scopeid 0x10<host>
        loop txqueuelen 1000 (Local Loopback)
        RX packets 163 bytes 14108 (14.1 KB)
        RX errors 0 dropped 0 overruns 0 frame 0
        TX packets 163 bytes 14108 (14.1 KB)
        TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

hazalila@hazalila-VirtualBoxUbuntu:~$ 
```

Command Prompt

```

Ping statistics for 10.65.61.232:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 1ms, Maximum = 2ms, Average = 1ms
C:\Users\User>ping 10.65.61.232

Pinging 10.65.61.232 with 32 bytes of data:
Reply from 10.65.61.232: bytes=32 time=2ms TTL=128
Reply from 10.65.61.232: bytes=32 time<1ms TTL=128
Reply from 10.65.61.232: bytes=32 time=1ms TTL=128
Reply from 10.65.61.232: bytes=32 time=1ms TTL=128

Ping statistics for 10.65.61.232:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 2ms, Average = 1ms
C:\Users\User>ping 10.0.2.15

Pinging 10.0.2.15 with 32 bytes of data:
Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 10.0.2.15:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
C:\Users\User>
```

hazalila@hazalila-VirtualBoxUbuntu:~

```

hazalila@hazalila-VirtualBoxUbuntu:~$ 
hazalila@hazalila-VirtualBoxUbuntu:~$ 
hazalila@hazalila-VirtualBoxUbuntu:~$ ping www.google.com
PING www.google.com (216.58.196.36) 56(84) bytes of data.
64 bytes from kul09s12-in-f4.1e100.net (216.58.196.36): icmp_seq=1 ttl=116 time=13.6 ms
64 bytes from kul09s12-in-f4.1e100.net (216.58.196.36): icmp_seq=2 ttl=116 time=13.5 ms
64 bytes from kul09s12-in-f4.1e100.net (216.58.196.36): icmp_seq=3 ttl=116 time=13.3 ms
64 bytes from kul09s12-in-f4.1e100.net (216.58.196.36): icmp_seq=4 ttl=116 time=13.6 ms
64 bytes from kul09s12-in-f4.1e100.net (216.58.196.36): icmp_seq=5 ttl=116 time=13.2 ms
^C
--- www.google.com ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4008ms
rtt min/avg/max/mdev = 13.155/13.418/13.583/0.158 ms
hazalila@hazalila-VirtualBoxUbuntu:~$ 
```

