

1.

Create a virtual machine having the os centos.

- a) Install firewall in the vm(centos might have a firewall installed by default).(firewalld or iptables)

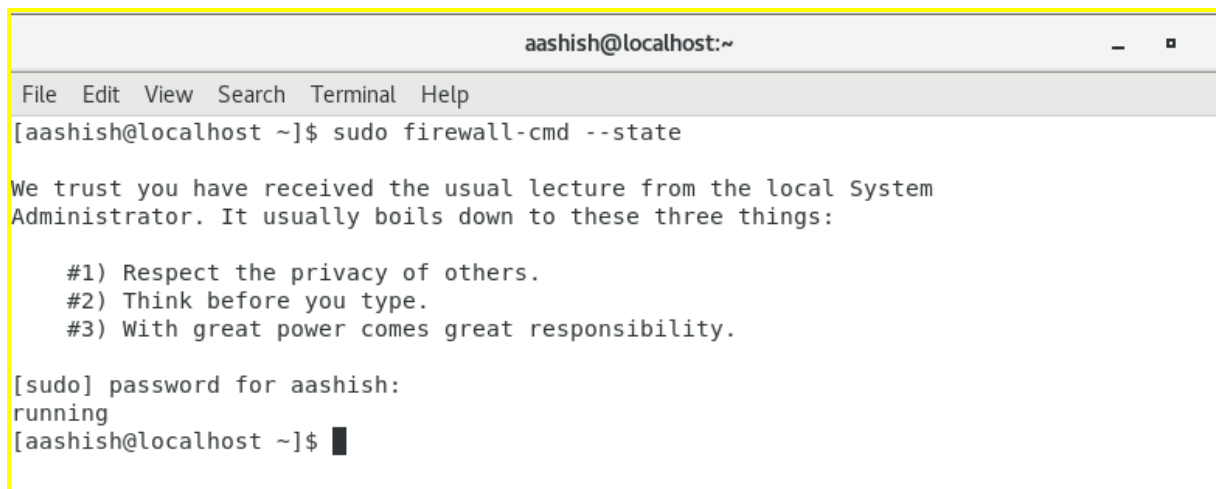
Answer:

To install firewall in the VM(Centos), we use following command;

**- sudo yum install firewalld**

And to verify that firewall is running or not we use following command;

**- sudo firewall -cmd --state**

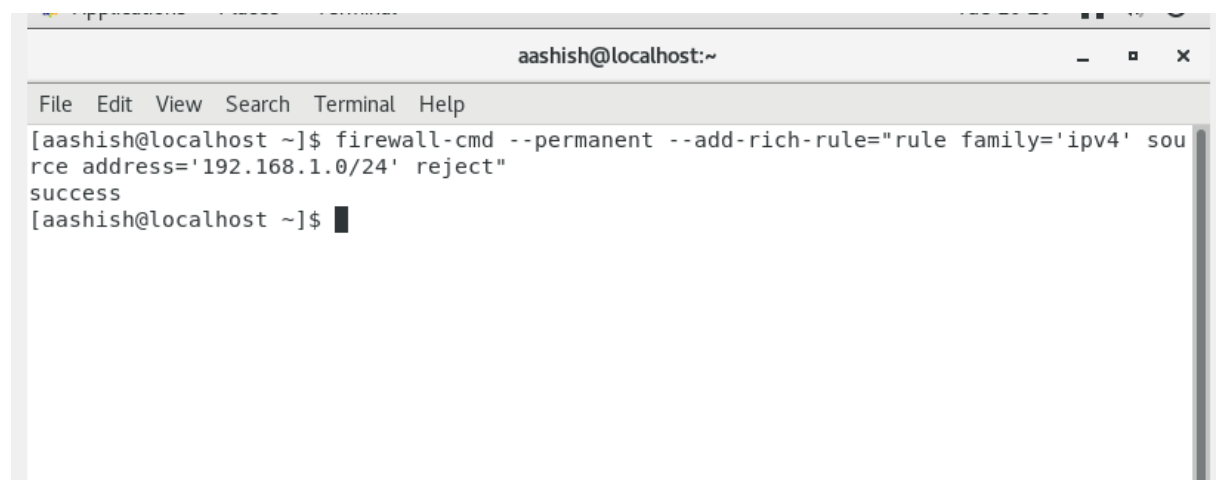
A terminal window titled 'aashish@localhost:~' with a menu bar (File, Edit, View, Search, Terminal, Help). The command 'sudo firewall-cmd --state' is entered. The output shows a warning from the local system administrator followed by three points: #1) Respect the privacy of others, #2) Think before you type, #3) With great power comes great responsibility. Then it says '[sudo] password for aashish:' followed by 'running' and the prompt '[aashish@localhost ~]\$' with a cursor.

```
aashish@localhost:~  
File Edit View Search Terminal Help  
[aashish@localhost ~]$ sudo firewall-cmd --state  
  
We trust you have received the usual lecture from the local System  
Administrator. It usually boils down to these three things:  
  
#1) Respect the privacy of others.  
#2) Think before you type.  
#3) With great power comes great responsibility.  
  
[sudo] password for aashish:  
running  
[aashish@localhost ~]$
```

- b) Block certain ip range/subnet using firewalld.

To block certain ip range/subnet using firewalld, we use following command;

**- firewall -cmd --permanent --add-rich-rule="rule family='ipv4' source address='192.168.1.0/24' reject"**

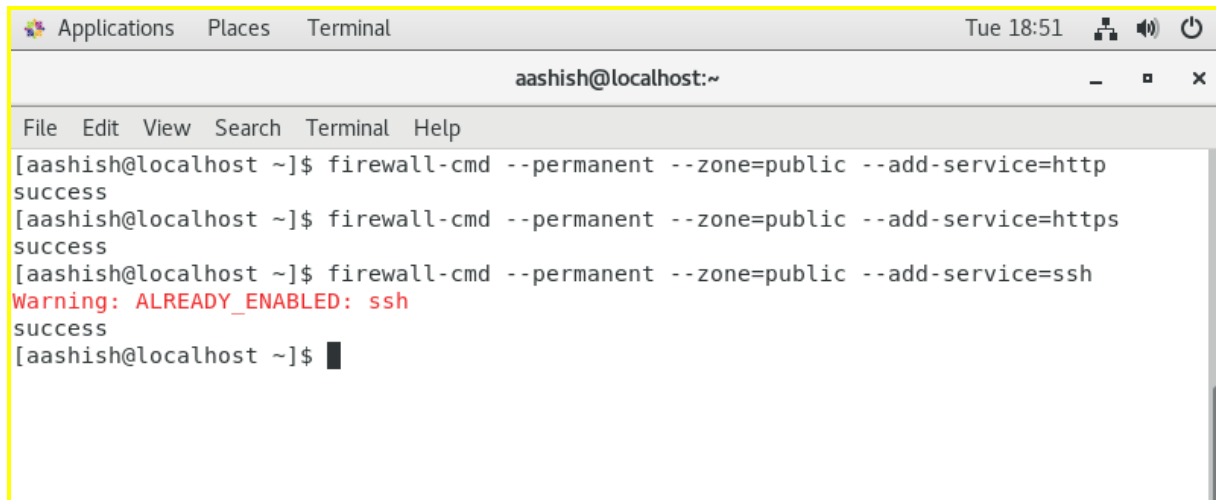
A terminal window titled 'aashish@localhost:~' with a menu bar (File, Edit, View, Search, Terminal, Help). The command 'firewall-cmd --permanent --add-rich-rule="rule family='ipv4' source address='192.168.1.0/24' reject"' is entered. The output is 'success' and the prompt '[aashish@localhost ~]\$' with a cursor.

```
aashish@localhost:~  
File Edit View Search Terminal Help  
[aashish@localhost ~]$ firewall-cmd --permanent --add-rich-rule="rule family='ipv4' sou  
rce address='192.168.1.0/24' reject"  
success  
[aashish@localhost ~]$
```

**c) Allow http, https and ssh connection using firewall.**

To allow http, https and ssh connection using firewall, we use following command;

- **firewall -cmd --permanent --zone=public --add-service=http**
- **firewall -cmd --permanent --zone=public --add-service=https**
- **firewall -cmd --permanent --zone=public --add-service=ssh**



The screenshot shows a terminal window titled 'Applications Places Terminal' with a timestamp of 'Tue 18:51'. The user 'aashish@localhost' is at the prompt. The terminal displays the following commands and output:

```
[aashish@localhost ~]$ firewall-cmd --permanent --zone=public --add-service=http
success
[aashish@localhost ~]$ firewall-cmd --permanent --zone=public --add-service=https
success
[aashish@localhost ~]$ firewall-cmd --permanent --zone=public --add-service=ssh
Warning: ALREADY_ENABLED: ssh
success
[aashish@localhost ~]$
```

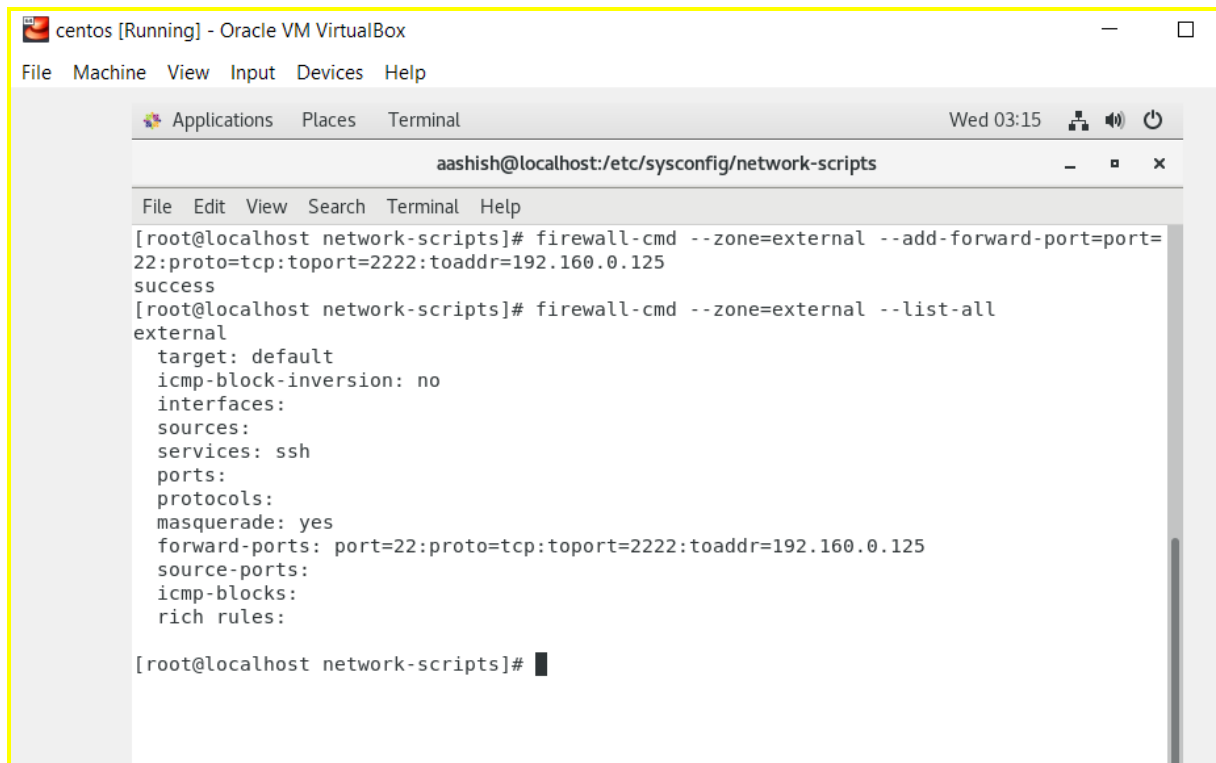
**d) You can add other rules as well as you prefer.**

To forward all ssh port 22 connections to port 2222 for IP address 192.168.0.132 we use the following command;

- **firewall-cmd --zone=external --add-forward-port=port=22:proto=tcp:toport=2222:toaddress=192.168.0.132**

To verify it we use following command;

- **firewall-cmd --zone=external --list-all**



```
centos [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help

Applications Places Terminal Wed 03:15

aashish@localhost:/etc/sysconfig/network-scripts

File Edit View Search Terminal Help

[root@localhost network-scripts]# firewall-cmd --zone=external --add-forward-port=port=22:proto=tcp:toport=2222:toaddr=192.160.0.125
success
[root@localhost network-scripts]# firewall-cmd --zone=external --list-all
external
  target: default
  icmp-block-inversion: no
  interfaces:
  sources:
  services: ssh
  ports:
  protocols:
  masquerade: yes
  forward-ports: port=22:proto=tcp:toport=2222:toaddr=192.160.0.125
  source-ports:
  icmp-blocks:
  rich rules:

[root@localhost network-scripts]#
```

2.

Create one vm with 2 network interfaces one should behave as WAN and another as LAN. Create another VM attaching the previously created LAN interface to it.

a) Implement NAT in the first vm, so that the second vm can access the internet.

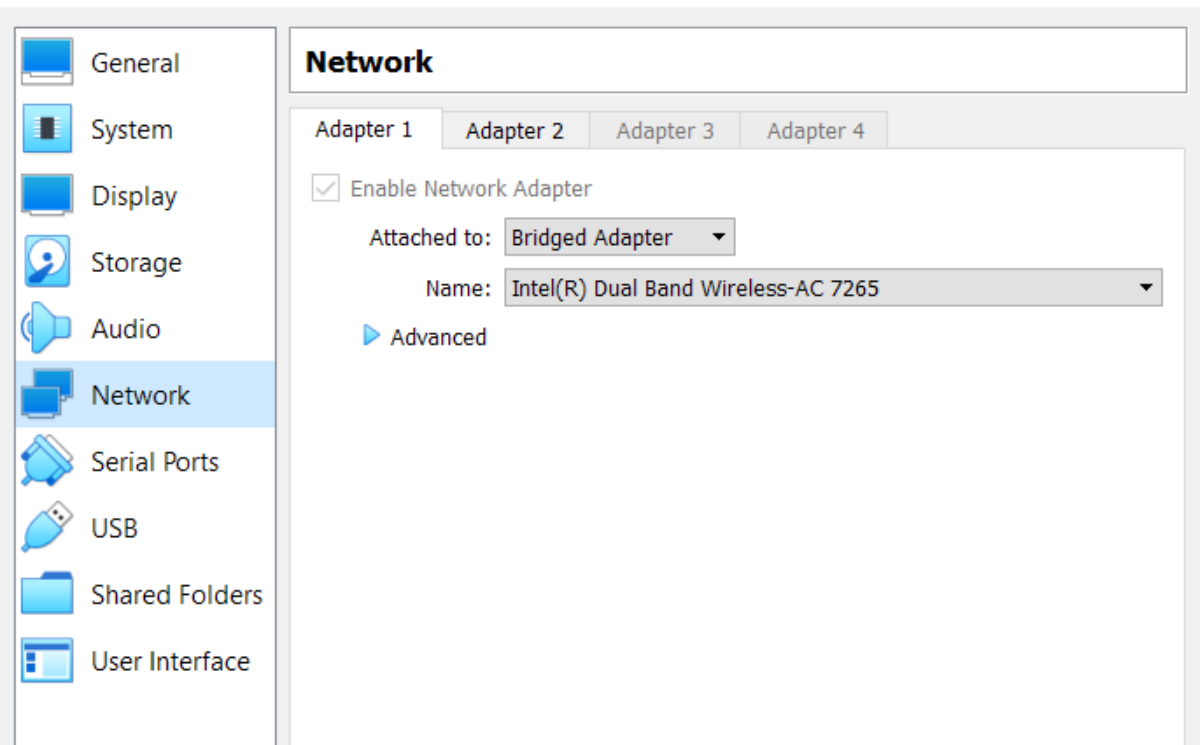
**Note:** Configure the first vm as a router, so make the LAN interfaces in the first vm as gateway to the LAN network. And in the second vm configure the gateway to the ip of the first vm LAN ip.

**Answer:**

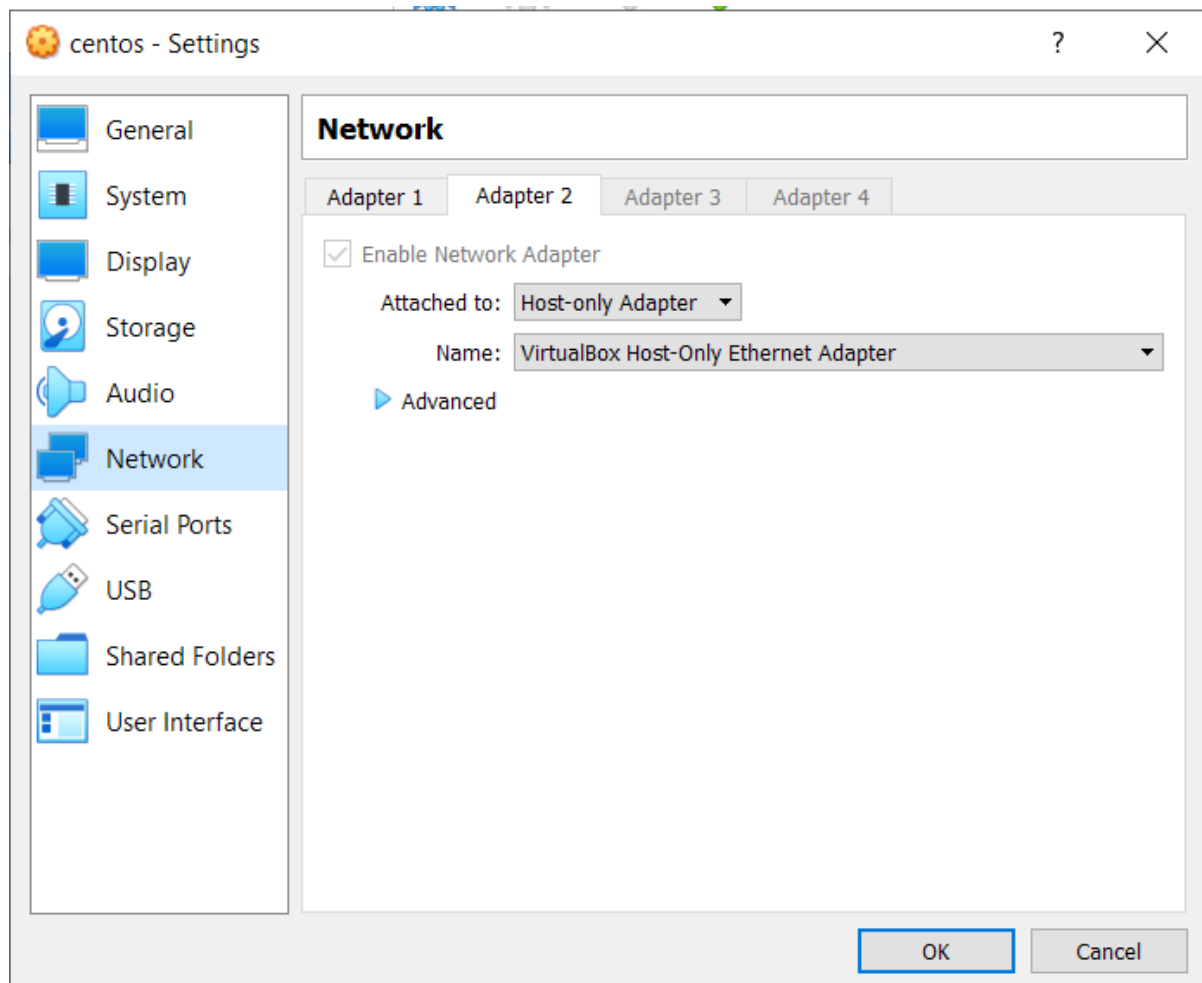
First of all, we create a VM named **Centos** with 2 network interfaces in which one behaves as WAN and another as LAN.

For that we have installed Centos as first VM with 2 interfaces;

- **Bridged Adapter (enp0s3)**

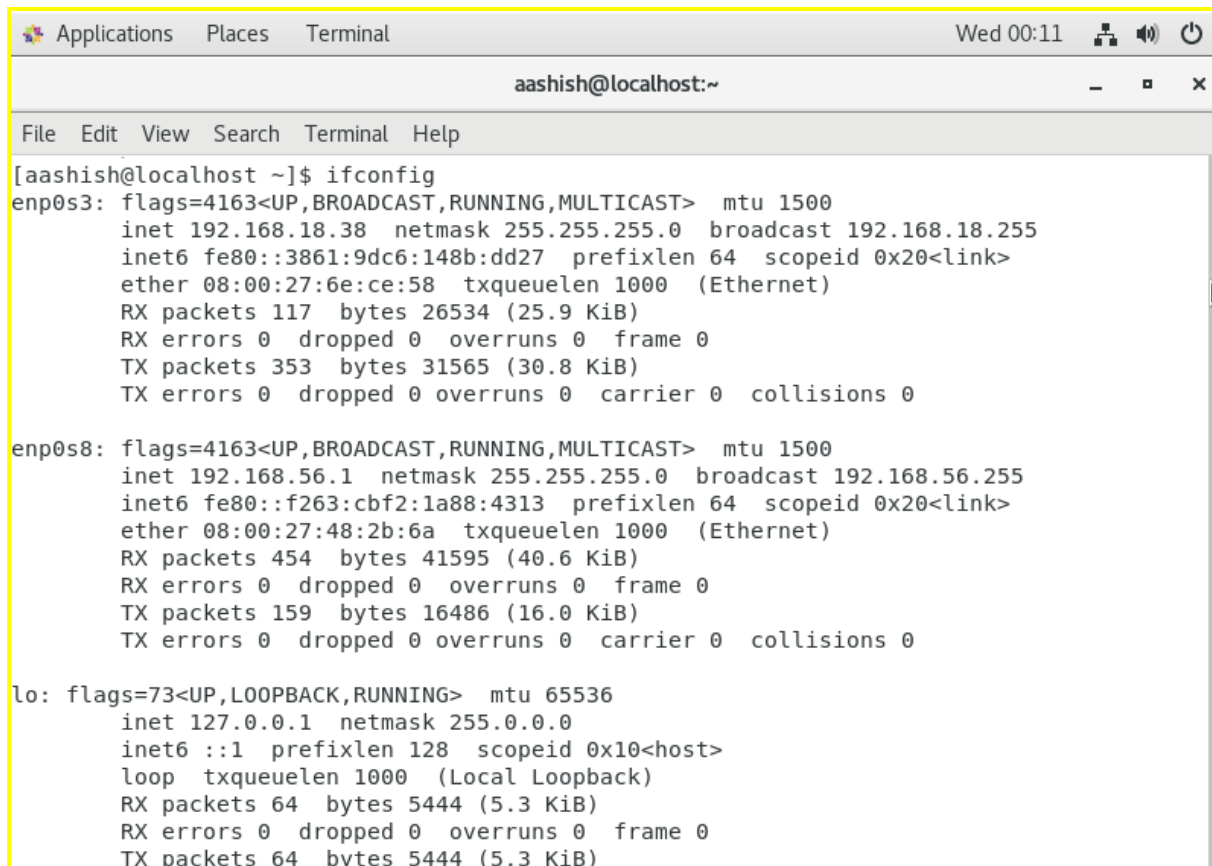


- **Host-Only adapter (enp0s8)**



After that we check the ip addresses from both the network interfaces using command;

**- Ifconfig**



```
Applications  Places  Terminal  Wed 00:11  [Icons]  [Volume]  [Power]
aashish@localhost:~
File Edit View Search Terminal Help
[aashish@localhost ~]$ ifconfig
enp0s3: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
    inet 192.168.18.38  netmask 255.255.255.0  broadcast 192.168.18.255
    inet6 fe80::3861:9dc6:148b:dd27  prefixlen 64  scopeid 0x20<link>
    ether 08:00:27:6e:ce:58  txqueuelen 1000  (Ethernet)
    RX packets 117  bytes 26534 (25.9 KiB)
    RX errors 0  dropped 0  overruns 0  frame 0
    TX packets 353  bytes 31565 (30.8 KiB)
    TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

enp0s8: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
    inet 192.168.56.1  netmask 255.255.255.0  broadcast 192.168.56.255
    inet6 fe80::f263:cbf2:1a88:4313  prefixlen 64  scopeid 0x20<link>
    ether 08:00:27:48:2b:6a  txqueuelen 1000  (Ethernet)
    RX packets 454  bytes 41595 (40.6 KiB)
    RX errors 0  dropped 0  overruns 0  frame 0
    TX packets 159  bytes 16486 (16.0 KiB)
    TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

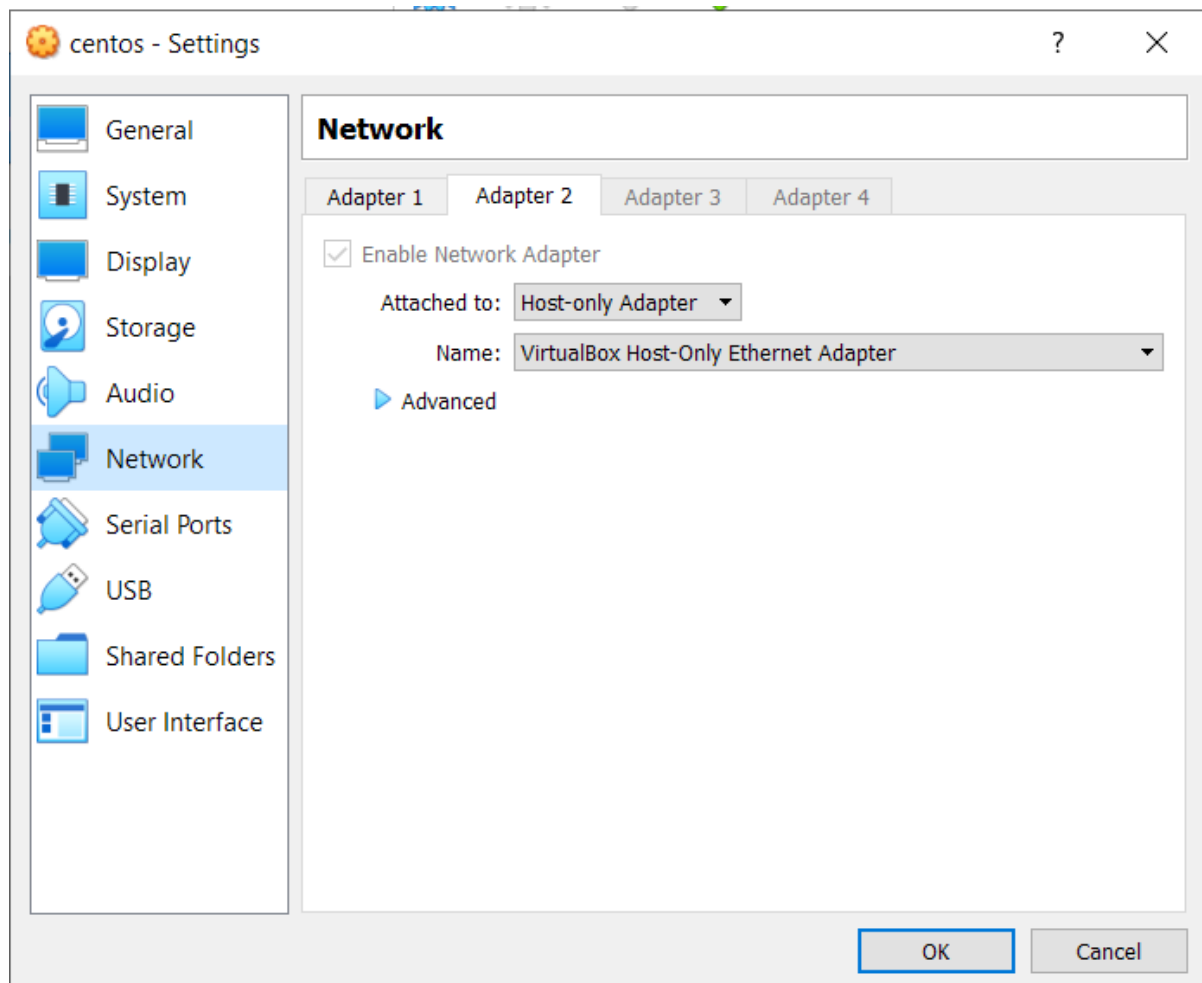
lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536
    inet 127.0.0.1  netmask 255.0.0.0
    inet6 ::1  prefixlen 128  scopeid 0x10<host>
    loop txqueuelen 1000  (Local Loopback)
    RX packets 64  bytes 5444 (5.3 KiB)
    RX errors 0  dropped 0  overruns 0  frame 0
    TX packets 64  bytes 5444 (5.3 KiB)
```

From the above figure we have IP addresses as follows for two interfaces respectively ;

- **enp0s3 IP = 192.168.18.38**
- **enp0s8 IP = 192.168.56.1**

Likewise, we need to set up another network interface in the second VM named **Centos2**.

- **Host-Only adapter (enp0s3)**



To check the IP address associate with the network interface we use;

- **Ifconfig**

```
Centos2 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Applications Places Terminal Wed 00:13
aashish@localhost:~

[aaashish@localhost ~]$ ifconfig
enp0s3: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
    inet 192.168.56.105  netmask 255.255.255.0  broadcast 192.168.56.255
    inet6 fe80::3a2d:1e97:f5ac:79bc  prefixlen 64  scopeid 0x20<link>
    ether 08:00:27:65:9d:02  txqueuelen 1000  (Ethernet)
    RX packets 147  bytes 15122 (14.7 KiB)
    RX errors 0  dropped 0  overruns 0  frame 0
    TX packets 494  bytes 43273 (42.2 KiB)
    TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

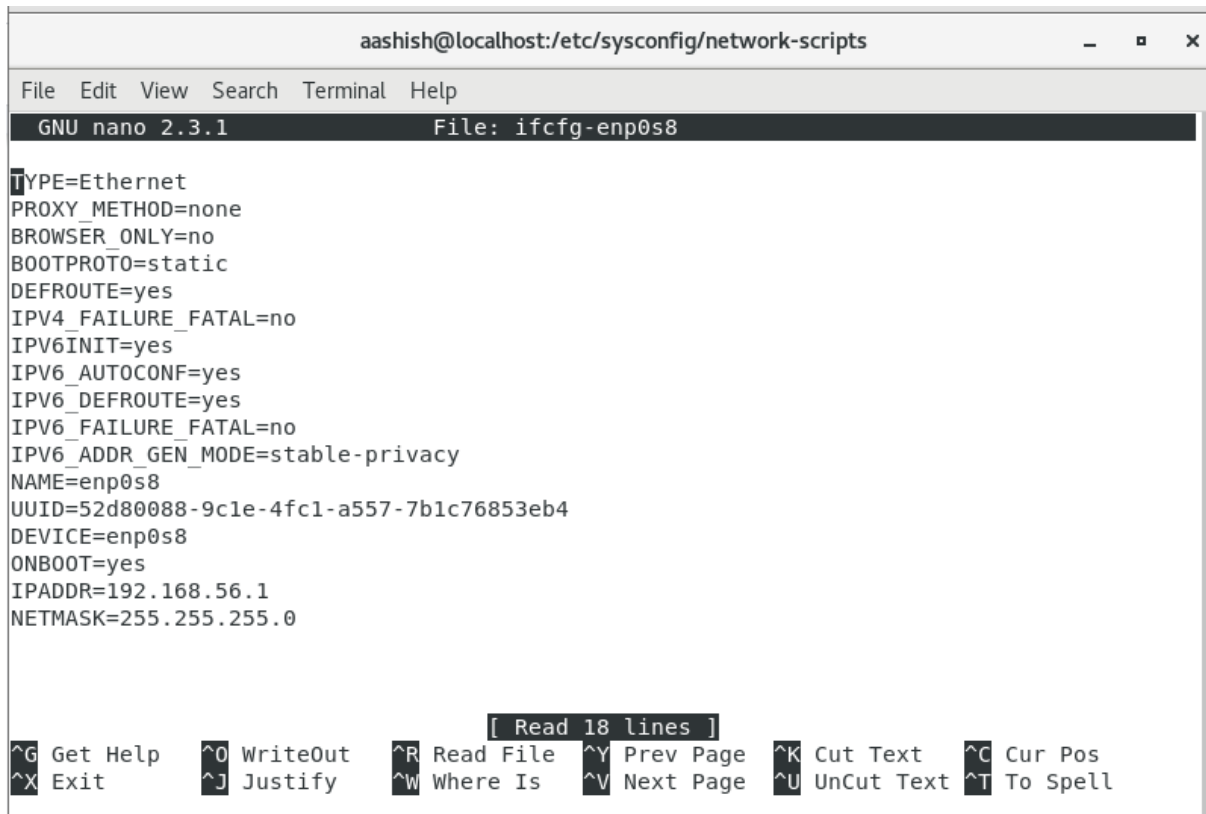
lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536
    inet 127.0.0.1  netmask 255.0.0.0
    inet6 ::1  prefixlen 128  scopeid 0x10<host>
    loop txqueuelen 1000  (Local Loopback)
    RX packets 310  bytes 26538 (25.9 KiB)
    RX errors 0  dropped 0  overruns 0  frame 0
    TX packets 310  bytes 26538 (25.9 KiB)
    TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

virbr0: flags=4099<UP,BROADCAST,MULTICAST>  mtu 1500
    inet 192.168.122.1  netmask 255.255.255.0  broadcast 192.168.122.255
    ether 52:54:00:8b:c2:d8  txqueuelen 1000  (Ethernet)
    RX packets 0  bytes 0 (0.0 B)
    RX errors 0  dropped 0  overruns 0  frame 0
    TX packets 0  bytes 0 (0.0 B)
    TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

From the above figure, the IP address is shown as;

- **enp0s3 IP = 192.168.56.105**

Now, to configure **enp0s8** we need to edit **/etc/sysconfig/network-scripts/ifcfg-enp0s8** file.



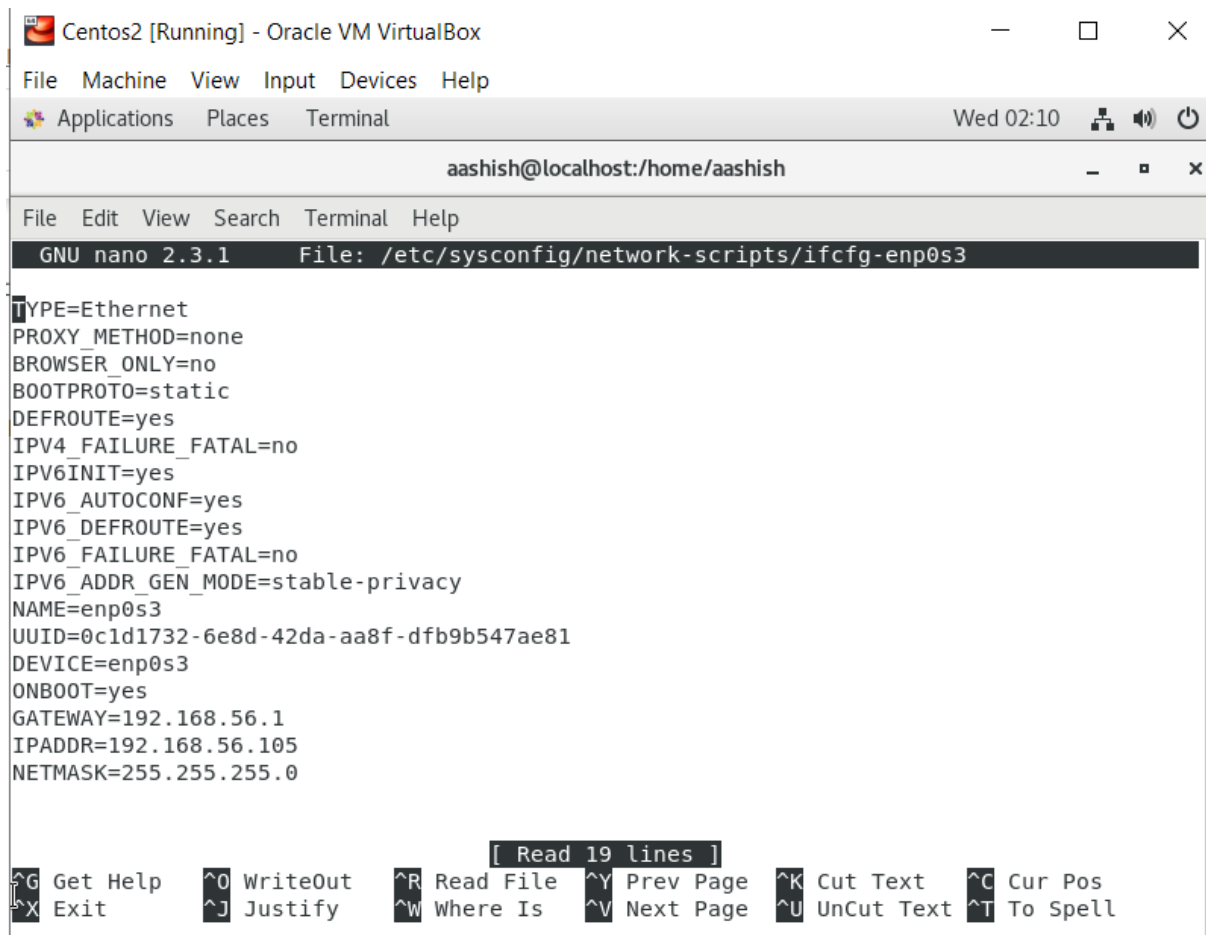
The screenshot shows a terminal window with the title bar 'aashish@localhost:/etc/sysconfig/network-scripts'. The window contains the GNU nano 2.3.1 text editor editing the file 'ifcfg-enp0s8'. The editor displays the following configuration:

```
TYPE=Ethernet
PROXY_METHOD=none
BROWSER_ONLY=no
BOOTPROTO=static
DEFROUTE=yes
IPV4_FAILURE_FATAL=no
IPV6INIT=yes
IPV6_AUTOCONF=yes
IPV6_DEFROUTE=yes
IPV6_FAILURE_FATAL=no
IPV6_ADDR_GEN_MODE=stable-privacy
NAME=enp0s8
UUID=52d80088-9c1e-4fc1-a557-7b1c76853eb4
DEVICE=enp0s8
ONBOOT=yes
IPADDR=192.168.56.1
NETMASK=255.255.255.0
```

At the bottom of the editor, a status bar shows '[ Read 18 lines ]' and a list of keyboard shortcuts: ^G Get Help, ^O WriteOut, ^R Read File, ^Y Prev Page, ^K Cut Text, ^C Cur Pos, ^X Exit, ^J Justify, ^W Where Is, ^V Next Page, ^U UnCut Text, and ^T To Spell.

In the above figure IP address and netmask is added into the file.

In the same way, we need to configure the **enp0s3** in **Centos2** as well.  
So, again, we need to edit the **/etc/sysconfig/network-scripts/ifcfg-enp0s3** file.



```
Centos2 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Applications Places Terminal Wed 02:10
aashish@localhost:/home/aashish
File Edit View Search Terminal Help
GNU nano 2.3.1 File: /etc/sysconfig/network-scripts/ifcfg-enp0s3
TYPE=Ethernet
PROXY_METHOD=none
BROWSER_ONLY=no
BOOTPROTO=static
DEFROUTE=yes
IPV4_FAILURE_FATAL=no
IPV6INIT=yes
IPV6_AUTOCONF=yes
IPV6_DEFROUTE=yes
IPV6_FAILURE_FATAL=no
IPV6_ADDR_GEN_MODE=stable-privacy
NAME=enp0s3
UUID=0c1d1732-6e8d-42da-aa8f-dfb9b547ae81
DEVICE=enp0s3
ONBOOT=yes
GATEWAY=192.168.56.1
IPADDR=192.168.56.105
NETMASK=255.255.255.0
[ Read 19 lines ]
^G Get Help ^O WriteOut ^R Read File ^Y Prev Page ^K Cut Text ^C Cur Pos
^X Exit ^J Justify ^W Where Is ^V Next Page ^U UnCut Text ^T To Spell
```

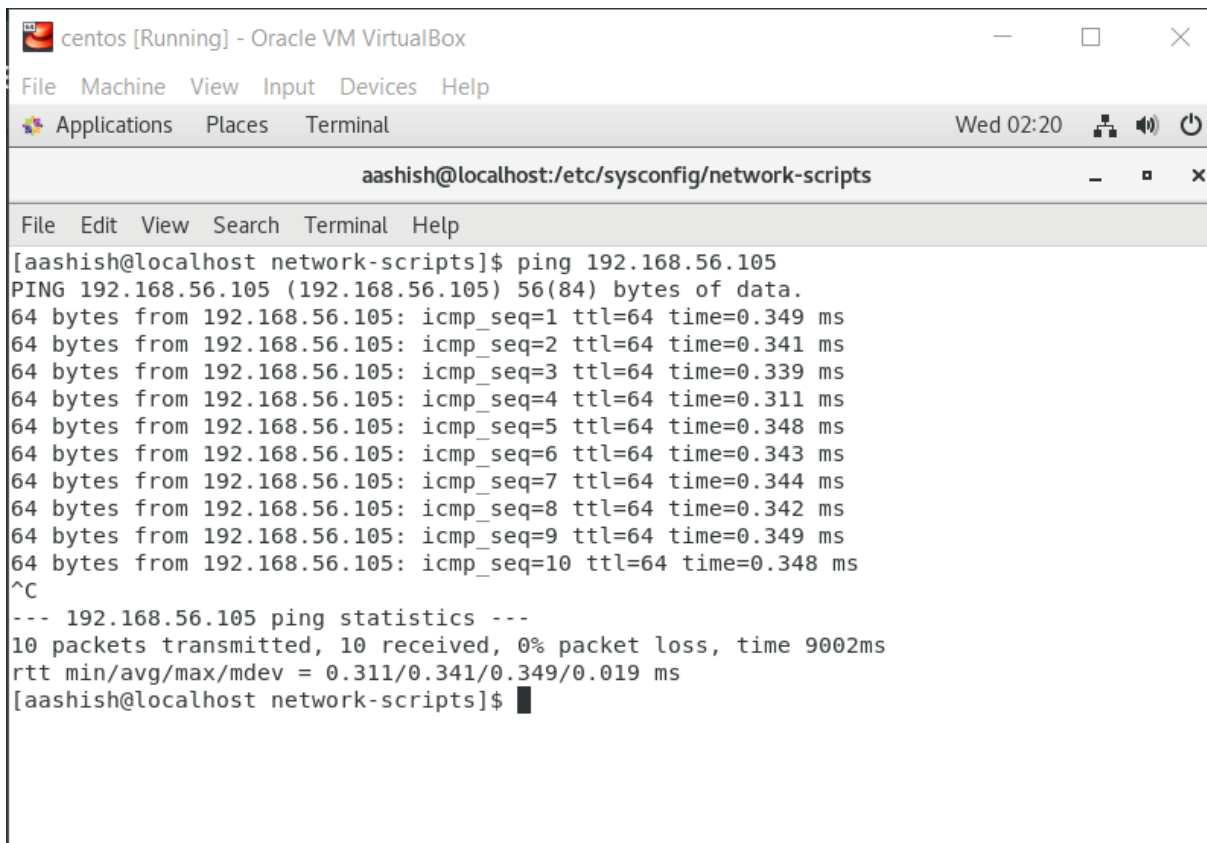
In the config file, we added IP address, subnet mask and gateway IP.

Since, the IPs of **enp0s8** of first VM (**Centos**) and **enp0s3** of second VM (**Centos2**) fall under the same network ID i.e. **192.168.56.0**, they should be able to communicate with each other.

**IP of First VM(Centos) = 192.168.56.1**

**IP of Seconda VM(Centos2) = 192.168.56.105**

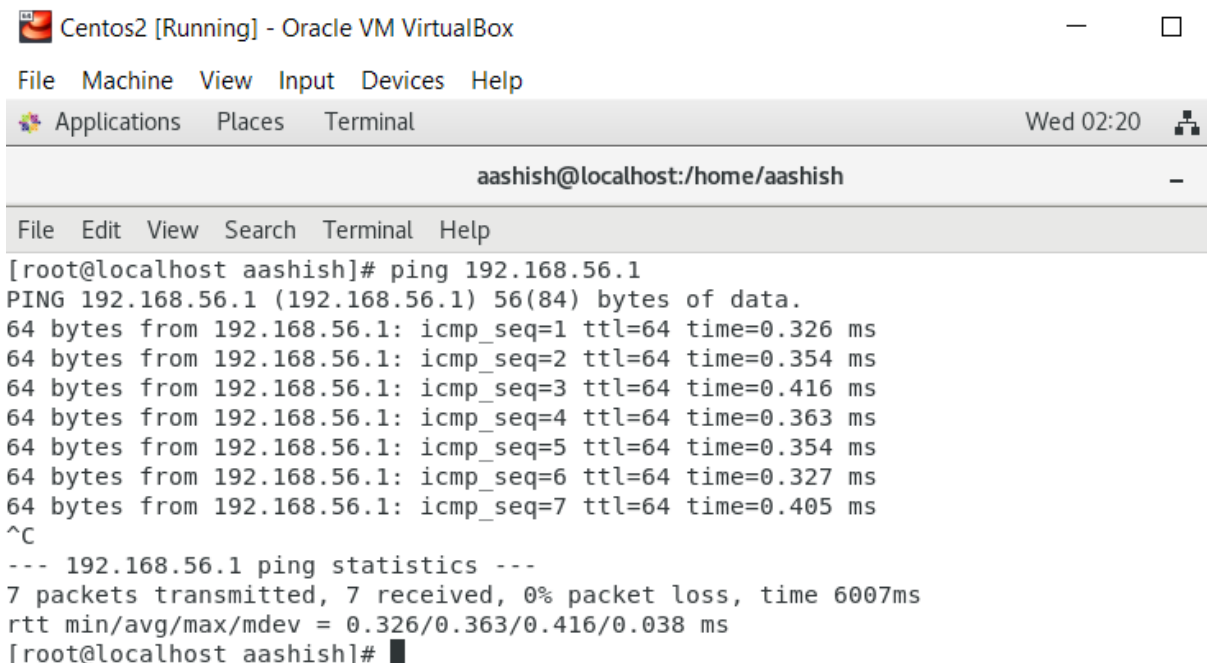
**Ping reports are provided below;**



```
centos [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Applications Places Terminal Wed 02:20
aashish@localhost:/etc/sysconfig/network-scripts

[File Edit View Search Terminal Help]
[aashish@localhost network-scripts]$ ping 192.168.56.105
PING 192.168.56.105 (192.168.56.105) 56(84) bytes of data.
64 bytes from 192.168.56.105: icmp_seq=1 ttl=64 time=0.349 ms
64 bytes from 192.168.56.105: icmp_seq=2 ttl=64 time=0.341 ms
64 bytes from 192.168.56.105: icmp_seq=3 ttl=64 time=0.339 ms
64 bytes from 192.168.56.105: icmp_seq=4 ttl=64 time=0.311 ms
64 bytes from 192.168.56.105: icmp_seq=5 ttl=64 time=0.348 ms
64 bytes from 192.168.56.105: icmp_seq=6 ttl=64 time=0.343 ms
64 bytes from 192.168.56.105: icmp_seq=7 ttl=64 time=0.344 ms
64 bytes from 192.168.56.105: icmp_seq=8 ttl=64 time=0.342 ms
64 bytes from 192.168.56.105: icmp_seq=9 ttl=64 time=0.349 ms
64 bytes from 192.168.56.105: icmp_seq=10 ttl=64 time=0.348 ms
^C
--- 192.168.56.105 ping statistics ---
10 packets transmitted, 10 received, 0% packet loss, time 9002ms
rtt min/avg/max/mdev = 0.311/0.341/0.349/0.019 ms
[aashish@localhost network-scripts]$
```

**Fig 1: Pinging to Centos2**

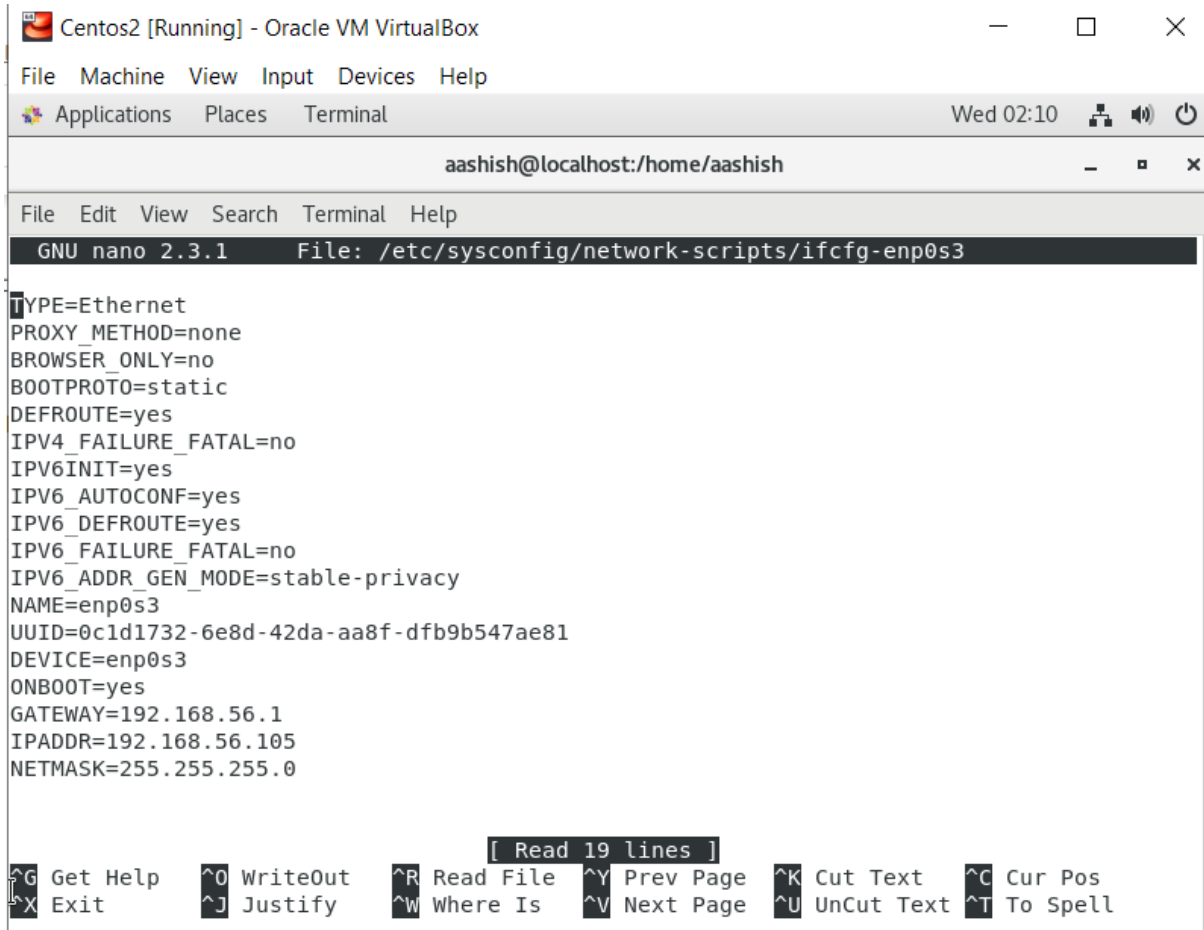


```
Centos2 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Applications Places Terminal Wed 02:20
aashish@localhost:/home/aashish

[File Edit View Search Terminal Help]
[root@localhost aashish]# 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=64 time=0.326 ms
64 bytes from 192.168.56.1: icmp_seq=2 ttl=64 time=0.354 ms
64 bytes from 192.168.56.1: icmp_seq=3 ttl=64 time=0.416 ms
64 bytes from 192.168.56.1: icmp_seq=4 ttl=64 time=0.363 ms
64 bytes from 192.168.56.1: icmp_seq=5 ttl=64 time=0.354 ms
64 bytes from 192.168.56.1: icmp_seq=6 ttl=64 time=0.327 ms
64 bytes from 192.168.56.1: icmp_seq=7 ttl=64 time=0.405 ms
^C
--- 192.168.56.1 ping statistics ---
7 packets transmitted, 7 received, 0% packet loss, time 6007ms
rtt min/avg/max/mdev = 0.326/0.363/0.416/0.038 ms
[root@localhost aashish]#
```

**Fig 2: Pinging to Centos**

Now, we need to tell **Centos2** that we want to use the card **enp0s8** from **Centos**.  
So, for that gateway IP(**192.168.56.1**) is added to the config file of **enp0s3** of **Centos2**.

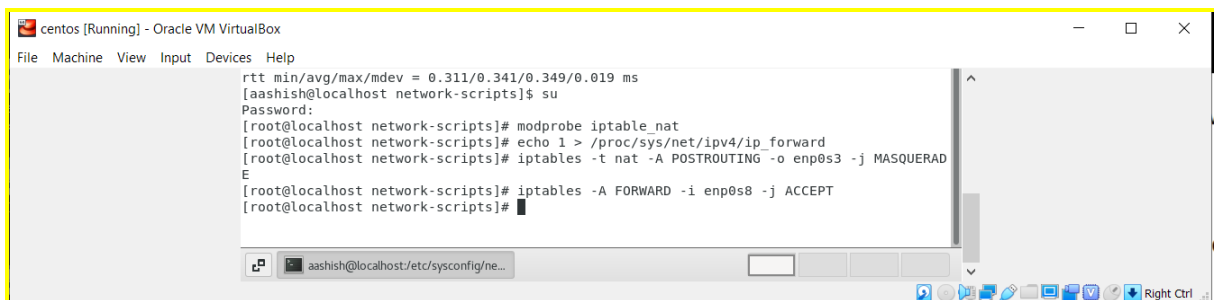


The screenshot shows a terminal window titled "Centos2 [Running] - Oracle VM VirtualBox". The terminal is running the nano text editor, editing the file `/etc/sysconfig/network-scripts/ifcfg-enp0s3`. The configuration is for an Ethernet interface named `enp0s3` with a static IP address of `192.168.56.105` and a gateway of `192.168.56.1`. The terminal also shows the nano editor's status bar with various keyboard shortcuts.

```
Centos2 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Applications Places Terminal Wed 02:10
aashish@localhost:/home/aashish
GNU nano 2.3.1 File: /etc/sysconfig/network-scripts/ifcfg-enp0s3
TYPE=Ethernet
PROXY_METHOD=none
BROWSER_ONLY=no
BOOTPROTO=static
DEFROUTE=yes
IPV4_FAILURE_FATAL=no
IPV6INIT=yes
IPV6_AUTOCONF=yes
IPV6_DEFROUTE=yes
IPV6_FAILURE_FATAL=no
IPV6_ADDR_GEN_MODE=stable-privacy
NAME=enp0s3
UUID=0c1d1732-6e8d-42da-aa8f-dfb9b547ae81
DEVICE=enp0s3
ONBOOT=yes
GATEWAY=192.168.56.1
IPADDR=192.168.56.105
NETMASK=255.255.255.0
[ Read 19 lines ]
^G Get Help ^O WriteOut ^R Read File ^Y Prev Page ^K Cut Text ^C Cur Pos
^X Exit ^J Justify ^W Where Is ^V Next Page ^U UnCut Text ^T To Spell
```

Since, we have connection from **Centos** to **Centos2**, we can tell **Centos** to share internet connection with **Centos2** by using following commands;

- **modprobe iptable\_nat**
- **echo 1 > /proc/sys/net/ipv4/ip\_forward**
- **iptables -t nat -A POSTROUTING -o eth0 -j MASQUERADE**
- **iptables -A FORWARD -i eth1 -j ACCEPT**

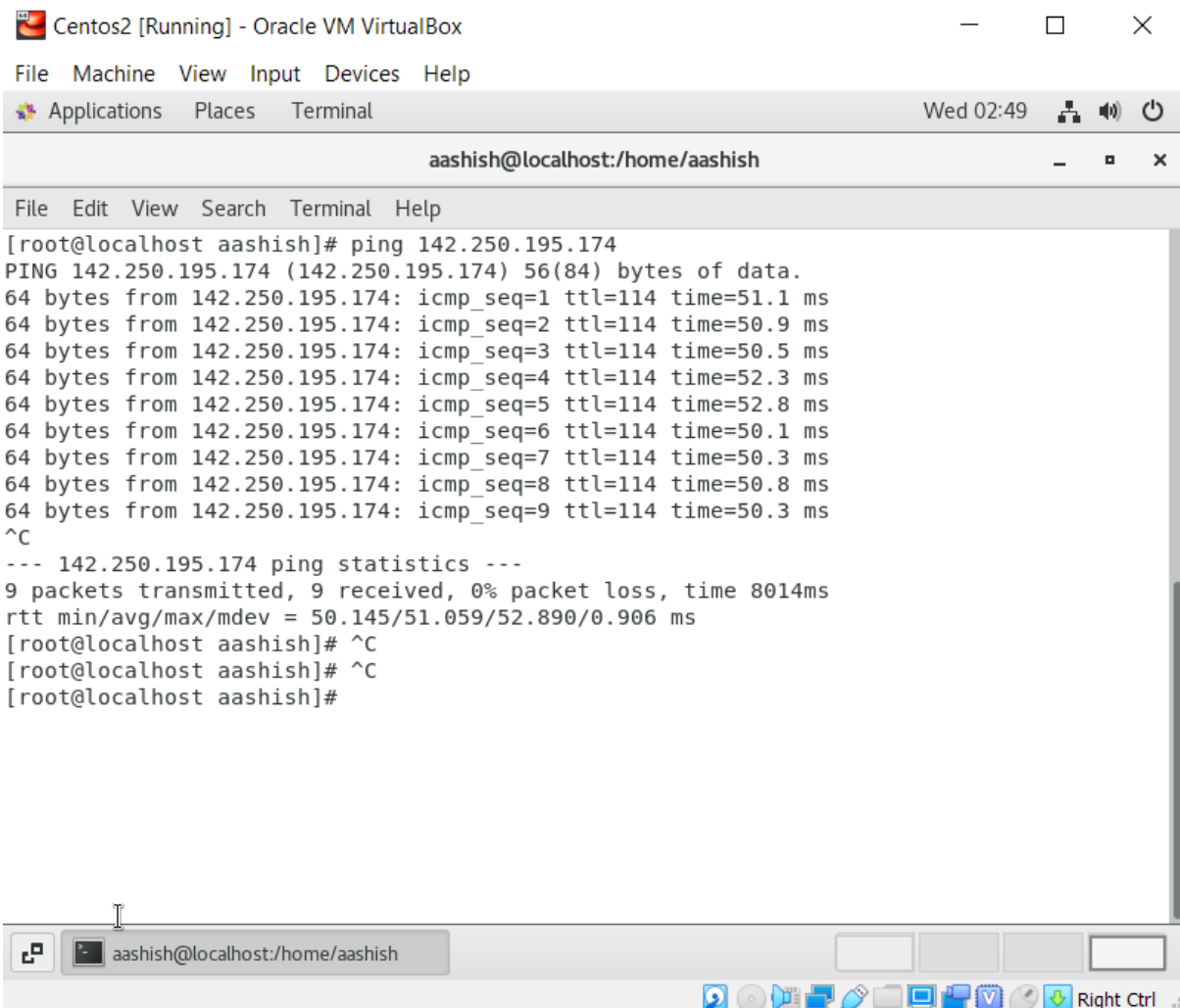


The screenshot shows a terminal window titled "centos [Running] - Oracle VM VirtualBox". The terminal displays the execution of several commands to configure network sharing. The commands are: `modprobe iptable_nat`, `echo 1 > /proc/sys/net/ipv4/ip_forward`, `iptables -t nat -A POSTROUTING -o enp0s3 -j MASQUERADE`, and `iptables -A FORWARD -i enp0s8 -j ACCEPT`. The terminal also shows the output of the `su` command and the `rtt` command.

```
centos [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
rtt min/avg/max/mdev = 0.311/0.341/0.349/0.019 ms
[aashish@localhost network-scripts]$ su
Password:
[root@localhost network-scripts]# modprobe iptable_nat
[root@localhost network-scripts]# echo 1 > /proc/sys/net/ipv4/ip_forward
[root@localhost network-scripts]# iptables -t nat -A POSTROUTING -o enp0s3 -j MASQUERADE
[root@localhost network-scripts]# iptables -A FORWARD -i enp0s8 -j ACCEPT
[root@localhost network-scripts]#
```

So, through the above processes we shared the network connection from **Centos** to **Centos2** via **NAT**.

To verify it we can ping to **google.com** IP address i.e. **142.250.195.174** from **Centos2**.



The screenshot shows a terminal window titled "Centos2 [Running] - Oracle VM VirtualBox". The terminal prompt is "aashish@localhost:/home/aashish". The user has executed the command "ping 142.250.195.174". The output shows 9 successful ping requests with varying response times between 50.1 ms and 52.8 ms. The statistics at the bottom indicate 9 packets transmitted, 9 received, 0% packet loss, and a total time of 8014ms. The user has pressed Ctrl+C twice to exit the ping command.

```
[root@localhost aashish]# ping 142.250.195.174
PING 142.250.195.174 (142.250.195.174) 56(84) bytes of data.
64 bytes from 142.250.195.174: icmp_seq=1 ttl=114 time=51.1 ms
64 bytes from 142.250.195.174: icmp_seq=2 ttl=114 time=50.9 ms
64 bytes from 142.250.195.174: icmp_seq=3 ttl=114 time=50.5 ms
64 bytes from 142.250.195.174: icmp_seq=4 ttl=114 time=52.3 ms
64 bytes from 142.250.195.174: icmp_seq=5 ttl=114 time=52.8 ms
64 bytes from 142.250.195.174: icmp_seq=6 ttl=114 time=50.1 ms
64 bytes from 142.250.195.174: icmp_seq=7 ttl=114 time=50.3 ms
64 bytes from 142.250.195.174: icmp_seq=8 ttl=114 time=50.8 ms
64 bytes from 142.250.195.174: icmp_seq=9 ttl=114 time=50.3 ms
^C
--- 142.250.195.174 ping statistics ---
9 packets transmitted, 9 received, 0% packet loss, time 8014ms
rtt min/avg/max/mdev = 50.145/51.059/52.890/0.906 ms
[root@localhost aashish]# ^C
[root@localhost aashish]# ^C
[root@localhost aashish]#
```

So, the above figure shows that **Centos2** is using the internet via **Centos** using **NAT**.

Thank You.