

# Lab 1: Ubuntu on VirtualBox

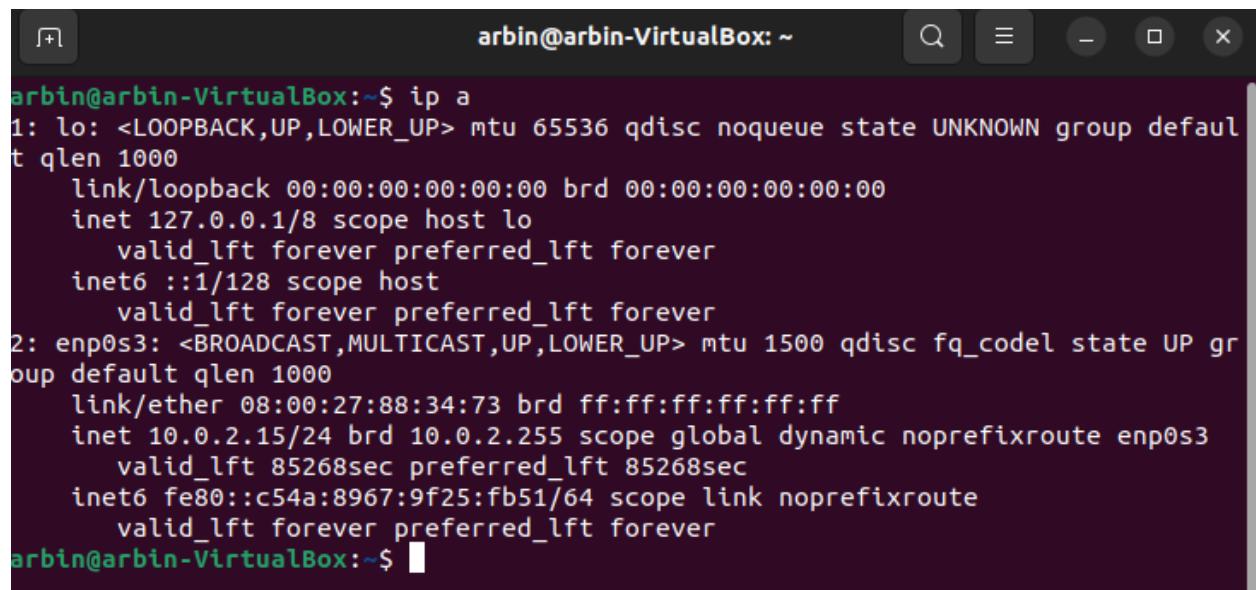
Virtualization is the creation of a software-based version of a physical resource, like an operating system or server. VirtualBox is a popular type-2 hypervisor, which allows a Guest OS (Ubuntu) to run on top of a Host OS. The VM is contained within a file, offering isolation and portability.

## Task 1) Different Network Modes

VirtualBox manages the VM's connectivity using specific network modes, which define how the VM's Network Interface Card (NIC) interacts with the physical network:

### i) NAT (Network Address Translation)

- The VM uses the host system's internet connection through network address translation.
- VM gets a private internal IP, not visible on the physical network.
- Internet works without extra configuration.
- Other machines on LAN cannot directly access the VM.



```
abin@arbin-VirtualBox:~$ 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 08:00:27:88:34:73 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 85268sec preferred_lft 85268sec
    inet6 fe80::c54a:8967:9f25:fb51/64 scope link noprefixroute
        valid_lft forever preferred_lft forever
abin@arbin-VirtualBox:~$
```

### ii) Bridge mode

- VM becomes a device directly on the physical network.

- VM gets IP from the router similar to host machine.
- LAN devices can ping or connect to the VM.
- Suitable for servers or accessing VM from other computers.

```
arbin@arbin-VirtualBox:~$ 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 08:00:27:88:34:73 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 86393sec preferred_lft 86393sec
        inet6 fe80::c54a:8967:9f25:fb51/64 scope link noprefixroute
            valid_lft forever preferred_lft forever
arbin@arbin-VirtualBox:~$ 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 08:00:27:88:34:73 brd ff:ff:ff:ff:ff:ff
        inet 192.168.80.153/21 brd 192.168.87.255 scope global dynamic noprefixroute enp0s3
            valid_lft 43195sec preferred_lft 43195sec
        inet6 fe80::c54a:8967:9f25:fb51/64 scope link noprefixroute
            valid_lft forever preferred_lft forever
arbin@arbin-VirtualBox:~$
```

### iii) Host Mode

- Creates a private network only between host and VM.
- VM cannot access the internet by default.
- Useful for test environments or secure communication.
- Other physical network devices cannot reach the VM.

```
arbin@arbin-VirtualBox:~$ 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 08:00:27:88:34:73 brd ff:ff:ff:ff:ff:ff
        inet 192.168.56.101/24 brd 192.168.56.255 scope global dynamic noprefixroute enp0s3
            valid_lft 595sec preferred_lft 595sec
        inet6 fe80::c54a:8967:9f25:fb51/64 scope link noprefixroute
            valid_lft forever preferred_lft forever
```

Pinging host from different IP address

```
C:\Users\LENOVO>ping 192.168.56.101
Pinging 192.168.56.101 with 32 bytes of data:
Reply from 192.168.56.101: bytes=32 time=4ms TTL=64
Reply from 192.168.56.101: bytes=32 time=1ms TTL=64
Reply from 192.168.56.101: bytes=32 time=1ms TTL=64
Reply from 192.168.56.101: bytes=32 time=1ms TTL=64

Ping statistics for 192.168.56.101:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 1ms, Maximum = 4ms, Average = 1ms

C:\Users\LENOVO>
```

## Task 2: Basic commands

Command	Description
cd	Change directory
pwd	Show current working directory
mkdir <directory>	Create a new directory
touch <file>	Create an empty file
ls	List files and directories
nano <file>	Open file in nano editor (exit: Ctrl X)
cat <file>	Display file contents
rm <file>	Delete a file
ls -ltr	List with details sorted by time
rm <directory>	Fails if directory not empty
rm -rf <directory>	Force delete directory
df -h	Show disk/storage usage
free -mh	Show RAM usage

Command	Description
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top	Show running processes
-----	------------------------

```

Activities Terminal arbin@arbin-VirtualBox: ~
arbin@arbin-VirtualBox:~$ pwd
/home/arbin
arbin@arbin-VirtualBox:~$ mkdir dir1 dir2 dir3
arbin@arbin-VirtualBox:~$ touch file1 file2 file3
arbin@arbin-VirtualBox:~$ ls
Desktop dir2 Documents file1 file3 Pictures snap Videos
dir1 dir3 Downloads file2 Music Public Templates
arbin@arbin-VirtualBox:~$ nano file1
arbin@arbin-VirtualBox:~$ cat file1
hello world
arbin@arbin-VirtualBox:~$ vmfiles
vmfiles: command not found
arbin@arbin-VirtualBox:~$ vm files
Command 'vm' not found, but can be installed with:
sudo apt install mgetty-voice
arbin@arbin-VirtualBox:~$ rm dir3
rm: cannot remove 'dir3': Is a directory
arbin@arbin-VirtualBox:~$ rm -rf dir3
arbin@arbin-VirtualBox:~$ ls
Desktop dir2 Downloads file2 Music Public Templates
dir1 Documents file1 file3 Pictures snap Videos
arbin@arbin-VirtualBox:~$ rm file3
arbin@arbin-VirtualBox:~$ ls
Desktop dir2 Downloads file2 Pictures snap Videos
dir1 Documents file1 Music Public Templates
arbin@arbin-VirtualBox:~$ S

```

```

arbin@arbin-VirtualBox:~$ df -h
Filesystem      Size  Used Avail Use% Mounted on
tmpfs          348M  1.6M  347M  1% /run
/dev/sda3        24G   12G   12G  51% /
tmpfs          1.7G     0  1.7G  0% /dev/shm
tmpfs          5.0M  4.0K  5.0M  1% /run/lock
/dev/sda2       512M   6.1M  506M  2% /boot/efi
tmpfs          348M  120K  348M  1% /run/user/1000
/dev/sr0         52M   52M     0 100% /media/arbin/VBox_GAs_7.0.14
arbin@arbin-VirtualBox:~$ free -mh
              total        used        free      shared  buff/cache   available
Mem:      3.4Gi     936Mi     256Mi      46Mi     2.2Gi     2.3Gi
Swap:    2.6Gi          0B     2.6Gi
arbin@arbin-VirtualBox:~$ 

```

### Task 3: Install nginx

Nginx is a powerful, high-performance web server, and reverse proxy. Unlike traditional web servers, it uses an asynchronous, event-driven architecture, making it highly scalable and memory-efficient.

Commands used:

```
# Install nginx web server
```

```
sudo apt install nginx -y
```

```
# Check nginx running processes
```

```
ps -ef | grep nginx
```

```
# Install net-tools package (includes netstat, ifconfig etc.)
```

```
sudo apt install net-tools
```

```
# Check which process is listening on port 80 (usually nginx)
```

```
netstat -tupln | grep 80
```

```
arbin@arbin-VirtualBox:~$ sudo apt install nginx -y
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following additional packages will be installed:
  libnginx-mod-http-geoip2 libnginx-mod-http-image-filter
  libnginx-mod-http-xslt-filter libnginx-mod-mail libnginx-mod-stream
  libnginx-mod-stream-geoip2 nginx-common nginx-core
Suggested packages:
  fcgiwrap nginx-doc
The following NEW packages will be installed:
  libnginx-mod-http-geoip2 libnginx-mod-http-image-filter
  libnginx-mod-http-xslt-filter libnginx-mod-mail libnginx-mod-stream
  libnginx-mod-stream-geoip2 nginx nginx-common nginx-core
```

```
arbin@arbin-VirtualBox:~$ ps -ef | grep nginx
arbin      3103     1748  0 07:26 pts/0    00:00:00 grep --color=auto nginx
arbin@arbin-VirtualBox:~$ sudo apt install net-tools
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following NEW packages will be installed:
  net-tools
0 upgraded, 1 newly installed, 0 to remove and 371 not upgraded.
Need to get 204 kB of archives.
After this operation, 819 kB of additional disk space will be used.
Get:1 http://np.archive.ubuntu.com/ubuntu jammy-updates/main amd64 net-tools amd64 1.60+git20181103.0eebece-1ubuntu5.4 [204 kB]
Fetched 204 kB in 2s (122 kB/s)
Selecting previously unselected package net-tools.
(Reading database ... 179509 files and directories currently installed.)
Preparing to unpack .../net-tools_1.60+git20181103.0eebece-1ubuntu5.4_amd64.deb
...
Unpacking net-tools (1.60+git20181103.0eebece-1ubuntu5.4) ...
Setting up net-tools (1.60+git20181103.0eebece-1ubuntu5.4) ...
Processing triggers for man-db (2.10.2-1) ...
```

```
arbin@arbin-VirtualBox:~$ netstat -tulpn | grep 80
(Not all processes could be identified, non-owned process info
 will not be shown, you would have to be root to see it all.)
tcp        0      0 0.0.0.0:80                    0.0.0.0:*          LISTEN
-
tcp6       0      0 ::::80                       ::::*           LISTEN
-
```

## Conclusion

Lab 1 successfully established an isolated and operational Ubuntu Virtual Machine environment. The core learning objective was met by practically demonstrating the distinct isolation and access properties of the three primary VirtualBox Network Modes (NAT, Bridged, Host-Only). This confirmed the theoretical concept that Bridged mode is necessary for external network accessibility, while NAT provides simple internet access with network isolation. The lab concluded by installing and verifying the operational status of the high-performance Nginx Web Server on the Ubuntu VM, confirming its ability to listen on Port 80 and serve web traffic within the configured network environment.