Lab-06: Firewall Exploration Lab

First let setup the environment. Volumes is a shared folder between the virtual machine & the containers. This lab we are going to use kernel modules and Iptables to set up the firewall. Bringing up and building up the containers.

```
seed@ip-172-31-44-212:~/Internet_Security/Lab-06/Labsetup$ dcbuild
HostA uses an image, skipping
Host1 uses an image, skipping
Host2 uses an image, skipping
Host3 uses an image, skipping
Building Router
Step 1/2 : FROM handsonsecurity/seed-ubuntu:large
 ---> cecb04fbf1dd
Step 2/2 : RUN apt-get update     && apt-get install -y kmod      && apt-get clean
 ---> Using cache
 ---> 431fee32e22b

Successfully built 431fee32e22b
Successfully tagged seed-router-image:latest
```

```
seed@ip-172-31-44-212:~/Internet_Security/Lab-06/Labsetup$ dcup
Starting host3-192.168.60.7 ... done
Starting seed-router        ... done
Starting host2-192.168.60.6 ... done
Starting host1-192.168.60.5 ... done
Starting hostA-10.9.0.5     ... done
Attaching to host1-192.168.60.5, host3-192.168.60.7, hostA-10.9.0.5, seed-router, host2
-192.168.60.6
host3-192.168.60.7 |  * Starting internet superserver inetd              [ OK ]
hostA-10.9.0.5 |  * Starting internet superserver inetd                   [ OK ]
host1-192.168.60.5 |  * Starting internet superserver inetd               [ OK ]
host2-192.168.60.6 |  * Starting internet superserver inetd               [ OK ]
seed-router |  * Starting internet superserver inetd                      [ OK ]
```

```
seed@ip-172-31-44-212:~/Internet_Security/Lab-06/Labsetup$ docker container ls
CONTAINER ID   IMAGE     COMMAND   CREATED   STATUS    PORTS     NAMES
seed@ip-172-31-44-212:~/Internet_Security/Lab-06/Labsetup$ dcbuild
HostA uses an image, skipping
Host1 uses an image, skipping
Host2 uses an image, skipping
Host3 uses an image, skipping
Building Router
Step 1/2 : FROM handsonsecurity/seed-ubuntu:large
 ---> cecb04fbf1dd
Step 2/2 : RUN apt-get update     && apt-get install -y kmod      && apt-get clean
 ---> Using cache
 ---> 431fee32e22b

Successfully built 431fee32e22b
Successfully tagged seed-router-image:latest
seed@ip-172-31-44-212:~/Internet_Security/Lab-06/Labsetup$ dcup
Creating host3-192.168.60.7 ... done
Creating seed-router        ... done
Creating host2-192.168.60.6 ... done
Creating host1-192.168.60.5 ... done
Creating hostA-10.9.0.5     ... done
Attaching to host3-192.168.60.7, host1-192.168.60.5, host2-192.168.60.6, hostA-10.9.0.5, seed-router
host2-192.168.60.6 |  * Starting internet superserver inetd              [ OK ]
host3-192.168.60.7 |  * Starting internet superserver inetd              [ OK ]
hostA-10.9.0.5 |  * Starting internet superserver inetd                   [ OK ]
host1-192.168.60.5 |  * Starting internet superserver inetd               [ OK ]
seed-router |  * Starting internet superserver inetd                      [ OK ]
```

```
seed@ip-172-31-44-212:~/Internet_Security/Lab-06/Labsetup$ dcbuild
HostA uses an image, skipping
Host1 uses an image, skipping
Host2 uses an image, skipping
Host3 uses an image, skipping
Building Router
Step 1/2 : FROM handsonsecurity/seed-ubuntu:large
 ---> cecb04fbf1dd
Step 2/2 : RUN apt-get update     && apt-get install -y kmod      && apt-get clean
 ---> Using cache
 ---> 431fee32e22b

Successfully built 431fee32e22b
Successfully tagged seed-router-image:latest
seed@ip-172-31-44-212:~/Internet_Security/Lab-06/Labsetup$ dcup
Creating host3-192.168.60.7 ... done
Creating seed-router        ... done
Creating host2-192.168.60.6 ... done
Creating host1-192.168.60.5 ... done
Creating hostA-10.9.0.5     ... done
Attaching to host3-192.168.60.7, host1-192.168.60.5, host2-192.168.60.6, hostA-10.9.0.5, seed-router
host2-192.168.60.6 |  * Starting internet superserver inetd              [ OK ]
host3-192.168.60.7 |  * Starting internet superserver inetd              [ OK ]
hostA-10.9.0.5 |  * Starting internet superserver inetd                  [ OK ]
host1-192.168.60.5 |  * Starting internet superserver inetd              [ OK ]
seed-router |  * Starting internet superserver inetd                     [ OK ]
```

Attacker is the virtual machine among this IP address- Attacker IP address-10.9.0.1

Most of the task will be carried out in the host machine the virtual machine.

Task 1: Implementing a Simple Firewall

SubTask 1.A: Implement a Simple Kernel Module

Here we will be seeing.

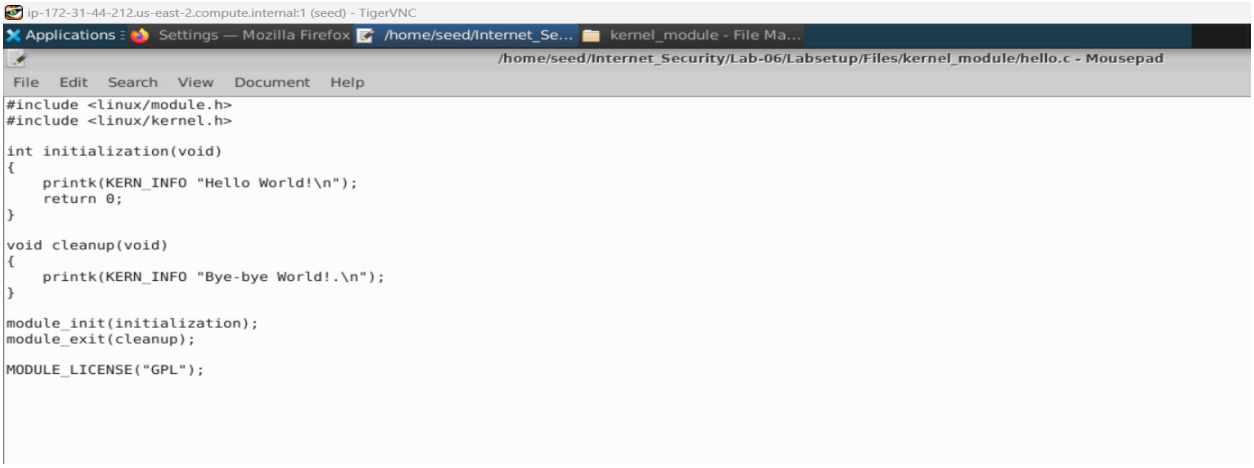
1. How to compile Kernel module
2. How to load Kernel module.
3. How to remove Kernel module
4. How to check it.

In the kernel_module we have hello.c and make file

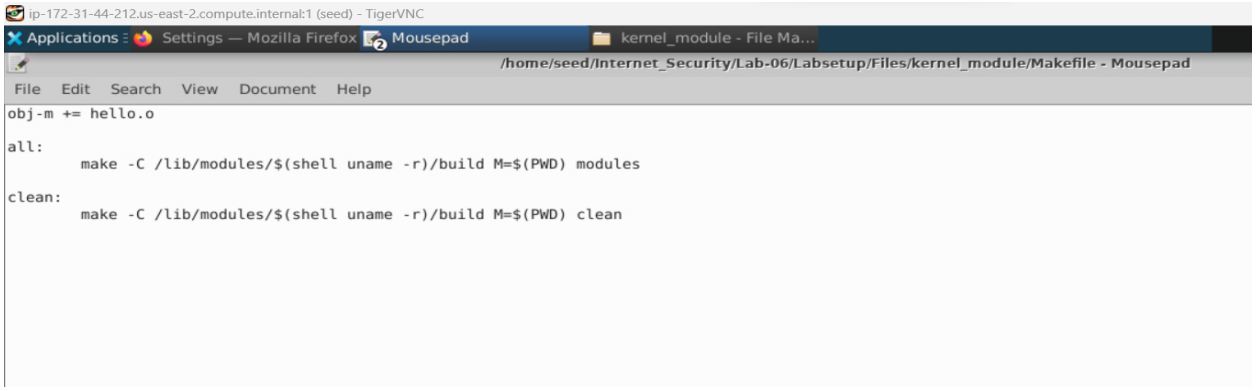
We open hello.c and make file from kernel module

Make file: - Make file helps us to how to compile kernel module(Learned in lecture module_init and module_exit)

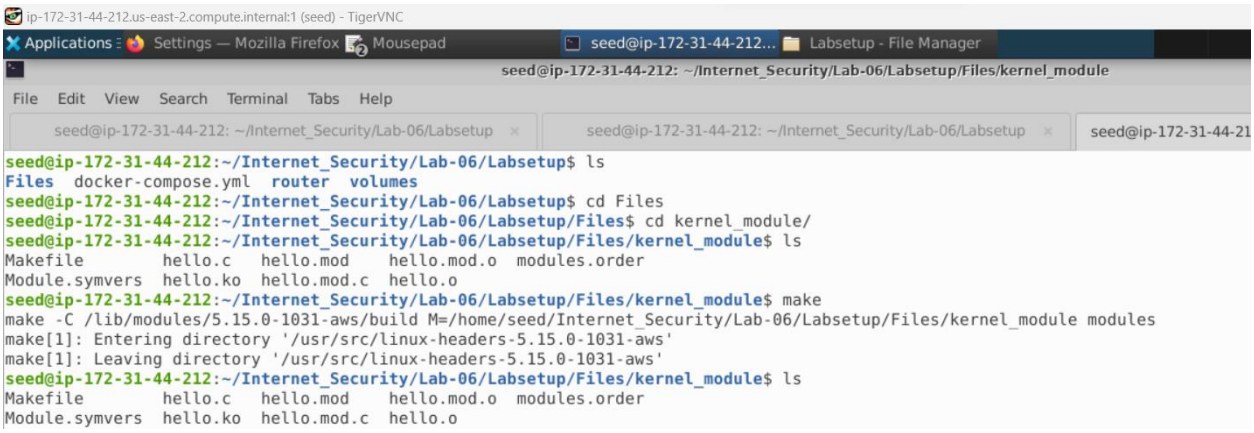
We have module init and module exit functions for the entry into the module and the other one for exiting from the module initialization and clean up.



We will be able to see this module information printed into the kernel buffer.



Here below we are able to see kernel module is built named as “hello.ko”



lsmod: - lsmod is a Unix-like operating system command which is used to display the status of modules in the Linux kernel. It results in a list of loaded modules.

We are able to see kernel module in built up hello.ko
make clean- To clean hello.ko
Now, for all the modules inside the system you can use **ls** model list or the modules. Here below in the screenshot we are able to see all the current modules inside the kernel.

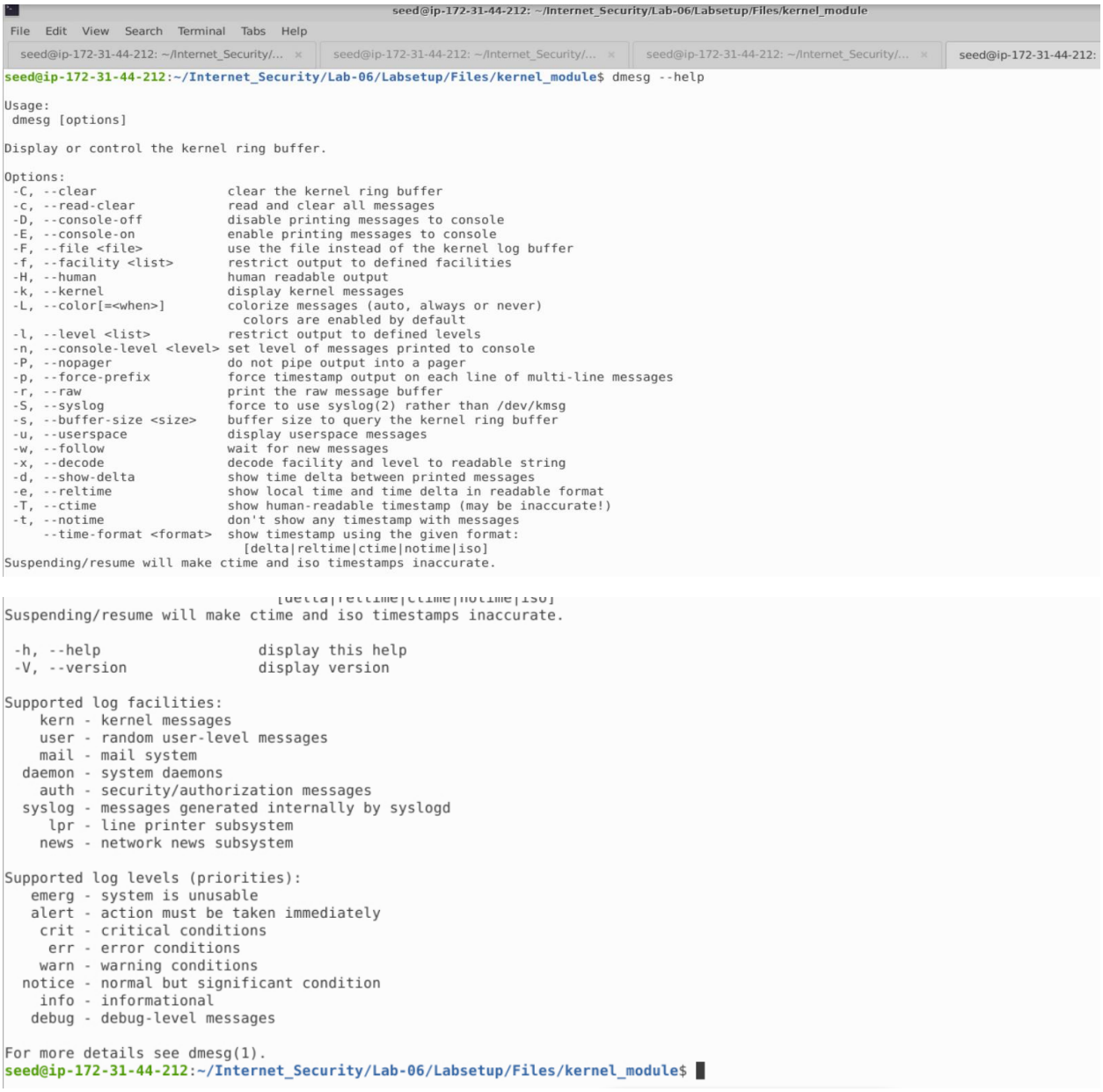
```
seed@ip-172-31-44-212:~/Internet_Security/Lab-06/Labsetup/Files/kernel_module$ lsmod
Module                  Size  Used by
xt_nat                 16384  20
xt_tcpudp              20480  20
veth                   32768  0
xt_conntrack           16384  4
xt_MASQUERADE          20480  4
nf_conntrack_netlink    49152  0
nfnetlink              20480  2 nf_conntrack_netlink
xfrm_user              40960  1
xfrm_algo              16384  1 xfrm_user
xt_addrtype            16384  2
iptable_filter         16384  1
iptable_nat            16384  6
nf_nat                 49152  3 xt_nat,iptable_nat,xt_MASQUERADE
nf_conntrack          172032  5 xt_conntrack,nf_nat,xt_nat,nf_conntrack_netlink,xt_MASQUERADE
nf_defrag_ipv6         24576  1 nf_conntrack
nf_defrag_ipv4         16384  1 nf_conntrack
libcrc32c              16384  2 nf_conntrack,nf_nat
bpfilter               16384  0
br_netfilter           28672  0
bridge                307200  1 br_netfilter
stp                    16384  1 bridge
llc                    16384  2 bridge,stp
aufs                  270336  0
overlay               151552  5
nls_iso8859_1          16384  1
dm_multipath           40960  0
scsi_dh_rdac           16384  0
scsi_dh_emc            16384  0
scsi_dh_alua           20480  0
binfmt_misc            24576  1
crct10dif_pclmul       16384  1
crc32_pclmul           16384  0
ghash_clmulni_intel    16384  0
```

Now we are only interested in the kernel module we built. To insert the module into the kernel we use **insmod by the kernel name.**

“sudo insmod hello.ko”

Run another command by opening the other terminal tab.

dmesg- to check the kernel buffer. It can specify the supported local networks and so on. The kernel message and supported local facilities.



The kernel message supported local facilities and you can show it.
We are able to see all the below messages in kernel

```
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/kernel_module$ sudo dmesg
[    0.000000] Linux version 5.15.0-1033-aws (buildd@lcy02-amd64-026) (gcc (Ubuntu 9.4.0-1ubuntu1~20.04.1) 9.4.0, GNU ld (G
ntu SMP Fri Mar 17 11:39:30 UTC 2023 (Ubuntu 5.15.0-1033.37~20.04.1-aws 5.15.87)
[    0.000000] Command line: BOOT_IMAGE=/boot/vmlinuz-5.15.0-1033-aws root=PARTUUID=645de17b-5f40-4fe7-8854-1cc9c4847270 ro
out=4294967295 panic=-1
[    0.000000] KERNEL supported cpus:
[    0.000000]   Intel GenuineIntel
[    0.000000]   AMD AuthenticAMD
[    0.000000]   Hygon HygonGenuine
[    0.000000]   Centaur CentaurHauls
[    0.000000]   zhaoxin   Shanghai
[    0.000000] x86/fpu: Supporting XSAVE feature 0x001: 'x87 floating point registers'
[    0.000000] x86/fpu: Supporting XSAVE feature 0x002: 'SSE registers'
[    0.000000] x86/fpu: Supporting XSAVE feature 0x004: 'AVX registers'
[    0.000000] x86/fpu: Supporting XSAVE feature 0x008: 'MPX bounds registers'
[    0.000000] x86/fpu: Supporting XSAVE feature 0x010: 'MPX CSR'
[    0.000000] x86/fpu: Supporting XSAVE feature 0x020: 'AVX-512 opmask'
[    0.000000] x86/fpu: Supporting XSAVE feature 0x040: 'AVX-512 Hi256'
[    0.000000] x86/fpu: Supporting XSAVE feature 0x080: 'AVX-512 ZMM_Hi256'
[    0.000000] x86/fpu: Supporting XSAVE feature 0x200: 'Protection Keys User registers'
[    0.000000] x86/fpu: xstate_offset[2]:  576, xstate_sizes[2]:  256
[    0.000000] x86/fpu: xstate_offset[3]:  832, xstate_sizes[3]:   64
[    0.000000] x86/fpu: xstate_offset[4]:  896, xstate_sizes[4]:   64
[    0.000000] x86/fpu: xstate_offset[5]:  960, xstate_sizes[5]:   64
[    0.000000] x86/fpu: xstate_offset[6]: 1024, xstate_sizes[6]:  512
[    0.000000] x86/fpu: xstate_offset[7]: 1536, xstate_sizes[7]: 1024
```

```
[  465.643424] br-aa07d6be7c22: port 3(vethda8e384) entered forwarding state
[  465.643632] eth0: renamed from veth06cf595
[  465.664877] IPv6: ADDRCONF(NETDEV_CHANGE): vethb17a6cf: link becomes ready
[  465.664947] br-aa07d6be7c22: port 2(vethb17a6cf) entered blocking state
[  465.664953] br-aa07d6be7c22: port 2(vethb17a6cf) entered forwarding state
[  465.665417] IPv6: ADDRCONF(NETDEV_CHANGE): veth703f5c9: link becomes ready
[  465.665473] br-f14e5311d392: port 2(veth703f5c9) entered blocking state
[  465.665476] br-f14e5311d392: port 2(veth703f5c9) entered forwarding state
[  750.291517] hello: loading out-of-tree module taints kernel.
[  750.291555] hello: module verification failed: signature and/or required key missing - tainting kernel
[  750.291721] Hello World!
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/kernel_module$
```

To clear the above messages we are going to use

"sudo dmesg --clear"

```
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/kernel_module$ sudo dmesg --clear
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/kernel_module$ dmesg
dmesg: read kernel buffer failed: Operation not permitted
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/kernel_module$ sudo dmesg
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/kernel_module$
```

```
seed@ip-172-31-44-212:~/Internet_Security/Lab-06/Labsetup/Files/kernel_module$ sudo dmesg --clear
seed@ip-172-31-44-212:~/Internet_Security/Lab-06/Labsetup/Files/kernel_module$ dmesg
dmesg: read kernel buffer failed: Operation not permitted
seed@ip-172-31-44-212:~/Internet_Security/Lab-06/Labsetup/Files/kernel_module$ sudo dmesg
seed@ip-172-31-44-212:~/Internet_Security/Lab-06/Labsetup/Files/kernel_module$
```

To show the message in real time we use **"sudo dmesg -k -e"**

```
seed@ip-172-31-44-212:~/Internet_Security/Lab-06/Labsetup/Files/kernel_module$ sudo dmesg
seed@ip-172-31-44-212:~/Internet_Security/Lab-06/Labsetup/Files/kernel_module$ dmesg -k -e
dmesg: read kernel buffer failed: Operation not permitted
seed@ip-172-31-44-212:~/Internet_Security/Lab-06/Labsetup/Files/kernel_module$ sudo dmesg -k -e
seed@ip-172-31-44-212:~/Internet_Security/Lab-06/Labsetup/Files/kernel_module$
```

```
seed@ip-172-31-44-212:~/Internet_Security/Lab-06/Labsetup/Files/kernel_module$ dmesg -k -w
dmesg: read kernel buffer failed: Operation not permitted
seed@ip-172-31-44-212:~/Internet_Security/Lab-06/Labsetup/Files/kernel_module$ sudo dmesg -k -w
```

Now lets insert our module

In the 2nd tab we use

By typing dmesg we are able to see the current modules inside the kernel

```
seed@ip-172-31-44-212:~/Internet_Security/Lab-06/Labsetup/Files/kernel_module$ sudo dmesg --kernel
[ 3360.308914] hello: loading out-of-tree module taints kernel.
[ 3360.308948] hello: module verification failed: signature and/or required key missing - tainting kernel
[ 3360.309076] Hello World!
seed@ip-172-31-44-212:~/Internet_Security/Lab-06/Labsetup/Files/kernel_module$ sudo dmesg
[ 3360.308914] hello: loading out-of-tree module taints kernel.
[ 3360.308948] hello: module verification failed: signature and/or required key missing - tainting kernel
[ 3360.309076] Hello World!
seed@ip-172-31-44-212:~/Internet_Security/Lab-06/Labsetup/Files/kernel_module$ sudo dmesg --clear
seed@ip-172-31-44-212:~/Internet_Security/Lab-06/Labsetup/Files/kernel_module$ sudo dmseg
sudo: dmseg: command not found
seed@ip-172-31-44-212:~/Internet_Security/Lab-06/Labsetup/Files/kernel_module$ sudo dmesg
seed@ip-172-31-44-212:~/Internet_Security/Lab-06/Labsetup/Files/kernel_module$ dmesg --version
dmesg from util-linux 2.34
seed@ip-172-31-44-212:~/Internet_Security/Lab-06/Labsetup/Files/kernel_module$ dmesg --reltime
dmesg: read kernel buffer failed: Operation not permitted
seed@ip-172-31-44-212:~/Internet_Security/Lab-06/Labsetup/Files/kernel_module$
```

```
seed@ip-172-31-44-212:~/Internet_Security/Lab-06/Labsetup/Files/kernel_module$ sudo dmesg --kernel
[ 3360.308914] hello: loading out-of-tree module taints kernel.
[ 3360.308948] hello: module verification failed: signature and/or required key missing - tainting kernel
[ 3360.309076] Hello World!
seed@ip-172-31-44-212:~/Internet_Security/Lab-06/Labsetup/Files/kernel_module$ sudo dmesg
[ 3360.308914] hello: loading out-of-tree module taints kernel.
[ 3360.308948] hello: module verification failed: signature and/or required key missing - tainting kernel
[ 3360.309076] Hello World!
seed@ip-172-31-44-212:~/Internet_Security/Lab-06/Labsetup/Files/kernel_module$ sudo dmesg --clear
seed@ip-172-31-44-212:~/Internet_Security/Lab-06/Labsetup/Files/kernel_module$ sudo dmseg
sudo: dmseg: command not found
seed@ip-172-31-44-212:~/Internet_Security/Lab-06/Labsetup/Files/kernel_module$ sudo dmesg
seed@ip-172-31-44-212:~/Internet_Security/Lab-06/Labsetup/Files/kernel_module$ dmesg --version
dmesg from util-linux 2.34
seed@ip-172-31-44-212:~/Internet_Security/Lab-06/Labsetup/Files/kernel_module$ dmesg --reltime
dmesg: read kernel buffer failed: Operation not permitted
seed@ip-172-31-44-212:~/Internet_Security/Lab-06/Labsetup/Files/kernel_module$
```

```
insmod: ERROR: could not insert module hello.ko: File exists
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/kernel_module$ sudo insmod hello.ko
insmod: ERROR: could not insert module hello.ko: File exists
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/kernel_module$ lsmod | grep -i hello
hello                  16384  0
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/kernel_module$
```

Now we need to use **lsmod** to find the hello model

We can see here hello model is in the list of the ls module.
To remove it we have used “sudo rmmod hello”, we get nothing from the list

```
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/kernel_module$ lsmod | grep -i hello
hello                  16384  0
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/kernel_module$ sudo rmmod hello
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/kernel_module$ lsmod | grep -i hello
```

```
seed@ip-172-31-44-212:~/Internet_Security/Lab-06/Labsetup/Files/kernel_module$ sudo dmesg --kernel
[ 3360.308914] hello: loading out-of-tree module taints kernel.
[ 3360.308948] hello: module verification failed: signature and/or required key missing - tainting kernel
[ 3360.309076] Hello World!
seed@ip-172-31-44-212:~/Internet_Security/Lab-06/Labsetup/Files/kernel_module$ sudo dmesg
[ 3360.308914] hello: loading out-of-tree module taints kernel.
[ 3360.308948] hello: module verification failed: signature and/or required key missing - tainting kernel
[ 3360.309076] Hello World!
```

When we remove the model we see the “Bye-bye World” information, printed into the kernel buffer.

```
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/kernel_module$ sudo dmesg --kernel
[ 1794.118767] Bye-bye World!.
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/kernel_module$ sudo dmesg -k -e
[Mar31 01:46] Bye-bye World!.
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/kernel_module$
```

This is how we compare, insert list and remove kernel module and check the messages printed into the kernel buffer.
If you want to develop drivers for hardware for linux, you need to know kernel development this just show you a very simple example.
Here it explains the so called make file and tell you how to insert it and how to list it, how to remove it, how to check the messages demonstrated, we can also use “modinfo” to show the information about the linux kernel module.
Since the hello kernel module is removed we can check the other modules.

```
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/kernel_module$ modinfo video
filename:       /lib/modules/5.15.0-1033-aws/kernel/drivers/acpi/video.ko
license:        GPL
description:    ACPI Video Driver
author:         Bruno Ducrot
srcversion:     3FB8E0D0EEBE51FE3059225
alias:          acpi*:LNXVIDEO:*
depends:
retpoline:      Y
intree:         Y
name:           video
vermagic:       5.15.0-1033-aws SMP mod_unload modversions
sig_id:         PKCS#7
signer:         Build time autogenerated kernel key
sig_key:        39:89:97:37:A4:55:14:5A:B2:BD:8C:99:D4:2A:D0:23:4D:D5:63:50
sig_hashalgo:   sha512
signature:      70:F1:6B:83:2A:23:49:2F:5F:2E:C2:8F:5A:60:A3:5B:10:14:63:6C:
                65:0C:9B:59:94:A4:D4:F8:94:9D:1D:1E:3B:D0:2E:D7:51:6C:7F:67:
                41:ED:BB:C5:54:09:9E:5C:2E:17:C3:C7:81:20:10:52:BD:4D:9F:D2:
                EB:C4:B7:8B:37:B4:73:93:35:AF:C7:B3:E1:00:FF:80:BE:21:81:A9:
                46:5C:97:81:7E:72:78:23:82:43:13:F8:E1:5A:12:B2:1A:E3:E1:CA:
                41:91:B3:D6:F3:A9:5E:BC:6C:F4:75:FA:1C:DE:FD:9C:94:A0:BB:D8:
                D0:A8:02:1F:D1:93:8B:89:82:EF:40:F7:AF:57:D0:FE:F4:C2:6B:BF:
                3F:90:EA:DD:7F:C4:3A:DA:D2:BE:A8:25:F3:57:03:CE:B2:0C:46:52:
                F6:66:5B:B6:36:E4:BE:75:F7:37:5E:B0:CF:08:C6:6D:E8:A5:77:86:
                47:5A:93:EF:8D:73:6B:FA:3E:EF:07:2C:A0:EF:A2:A7:8B:78:C2:BC:
                0B:8C:ED:68:2F:30:D2:50:73:26:B7:B1:34:0B:EC:B5:17:18:98:D2:
                6A:48:2E:43:63:F5:49:F6:4B:65:1E:1F:18:30:C3:DF:26:17:1B:B0:
```

We can see the information for the video module. In the below image we are able to see the filename, location, license cpr description, the video driver.
So to develop like these a video driver, we need a lots of knowledge.
How to design parameters for kernel module in linux kind of programming(We can find detail information from the guide in github “ The Linux Kernel Module Programming guide”

```
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/kernel_module$ sudo insmod hello.ko
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/kernel_module$ modinfo hello.ko
filename:       /home/seed/Internet_Security/Lab6/Labsetup/Files/kernel_module/hello.ko
license:        GPL
srcversion:     717A72281ACFAA8385B33A8
depends:
retpoline:      Y
name:           hello
vermagic:       5.15.0-1033-aws SMP mod_unload modversions
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/kernel_module$
```

```
seed@ip-172-31-44-212:~/Internet_Security/Lab-06/Labsetup/Files/kernel_module$ modelinfo hello.ko -n
modelinfo: command not found
seed@ip-172-31-44-212:~/Internet_Security/Lab-06/Labsetup/Files/kernel_module$ modelinfo hello -n
modelinfo: command not found
seed@ip-172-31-44-212:~/Internet_Security/Lab-06/Labsetup/Files/kernel_module$ modeinfo hello.ko

Command 'modeinfo' not found, did you mean:

  command 'modinfo' from deb kmod (27-1ubuntu2.1)

Try: apt install <deb name>

seed@ip-172-31-44-212:~/Internet_Security/Lab-06/Labsetup/Files/kernel_module$ modinfo hello.ko
filename:       /home/seed/Internet_Security/Lab-06/Labsetup/Files/kernel_module/hello.ko
license:        GPL
srcversion:     717A72281ACFAA8385B33A8
depends:
retpoline:      Y
name:           hello
vermagic:       5.15.0-1031-aws SMP mod_unload modversions
seed@ip-172-31-44-212:~/Internet_Security/Lab-06/Labsetup/Files/kernel_module$
```

Task 1.B Implement a Simple firewall using Netfilter

Subtask-1

```
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/kernel_module$ cd ..
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files$ ls
kernel_module  packet_filter
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files$ cd packet_filter/
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/packet_filter$
```

```
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/kernel_module$ cd ..
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files$ ls
kernel_module  packet_filter
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files$ cd packet_filter/
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/packet_filter$ ls
Makefile  seedFilter.c
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/packet_filter$ gedit * &
[1] 3912
```

There are two hooks we need to initialize the hook

```
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/packet_filter$ 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=110 time=10.8 ms
64 bytes from 8.8.8.8: icmp_seq=2 ttl=110 time=10.9 ms
64 bytes from 8.8.8.8: icmp_seq=3 ttl=110 time=10.8 ms
64 bytes from 8.8.8.8: icmp_seq=4 ttl=110 time=10.8 ms
^C
--- 8.8.8.8 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3006ms
rtt min/avg/max/mdev = 10.803/10.841/10.911/0.042 ms
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/packet_filter$ ls
Makefile  seedFilter.c
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/packet_filter$ make
make -C /lib/modules/5.15.0-1033-aws/build M=/home/seed/Internet_Security/Lab6/Labsetup/Files/packet_filter modules
make[1]: Entering directory '/usr/src/linux-headers-5.15.0-1033-aws'
  CC [M]  /home/seed/Internet_Security/Lab6/Labsetup/Files/packet_filter/seedFilter.o
  MODPOST /home/seed/Internet_Security/Lab6/Labsetup/Files/packet_filter/Module.symvers
  CC [M]  /home/seed/Internet_Security/Lab6/Labsetup/Files/packet_filter/seedFilter.mod.o
  LD [M]  /home/seed/Internet_Security/Lab6/Labsetup/Files/packet_filter/seedFilter.ko
  BTF [M] /home/seed/Internet_Security/Lab6/Labsetup/Files/packet_filter/seedFilter.ko
Skipping BTF generation for /home/seed/Internet_Security/Lab6/Labsetup/Files/packet_filter/seedFilter.ko due to unavailability of vmlinux
make[1]: Leaving directory '/usr/src/linux-headers-5.15.0-1033-aws'
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/packet_filter$
```

Here the kernel module is generated

```
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/packet_filter$ make
make -C /lib/modules/5.15.0-1033-aws/build M=/home/seed/Internet_Security/Lab6/Labsetup/Files/packet_filter modules
make[1]: Entering directory '/usr/src/linux-headers-5.15.0-1033-aws'
  CC [M]  /home/seed/Internet_Security/Lab6/Labsetup/Files/packet_filter/seedFilter.o
  MODPOST /home/seed/Internet_Security/Lab6/Labsetup/Files/packet_filter/Module.symvers
  CC [M]  /home/seed/Internet_Security/Lab6/Labsetup/Files/packet_filter/seedFilter.mod.o
  LD [M]  /home/seed/Internet_Security/Lab6/Labsetup/Files/packet_filter/seedFilter.ko
  BTF [M] /home/seed/Internet_Security/Lab6/Labsetup/Files/packet_filter/seedFilter.ko
Skipping BTF generation for /home/seed/Internet_Security/Lab6/Labsetup/Files/packet_filter/seedFilter.ko due to unavailability of vmlinux
make[1]: Leaving directory '/usr/src/linux-headers-5.15.0-1033-aws'
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/packet_filter$ ls
Makefile  Module.symvers  modules.order  seedFilter.c  seedFilter.ko  seedFilter.mod  seedFilter.mod.c  seedFilter.mod.o  seedFilter.o
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/packet_filter$
```

Above kernel module is generated

```
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/packet_filter$ make
make -C /lib/modules/5.15.0-1033-aws/build M=/home/seed/Internet_Security/Lab6/Labsetup/Files/packet_filter modules
make[1]: Entering directory '/usr/src/linux-headers-5.15.0-1033-aws'
  CC [M]  /home/seed/Internet_Security/Lab6/Labsetup/Files/packet_filter/seedFilter.o
  MODPOST /home/seed/Internet_Security/Lab6/Labsetup/Files/packet_filter/Module.symvers
  CC [M]  /home/seed/Internet_Security/Lab6/Labsetup/Files/packet_filter/seedFilter.mod.o
  LD [M]  /home/seed/Internet_Security/Lab6/Labsetup/Files/packet_filter/seedFilter.ko
  BTF [M] /home/seed/Internet_Security/Lab6/Labsetup/Files/packet_filter/seedFilter.ko
Skipping BTF generation for /home/seed/Internet_Security/Lab6/Labsetup/Files/packet_filter/seedFilter.ko due to unavailability of vmlinux
make[1]: Leaving directory '/usr/src/linux-headers-5.15.0-1033-aws'
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/packet_filter$ ls
Makefile  Module.symvers  modules.order  seedFilter.c  seedFilter.ko  seedFilter.mod  seedFilter.mod.c  seedFilter.mod.o  seedFilter.o
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/packet_filter$ sudo insmod seedFilter.ko
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/packet_filter$ lsmod | grep -i seed
seedFilter             16384  0
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/packet_filter$
```

```
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/kernel_module$ sudo dmesg -k -w
[ 1794.118767] Bye-bye World!.
[ 2159.338373] Hello World!
[ 4053.829387] Registering filters.
[ 4053.858450] *** LOCAL_OUT
[ 4053.858454]     172.31.44.212  --> 71.176.66.85 (TCP)
[ 4053.858478] *** LOCAL_OUT
[ 4053.858479]     172.31.44.212  --> 71.176.66.85 (TCP)
[ 4053.858507] *** LOCAL_OUT
[ 4053.858507]     172.31.44.212  --> 71.176.66.85 (TCP)
[ 4053.858756] *** LOCAL_OUT
[ 4053.858757]     172.31.44.212  --> 71.176.66.85 (TCP)
[ 4053.858761] *** LOCAL_OUT
[ 4053.858762]     172.31.44.212  --> 71.176.66.85 (TCP)
[ 4053.897413] *** LOCAL_OUT
[ 4053.897417]     172.31.44.212  --> 71.176.66.85 (TCP)
[ 4053.897433] *** LOCAL_OUT
[ 4053.897434]     172.31.44.212  --> 71.176.66.85 (TCP)
```

```
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/kernel_module$ sudo dmesg -k -w
[ 1794.118767] Bye-bye World!.
[ 2159.338373] Hello World!
[ 4053.829387] Registering filters.
```

We are able to see hook information, prototype udp and IP address for source to destination and the hook where it is hooked and which hook it has triggered.
We are getting as timeout when we try to dig because it's opened by our filter

```
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/kernel_module$ dig @8.8.8.8 www.example.com

; <<>> DiG 9.16.1-Ubuntu <<>> @8.8.8.8 www.example.com
; (1 server found)
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 41794
;; flags: qr rd ra ad; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 512
;; QUESTION SECTION:
;www.example.com.               IN      A

;; ANSWER SECTION:
www.example.com.        20833   IN      A       93.184.216.34

;; Query time: 12 msec
;; SERVER: 8.8.8.8#53(8.8.8.8)
;; WHEN: Fri Mar 31 02:19:39 UTC 2023
;; MSG SIZE  rcvd: 60

seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/kernel_module$ dig @8.8.8.8 www.example.com

; <<>> DiG 9.16.1-Ubuntu <<>> @8.8.8.8 www.example.com
; (1 server found)
;; global options: +cmd
;; connection timed out; no servers could be reached

seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/kernel_module$
```

We want to see that the dig was dropped, that the dna's credit was dropped

```
[ 4728.406355]     172.31.44.212  --> 71.176.66.85 (TCP)
[ 4728.447819] *** LOCAL_OUT
[ 4728.447823]     172.31.44.212  --> 71.176.66.85 (TCP)
[ 4728.447886] *** LOCAL_OUT
[ 4728.447890]     172.31.44.212  --> 71.176.66.85 (TCP)
[ 4728.484296] *** LOCAL_OUT
[ 4728.484301]     172.31.44.212  --> 8.8.8.8 (UDP)
[ 4728.484312] *** Dropping 8.8.8.8 (UDP), port 53
[ 4728.488400] *** LOCAL_OUT
[ 4728.488403]     172.31.44.212  --> 71.176.66.85 (TCP)
[ 4728.536241] *** LOCAL_OUT
[ 4728.536245]     172.31.44.212  --> 71.176.66.85 (TCP)
[ 4728.575240] *** LOCAL_OUT
[ 4728.575243]     172.31.44.212  --> 71.176.66.85 (TCP)
[ 4728.611115] *** LOCAL_OUT
```

```
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/kernel_module$ sudo dmesg -k -w
[ 4835.483363] *** LOCAL_OUT
[ 4835.483364]     172.31.44.212  --> 71.176.66.85 (TCP)
[ 4835.483377] *** LOCAL_OUT
[ 4835.483378]     172.31.44.212  --> 71.176.66.85 (TCP)
[ 4835.498836] *** LOCAL_OUT
[ 4835.498839]     172.31.44.212  --> 71.176.66.85 (TCP)
[ 4835.499281] *** LOCAL_OUT
[ 4835.499283]     172.31.44.212  --> 71.176.66.85 (TCP)
[ 4835.499339] *** LOCAL_OUT
[ 4835.499340]     172.31.44.212  --> 71.176.66.85 (TCP)
[ 4835.499497] *** LOCAL_OUT
[ 4835.499497]     172.31.44.212  --> 71.176.66.85 (TCP)
```

```
[ 4723.480862]     172.31.44.212  --> 71.176.66.85 (TCP)
[ 4723.481016] *** LOCAL_OUT
[ 4723.481017]     172.31.44.212  --> 71.176.66.85 (TCP)
[ 4723.481084] *** LOCAL_OUT
[ 4723.481085]     172.31.44.212  --> 71.176.66.85 (TCP)
[ 4723.481154] *** LOCAL_OUT
[ 4723.481155]     172.31.44.212  --> 71.176.66.85 (TCP)
[ 4723.484469] *** LOCAL_OUT
[ 4723.484472]     172.31.44.212  --> 8.8.8.8 (UDP)
[ 4723.484486] *** Dropping 8.8.8.8 (UDP), port 53
[ 4723.486384] *** LOCAL_OUT
[ 4723.486386]     172.31.44.212  --> 71.176.66.85 (TCP)
[ 4723.486565] *** LOCAL_OUT
[ 4723.486566]     172.31.44.212  --> 71.176.66.85 (TCP)
[ 4723.486611] *** LOCAL_OUT
[ 4723.486612]     172.31.44.212  --> 71.176.66.85 (TCP)
[ 4723.491159] *** LOCAL_OUT
[ 4723.491162]     172.31.44.212  --> 71.176.66.85 (TCP)
```

We are able to see the packets which are dropped for number 53
Let's remove the module, in remote we can see the message

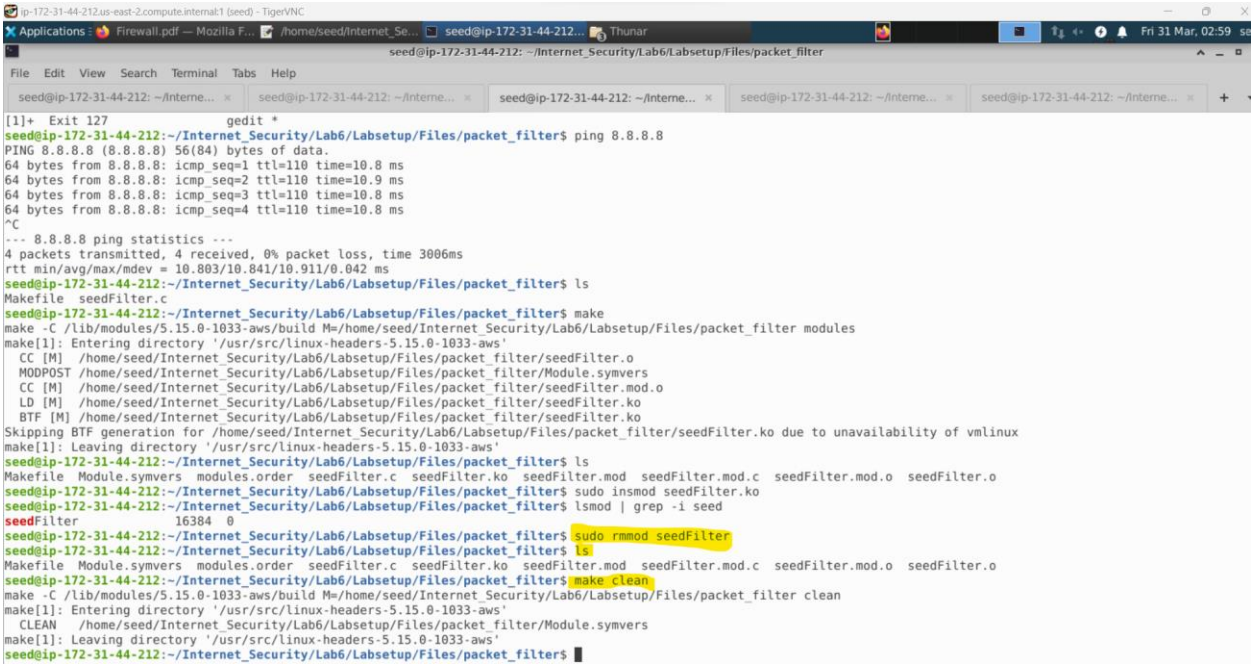
```
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/kernel_module$ sudo dmesg -k -w
[ 5268.746650] *** LOCAL_OUT
[ 5268.746653]     172.31.44.212  --> 71.176.66.85 (TCP)
[ 5268.771662] *** LOCAL_OUT
[ 5268.771666]     172.31.44.212  --> 71.176.66.85 (TCP)
[ 5268.775191] *** LOCAL_OUT
[ 5268.775195]     172.31.44.212  --> 71.176.66.85 (TCP)
[ 5268.775257] *** LOCAL_OUT
[ 5268.775258]     172.31.44.212  --> 71.176.66.85 (TCP)
[ 5268.775268] *** LOCAL_OUT
[ 5268.775269]     172.31.44.212  --> 71.176.66.85 (TCP)
```

```
[ 5655.001832] *** LOCAL_OUT
[ 5655.001834]     127.0.0.1  --> 127.0.0.53 (UDP)
[ 5655.002064] *** LOCAL_OUT
[ 5655.002065]     172.31.44.212  --> 172.31.0.2 (UDP)
[ 5655.002154] *** LOCAL_OUT
[ 5655.002155]     172.31.44.212  --> 172.31.0.2 (UDP)
[ 5655.003052] *** LOCAL_OUT
[ 5655.003054]     127.0.0.53  --> 127.0.0.1 (UDP)
[ 5655.003113] *** LOCAL_OUT
[ 5655.003115]     127.0.0.53  --> 127.0.0.1 (UDP)
[ 5655.011933] The filters are being removed.
```

Subtask-2

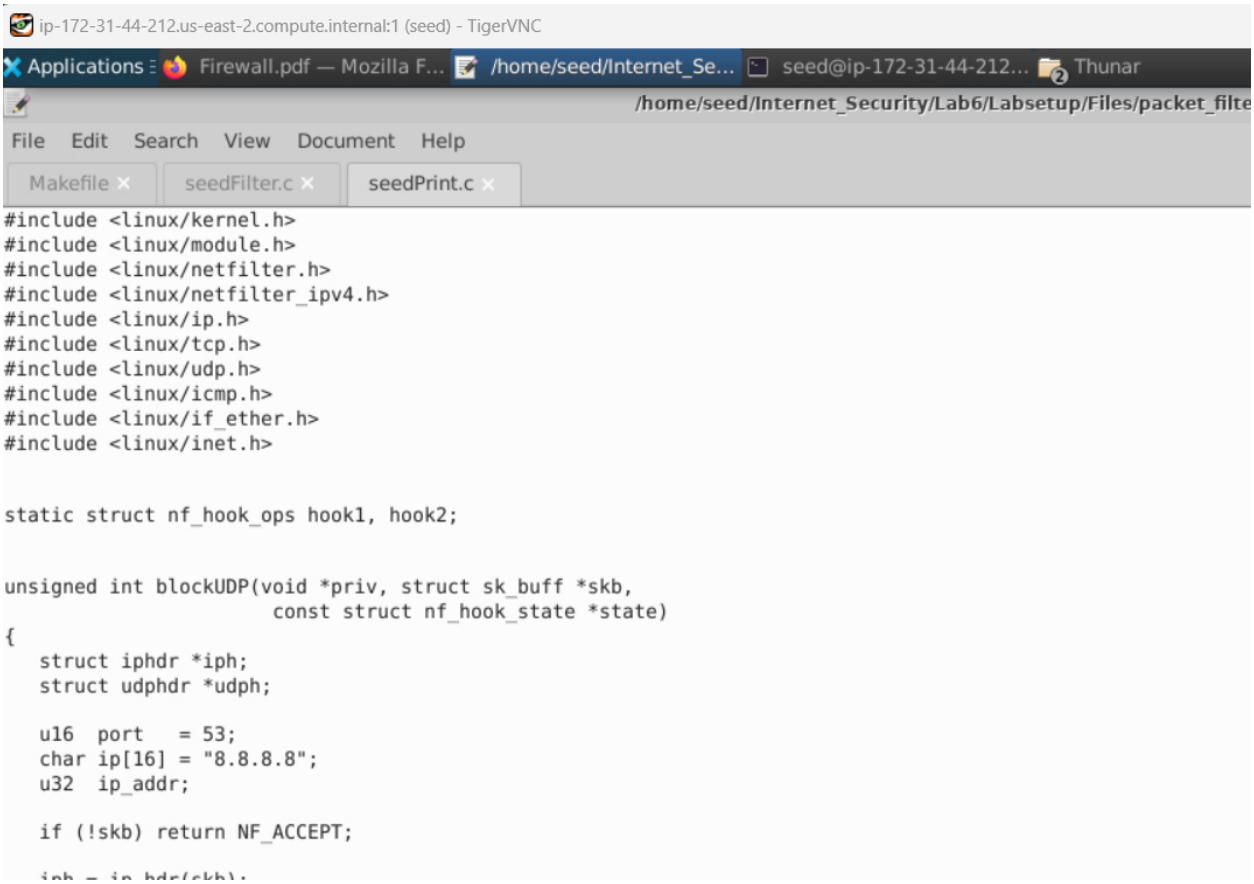
Here we need to modify the seedFilter

```
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/packet_filter$ sudo rmmod seedFilter
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/packet_filter$ ls
Makefile  Module.symvers  modules.order  seedFilter.c  seedFilter.ko  seedFilter.mod  seedFilter.mod.c  seedFilter.mod.o  seedFilter.o
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/packet_filter$ make clean
make -C /lib/modules/5.15.0-1033-aws/build M=/home/seed/Internet_Security/Lab6/Labsetup/Files/packet_filter clean
make[1]: Entering directory '/usr/src/linux-headers-5.15.0-1033-aws'
  CLEAN   /home/seed/Internet_Security/Lab6/Labsetup/Files/packet_filter/Module.symvers
make[1]: Leaving directory '/usr/src/linux-headers-5.15.0-1033-aws'
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/packet_filter$
```

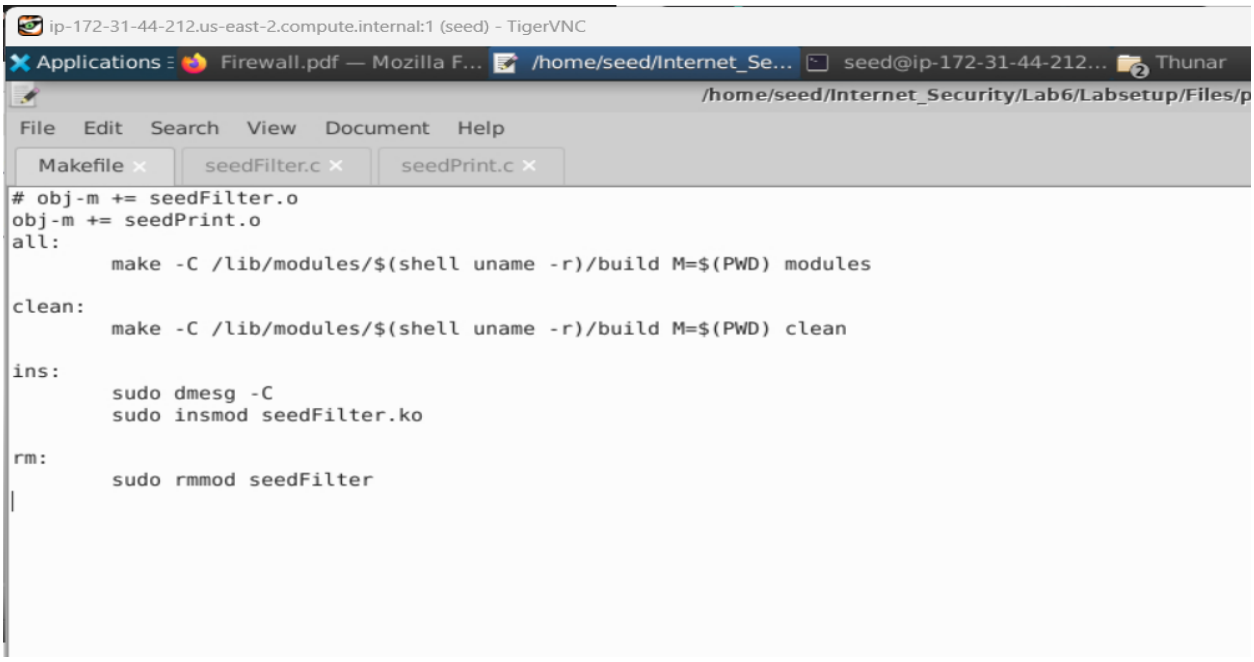



```
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/packet_filter$ sudo rmmod seedFilter
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/packet_filter$ ls
Makefile  Module.symvers  modules.order  seedFilter.c  seedFilter.ko  seedFilter.mod  seedFilter.mod.c  seedFilter.mod.o  seedFilter.o
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/packet_filter$ make clean
make -C /lib/modules/5.15.0-1033-aws/build M=/home/seed/Internet_Security/Lab6/Labsetup/Files/packet_filter clean
make[1]: Entering directory '/usr/src/linux-headers-5.15.0-1033-aws'
  CLEAN   /home/seed/Internet_Security/Lab6/Labsetup/Files/packet_filter/Module.symvers
make[1]: Leaving directory '/usr/src/linux-headers-5.15.0-1033-aws'
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/packet_filter$ make clean
make -C /lib/modules/5.15.0-1033-aws/build M=/home/seed/Internet_Security/Lab6/Labsetup/Files/packet_filter clean
make[1]: Entering directory '/usr/src/linux-headers-5.15.0-1033-aws'
make[1]: Leaving directory '/usr/src/linux-headers-5.15.0-1033-aws'
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/packet_filter$
```

We can use the seedFilter as out Template

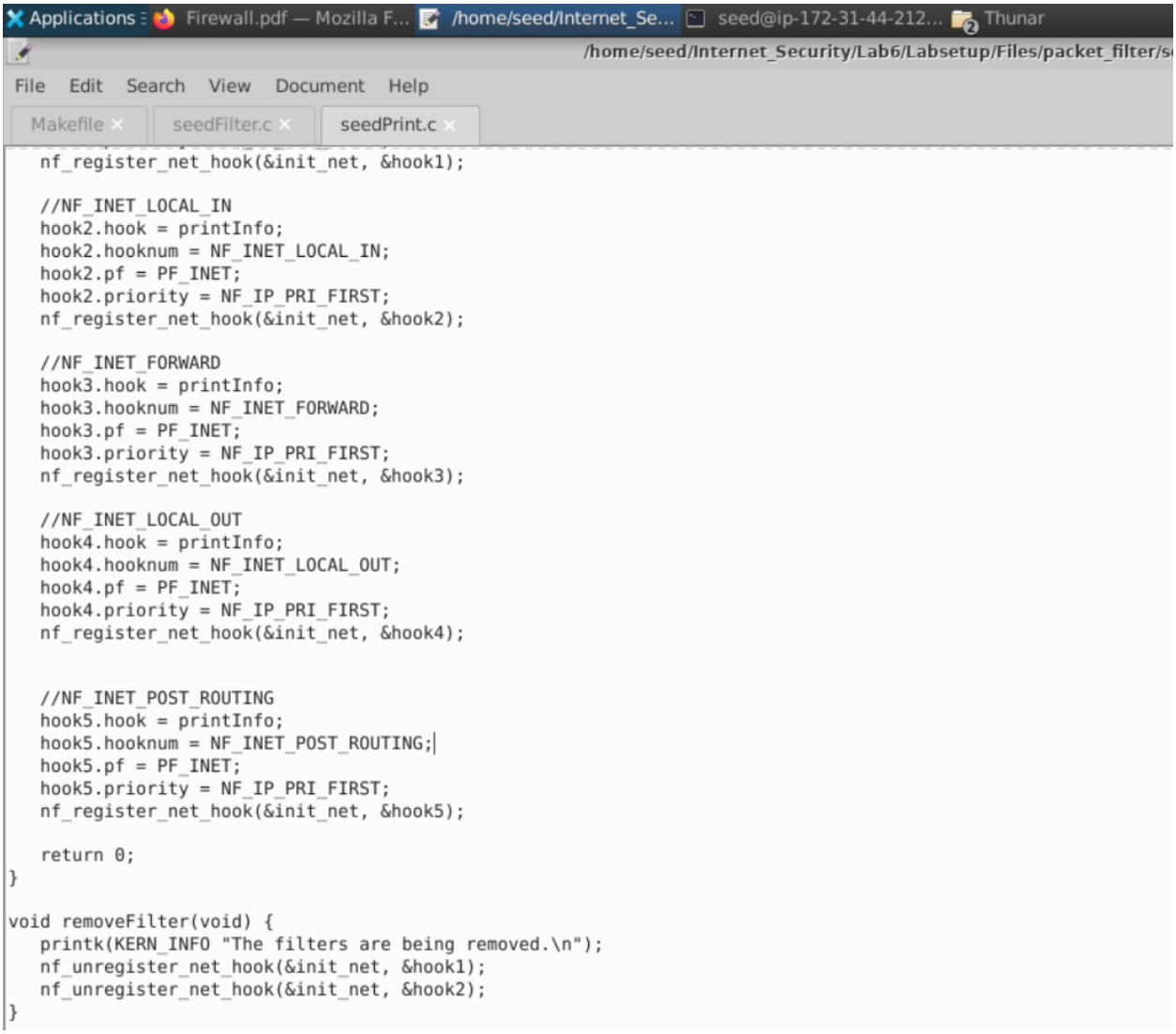

ip-172-31-44-212.us-east-2.compute.internal:1 (seed) - TigerVNC
Applications
Firewall.pdf — Mozilla F...
/home/seed/Internet_Se...
seed@ip-172-31-44-212...
Thunar
/home/seed/Internet_Security/Lab6/Labsetup/Files/packet_filte
File Edit Search View Document Help
Makefile
seedFilter.c
seedPrint.c
#include <linux/kernel.h>
#include <linux/module.h>
#include <linux/netfilter.h>
#include <linux/netfilter_ipv4.h>
#include <linux/ip.h>
#include <linux/tcp.h>
#include <linux/udp.h>
#include <linux/icmp.h>
#include <linux/if_ether.h>
#include <linux/inet.h>
static struct nf_hook_ops hook1, hook2;
unsigned int blockUDP(void *priv, struct sk_buff *skb,
const struct nf_hook_state *state)
{
struct iphdr *iph;
struct udphdr *udph;
u16 port = 53;
char ip[16] = "8.8.8.8";
u32 ip_addr;
if (!skb) return NF_ACCEPT;

MakeFile:-


ip-172-31-44-212.us-east-2.compute.internal:1 (seed) - TigerVNC
Applications
Firewall.pdf — Mozilla F...
/home/seed/Internet_Se...
seed@ip-172-31-44-212...
Thunar
/home/seed/Internet_Security/Lab6/Labsetup/Files/p
File Edit Search View Document Help
Makefile
seedFilter.c
seedPrint.c
obj-m += seedFilter.o
obj-m += seedPrint.o
all:
make -C /lib/modules/$(shell uname -r)/build M=$(PWD) modules
clean:
make -C /lib/modules/$(shell uname -r)/build M=$(PWD) clean
ins:
sudo dmesg -C
sudo insmod seedFilter.ko
rm:
sudo rmmod seedFilter

Now total we need 5 hooks

These are the register features with register file focus




```
   nf_register_net_hook(&init_net, &hook1);

   //NF_INET_LOCAL_IN
   hook2.hook = printInfo;
   hook2.hooknum = NF_INET_LOCAL_IN;
   hook2.pf = PF_INET;
   hook2.priority = NF_IP_PRI_FIRST;
   nf_register_net_hook(&init_net, &hook2);

   //NF_INET_FORWARD
   hook3.hook = printInfo;
   hook3.hooknum = NF_INET_FORWARD;
   hook3.pf = PF_INET;
   hook3.priority = NF_IP_PRI_FIRST;
   nf_register_net_hook(&init_net, &hook3);

   //NF_INET_LOCAL_OUT
   hook4.hook = printInfo;
   hook4.hooknum = NF_INET_LOCAL_OUT;
   hook4.pf = PF_INET;
   hook4.priority = NF_IP_PRI_FIRST;
   nf_register_net_hook(&init_net, &hook4);


   //NF_INET_POST_ROUTING
   hook5.hook = printInfo;
   hook5.hooknum = NF_INET_POST_ROUTING;
   hook5.pf = PF_INET;
   hook5.priority = NF_IP_PRI_FIRST;
   nf_register_net_hook(&init_net, &hook5);

   return 0;
}

void removeFilter(void) {
   printk(KERN_INFO "The filters are being removed.\n");
   nf_unregister_net_hook(&init_net, &hook1);
   nf_unregister_net_hook(&init_net, &hook2);
}
```

```
   return 0;
}

void removeFilter(void) {
   printk(KERN_INFO "The filters are being removed.\n");
   nf_unregister_net_hook(&init_net, &hook1);
   nf_unregister_net_hook(&init_net, &hook2);
   nf_unregister_net_hook(&init_net, &hook3);
   nf_unregister_net_hook(&init_net, &hook4);
   nf_unregister_net_hook(&init_net, &hook5);

}
```

We need to unregister all the networks. Lets make seedPrint.ko

```
[11142.213615] *** POST_ROUTING
[11142.213616]     172.31.44.212  --> 71.176.66.85 (TCP)
[11142.213748] *** LOCAL_OUT
[11142.213750]     172.31.44.212  --> 71.176.66.85 (TCP)
[11142.213752] *** POST_ROUTING
[11142.213754]     172.31.44.212  --> 71.176.66.85 (TCP)
[11142.213924] *** LOCAL_OUT
[11142.213925]     172.31.44.212  --> 71.176.66.85 (TCP)
[11142.213928] *** POST_ROUTING
[11142.213929]     172.31.44.212  --> 71.176.66.85 (TCP)
[11142.213949] *** LOCAL_OUT
[11142.213950]     172.31.44.212  --> 71.176.66.85 (TCP)
[11142.213952] *** POST_ROUTING
[11142.213953]     172.31.44.212  --> 71.176.66.85 (TCP)
[11142.223761] *** PRE_ROUTING
[11142.223779]     71.176.66.85  --> 172.31.44.212 (TCP)
[11142.223790] *** PRE_ROUTING
[11142.223792]     71.176.66.85  --> 172.31.44.212 (TCP)
[11142.223801] *** LOCAL_IN
[11142.223802]     71.176.66.85  --> 172.31.44.212 (TCP)
[11142.223816] *** LOCAL_IN
[11142.223818]     71.176.66.85  --> 172.31.44.212 (TCP)
[11142.234090] *** LOCAL_OUT
[11142.234093]     172.31.44.212  --> 71.176.66.85 (TCP)
```

```
[ 4723.480862]     172.31.44.212  --> 71.176.66.85 (TCP)
[ 4723.481016] *** LOCAL_OUT
[ 4723.481017]     172.31.44.212  --> 71.176.66.85 (TCP)
[ 4723.481084] *** LOCAL_OUT
[ 4723.481085]     172.31.44.212  --> 71.176.66.85 (TCP)
[ 4723.481154] *** LOCAL_OUT
[ 4723.481155]     172.31.44.212  --> 71.176.66.85 (TCP)
[ 4723.484469] *** LOCAL_OUT
[ 4723.484472]     172.31.44.212  --> 8.8.8.8 (UDP)
[ 4723.484486] *** Dropping 8.8.8.8 (UDP), port 53
[ 4723.486384] *** LOCAL_OUT
[ 4723.486386]     172.31.44.212  --> 71.176.66.85 (TCP)
[ 4723.486565] *** LOCAL_OUT
[ 4723.486566]     172.31.44.212  --> 71.176.66.85 (TCP)
[ 4723.486611] *** LOCAL_OUT
[ 4723.486612]     172.31.44.212  --> 71.176.66.85 (TCP)
[ 4723.491159] *** LOCAL_OUT
[ 4723.491162]     172.31.44.212  --> 71.176.66.85 (TCP)
```

```
[ 3112.842092] *** LOCAL_OUT
[ 3112.842094]     10.20.30.13  --> 54.192.121.83 (TCP)
[ 3112.852603] *** LOCAL_OUT
[ 3112.852615]     10.20.30.13  --> 54.192.121.83 (TCP)
[ 3130.642747] The filters are being removed.
[ 3726.258025] seedPrint: Registering filters.
```

```
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/packet_filter$ make
make -C /lib/modules/5.15.0-1033-aws/build M=/home/seed/Internet_Security/Lab6/Labsetup/Files/packet_filter modules
make[1]: Entering directory '/usr/src/linux-headers-5.15.0-1033-aws'
  CC [M]  /home/seed/Internet_Security/Lab6/Labsetup/Files/packet_filter/seedPrint.o
  MODPOST /home/seed/Internet_Security/Lab6/Labsetup/Files/packet_filter/Module.symvers
  CC [M]  /home/seed/Internet_Security/Lab6/Labsetup/Files/packet_filter/seedPrint.mod.o
  LD [M]  /home/seed/Internet_Security/Lab6/Labsetup/Files/packet_filter/seedPrint.ko
  BTF [M] /home/seed/Internet_Security/Lab6/Labsetup/Files/packet_filter/seedPrint.ko
Skipping BTF generation for /home/seed/Internet_Security/Lab6/Labsetup/Files/packet_filter/seedPrint.ko due to unavailability of vmlinux
make[1]: Leaving directory '/usr/src/linux-headers-5.15.0-1033-aws'
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/packet_filter$ sudo insmod seedPrint.ko
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/packet_filter$ sudo insmod seedPrint.ko
insmod: ERROR: could not insert module seedPrint.ko: File exists
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/packet_filter$ sudo rmmod seedPrint
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/packet_filter$
```

```
[11449.425536]     127.0.0.53  --> 127.0.0.1 (UDP)
[11449.450092] *** PRE_ROUTING
[11449.450095]     71.176.66.85  --> 172.31.44.212 (TCP)
[11449.450102] *** PRE_ROUTING
[11449.450103]     71.176.66.85  --> 172.31.44.212 (TCP)
[11449.450110] *** LOCAL_IN
[11449.450110]     71.176.66.85  --> 172.31.44.212 (TCP)
[11449.450122] *** LOCAL_IN
[11449.450123]     71.176.66.85  --> 172.31.44.212 (TCP)
[11449.450714] *** LOCAL_OUT
[11449.450716]     172.31.44.212  --> 71.176.66.85 (TCP)
[11449.450724] *** POST_ROUTING
[11449.450725]     172.31.44.212  --> 71.176.66.85 (TCP)
[11449.450739] seedPrint: The filters are being removed.
```

Subtask-3

To create a kernel module to hook into this netfilter to block just to attempt the ping and the ethernet

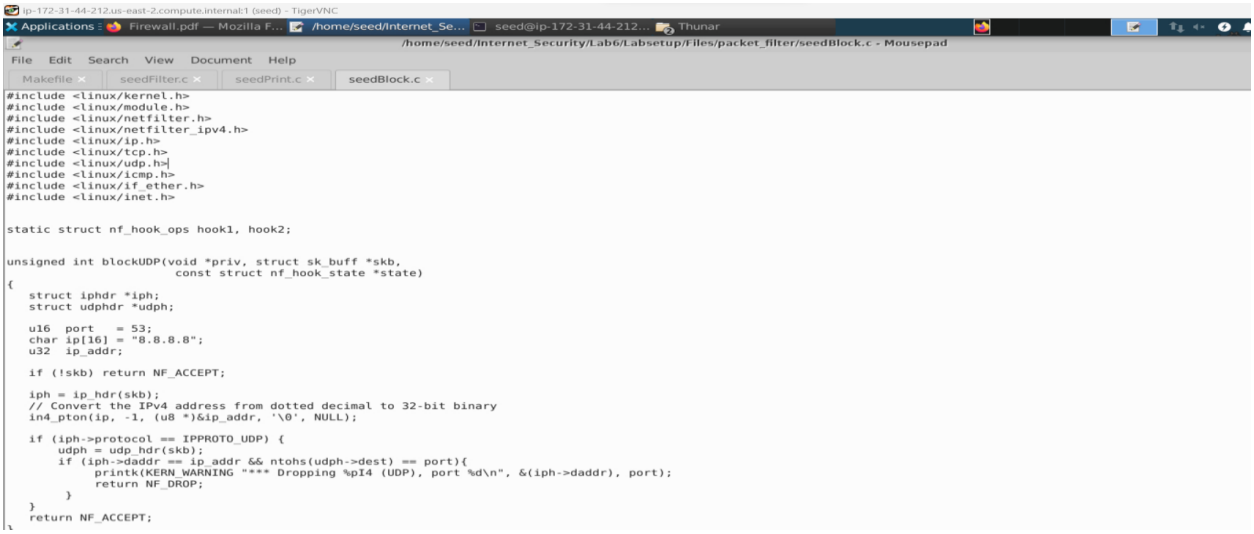
```
```

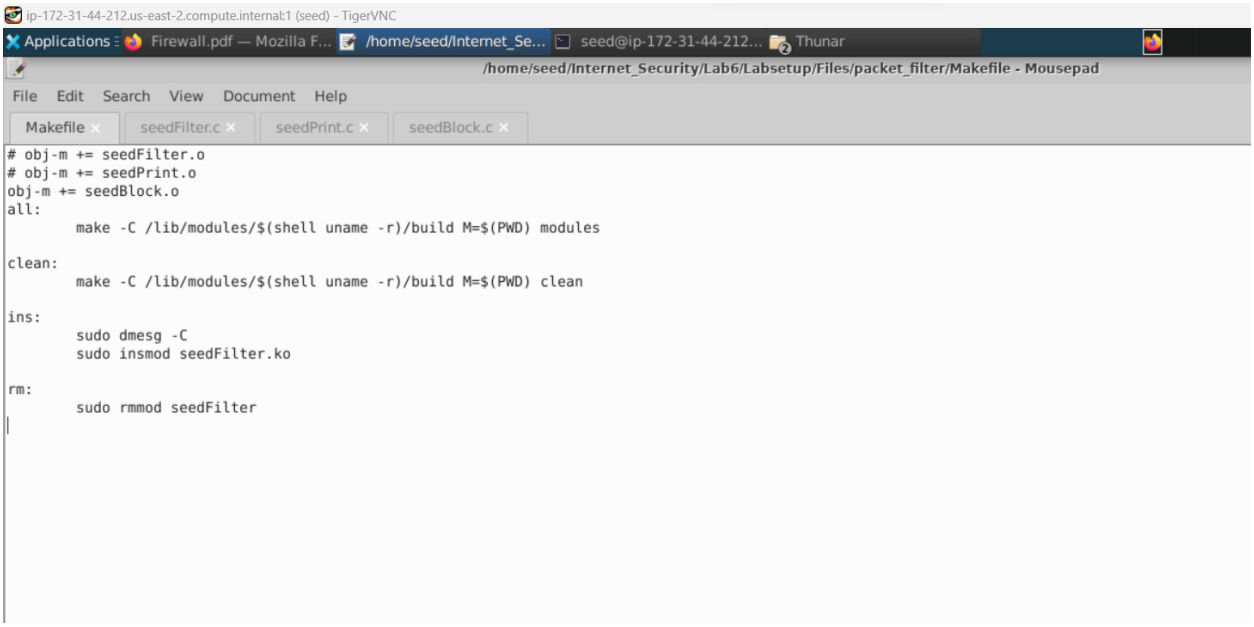
```
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/kernel_module$ docksh  hostA-10.9.0.5
root@86470afd2d65:/# ping 10.9.0.1
PING 10.9.0.1 (10.9.0.1) 56(84) bytes of data.
64 bytes from 10.9.0.1: icmp_seq=1 ttl=64 time=0.130 ms
64 bytes from 10.9.0.1: icmp_seq=2 ttl=64 time=0.089 ms
64 bytes from 10.9.0.1: icmp_seq=3 ttl=64 time=0.059 ms
64 bytes from 10.9.0.1: icmp_seq=4 ttl=64 time=0.055 ms
64 bytes from 10.9.0.1: icmp_seq=5 ttl=64 time=0.178 ms
^C
--- 10.9.0.1 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4076ms
rtt min/avg/max/mdev = 0.055/0.102/0.178/0.046 ms
root@86470afd2d65:/# telnet 10.9.0.1
Trying 10.9.0.1...
Connected to 10.9.0.1.
Escape character is '^]'.
Ubuntu 20.04.5 LTS
ip-172-31-44-212 login: seed
Password:

Login incorrect
ip-172-31-44-212 login: seed
Password:

Login incorrect
```

```
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/packet_filter$ sudo insmod seedPrint.ko
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/packet_filter$ sudo insmod seedPrint.ko
insmod: ERROR: could not insert module seedPrint.ko: File exists
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/packet_filter$ sudo rmmod seedPrint
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/packet_filter$ ls
Makefile  Module.symvers  modules.order  seedFilter.c  seedPrint.c  seedPrint.ko  seedPrint.mod  seedPrint.mod.c  seedPrint.mod.o  seedPrint.o
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/packet_filter$ make clean
make -C /lib/modules/5.15.0-1033-aws/build M=/home/seed/Internet_Security/Lab6/Labsetup/Files/packet_filter clean
make[1]: Entering directory '/usr/src/linux-headers-5.15.0-1033-aws'
  CLEAN   /home/seed/Internet_Security/Lab6/Labsetup/Files/packet_filter/Module.symvers
make[1]: Leaving directory '/usr/src/linux-headers-5.15.0-1033-aws'
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/packet_filter$ ls
Makefile  seedFilter.c  seedPrint.c
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/packet_filter$ cp seedFilter.c seedBlock.c
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/packet_filter$
```

```
Login incorrect
ip-172-31-44-212 login:
Login timed out after 60 seconds.
Connection closed by foreign host.
root@86470afd2d65:/# telnet 10.9.0.1
Trying 10.9.0.1...
Connected to 10.9.0.1.
Escape character is '^]'.
Ubuntu 20.04.5 LTS
ip-172-31-44-212 login: seed
Password:

Login incorrect
ip-172-31-44-212 login: seed
Password:

Login incorrect
ip-172-31-44-212 login: seed
Password:

Login incorrect
ip-172-31-44-212 login:
Login timed out after 60 seconds.
Connection closed by foreign host.
root@86470afd2d65:/# telnet 10.9.0.1
Trying 10.9.0.1...
Connected to 10.9.0.1.
Escape character is '^]'.
Ubuntu 20.04.5 LTS
```

seedBlock.c

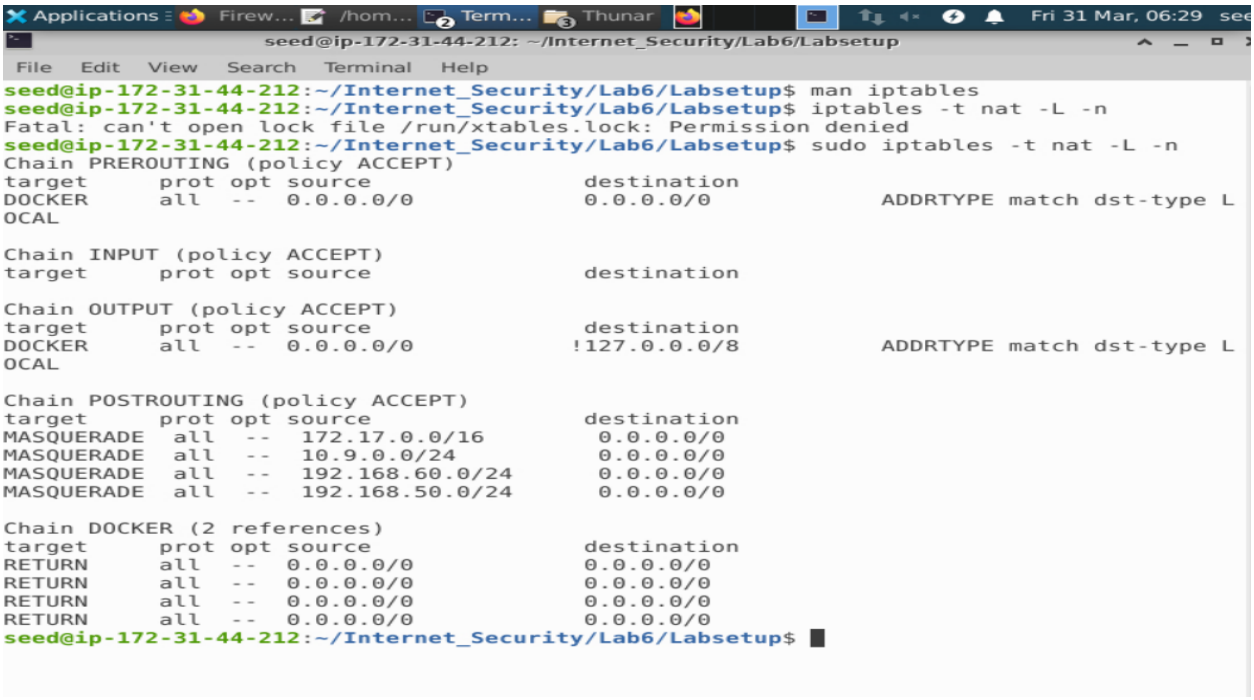




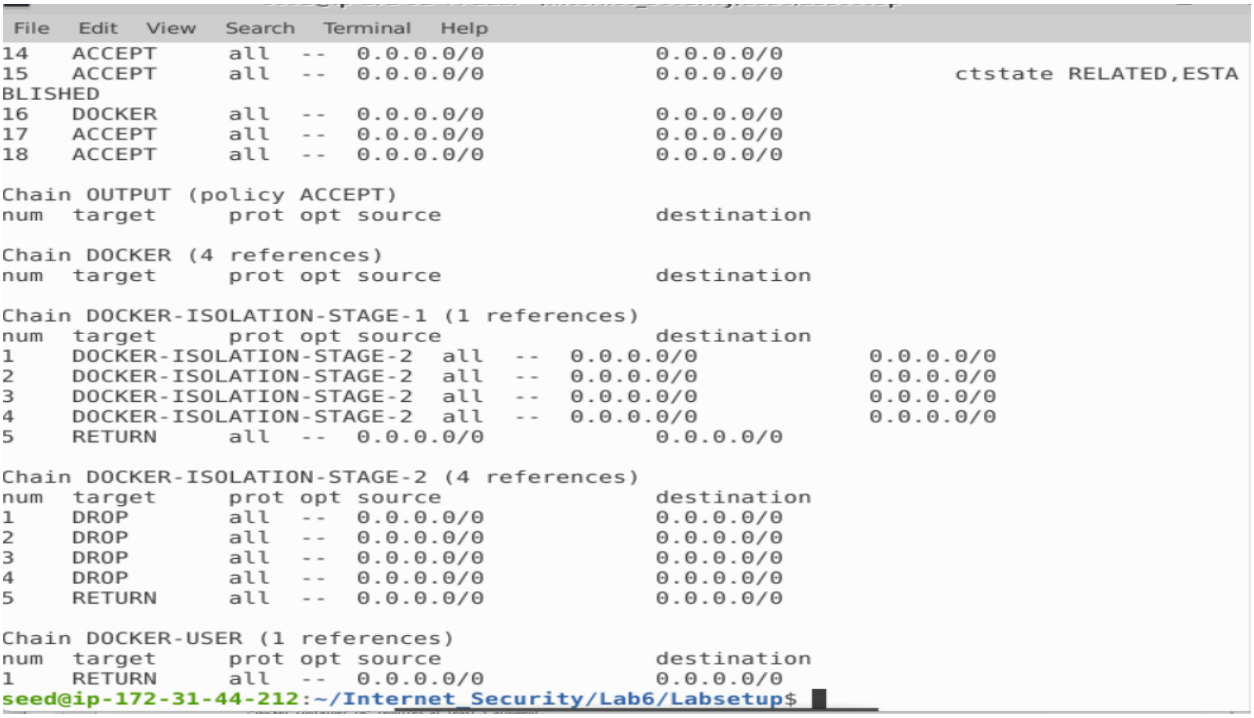
Task 1 is to block ping to our virtual machine

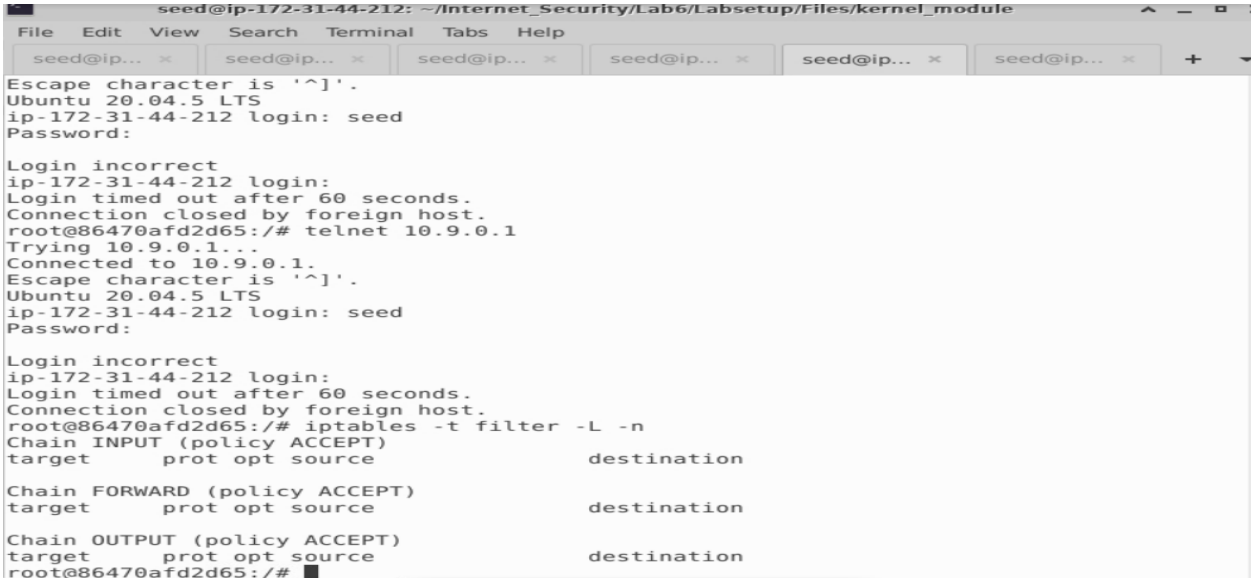
Now check the virtual machine IP address if it equals virtual machine IP address

Task-2 Experimenting with Stateless Firewall Rules




```
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup$ sudo iptables -t filter -L -n
--line-numbers
Chain INPUT (policy ACCEPT)
num  target     prot opt source               destination

Chain FORWARD (policy DROP)
num  target     prot opt source               destination
1    DOCKER-USER  all  --  0.0.0.0/0            0.0.0.0/0
2    DOCKER-ISOLATION-STAGE-1  all  --  0.0.0.0/0            0.0.0.0/0
3    ACCEPT     all  --  0.0.0.0/0            0.0.0.0/0            ctstate RELATED,ESTA
BLISHED
4    DOCKER     all  --  0.0.0.0/0            0.0.0.0/0
5    ACCEPT     all  --  0.0.0.0/0            0.0.0.0/0
6    ACCEPT     all  --  0.0.0.0/0            0.0.0.0/0
7    ACCEPT     all  --  0.0.0.0/0            0.0.0.0/0            ctstate RELATED,ESTA
```

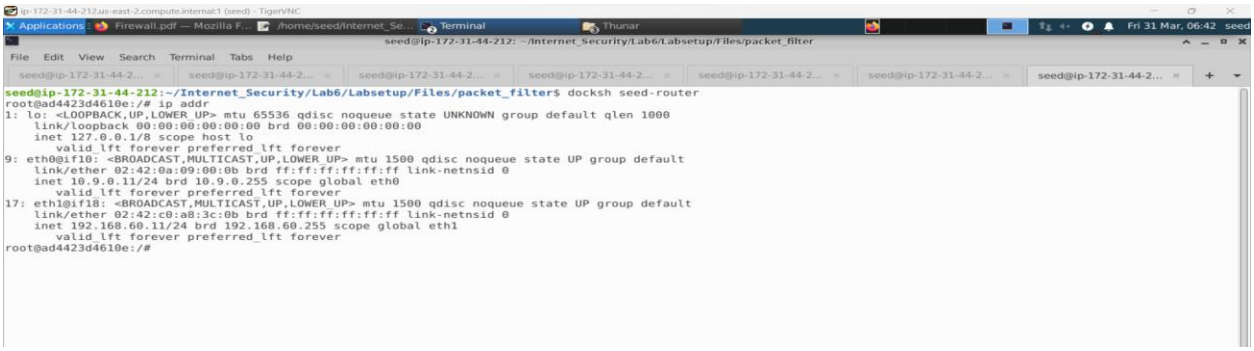

File Edit View Search Terminal Help
14 ACCEPT all -- 0.0.0.0/0 0.0.0.0/0
15 ACCEPT all -- 0.0.0.0/0 0.0.0.0/0 ctstate RELATED,ESTA
BLISHED
16 DOCKER all -- 0.0.0.0/0 0.0.0.0/0
17 ACCEPT all -- 0.0.0.0/0 0.0.0.0/0
18 ACCEPT all -- 0.0.0.0/0 0.0.0.0/0
Chain OUTPUT (policy ACCEPT)
num target prot opt source destination
Chain DOCKER (4 references)
num target prot opt source destination
Chain DOCKER-ISOLATION-STAGE-1 (1 references)
num target prot opt source destination
1 DOCKER-ISOLATION-STAGE-2 all -- 0.0.0.0/0 0.0.0.0/0
2 DOCKER-ISOLATION-STAGE-2 all -- 0.0.0.0/0 0.0.0.0/0
3 DOCKER-ISOLATION-STAGE-2 all -- 0.0.0.0/0 0.0.0.0/0
4 DOCKER-ISOLATION-STAGE-2 all -- 0.0.0.0/0 0.0.0.0/0
5 RETURN all -- 0.0.0.0/0 0.0.0.0/0
Chain DOCKER-ISOLATION-STAGE-2 (4 references)
num target prot opt source destination
1 DROP all -- 0.0.0.0/0 0.0.0.0/0
2 DROP all -- 0.0.0.0/0 0.0.0.0/0
3 DROP all -- 0.0.0.0/0 0.0.0.0/0
4 DROP all -- 0.0.0.0/0 0.0.0.0/0
5 RETURN all -- 0.0.0.0/0 0.0.0.0/0
Chain DOCKER-USER (1 references)
num target prot opt source destination
1 RETURN all -- 0.0.0.0/0 0.0.0.0/0
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup$


seed@ip-172-31-44-212: ~/Internet_Security/Lab6/Labsetup/Files/kernel_module
File Edit View Search Terminal Tabs Help
seed@ip... seed@ip... seed@ip... seed@ip... seed@ip... seed@ip...
Escape character is '^]'.
Ubuntu 20.04.5 LTS
ip-172-31-44-212 login: seed
Password:
Login incorrect
ip-172-31-44-212 login:
Login timed out after 60 seconds.
Connection closed by foreign host.
root@86470afd2d65:/# telnet 10.9.0.1
Trying 10.9.0.1...
Connected to 10.9.0.1.
Escape character is '^]'.
Ubuntu 20.04.5 LTS
ip-172-31-44-212 login: seed
Password:
Login incorrect
ip-172-31-44-212 login:
Login timed out after 60 seconds.
Connection closed by foreign host.
root@86470afd2d65:/# iptables -t filter -L -n
Chain INPUT (policy ACCEPT)
target prot opt source destination
Chain FORWARD (policy ACCEPT)
target prot opt source destination
Chain OUTPUT (policy ACCEPT)
target prot opt source destination
root@86470afd2d65:/#

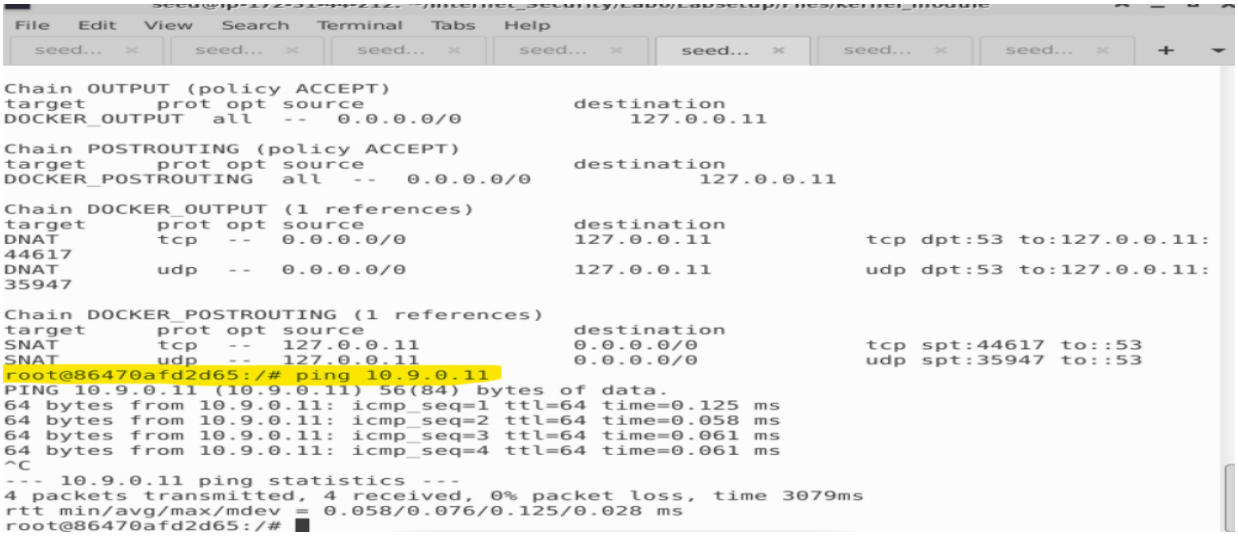
```
root@86470afd2d65:/# iptables -t nat -L -n
Chain PREROUTING (policy ACCEPT)
target     prot opt source               destination

Chain INPUT (policy ACCEPT)
target     prot opt source               destination

Chain OUTPUT (policy ACCEPT)
target     prot opt source               destination
DOCKER_OUTPUT  all  --  0.0.0.0/0            127.0.0.11

Chain POSTROUTING (policy ACCEPT)
target     prot opt source               destination
DOCKER_POSTROUTING  all  --  0.0.0.0/0            127.0.0.11

Chain DOCKER_OUTPUT (1 references)
target     prot opt source               destination
DNAT       tcp  --  0.0.0.0/0            127.0.0.11           tcp dpt:53 to:127.0.0.11:
44617
```

Task-2A Protecting the Router

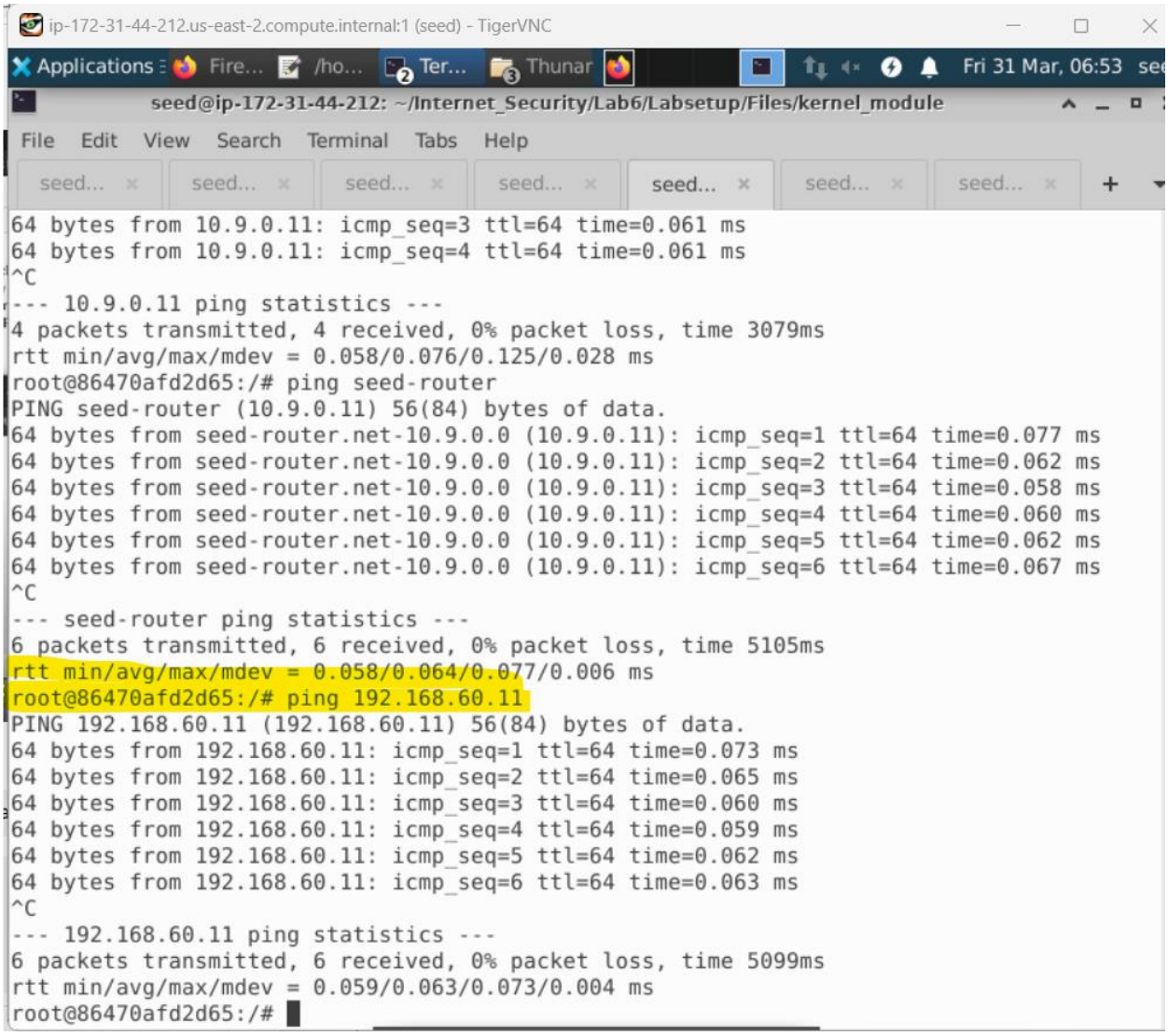
As a router it has 2 ip addresses



Use telnet to save as an example. The ping has worked how about we set an other interface



```
root@86470afd2d65:/# ping seed-router
PING seed-router (10.9.0.11) 56(84) bytes of data.
64 bytes from seed-router.net-10.9.0.0 (10.9.0.11): icmp_seq=1 ttl=64 time=0.077 ms
64 bytes from seed-router.net-10.9.0.0 (10.9.0.11): icmp_seq=2 ttl=64 time=0.062 ms
64 bytes from seed-router.net-10.9.0.0 (10.9.0.11): icmp_seq=3 ttl=64 time=0.058 ms
64 bytes from seed-router.net-10.9.0.0 (10.9.0.11): icmp_seq=4 ttl=64 time=0.060 ms
64 bytes from seed-router.net-10.9.0.0 (10.9.0.11): icmp_seq=5 ttl=64 time=0.062 ms
64 bytes from seed-router.net-10.9.0.0 (10.9.0.11): icmp_seq=6 ttl=64 time=0.067 ms
^C
--- seed-router ping statistics ---
6 packets transmitted, 6 received, 0% packet loss, time 5105ms
rtt min/avg/max/mdev = 0.058/0.064/0.077/0.006 ms
root@86470afd2d65:/#
```



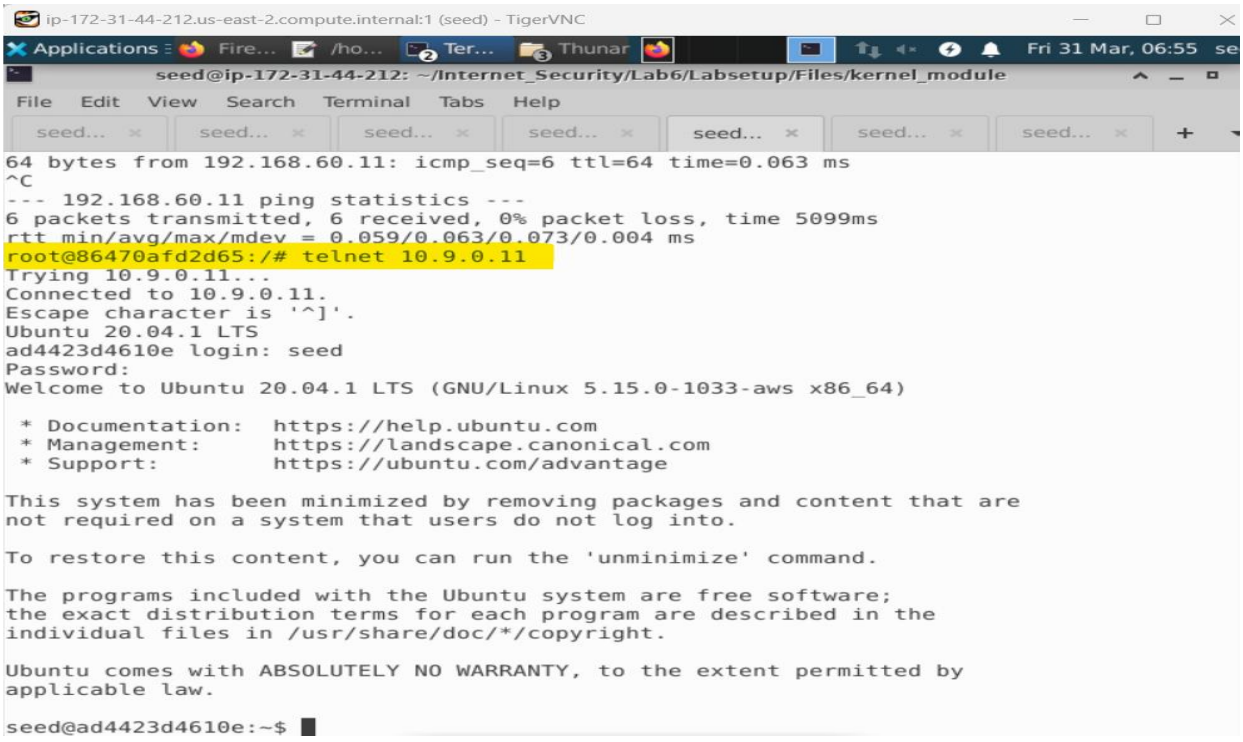
We can also use telnet to turn into this router

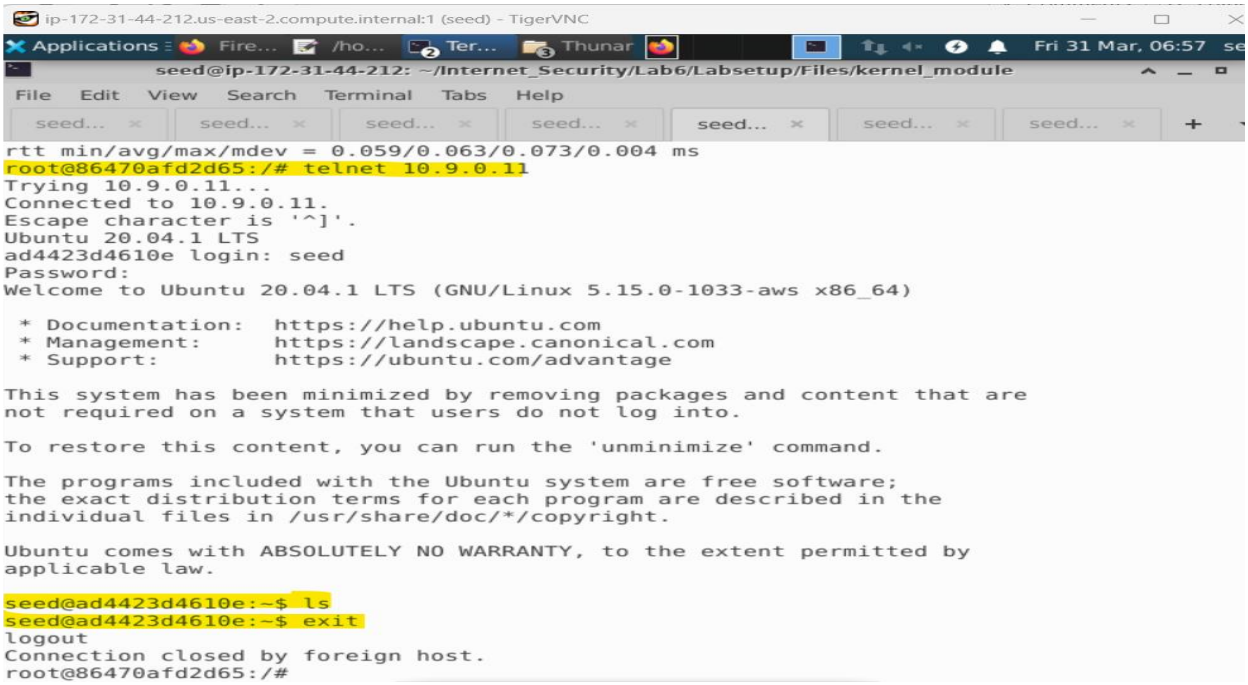
Before we run the active commands we can print it we can telnet it, now it asks us to execute those ip tips command and try it again by pinging and telnetting it.

Telnet service is running on all the containers, the core seat was created on them with the panel ds as I jus demonstrated

Report your observation and explain the problems of each row.

Here we need to setup these rows in the router inside the router





Before we run the active commands we can print it we can telnet it, now it asks us to execute those ip tips command and try it again by pinging and telnetting it.

Telnet service is running on all the containers, the core seat was created on them with the panel ds as I jus demonstrated

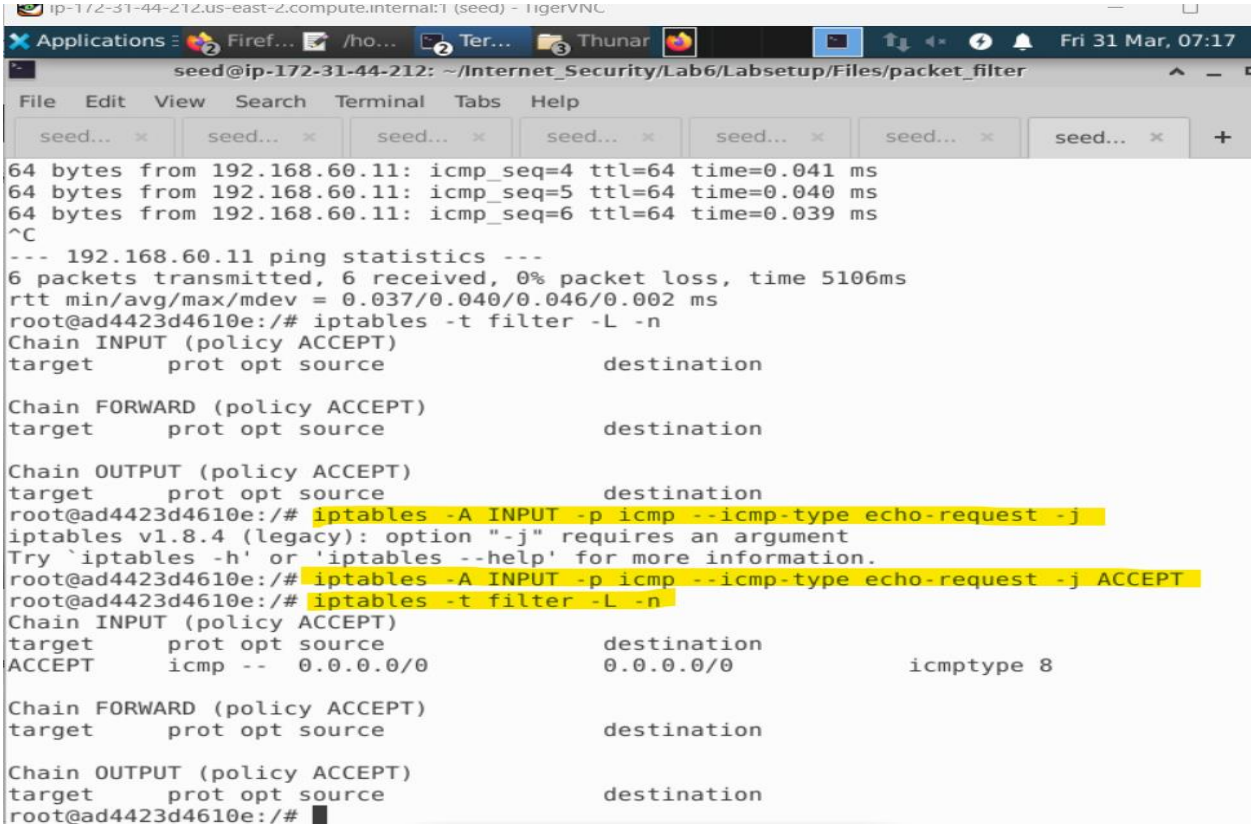
Report your observation and explain the problems of each row.

Here we need to setup these rows in the router inside the router

It lists out this field table

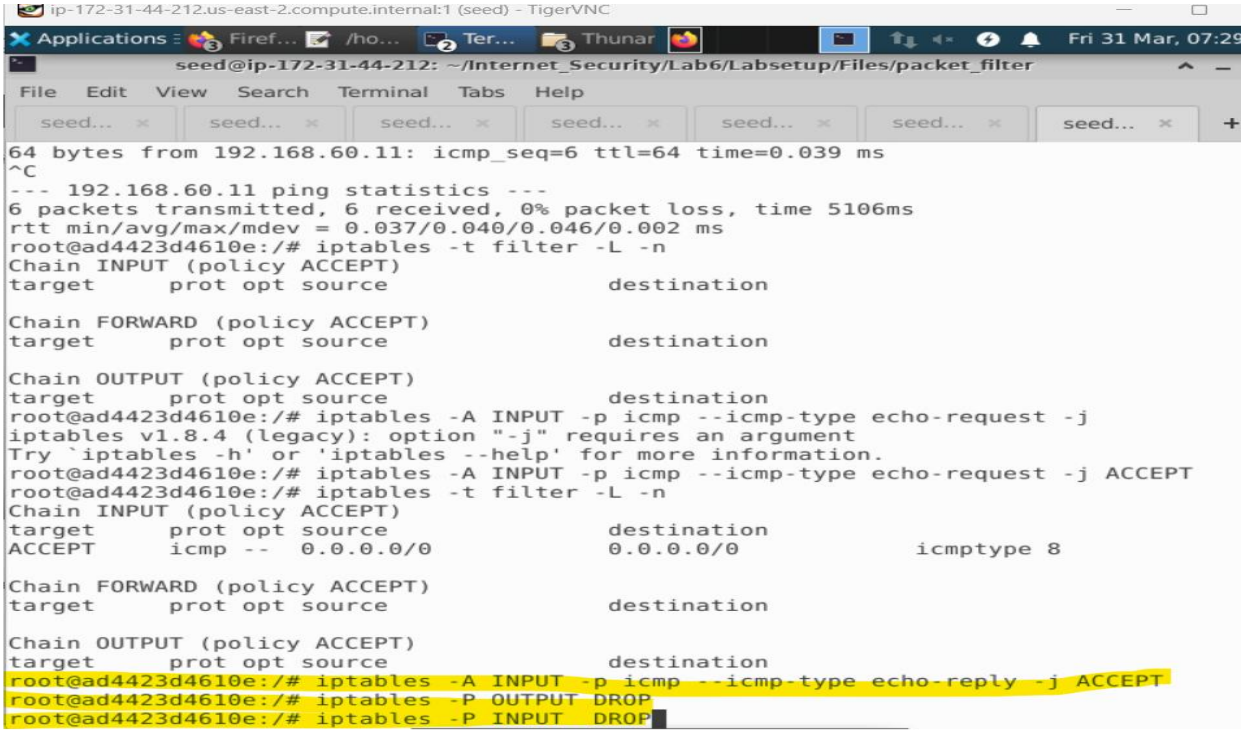
```
root@ad4423d4610e:/# iptables -t filter -L -n
Chain INPUT (policy ACCEPT)
target     prot opt source               destination

Chain FORWARD (policy ACCEPT)
target     prot opt source               destination

Chain OUTPUT (policy ACCEPT)
target     prot opt source               destination
root@ad4423d4610e:/#
```

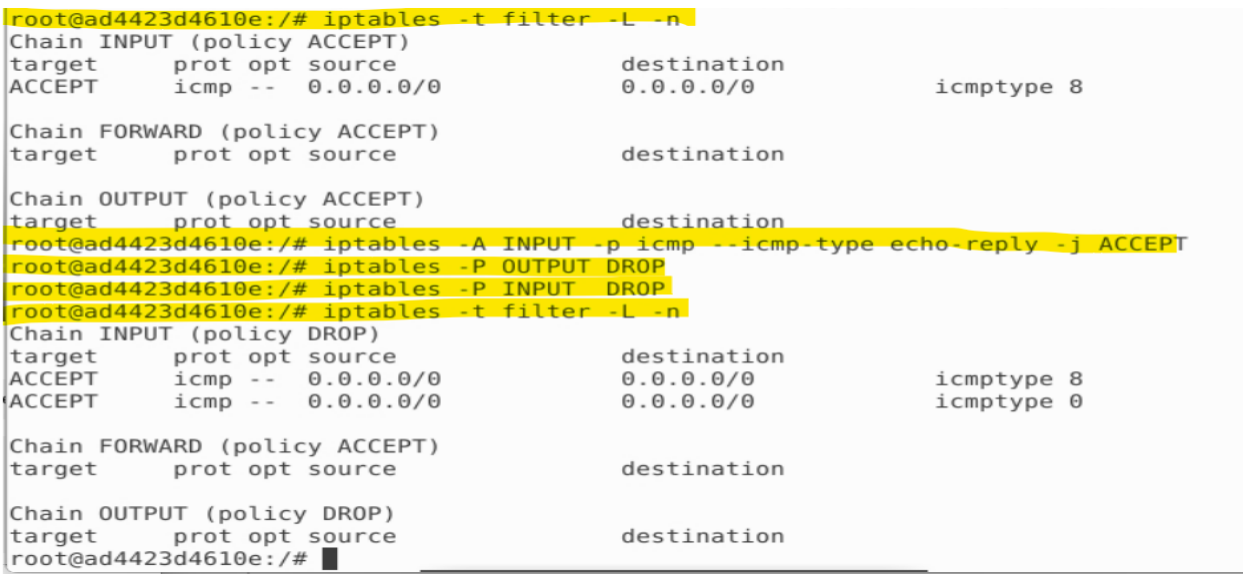
We can use the check command to see whether the ICMP rule is added here



For the echo reply we also accept the reply which means we let the reply go back to the accessor and we set the default rules ot the output to be job and input to job which means other protocols cannot access our router.

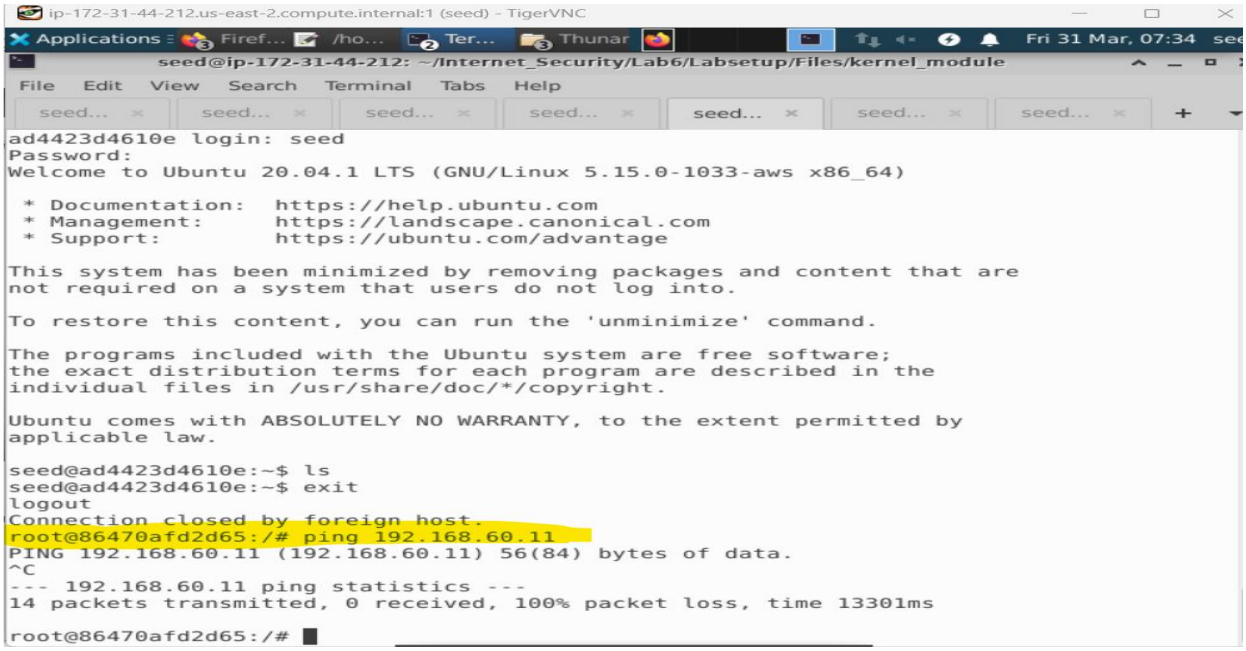
To specify the default rule touch p, on this output chain drop everything

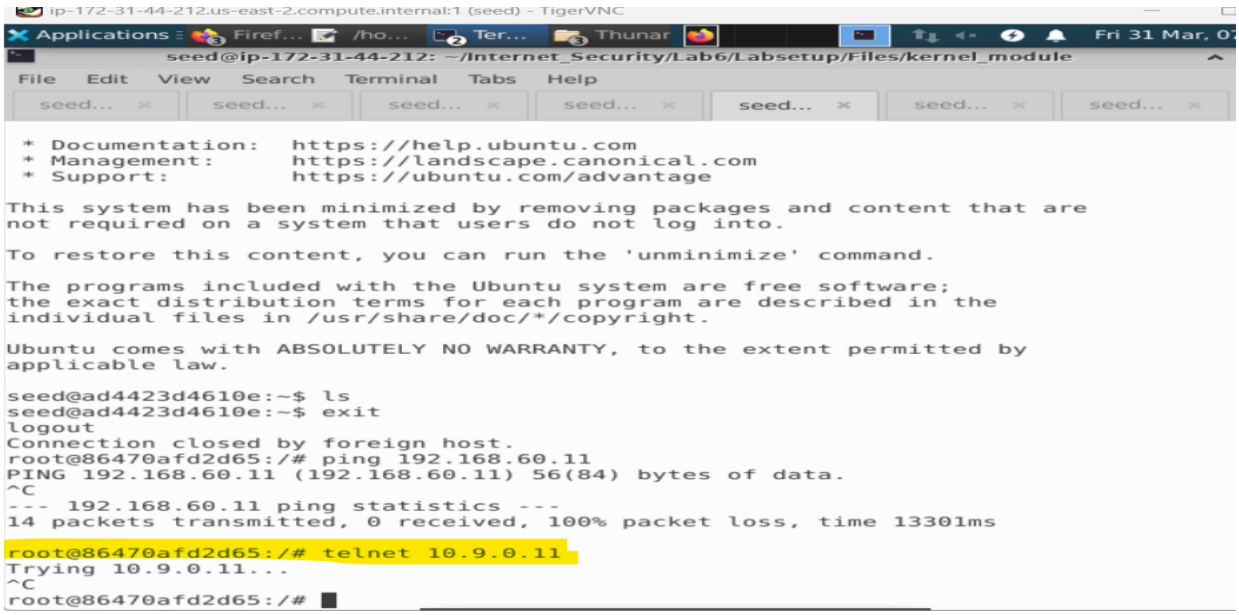




Now we should test it here ping should work and telnet should deny

Here below the ping does not work

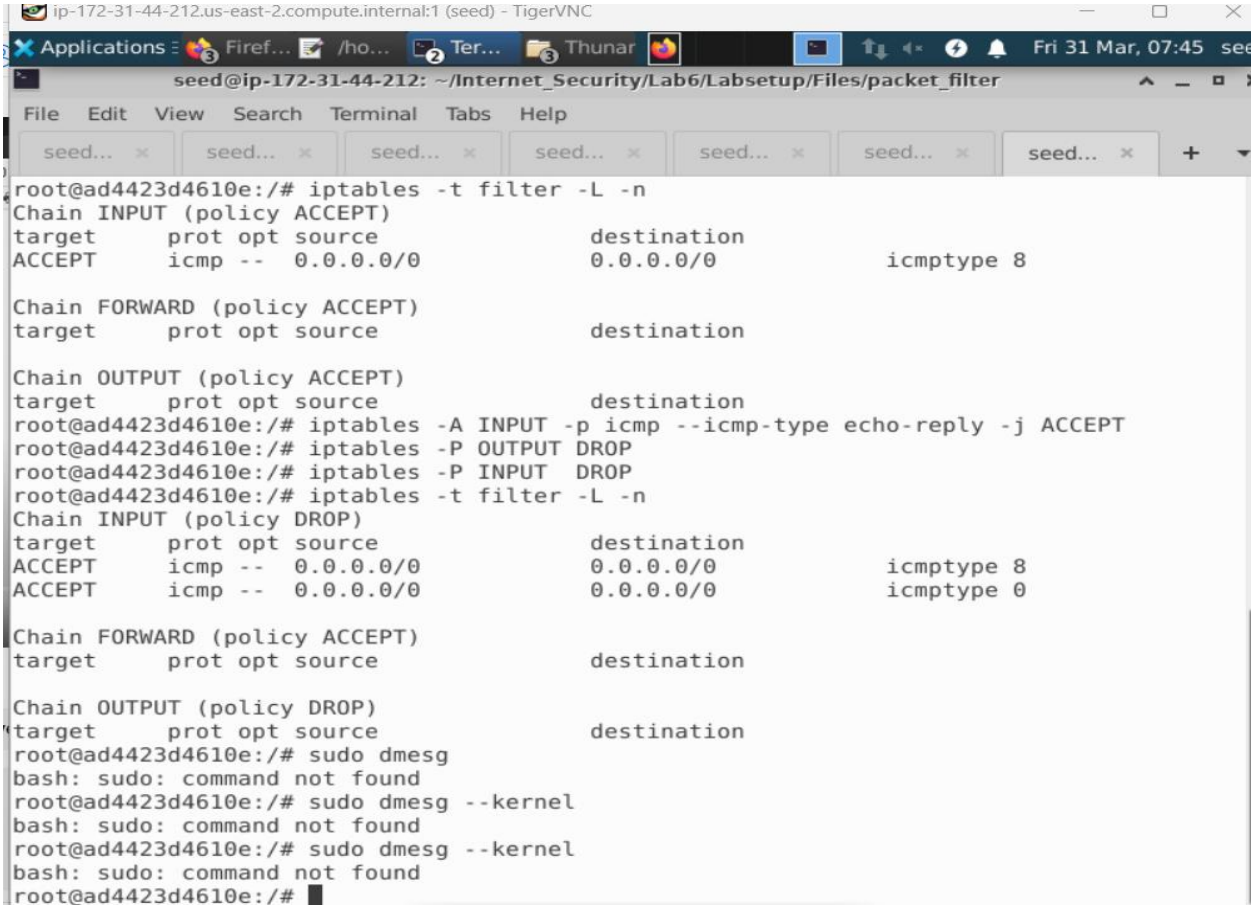




We can check whether we are able to see any kernel information from here

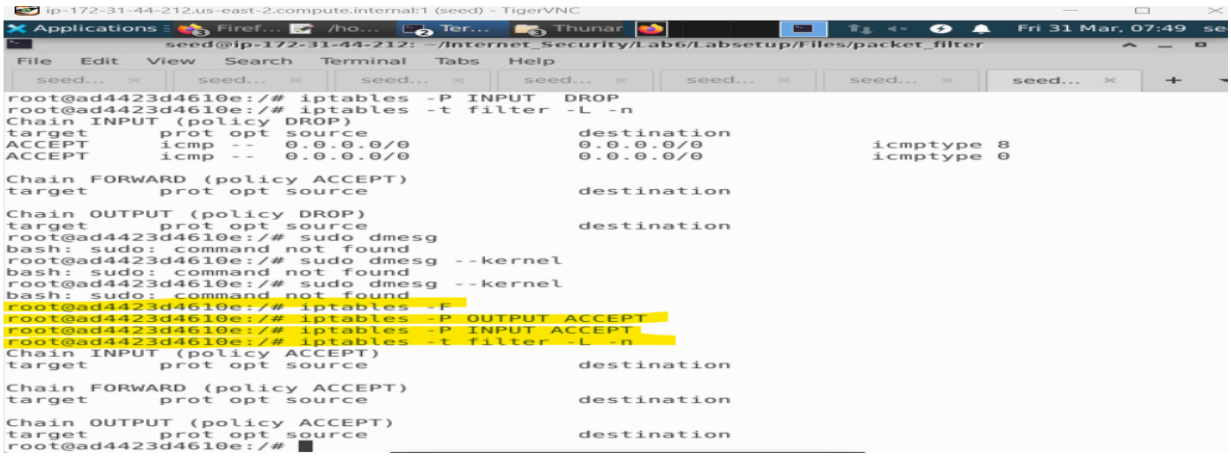
The information which we got in our virtual machine and the kernel message they share same kind of buffer between these containers and virtual machine and we didn't see any new messages printed out here

We get the output as **seedBlock:The filter are being removed.**



Restoring the filter table to it's original state with the following commands

The policy rules as removed now



Another way to restore the states of all the tables is to restart the container. Here we need to find the ID docker restore command id

Task 2.B: Protecting the Internal Network

Here we make use of internal network we have 3 containers

192.168.60.5/.6/.7

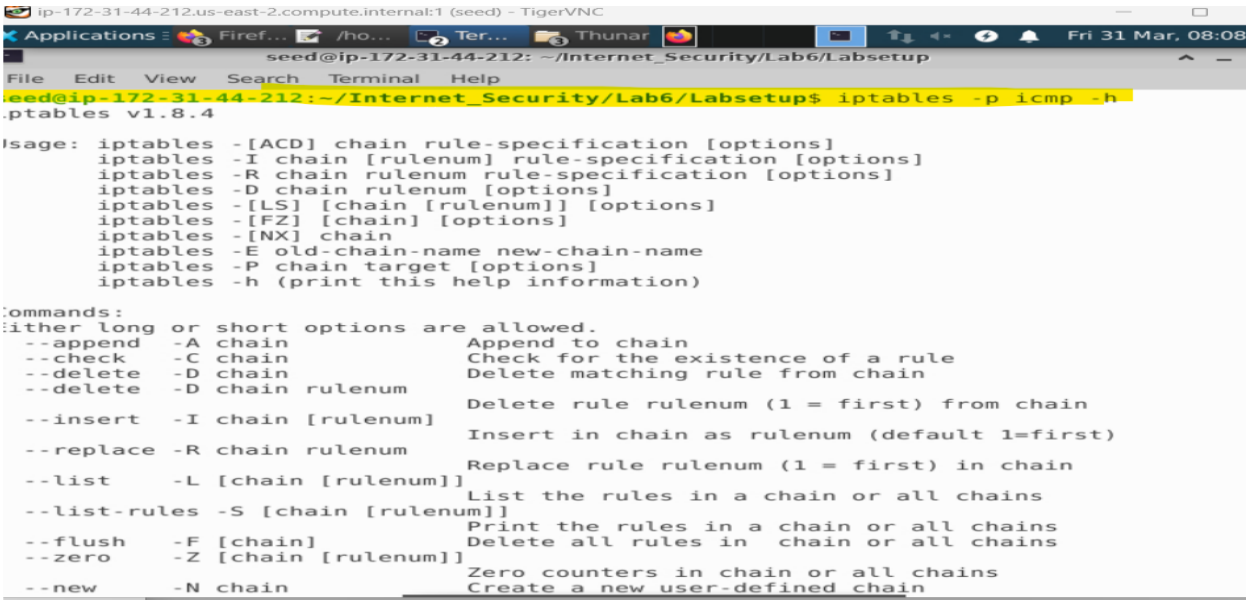
We need to use the forward chain for this purpose because the router sit between the outsideand this this internal network so we need the forward chain in the router

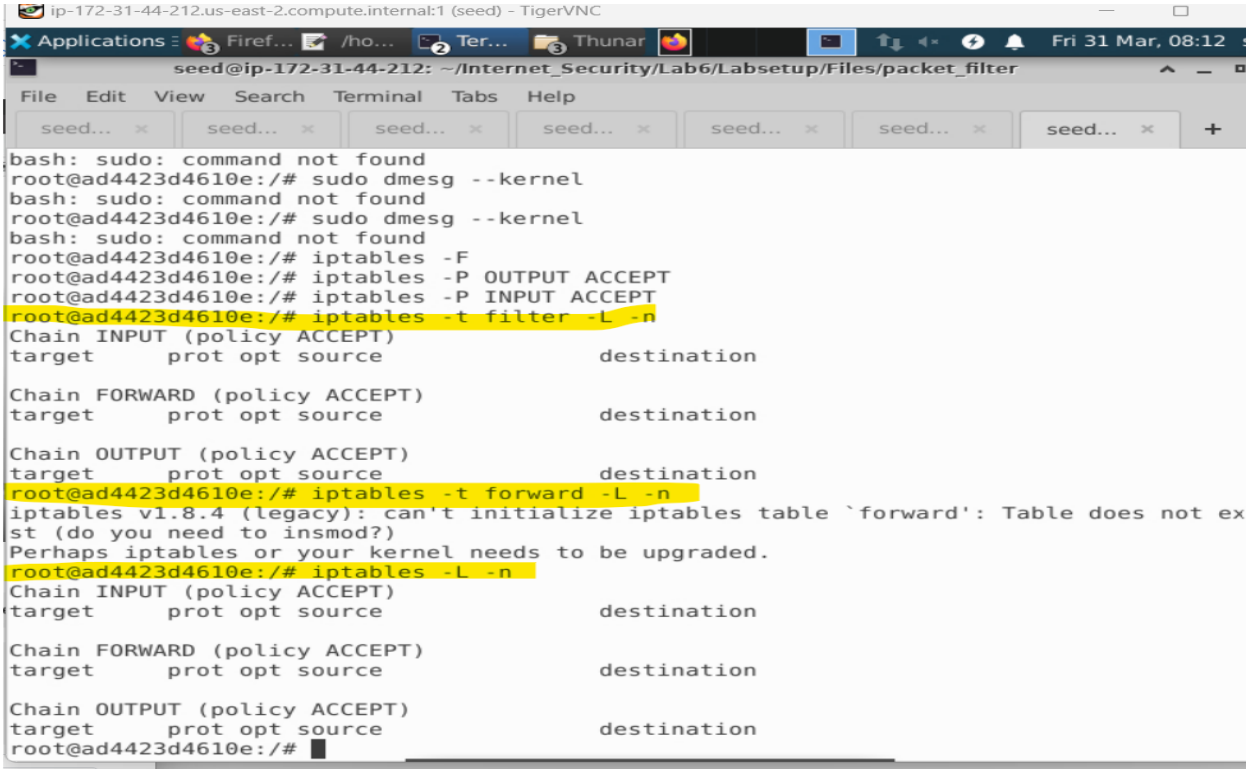
The directions of the packet in the input and output chains are clear effects are either coming into for the input or going out for the output it's not true for the forward check because its bi-directional, because going into the internal network or going out to the external network or go through this forward chain.

Outside host cannot ping internal hosts

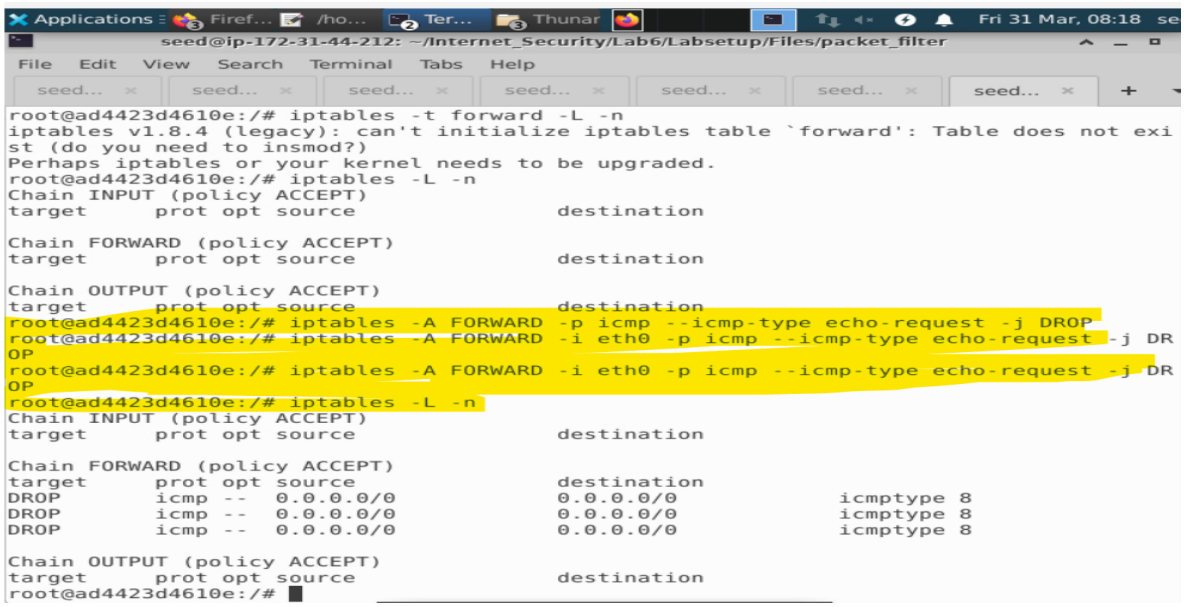
We are insid ethe router now as in containers the autocomplete does not work.

We use the below command to find the other match options. The match options are for the snmp protocol.

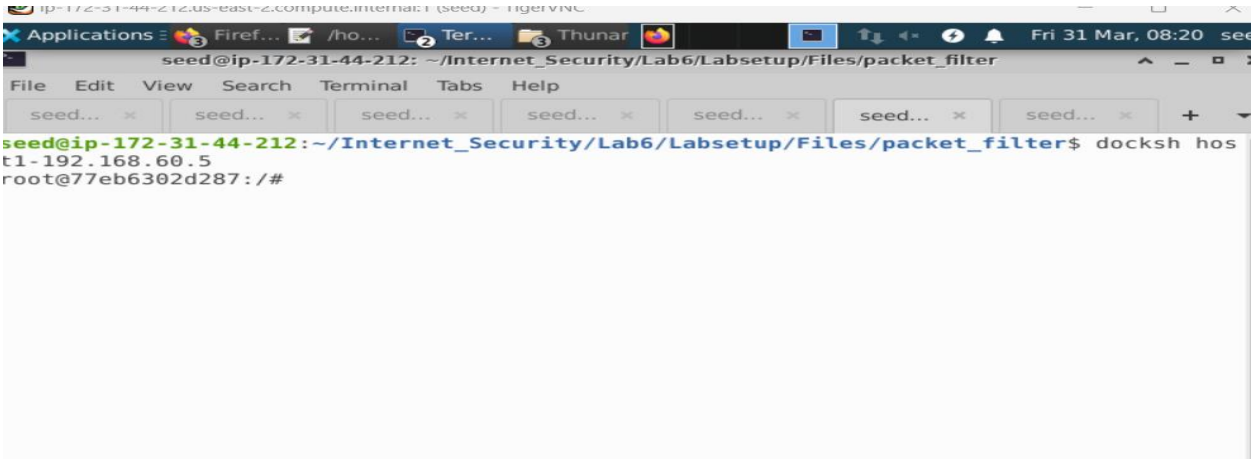




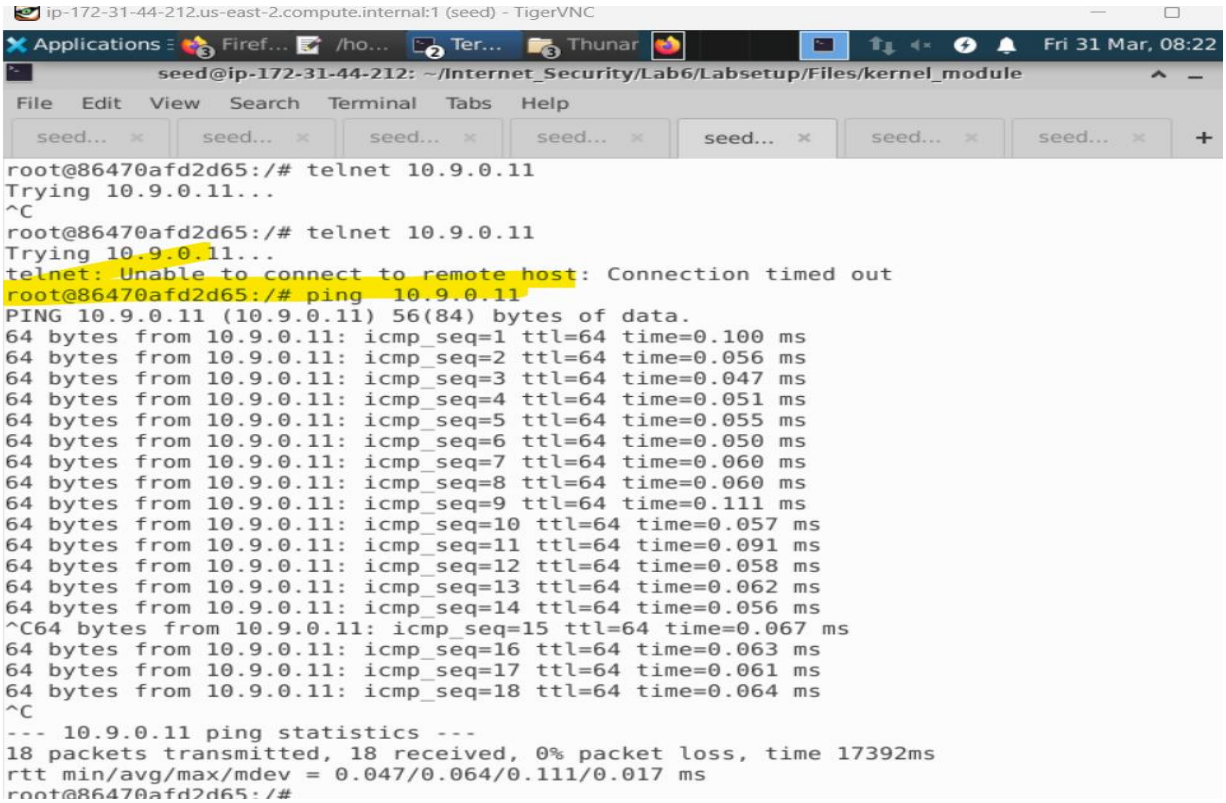
The outside host will be able to ping inner host because they were also dropped when they come to the router



Inside network below



1. Outside hosts cannot ping internal hosts



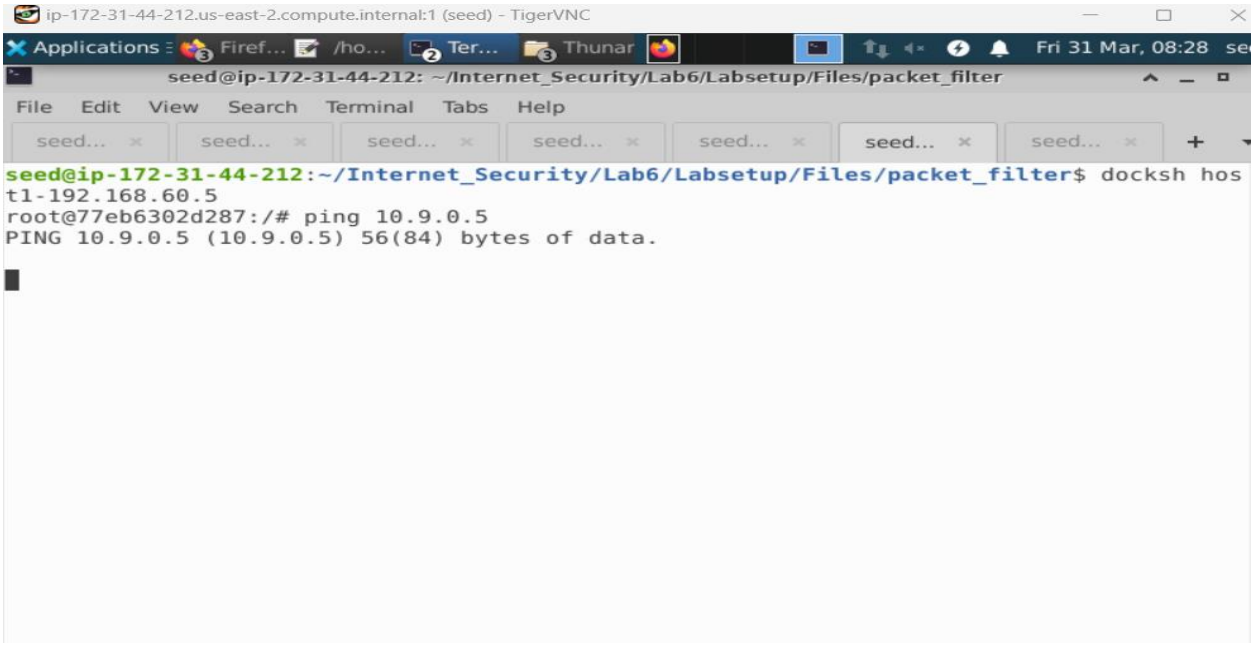
Now is able to ping the router.

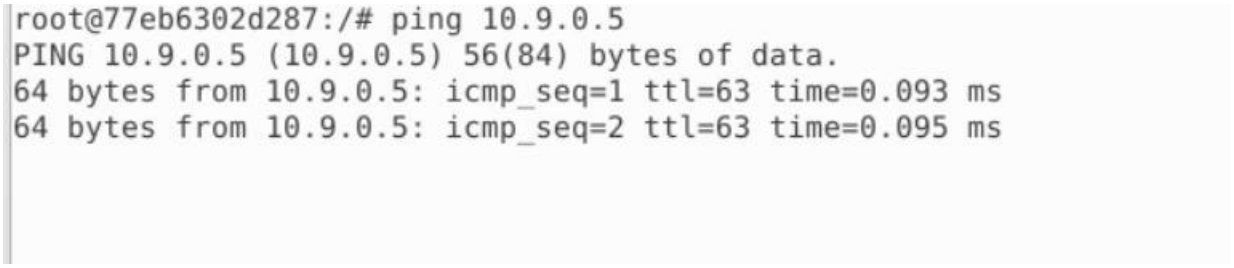
When we ping the inner host it has stopped, it cannot ping the inner host.

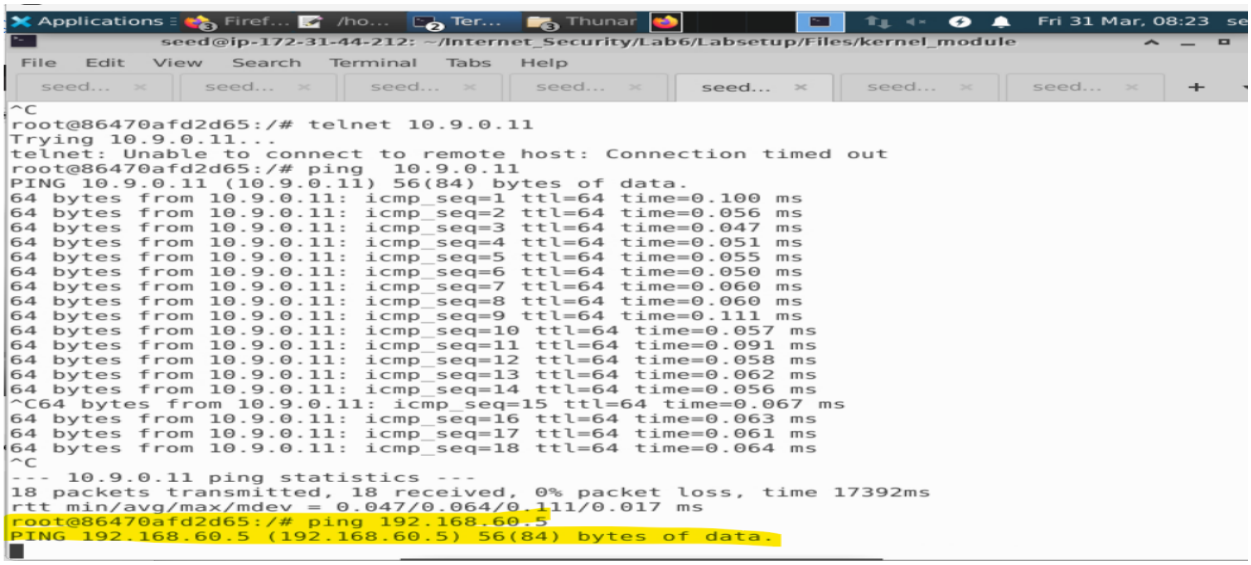
2) Outside host can ping the router

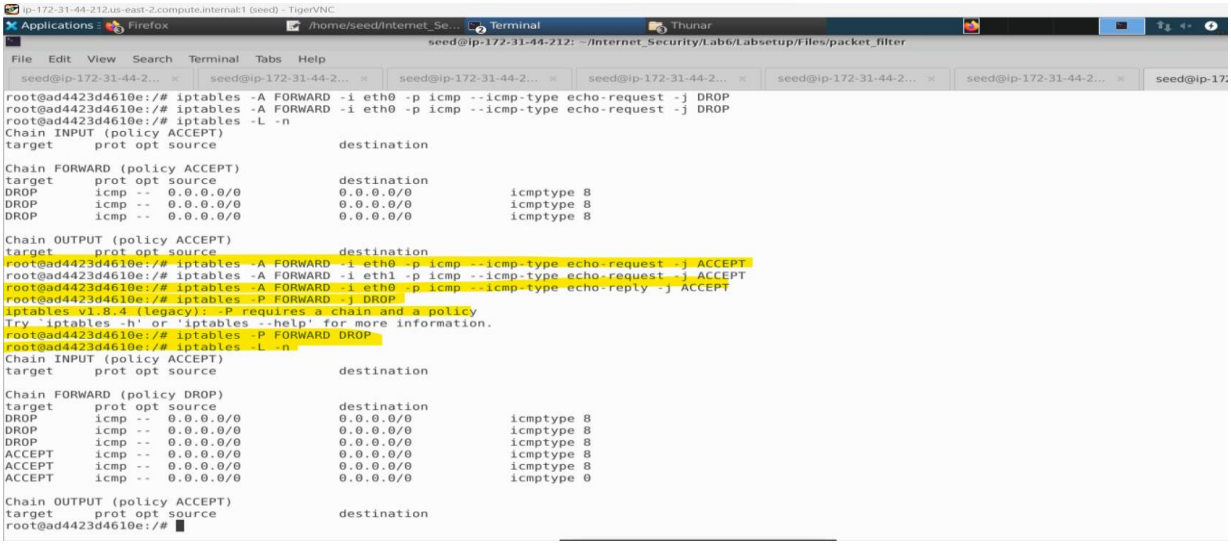
The inner host can ping outside host.

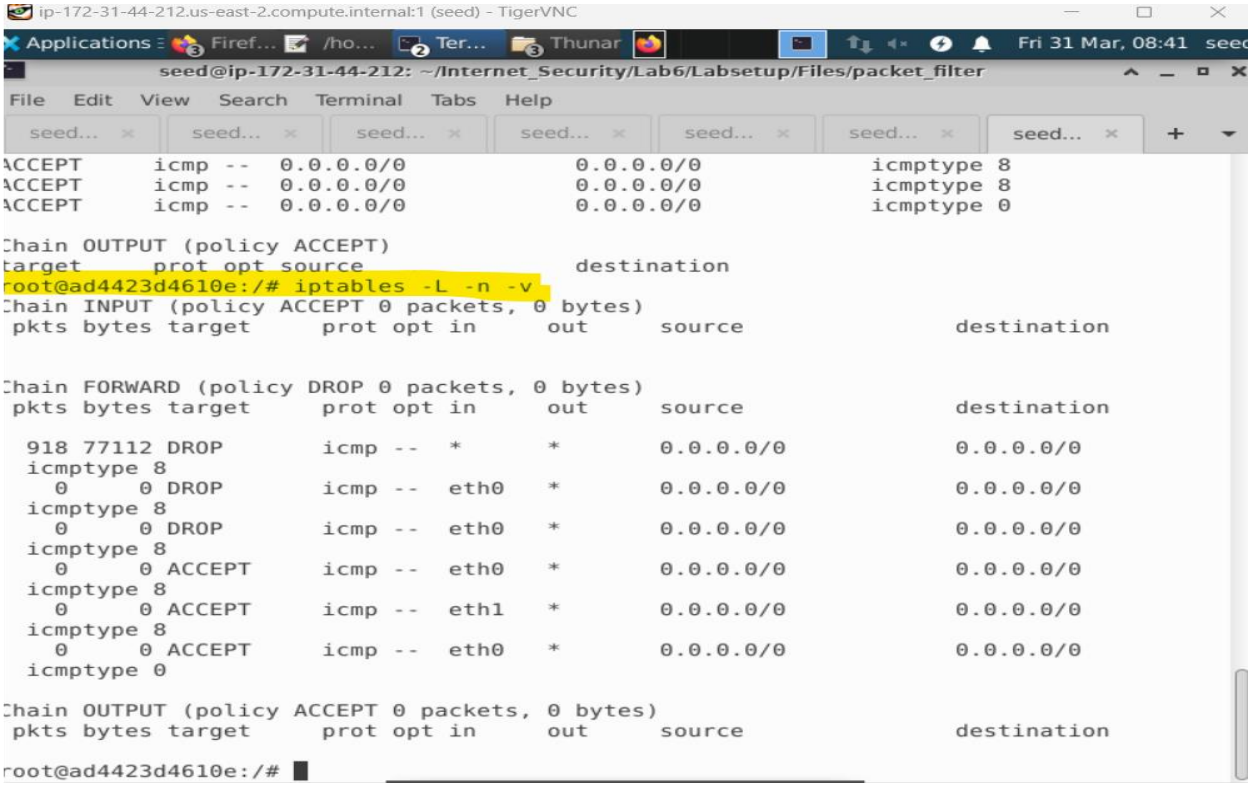
Internal host can ping the outsid ehost



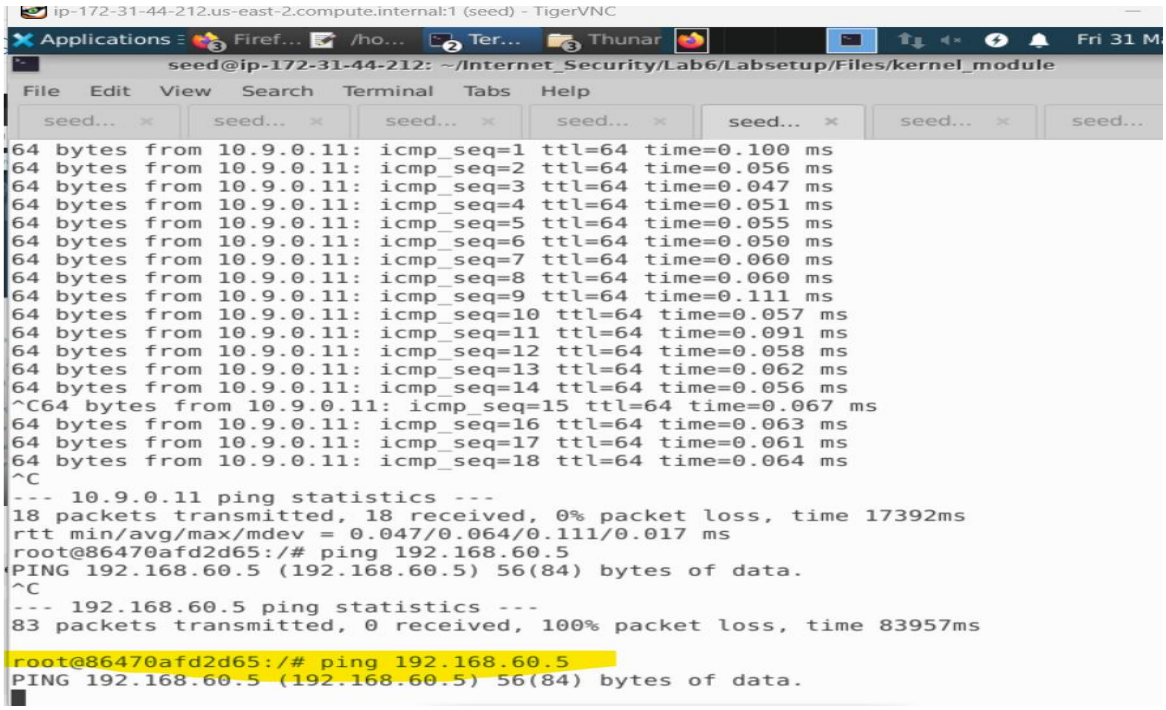


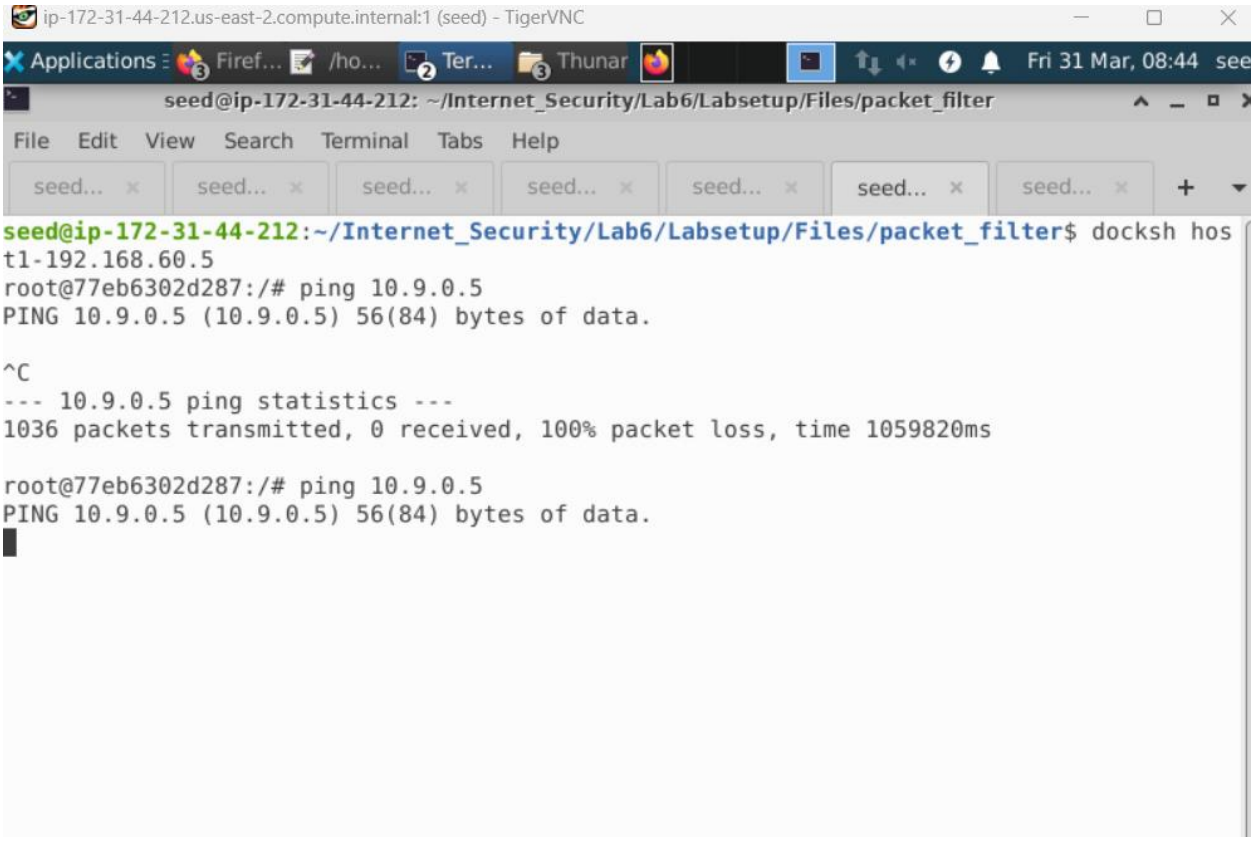

Applications
Fri 31 Mar, 08:23
seed@ip-172-31-44-212: ~/Internet_Security/Lab6/Labsetup/Files/kernel_module
File Edit View Search Terminal Tabs Help
^C
root@86470afd2d65:/# telnet 10.9.0.11
Trying 10.9.0.11...
telnet: Unable to connect to remote host: Connection timed out
root@86470afd2d65:/# ping 10.9.0.11
PING 10.9.0.11 (10.9.0.11) 56(84) bytes of data.
64 bytes from 10.9.0.11: icmp_seq=1 ttl=64 time=0.100 ms
64 bytes from 10.9.0.11: icmp_seq=2 ttl=64 time=0.056 ms
64 bytes from 10.9.0.11: icmp_seq=3 ttl=64 time=0.047 ms
64 bytes from 10.9.0.11: icmp_seq=4 ttl=64 time=0.051 ms
64 bytes from 10.9.0.11: icmp_seq=5 ttl=64 time=0.055 ms
64 bytes from 10.9.0.11: icmp_seq=6 ttl=64 time=0.050 ms
64 bytes from 10.9.0.11: icmp_seq=7 ttl=64 time=0.060 ms
64 bytes from 10.9.0.11: icmp_seq=8 ttl=64 time=0.060 ms
64 bytes from 10.9.0.11: icmp_seq=9 ttl=64 time=0.111 ms
64 bytes from 10.9.0.11: icmp_seq=10 ttl=64 time=0.057 ms
64 bytes from 10.9.0.11: icmp_seq=11 ttl=64 time=0.091 ms
64 bytes from 10.9.0.11: icmp_seq=12 ttl=64 time=0.058 ms
64 bytes from 10.9.0.11: icmp_seq=13 ttl=64 time=0.062 ms
64 bytes from 10.9.0.11: icmp_seq=14 ttl=64 time=0.056 ms
^C64 bytes from 10.9.0.11: icmp_seq=15 ttl=64 time=0.067 ms
64 bytes from 10.9.0.11: icmp_seq=16 ttl=64 time=0.063 ms
64 bytes from 10.9.0.11: icmp_seq=17 ttl=64 time=0.061 ms
64 bytes from 10.9.0.11: icmp_seq=18 ttl=64 time=0.064 ms
^C
--- 10.9.0.11 ping statistics ---
18 packets transmitted, 18 received, 0% packet loss, time 17392ms
rtt min/avg/max/mdev = 0.047/0.064/0.111/0.017 ms
root@86470afd2d65:/# ping 192.168.60.5
PING 192.168.60.5 (192.168.60.5) 56(84) bytes of data.


Applications
Firefox
Terminal
Thunar
seed@ip-172-31-44-212: ~/Internet_Security/Lab6/Labsetup/Files/packet_filter
File Edit View Search Terminal Tabs Help
root@ad4423d4610e:/# iptables -A FORWARD -i eth0 -p icmp --icmp-type echo-request -j DROP
root@ad4423d4610e:/# iptables -A FORWARD -i eth0 -p icmp --icmp-type echo-request -j DROP
root@ad4423d4610e:/# iptables -L -n
Chain INPUT (policy ACCEPT)
target prot opt source destination
Chain FORWARD (policy ACCEPT)
target prot opt source destination
DROP icmp -- 0.0.0.0/0 0.0.0.0/0 icmptype 8
DROP icmp -- 0.0.0.0/0 0.0.0.0/0 icmptype 8
DROP icmp -- 0.0.0.0/0 0.0.0.0/0 icmptype 8
Chain OUTPUT (policy ACCEPT)
target prot opt source destination
root@ad4423d4610e:/# iptables -A FORWARD -i eth0 -p icmp --icmp-type echo-request -j ACCEPT
root@ad4423d4610e:/# iptables -A FORWARD -i eth1 -p icmp --icmp-type echo-request -j ACCEPT
root@ad4423d4610e:/# iptables -A FORWARD -i eth0 -p icmp --icmp-type echo-reply -j ACCEPT
root@ad4423d4610e:/# iptables -P FORWARD -j DROP
iptables v1.8.4 (legacy): -P requires a chain and a policy
Try 'iptables -h' or 'iptables --help' for more information.
root@ad4423d4610e:/# iptables -P FORWARD DROP
root@ad4423d4610e:/# iptables -L -n
Chain INPUT (policy ACCEPT)
target prot opt source destination
Chain FORWARD (policy DROP)
target prot opt source destination
DROP icmp -- 0.0.0.0/0 0.0.0.0/0 icmptype 8
DROP icmp -- 0.0.0.0/0 0.0.0.0/0 icmptype 8
DROP icmp -- 0.0.0.0/0 0.0.0.0/0 icmptype 8
ACCEPT icmp -- 0.0.0.0/0 0.0.0.0/0 icmptype 8
ACCEPT icmp -- 0.0.0.0/0 0.0.0.0/0 icmptype 8
ACCEPT icmp -- 0.0.0.0/0 0.0.0.0/0 icmptype 0
Chain OUTPUT (policy ACCEPT)
target prot opt source destination
root@ad4423d4610e:/#



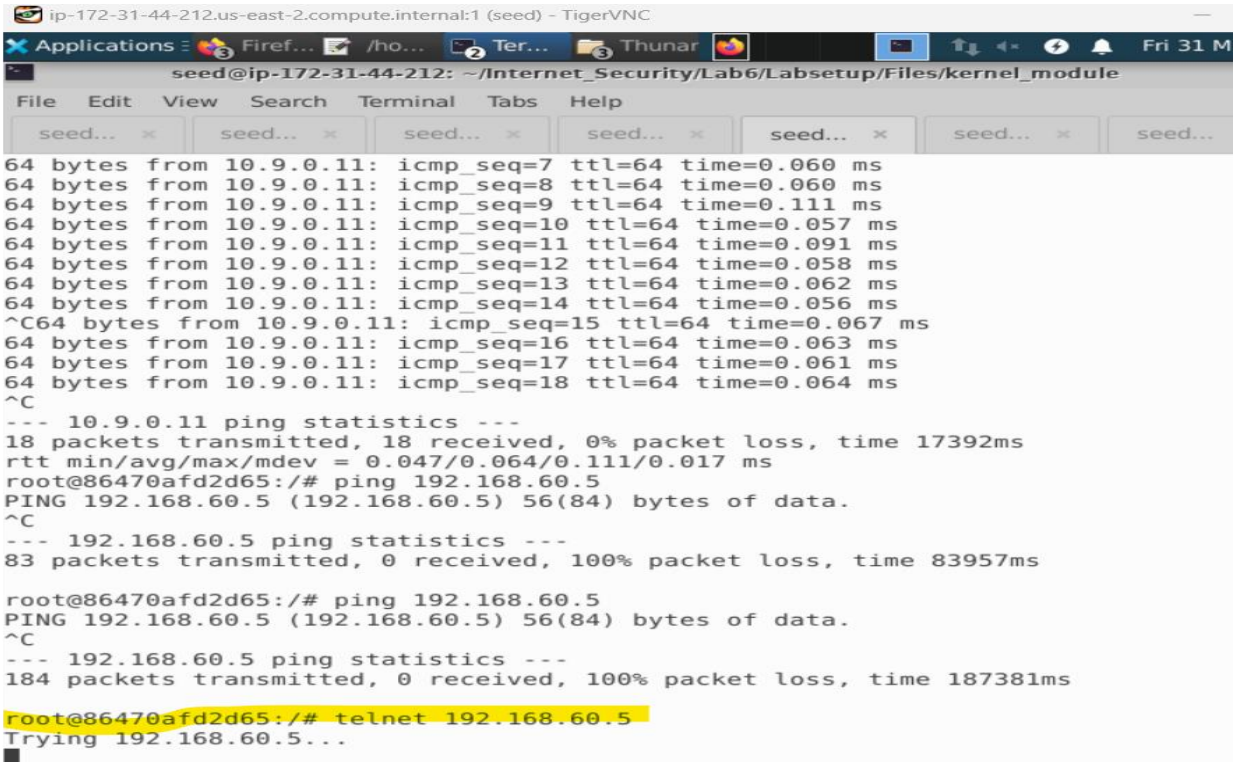
From the outside host ping the inside host



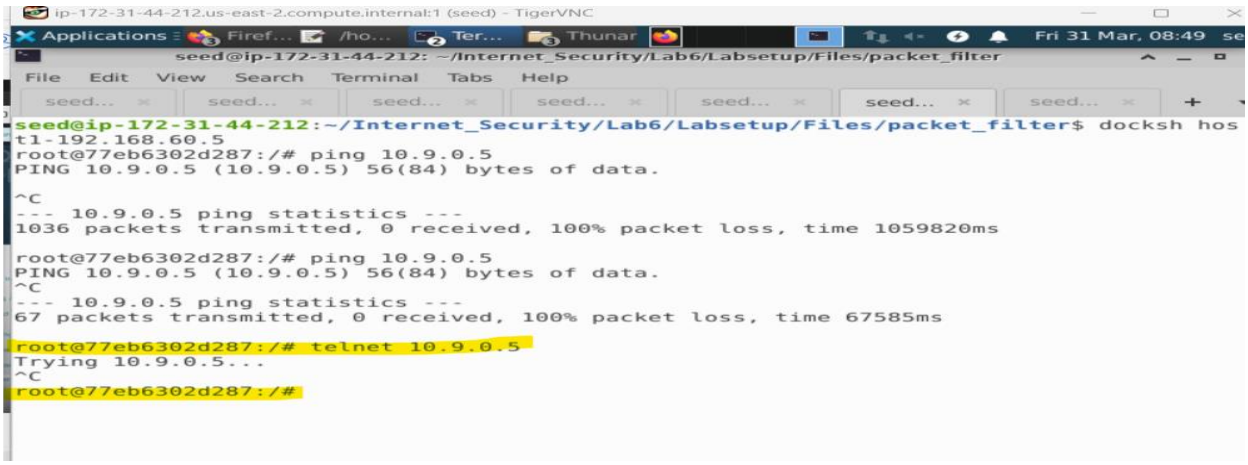



```
root@77eb6302d287:/# ping 10.9.0.5
PING 10.9.0.5 (10.9.0.5) 56(84) bytes of data.
64 bytes from 10.9.0.5: icmp_seq=1 ttl=63 time=0.073 ms
64 bytes from 10.9.0.5: icmp_seq=2 ttl=63 time=0.079 ms
```

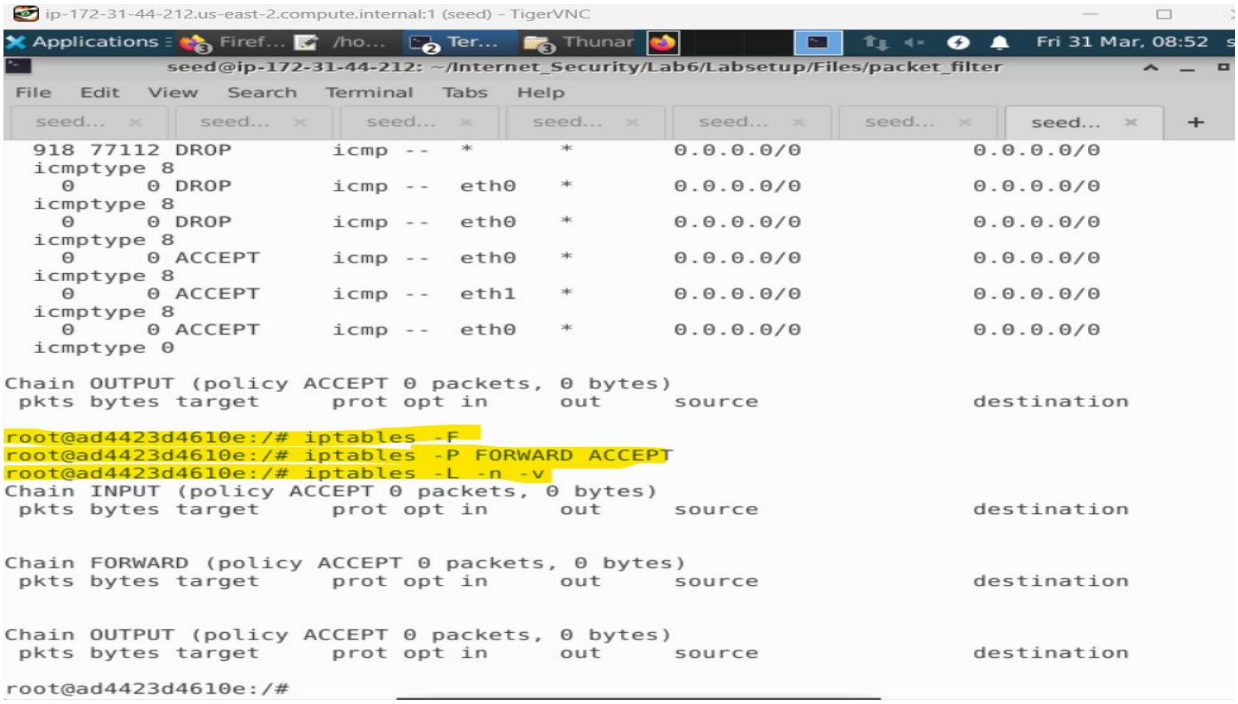
Telnet to inside host does not work



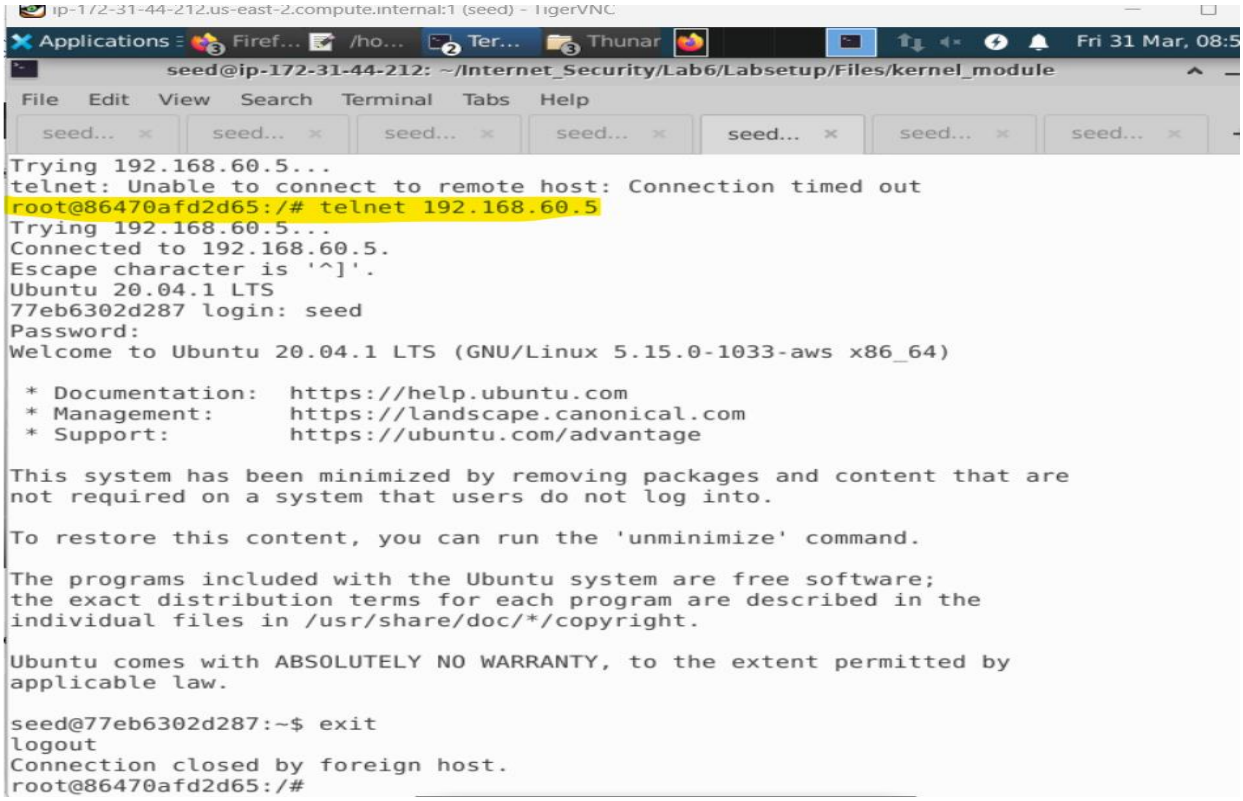
Telnet from inside to outside host

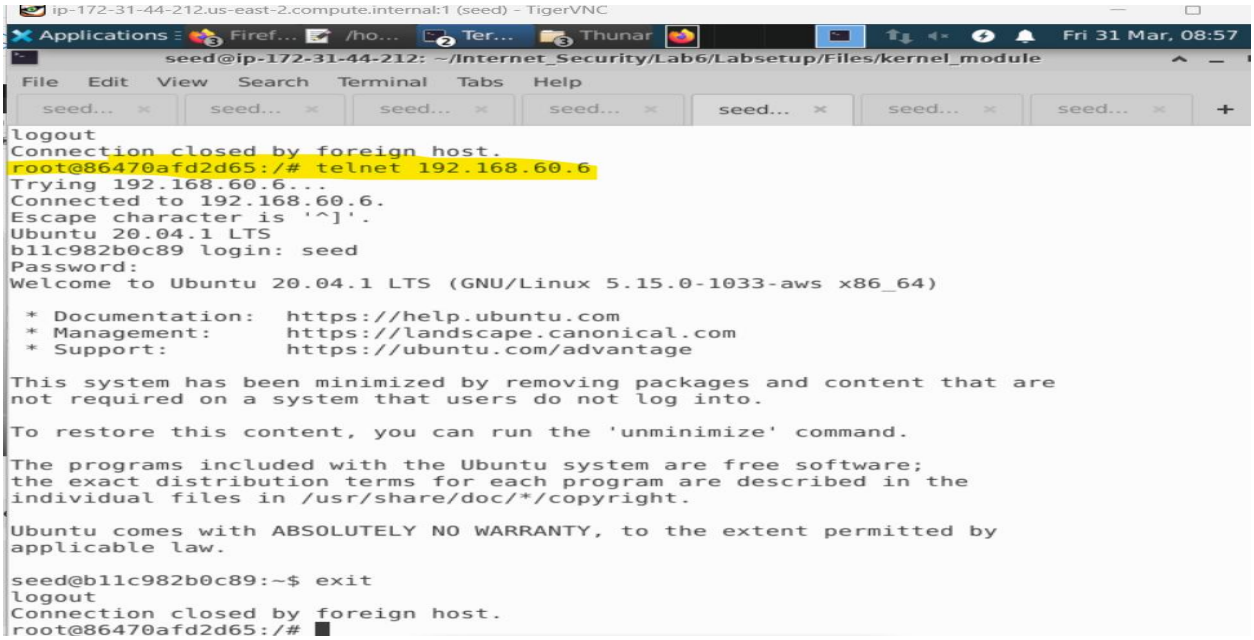


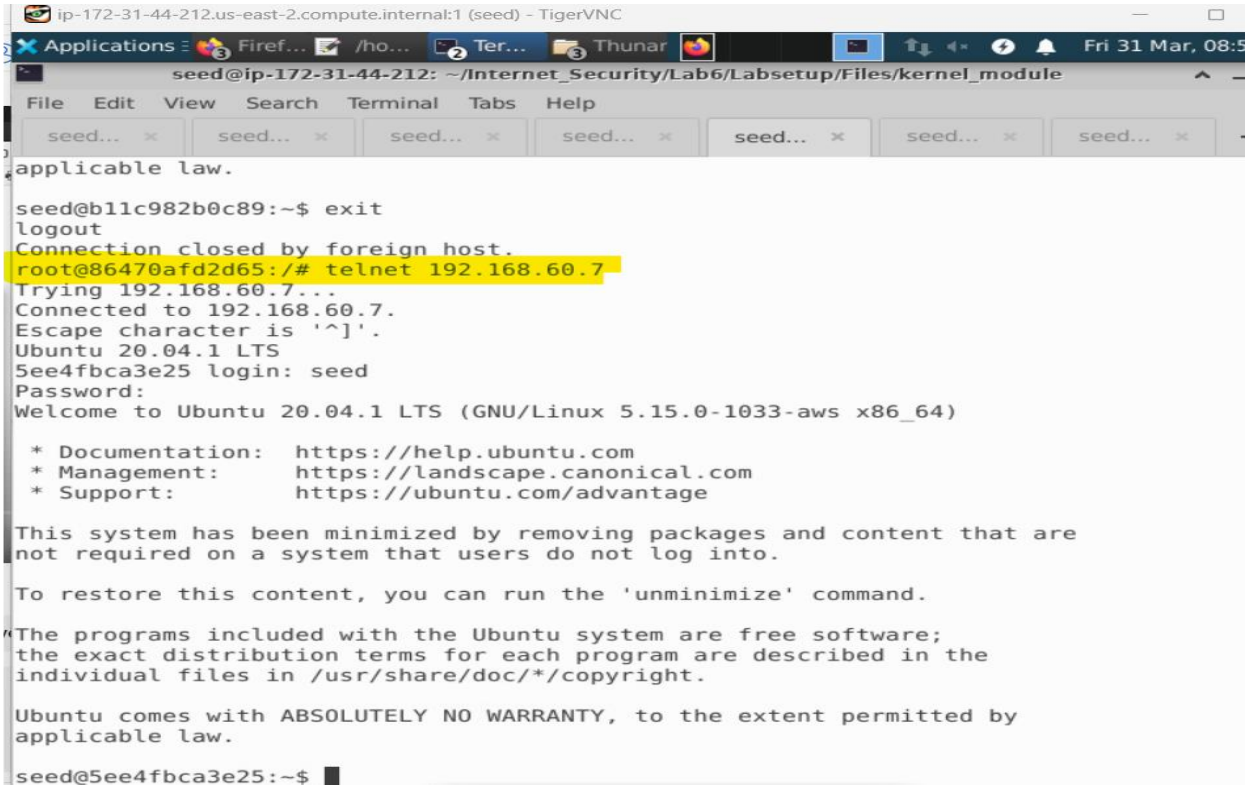
To clean and restore

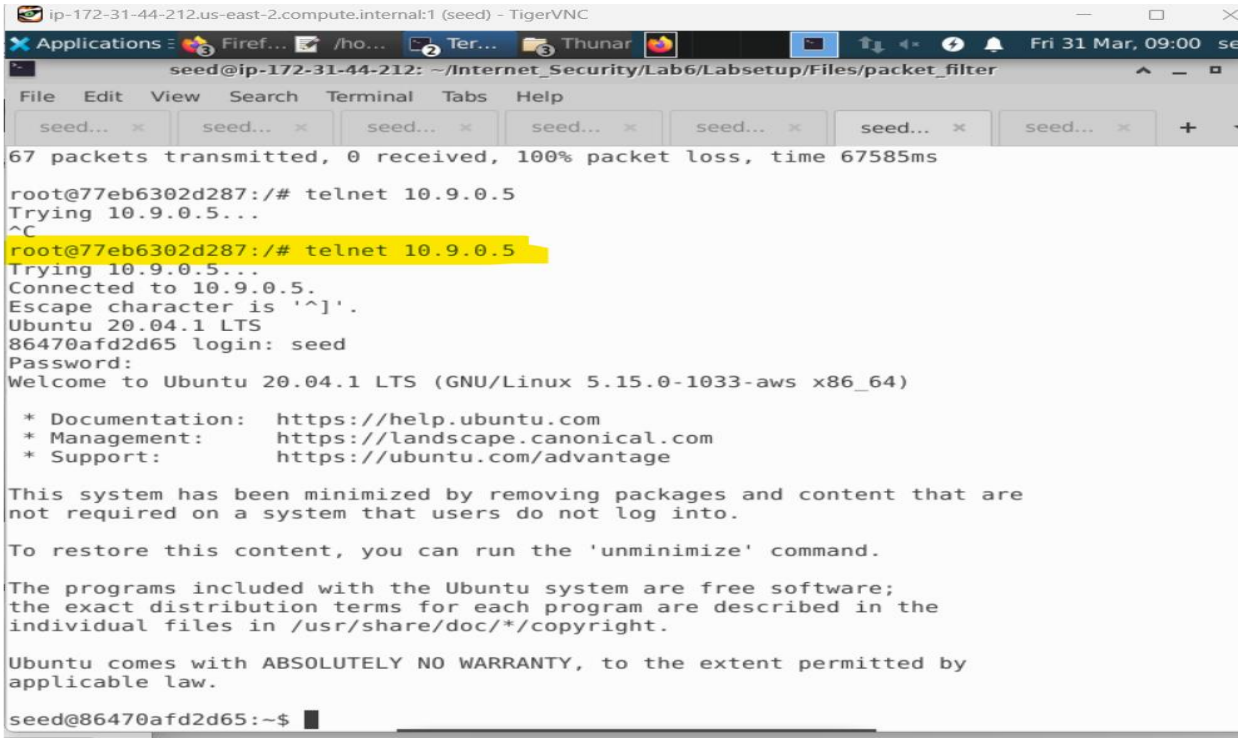

ip-172-31-44-212.us-east-2.compute.internal:1 (seed) - TigerVNC
Applications
Fri 31 Mar, 08:52
seed@ip-172-31-44-212: ~/Internet_Security/Lab6/Labsetup/Files/packet_filter
File Edit View Search Terminal Tabs Help
seed...
918 77112 DROP icmp -- * * 0.0.0.0/0 0.0.0.0/0
icmptype 8
0 0 DROP icmp -- eth0 * 0.0.0.0/0 0.0.0.0/0
icmptype 8
0 0 DROP icmp -- eth0 * 0.0.0.0/0 0.0.0.0/0
icmptype 8
0 0 ACCEPT icmp -- eth0 * 0.0.0.0/0 0.0.0.0/0
icmptype 8
0 0 ACCEPT icmp -- eth1 * 0.0.0.0/0 0.0.0.0/0
icmptype 8
0 0 ACCEPT icmp -- eth0 * 0.0.0.0/0 0.0.0.0/0
icmptype 0
Chain OUTPUT (policy ACCEPT 0 packets, 0 bytes)
pkts bytes target prot opt in out source destination
root@ad4423d4610e:/# iptables -F
root@ad4423d4610e:/# iptables -P FORWARD ACCEPT
root@ad4423d4610e:/# iptables -L -n -v
Chain INPUT (policy ACCEPT 0 packets, 0 bytes)
pkts bytes target prot opt in out source destination
Chain FORWARD (policy ACCEPT 0 packets, 0 bytes)
pkts bytes target prot opt in out source destination
Chain OUTPUT (policy ACCEPT 0 packets, 0 bytes)
pkts bytes target prot opt in out source destination
root@ad4423d4610e:/#

Task 2.C Protecting Internal Servers



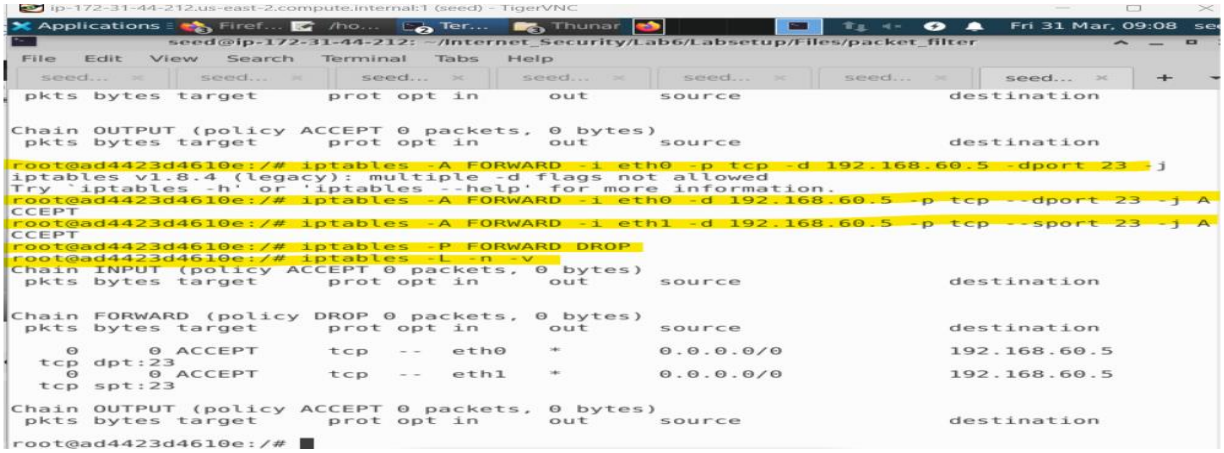


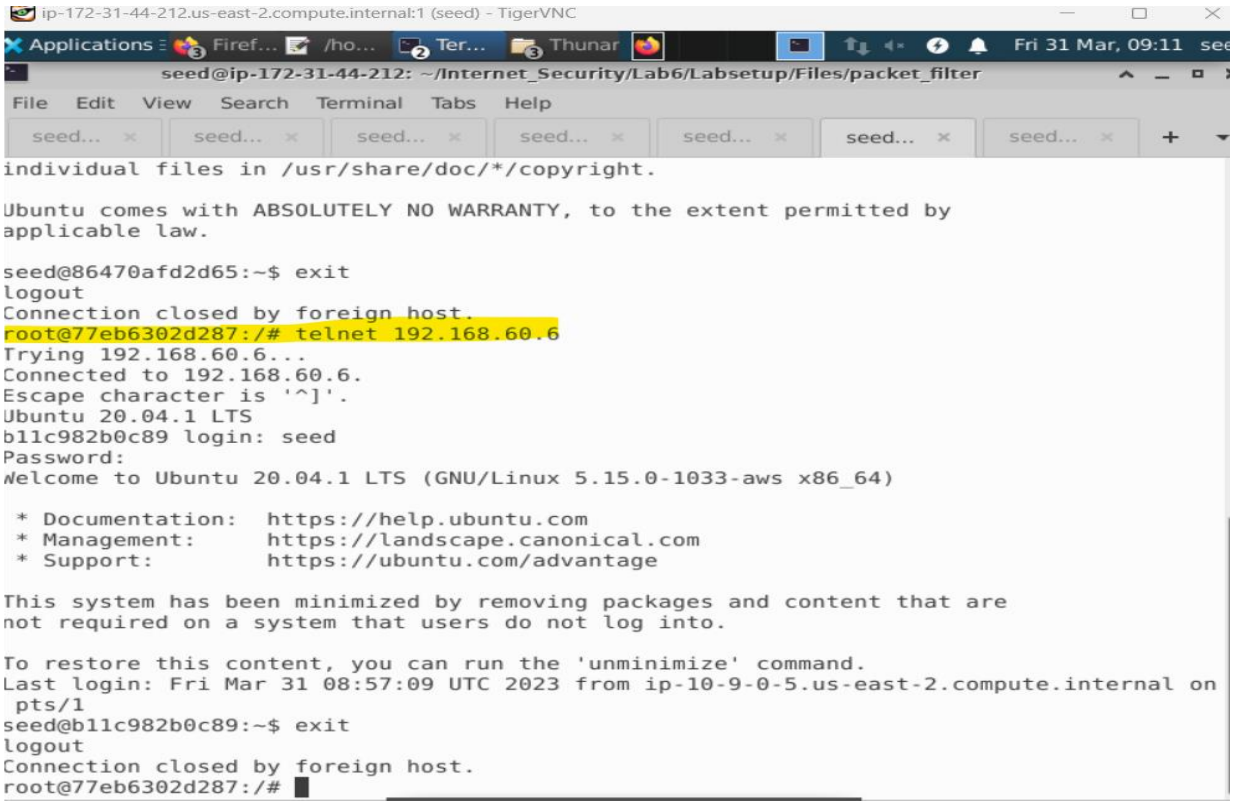




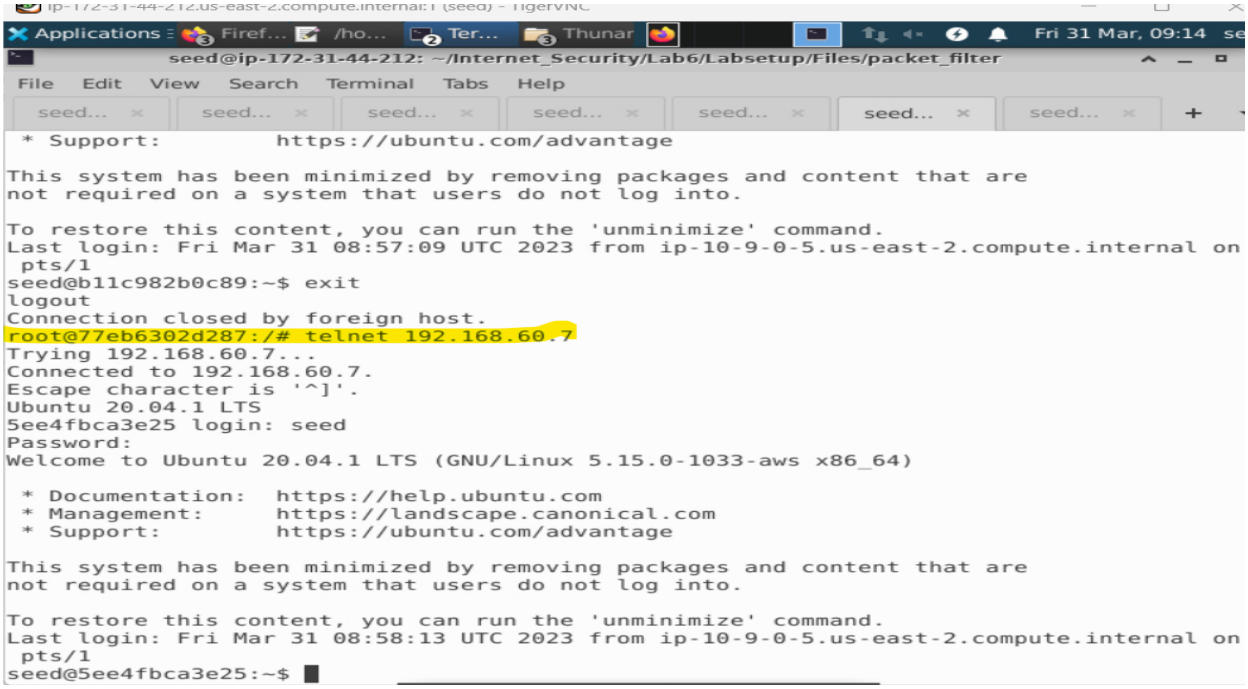
Inside the router lets set up the rule

1. All the internal hosts run a telnet server (listening to port 23). Outside hosts can only access the telnet server on 192.168.60.5, not the other internal hosts. 2. Outside hosts cannot access other internal servers. 3. Internal hosts can access all the internal servers. 4. Internal hosts cannot access external servers.



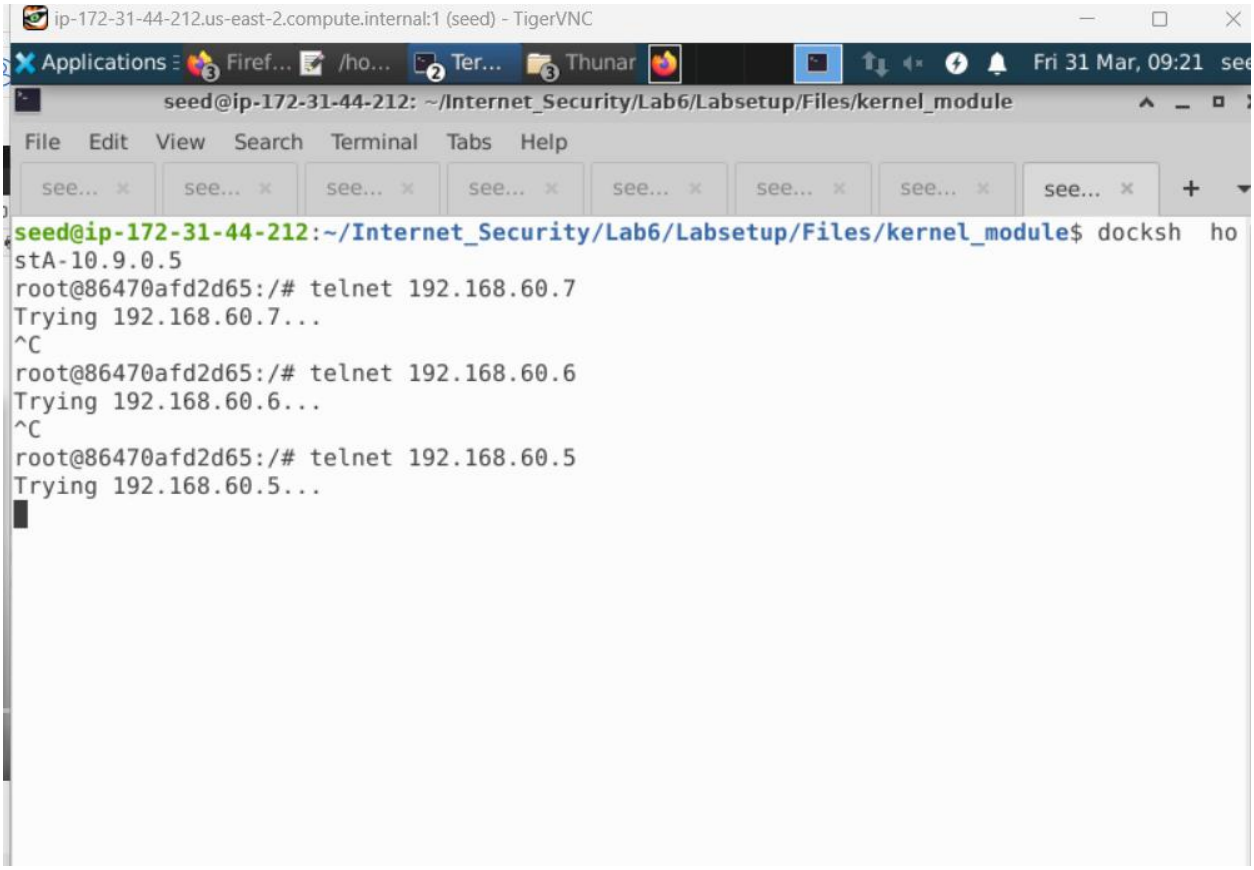


Need to check whether other internal host can access other internal servers

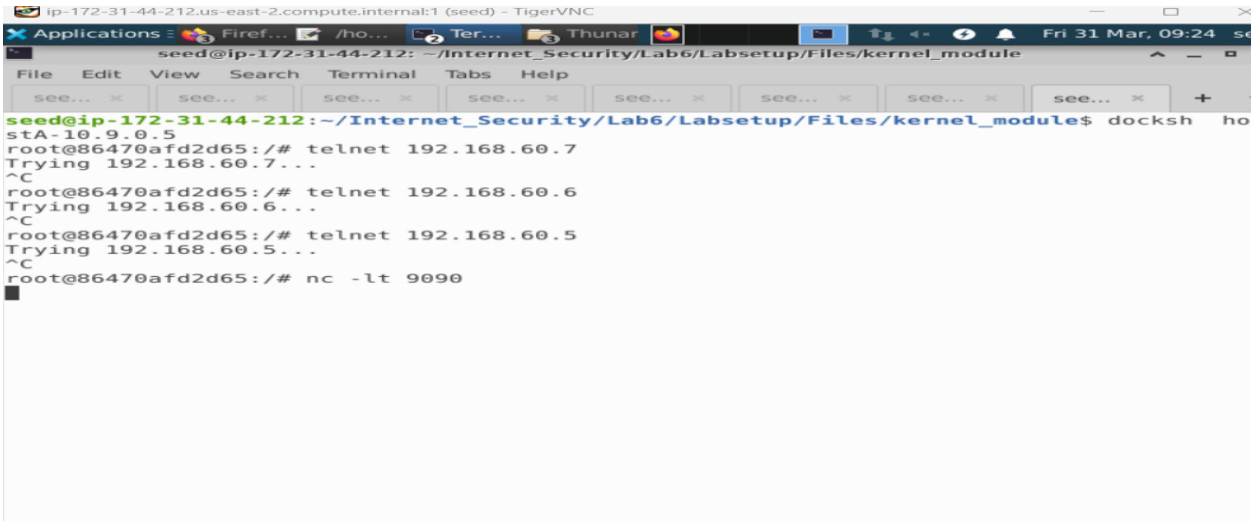


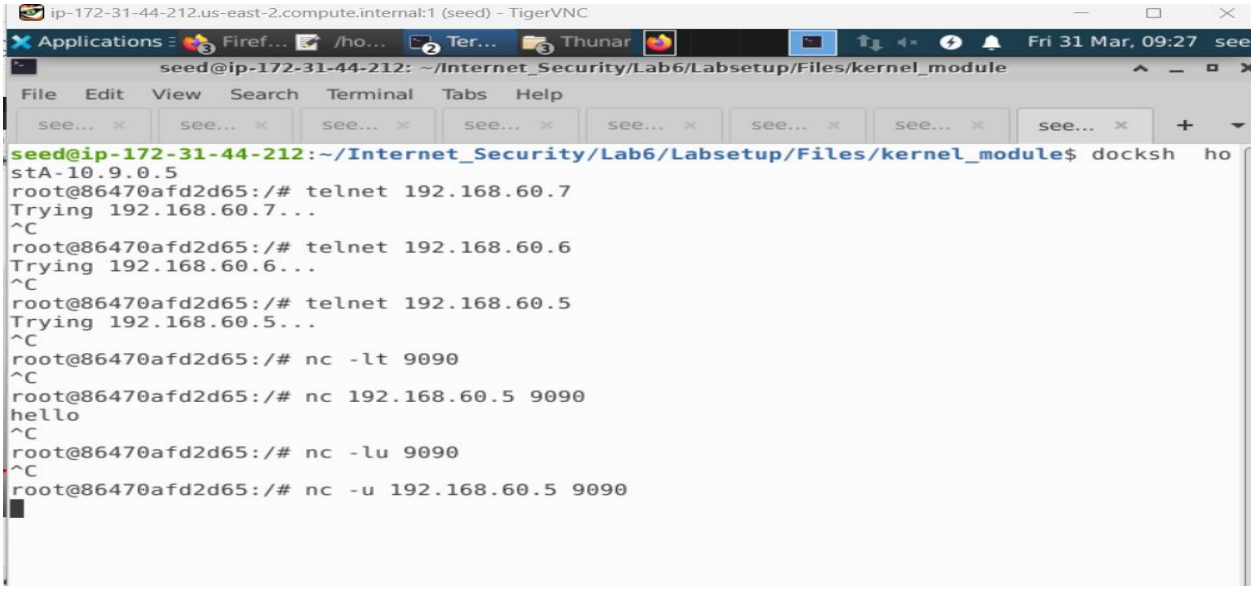
We didn't specify any rules to drop packets from one internal machine to another internal machine

```
root@77eb6302d287:/# telnet 192.168.60.7
Trying 192.168.60.7...
^C
root@77eb6302d287:/#
```

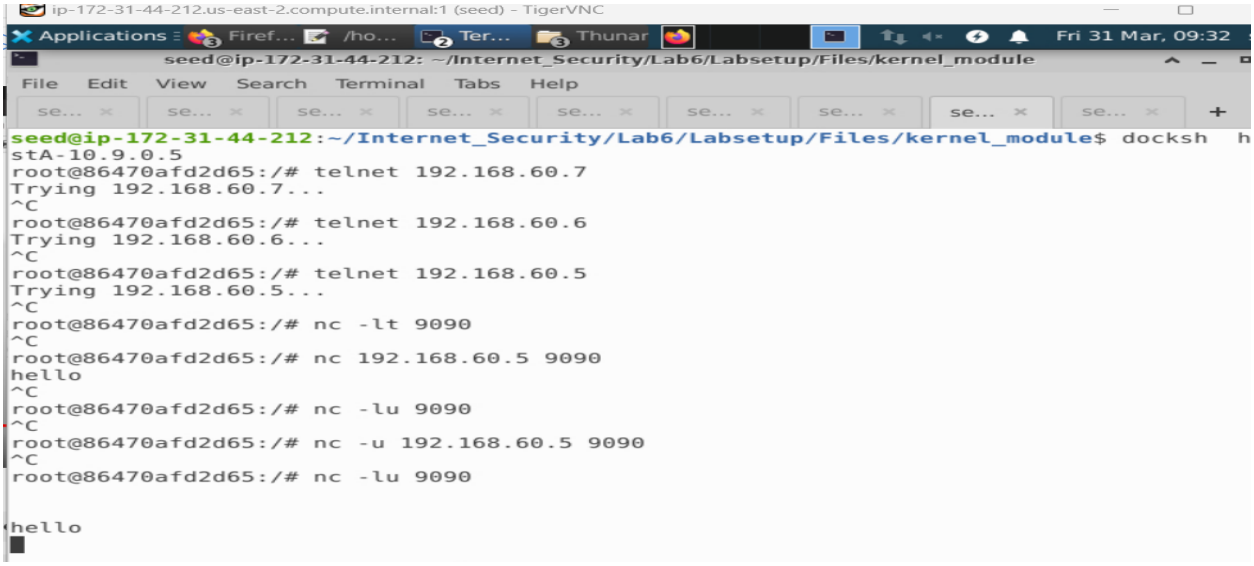


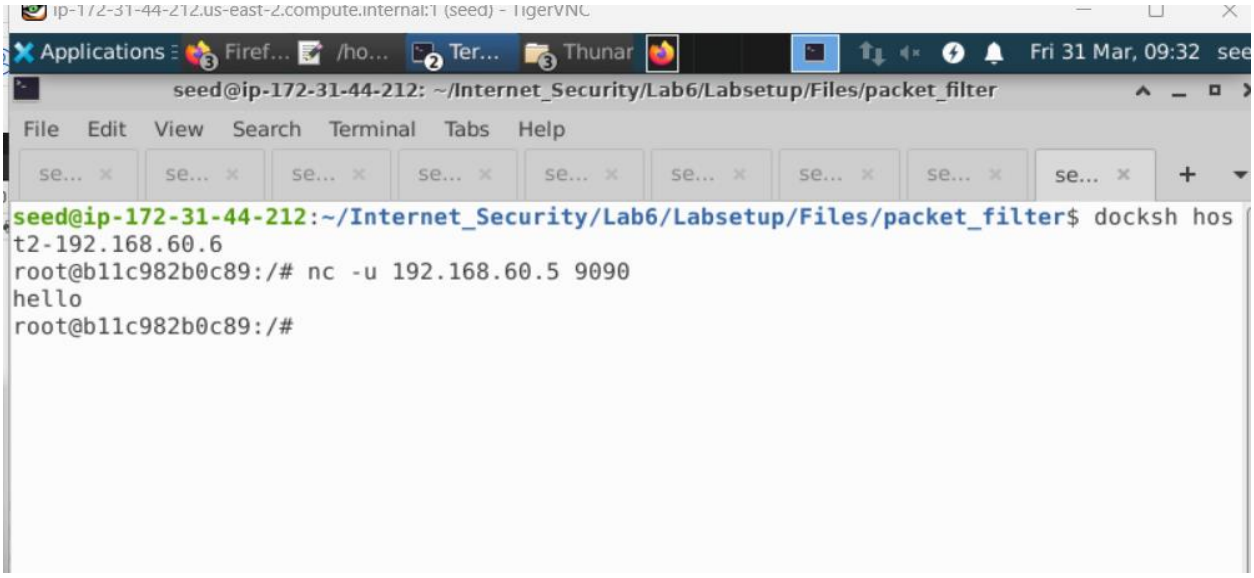
There is a longer interface to that subnetwork so there is a source destination, there is also a ping from the router to the target

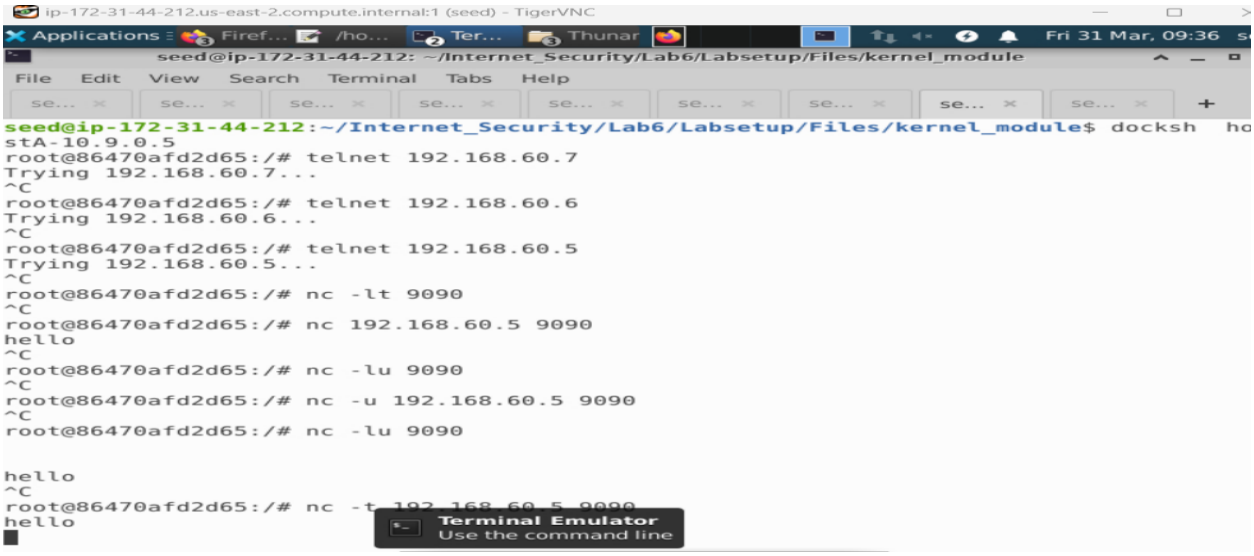


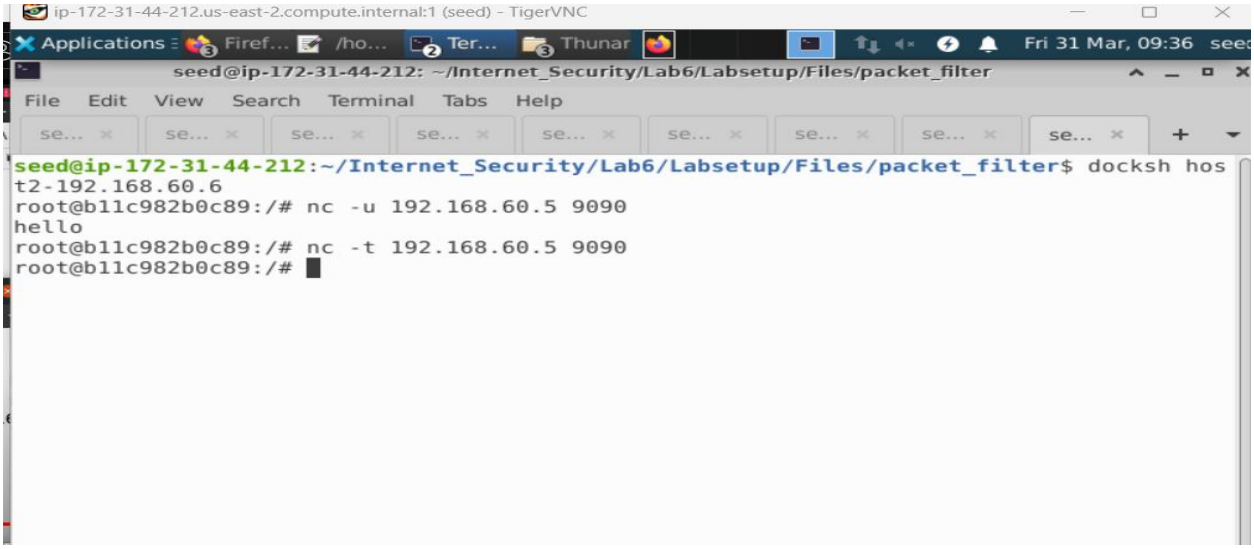


We are unable to connect




ip-172-31-44-212.us-east-2.compute.internal:1 (seed) - TigerVNC
Applications
Fri 31 Mar, 09:32
seed@ip-172-31-44-212: ~/Internet_Security/Lab6/Labsetup/Files/packet_filter
File Edit View Search Terminal Tabs Help
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/packet_filter$ docksh hos
t2-192.168.60.6
root@b11c982b0c89:/# nc -u 192.168.60.5 9090
hello
root@b11c982b0c89:/#

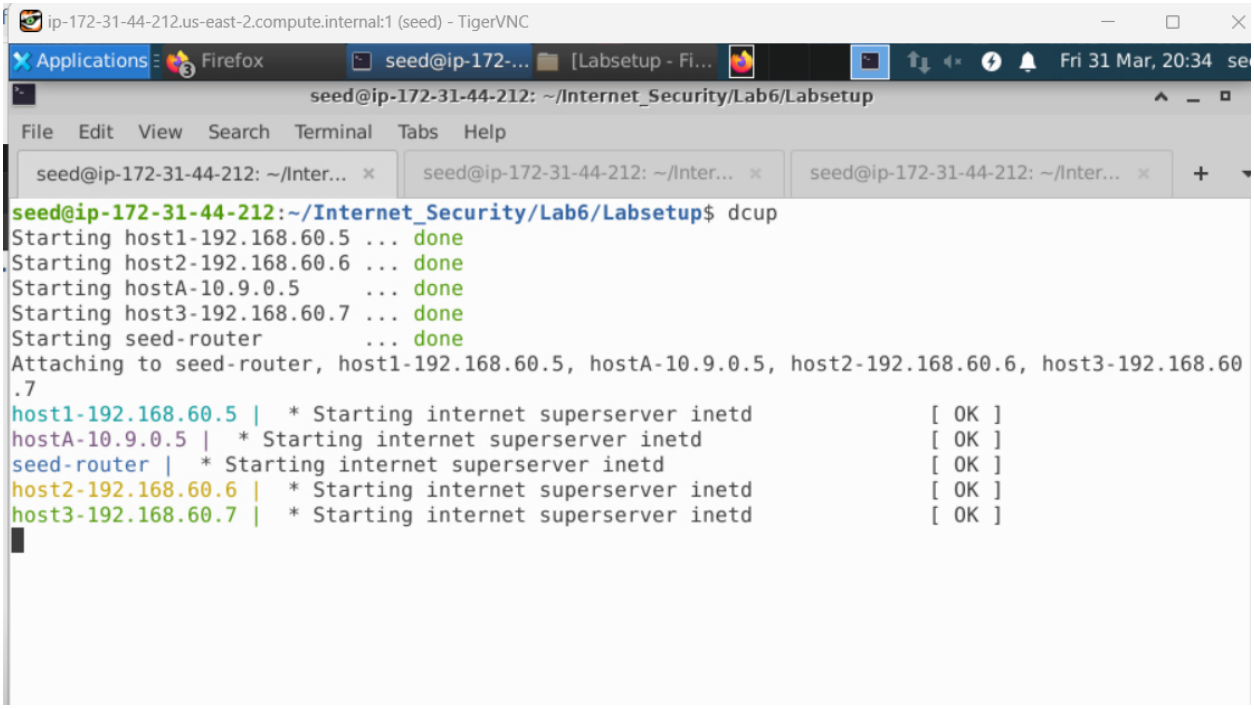

ip-172-31-44-212.us-east-2.compute.internal:1 (seed) - TigerVNC
Applications
Fri 31 Mar, 09:36
seed@ip-172-31-44-212: ~/Internet_Security/Lab6/Labsetup/Files/kernel_module
File Edit View Search Terminal Tabs Help
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/kernel_module$ docksh ho
stA-10.9.0.5
root@86470afd2d65:/# telnet 192.168.60.7
Trying 192.168.60.7...
^C
root@86470afd2d65:/# telnet 192.168.60.6
Trying 192.168.60.6...
^C
root@86470afd2d65:/# telnet 192.168.60.5
Trying 192.168.60.5...
^C
root@86470afd2d65:/# nc -lt 9090
^C
root@86470afd2d65:/# nc 192.168.60.5 9090
hello
^C
root@86470afd2d65:/# nc -lu 9090
^C
root@86470afd2d65:/# nc -u 192.168.60.5 9090
^C
root@86470afd2d65:/# nc -lu 9090
hello
^C
root@86470afd2d65:/# nc -t 192.168.60.5 9090
hello
Terminal Emulator
Use the command line


ip-172-31-44-212.us-east-2.compute.internal:1 (seed) - TigerVNC
Applications
Firef...
/ho...
Ter...
Thunar
Fri 31 Mar, 09:36
seed@ip-172-31-44-212: ~/Internet_Security/Lab6/Labsetup/Files/packet_filter
File Edit View Search Terminal Tabs Help
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup/Files/packet_filter$ docksh hos
t2-192.168.60.6
root@b11c982b0c89:/# nc -u 192.168.60.5 9090
hello
root@b11c982b0c89:/# nc -t 192.168.60.5 9090
root@b11c982b0c89:/#

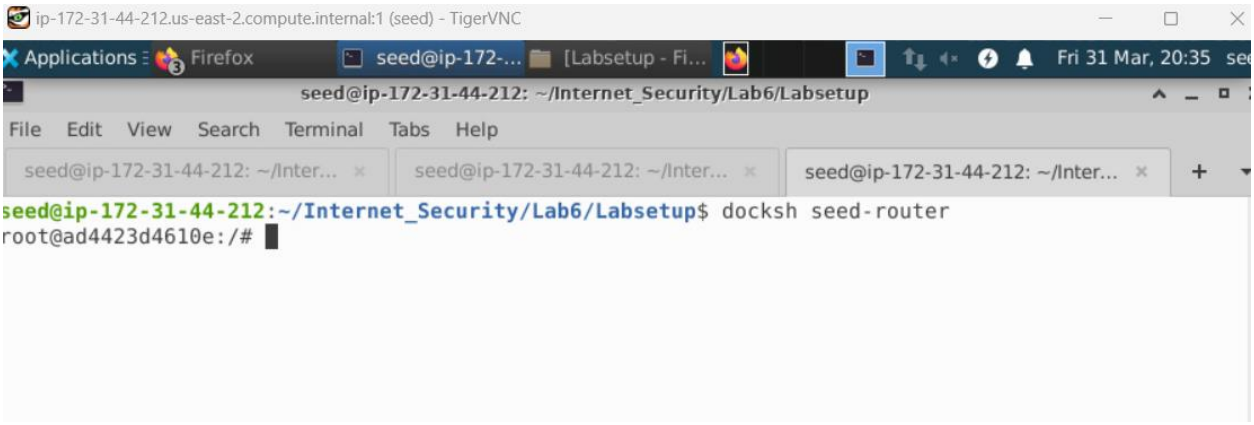
Task 3: Connection Tracking and Stateful Firewall

5.1 Task 3.A: Experiment with the Connection Tracking

Here we will work inside the loader container



We need to go inside the seed router



To check the connection tracking information of any container we need to run this command

Here we have 0 flow entries we didn't set up any connection tracking rows

1. ICMP Experiment

ICMP experiment: Run the following command and check the connection tracking information on the router. Describe your observation. How long is the ICMP connection state be kept?

We can put the ping into the background

```
root@ad4423d4610e:/# conntrack --help
Command line interface for the connection tracking system. Version 1.4.5
Usage: conntrack [commands] [options]

Commands:
  -L [table] [options]          List conntrack or expectation table
  -G [table] parameters         Get conntrack or expectation
  -D [table] parameters         Delete conntrack or expectation
  -I [table] parameters         Create a conntrack or expectation
  -U [table] parameters         Update a conntrack
  -E [table] [options]          Show events
  -F [table]                    Flush table
  -C [table]                    Show counter
  -S                            Show statistics

Tables: conntrack, expect, dying, unconfirmed

Conntrack parameters and options:
  -n, --src-nat ip                      source NAT ip
  -g, --dst-nat ip                      destination NAT ip
  -j, --any-nat ip                      source or destination NAT ip
  -m, --mark mark                       Set mark
  -c, --secmark secmark                 Set selinux secmark
  -e, --event-mask eventmask            Event mask, eg. NEW,DESTROY
  -z, --zero                            Zero counters while listing
```

```
Common parameters and options:
  -s, --src, --orig-src ip              Source address from original direction
  -d, --dst, --orig-dst ip              Destination address from original direction
  -r, --reply-src ip            Source addres from reply direction
  -q, --reply-dst ip            Destination address from reply direction
  -p, --protonum proto          Layer 4 Protocol, eg. 'tcp'
  -f, --family proto            Layer 3 Protocol, eg. 'ipv6'
  -t, --timeout timeout         Set timeout
  -u, --status status           Set status, eg. ASSURED
  -w, --zone value              Set conntrack zone
  --orig-zone value             Set zone for original direction
  --reply-zone value            Set zone for reply direction
  -b, --buffer-size             Netlink socket buffer size
  --mask-src ip                 Source mask address
  --mask-dst ip                 Destination mask address

root@ad4423d4610e:/# ping 192.168.60.5
PING 192.168.60.5 (192.168.60.5) 56(84) bytes of data.
64 bytes from 192.168.60.5: icmp_seq=1 ttl=64 time=0.136 ms
64 bytes from 192.168.60.5: icmp_seq=2 ttl=64 time=0.074 ms
64 bytes from 192.168.60.5: icmp_seq=3 ttl=64 time=0.059 ms
^C
--- 192.168.60.5 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2054ms
rtt min/avg/max/mdev = 0.059/0.089/0.136/0.033 ms
root@ad4423d4610e:/#
```

We need to ping, ther’s a whole screen inside the internal network put it in for the background

```
root@ad4423d4610e:/# ping 192.168.60.5
PING 192.168.60.5 (192.168.60.5) 56(84) bytes of data.
64 bytes from 192.168.60.5: icmp_seq=1 ttl=64 time=0.136 ms
64 bytes from 192.168.60.5: icmp_seq=2 ttl=64 time=0.074 ms
64 bytes from 192.168.60.5: icmp_seq=3 ttl=64 time=0.059 ms
^C
--- 192.168.60.5 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2054ms
rtt min/avg/max/mdev = 0.059/0.089/0.136/0.033 ms
root@ad4423d4610e:/# ping 192.168.60.5 &
[1] 34
root@ad4423d4610e:/# PING 192.168.60.5 (192.168.60.5) 56(84) bytes of data.
64 bytes from 192.168.60.5: icmp_seq=1 ttl=64 time=0.079 ms
64 bytes from 192.168.60.5: icmp_seq=2 ttl=64 time=0.058 ms
64 bytes from 192.168.60.5: icmp_seq=3 ttl=64 time=0.060 ms
64 bytes from 192.168.60.5: icmp_seq=4 ttl=64 time=0.064 ms
64 bytes from 192.168.60.5: icmp_seq=5 ttl=64 time=0.118 ms
^C
root@ad4423d4610e:/# 64 bytes from 192.168.60.5: icmp_seq=6 ttl=64 time=0.063 ms
64 bytes from 192.168.60.5: icmp_seq=7 ttl=64 time=0.052 ms
64 bytes from 192.168.60.5: icmp_seq=8 ttl=64 time=0.056 ms
64 bytes from 192.168.60.5: icmp_seq=9 ttl=64 time=0.062 ms
```

```
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup$ conntrack -L
conntrack v1.4.5 (conntrack-tools): Operation failed: sorry, you must be root or get CAP_NET_ADMIN capability to do this
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup$ docksh seed-router
root@ad4423d4610e:/# conntrack -L
icmp     1 29 src=192.168.60.11 dst=192.168.60.5 type=8 code=0 id=34 src=192.168.60.5 dst=192.168.60.11 type=0 code=0 id=34 use=1
conntrack v1.4.5 (conntrack-tools): 1 flow entries have been shown.
root@ad4423d4610e:/#
```

Kill the jobs and show the current status

```
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup$ conntrack -L
conntrack v1.4.5 (conntrack-tools): Operation failed: sorry, you must be root or get CAP_NET_ADMIN capability to do this
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup$ docksh seed-router
root@ad4423d4610e:/# conntrack -L
icmp     1 29 src=192.168.60.11 dst=192.168.60.5 type=8 code=0 id=34 src=192.168.60.5 dst=192.168.60.11 type=0 code=0 id=34 use=1
conntrack v1.4.5 (conntrack-tools): 1 flow entries have been shown.
root@ad4423d4610e:/# jobs
root@ad4423d4610e:/# ping 192.168.60.5 &> /dev/null &
[1] 43
root@ad4423d4610e:/# conntrack -L
icmp     1 29 src=192.168.60.11 dst=192.168.60.5 type=8 code=0 id=43 src=192.168.60.5 dst=192.168.60.11 type=0 code=0 id=43 use=1
icmp     1 29 src=192.168.60.11 dst=192.168.60.5 type=8 code=0 id=34 src=192.168.60.5 dst=192.168.60.11 type=0 code=0 id=34 use=1
conntrack v1.4.5 (conntrack-tools): 2 flow entries have been shown.
root@ad4423d4610e:/# jobs
[1]+  Running                 ping 192.168.60.5 &> /dev/null &
root@ad4423d4610e:/# kill %1
root@ad4423d4610e:/# conntrack -L
icmp     1 15 src=192.168.60.11 dst=192.168.60.5 type=8 code=0 id=43 src=192.168.60.5 dst=192.168.60.11 type=0 code=0 id=43 use=1
icmp     1 29 src=192.168.60.11 dst=192.168.60.5 type=8 code=0 id=34 src=192.168.60.5 dst=192.168.60.11 type=0 code=0 id=34 use=1
conntrack v1.4.5 (conntrack-tools): 2 flow entries have been shown.
[1]+  Terminated              ping 192.168.60.5 &> /dev/null
root@ad4423d4610e:/# conntrack -L
icmp     1 0 src=192.168.60.11 dst=192.168.60.5 type=8 code=0 id=43 src=192.168.60.5 dst=192.168.60.11 type=0 code=0 id=43 use=1
icmp     1 29 src=192.168.60.11 dst=192.168.60.5 type=8 code=0 id=34 src=192.168.60.5 dst=192.168.60.11 type=0 code=0 id=34 use=1
conntrack v1.4.5 (conntrack-tools): 2 flow entries have been shown.
root@ad4423d4610e:/#
```

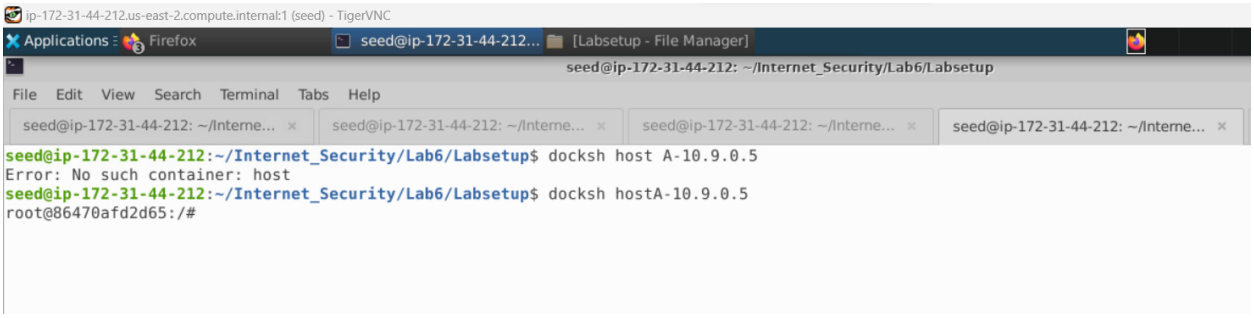
How long we can kep the icmp connection state

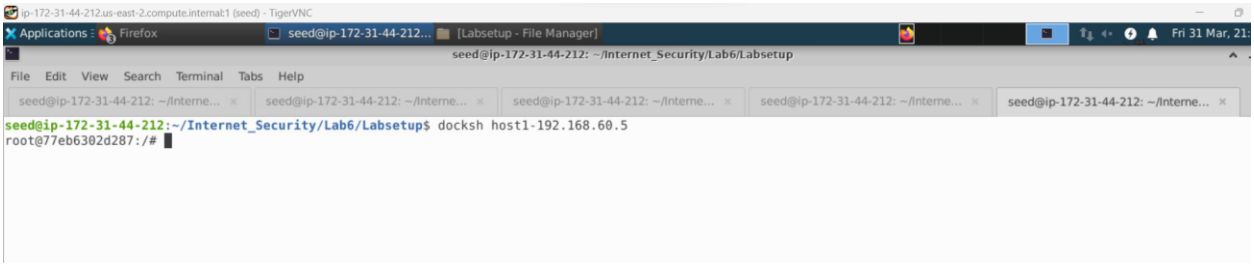
-We can write bash script to check when this connection becomes empty for this contract

-It will keep roughly the icmp connection state for 5 to 6 seconds or in other situations may be different just based on our own estimation

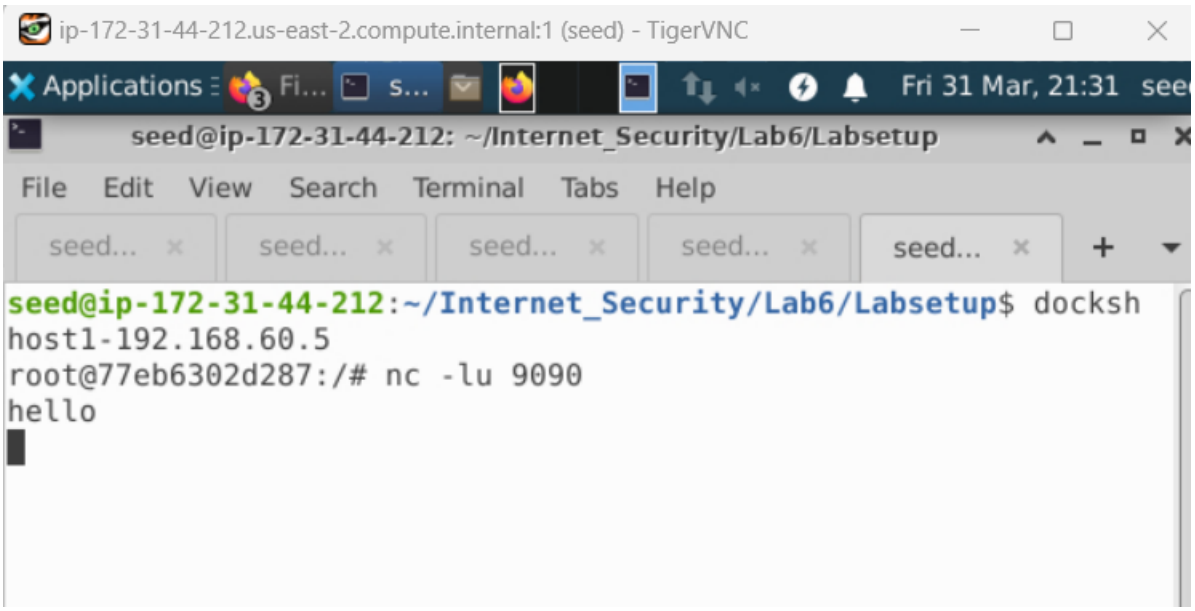
```
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup$ conntrack -L
conntrack v1.4.5 (conntrack-tools): Operation failed: sorry, you must be root or get CAP_NET_ADMIN capability to do this
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup$ docksh seed-router
root@ad4423d4610e:/# conntrack -L
icmp     1 29 src=192.168.60.11 dst=192.168.60.5 type=8 code=0 id=34 src=192.168.60.5 dst=192.168.60.11 type=0 code=0 id=34 use=1
conntrack v1.4.5 (conntrack-tools): 1 flow entries have been shown.
root@ad4423d4610e:/# jobs
root@ad4423d4610e:/# ping 192.168.60.5 &> /dev/null &
[1] 43
root@ad4423d4610e:/# conntrack -L
icmp     1 29 src=192.168.60.11 dst=192.168.60.5 type=8 code=0 id=43 src=192.168.60.5 dst=192.168.60.11 type=0 code=0 id=43 use=1
icmp     1 29 src=192.168.60.11 dst=192.168.60.5 type=8 code=0 id=34 src=192.168.60.5 dst=192.168.60.11 type=0 code=0 id=34 use=1
conntrack v1.4.5 (conntrack-tools): 2 flow entries have been shown.
root@ad4423d4610e:/# jobs
[1]+  Running                 ping 192.168.60.5 &> /dev/null &
root@ad4423d4610e:/# kill %1
root@ad4423d4610e:/# conntrack -L
icmp     1 15 src=192.168.60.11 dst=192.168.60.5 type=8 code=0 id=43 src=192.168.60.5 dst=192.168.60.11 type=0 code=0 id=43 use=1
icmp     1 29 src=192.168.60.11 dst=192.168.60.5 type=8 code=0 id=34 src=192.168.60.5 dst=192.168.60.11 type=0 code=0 id=34 use=1
conntrack v1.4.5 (conntrack-tools): 2 flow entries have been shown.
[1]+  Terminated              ping 192.168.60.5 &> /dev/null
root@ad4423d4610e:/# conntrack -L
icmp     1 0 src=192.168.60.11 dst=192.168.60.5 type=8 code=0 id=43 src=192.168.60.5 dst=192.168.60.11 type=0 code=0 id=43 use=1
icmp     1 29 src=192.168.60.11 dst=192.168.60.5 type=8 code=0 id=34 src=192.168.60.5 dst=192.168.60.11 type=0 code=0 id=34 use=1
conntrack v1.4.5 (conntrack-tools): 2 flow entries have been shown.
root@ad4423d4610e:/# contrack -L
bash: contrack: command not found
root@ad4423d4610e:/#
```

2) UDP experiment: Run the following command and check the connection tracking information on the router. Describe your observation. How long is the UDP connection state be kept?






ip-172-31-44-212.us-east-2.compute.internal:1 (seed) - TigerVNC
Applications
Fri 31 Mar, 21:30
seed@ip-172-31-44-212: ~/Internet_Security/Lab6/Labsetup
File Edit View Search Terminal Tabs Help
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup$ docksh
host A-10.9.0.5
Error: No such container: host
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup$ docksh
hostA-10.9.0.5
root@86470afd2d65:/# nc -u 192.168.60.5 9090
hello

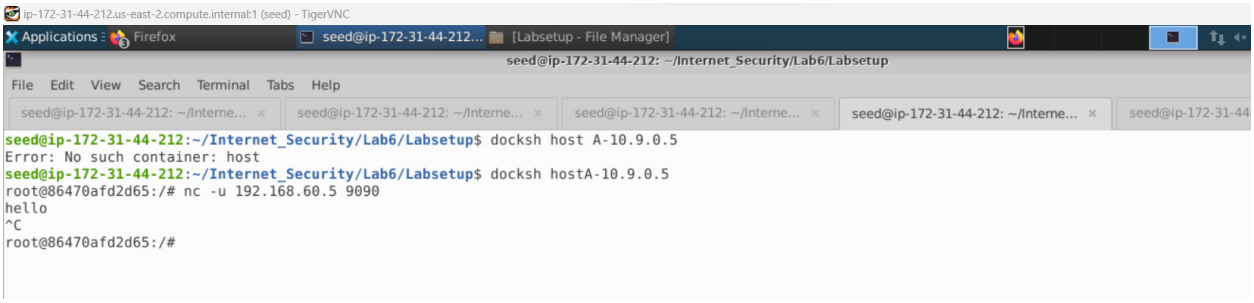

ip-172-31-44-212.us-east-2.compute.internal:1 (seed) - TigerVNC
Applications
Fri 31 Mar, 21:31
seed@ip-172-31-44-212: ~/Internet_Security/Lab6/Labsetup
File Edit View Search Terminal Tabs Help
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup$ docksh
host1-192.168.60.5
root@77eb6302d287:/# nc -lu 9090
hello


root@ad4423d4610e:/# conntrack -L
icmp 1 29 src=192.168.60.11 dst=192.168.60.5 type=8 code=0 id=34 src=192.168.60.5 dst=192.168.60.11 type=0 code=0 id=34 use=1
conntrack v1.4.5 (conntrack-tools): 1 flow entries have been shown.
root@ad4423d4610e:/#

```
root@ad4423d4610e:/# conntrack -L
icmp     1 29 src=192.168.60.11 dst=192.168.60.5 type=8 code=0 id=34 src=192.168.60.5 dst=192.168.60.11 type=0 code=0 id=34 use=1
conntrack v1.4.5 (conntrack-tools): 1 flow entries have been shown.
root@ad4423d4610e:/#
```

The connection is active roughly for 6 to 8 seconds

Now lets stop it



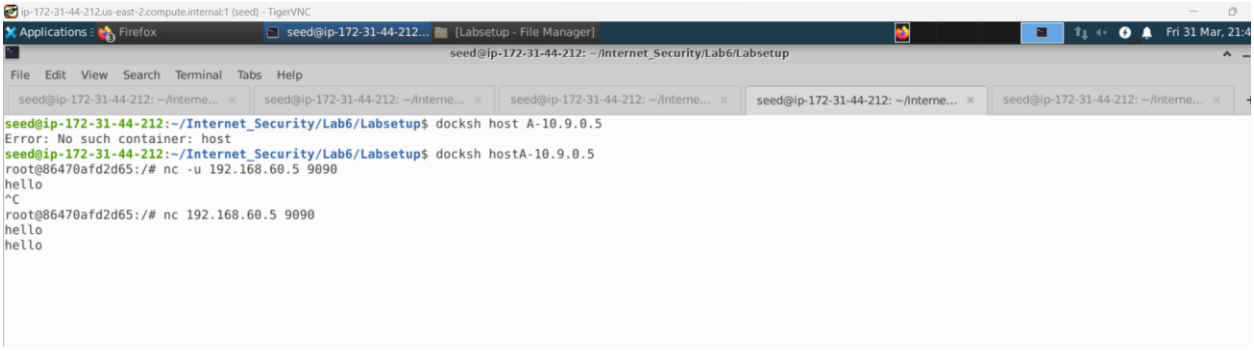
3) TCP experiment: Run the following command and check the connection tracking information on the router. Describe your observation. How long is the TCP connection state be kept?

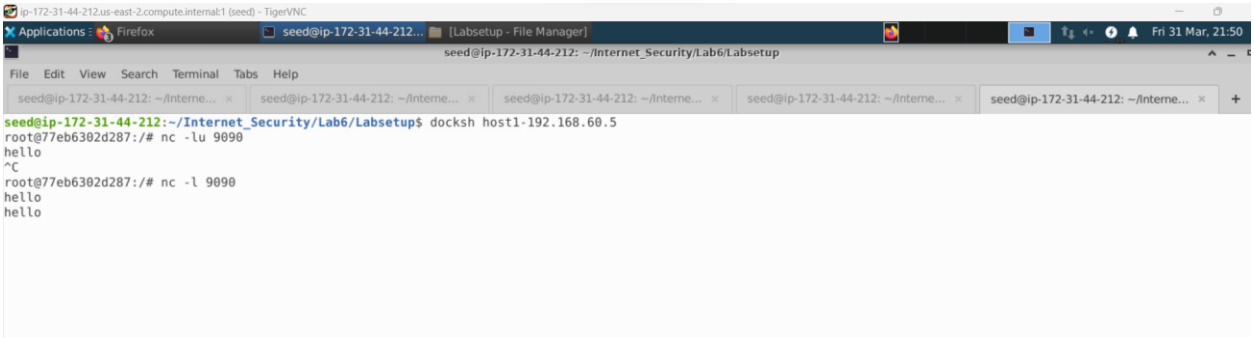
Again on inside host A host 1 we run a netcat tcp server

```
root@ad4423d4610e:/# conntrack -L
tcp      6 431972 ESTABLISHED src=10.9.0.5 dst=192.168.60.5 sport=39530 dport=9090 src=192.168.60.5 dst=10.9.0.5 sport=9090 dport=39530 [ASSURED] use=1
icmp     1 29 src=192.168.60.11 dst=192.168.60.5 type=8 code=0 id=34 src=192.168.60.5 dst=192.168.60.11 type=0 code=0 id=34 use=1
conntrack v1.4.5 (conntrack-tools): 2 flow entries have been shown.
root@ad4423d4610e:/#
```

In TCP we should be able to see the connection. Once we set up the connection we are going to set up a three way handshake.

Connection is set up from source to destination we did not send anything yet, because TCP is a connection oriented





It will be kept as long as the TCP connection is not as broken

```
tcp      6 431972 ESTABLISHED src=10.9.0.5 dst=192.168.60.5 sport=39530 dport=9090 src=192.168.60.5 dst=10.9.0.5 sport=9090 dport=39530 [ASSURED] use=1
icmp     1 29 src=192.168.60.11 dst=192.168.60.5 type=8 code=0 id=34 src=192.168.60.5 dst=192.168.60.11 type=0 code=0 id=34 use=1
conntrack v1.4.5 (conntrack-tools): 2 flow entries have been shown.
root@ad4423d4610e:/# conntrack -L
tcp      6 431785 ESTABLISHED src=10.9.0.5 dst=192.168.60.5 sport=39530 dport=9090 src=192.168.60.5 dst=10.9.0.5 sport=9090 dport=39530 [ASSURED] use=1
icmp     1 29 src=192.168.60.11 dst=192.168.60.5 type=8 code=0 id=34 src=192.168.60.5 dst=192.168.60.11 type=0 code=0 id=34 use=1
conntrack v1.4.5 (conntrack-tools): 2 flow entries have been shown.
root@ad4423d4610e:/# conntrack -L
tcp      6 431780 ESTABLISHED src=10.9.0.5 dst=192.168.60.5 sport=39530 dport=9090 src=192.168.60.5 dst=10.9.0.5 sport=9090 dport=39530 [ASSURED] use=1
icmp     1 29 src=192.168.60.11 dst=192.168.60.5 type=8 code=0 id=34 src=192.168.60.5 dst=192.168.60.11 type=0 code=0 id=34 use=1
conntrack v1.4.5 (conntrack-tools): 2 flow entries have been shown.
root@ad4423d4610e:/# conntrack -L
tcp      6 431765 ESTABLISHED src=10.9.0.5 dst=192.168.60.5 sport=39530 dport=9090 src=192.168.60.5 dst=10.9.0.5 sport=9090 dport=39530 [ASSURED] use=1
icmp     1 29 src=192.168.60.11 dst=192.168.60.5 type=8 code=0 id=34 src=192.168.60.5 dst=192.168.60.11 type=0 code=0 id=34 use=1
conntrack v1.4.5 (conntrack-tools): 2 flow entries have been shown.
root@ad4423d4610e:/#
```

Now we will see it after the connection broke how long will be able to see it

```
root@ad4423d4610e:/# conntrack -L
tcp      6 431765 ESTABLISHED src=10.9.0.5 dst=192.168.60.5 sport=39530 dport=9090 src=192.168.60.5 dst=10.9.0.5 sport=9090 dport=39530 [ASSURED] use=1
icmp     1 29 src=192.168.60.11 dst=192.168.60.5 type=8 code=0 id=34 src=192.168.60.5 dst=192.168.60.11 type=0 code=0 id=34 use=1
conntrack v1.4.5 (conntrack-tools): 2 flow entries have been shown.
root@ad4423d4610e:/# conntrack -L
tcp      6 55 TIME_WAIT src=10.9.0.5 dst=192.168.60.5 sport=39530 dport=9090 src=192.168.60.5 dst=10.9.0.5 sport=9090 dport=39530 [ASSURED] use=1
icmp     1 29 src=192.168.60.11 dst=192.168.60.5 type=8 code=0 id=34 src=192.168.60.5 dst=192.168.60.11 type=0 code=0 id=34 use=1
conntrack v1.4.5 (conntrack-tools): 2 flow entries have been shown.
root@ad4423d4610e:/# contrack -L
bash: contrack: command not found
root@ad4423d4610e:/#
```

We are getting time wait means the connection did not stop completely

```
root@ad4423d4610e:/# conntrack -L
icmp     1 29 src=192.168.60.11 dst=192.168.60.5 type=8 code=0 id=34 src=192.168.60.5 dst=192.168.60.11 type=0 code=0 id=34 use=1
conntrack v1.4.5 (conntrack-tools): 1 flow entries have been shown.
root@ad4423d4610e:/# conntrack -L
icmp     1 29 src=192.168.60.11 dst=192.168.60.5 type=8 code=0 id=34 src=192.168.60.5 dst=192.168.60.11 type=0 code=0 id=34 use=1
conntrack v1.4.5 (conntrack-tools): 1 flow entries have been shown.
root@ad4423d4610e:/# conntrack -L
icmp     1 29 src=192.168.60.11 dst=192.168.60.5 type=8 code=0 id=34 src=192.168.60.5 dst=192.168.60.11 type=0 code=0 id=34 use=1
conntrack v1.4.5 (conntrack-tools): 1 flow entries have been shown.
root@ad4423d4610e:/# conntrack -L
icmp     1 29 src=192.168.60.11 dst=192.168.60.5 type=8 code=0 id=34 src=192.168.60.5 dst=192.168.60.11 type=0 code=0 id=34 use=1
conntrack v1.4.5 (conntrack-tools): 1 flow entries have been shown.
root@ad4423d4610e:/# conntrack -L
icmp     1 29 src=192.168.60.11 dst=192.168.60.5 type=8 code=0 id=34 src=192.168.60.5 dst=192.168.60.11 type=0 code=0 id=34 use=1
conntrack v1.4.5 (conntrack-tools): 1 flow entries have been shown.
root@ad4423d4610e:/# conntrack -L
icmp     1 29 src=192.168.60.11 dst=192.168.60.5 type=8 code=0 id=34 src=192.168.60.5 dst=192.168.60.11 type=0 code=0 id=34 use=1
conntrack v1.4.5 (conntrack-tools): 1 flow entries have been shown.
root@ad4423d4610e:/#
```

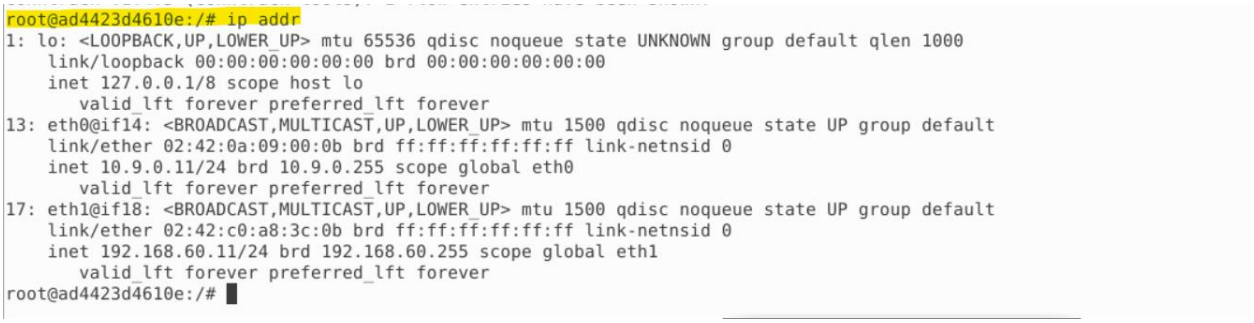
We are able to see that the number is decreasing to the local timeout

```
root@ad4423d4610e:/# conntrack -L
icmp 1 29 src=192.168.11 dst=192.168.60.5 type=8 code=0 id=34 use=1
conntrack v1.4.5 (conntrack-tools):1 flow enteries have been shown.
root@ad4423d4610e:/# conntrack -L
icmp 1 29 src=192.168.11 dst=192.168.60.5 type=8 code=0 id=34 use=1
conntrack v1.4.5 (conntrack-tools):1 flow enteries have been shown.
root@ad4423d4610e:/# conntrack -L
icmp 1 29 src=192.168.11 dst=192.168.60.5 type=8 code=0 id=34 use=1
conntrack v1.4.5 (conntrack-tools):1 flow enteries have been shown.
root@ad4423d4610e:/# conntrack -L
icmp 1 29 src=192.168.11 dst=192.168.60.5 type=8 code=0 id=34 use=1
conntrack v1.4.5 (conntrack-tools):0 flow enteries have been shown.
```

And lastly it becomes 0

Task 3.B: Setting Up a Stateful Firewall

We need to check inside our router to find those interface



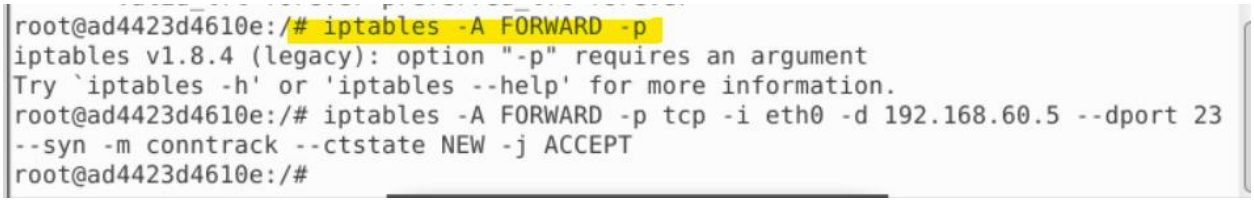
We have two interfaces eth1 and eth0

For task 2 we need to rewrite those rules we need to check our record or task 2 and write the rules in these router, good idea is u may save those rules in the script, here I just type them line by line.

In task 2 there are telnet services, we need to refer to task 2. Firstly we will accept the new sync packet which will accept the tcp connection.

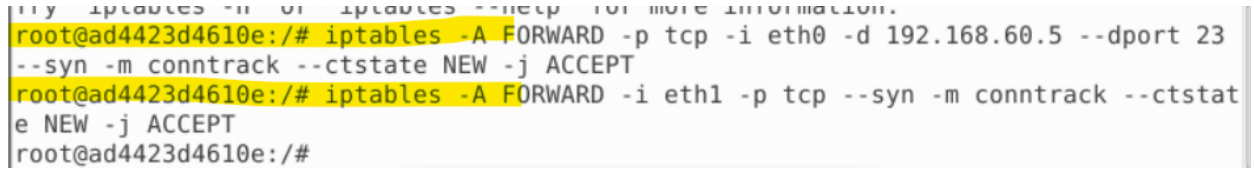
New sync packet used to establish TCP connection

Here we write the rule to accept the tcp connection a three way handshake



Now we want to allow to be able to access our cell host. A lot internal host with any external server.

So this allows internal host with any external server we didn't specify any target but for any destination ip and destination port which means any external server



Once this connection is established so they are following tcp packets we need to accept them. We want to accept any following tcp packets belong to the established tcp connections related

```
root@ad4423d4610e:/# iptables -A FORWARD -p tcp -m conntrack --ctstate RELATED,ESTABLISHED -j  ACCEPT
root@ad4423d4610e:/#
```

Any packet other than the rules allowed we will drop them

```
root@ad4423d4610e:/# iptables -A FORWARD -p tcp -j DROP
root@ad4423d4610e:/#
```

For other packets or ping packets we allow them pass by udp packets.Set up the default policy

```
root@ad4423d4610e:/# iptables -A FORWARD -p tcp -j DROP
root@ad4423d4610e:/# iptables -P FORWARD ACCEPT
root@ad4423d4610e:/#
```

Now lets test this one, internal host with any external host. We can confirm this internal host to the telent to the external host. Before that we need to check the rules which are set iptables

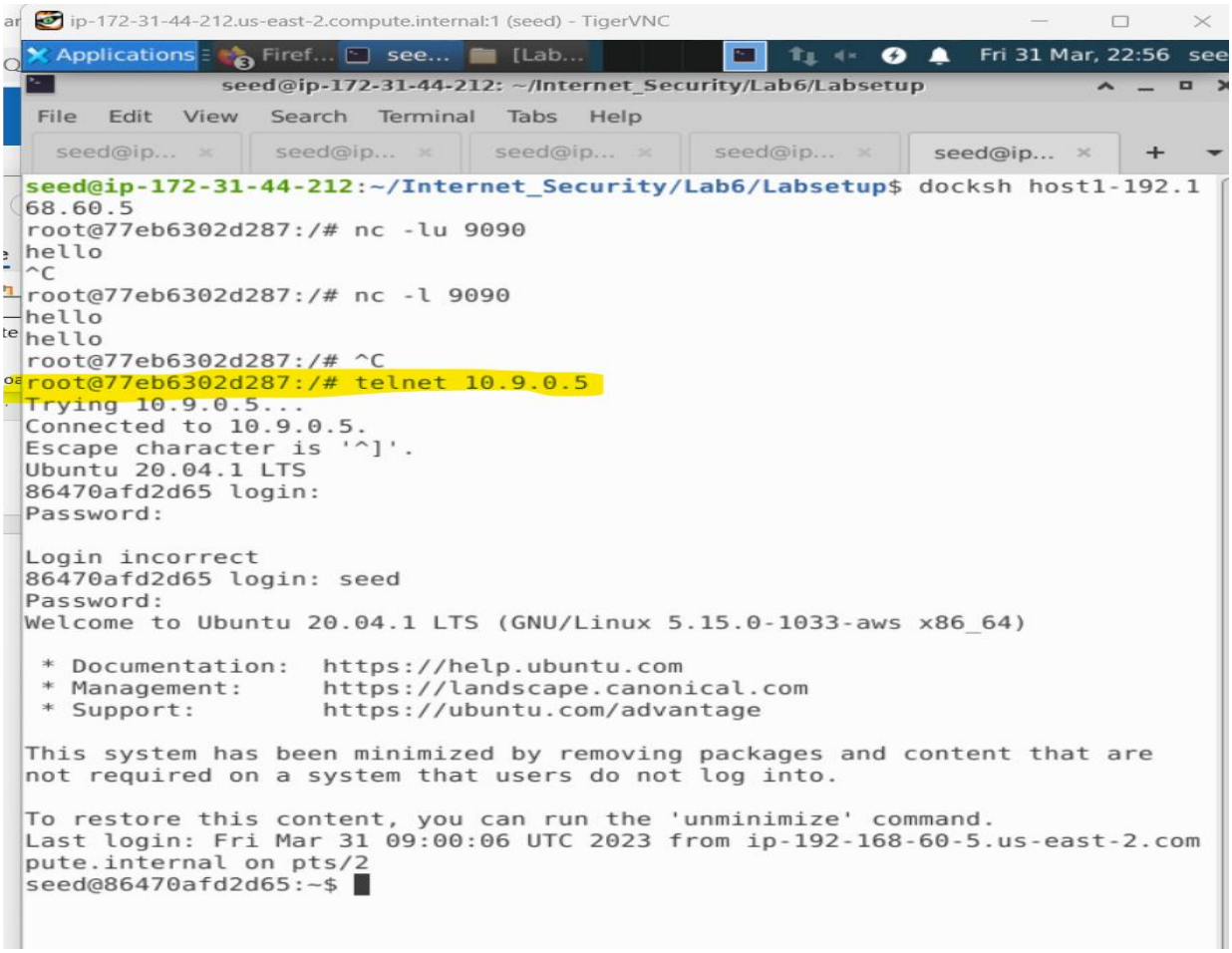
```
root@ad4423d4610e:/# iptables -A FORWARD -p tcp -j DROP
root@ad4423d4610e:/# iptables -P FORWARD ACCEPT
root@ad4423d4610e:/# iptables -L -n
Chain INPUT (policy ACCEPT)
target     prot opt source               destination

Chain FORWARD (policy ACCEPT)
target     prot opt source               destination
ACCEPT     tcp  --  0.0.0.0/0            192.168.60.5         tcp dpt:23 fl
ags:0x17/0x02 ctstate NEW
ACCEPT     tcp  --  0.0.0.0/0            0.0.0.0/0            tcp flags:0x1
7/0x02 ctstate NEW
ACCEPT     tcp  --  0.0.0.0/0            0.0.0.0/0            ctstate RELAT
ED,ESTABLISHED
DROP       tcp  --  0.0.0.0/0            0.0.0.0/0

Chain OUTPUT (policy ACCEPT)
target     prot opt source               destination
root@ad4423d4610e:/#
```

Here the rules are jus set up. From the above screenshot we can see the conntrack module added some flag and related established and so the default policy in this forward accept

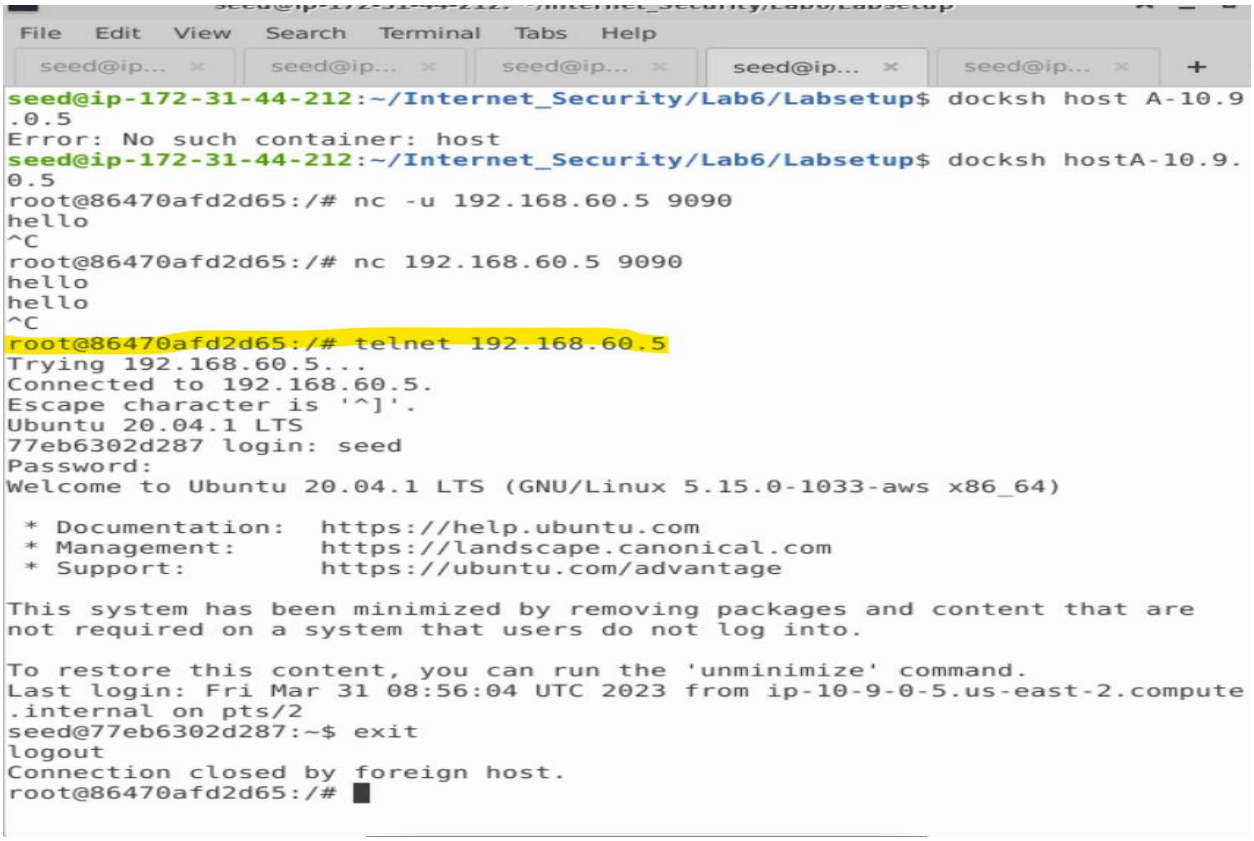
```
root@ad4423d4610e:/# conntrack -L
icmp     1 29 src=192.168.60.11 dst=192.168.60.5 type=8 code=0 id=34 src=19
2.168.60.5 dst=192.168.60.11 type=0 code=0 id=34 use=1
conntrack v1.4.5 (conntrack-tools): 1 flow entries have been shown.
root@ad4423d4610e:/#
```

Now we let the module track automatically with these rules.

Now lets try “telnet 10.9.0.5” from the inside host one to the external host



And for the outside host it can only telnet into a host one inside host one

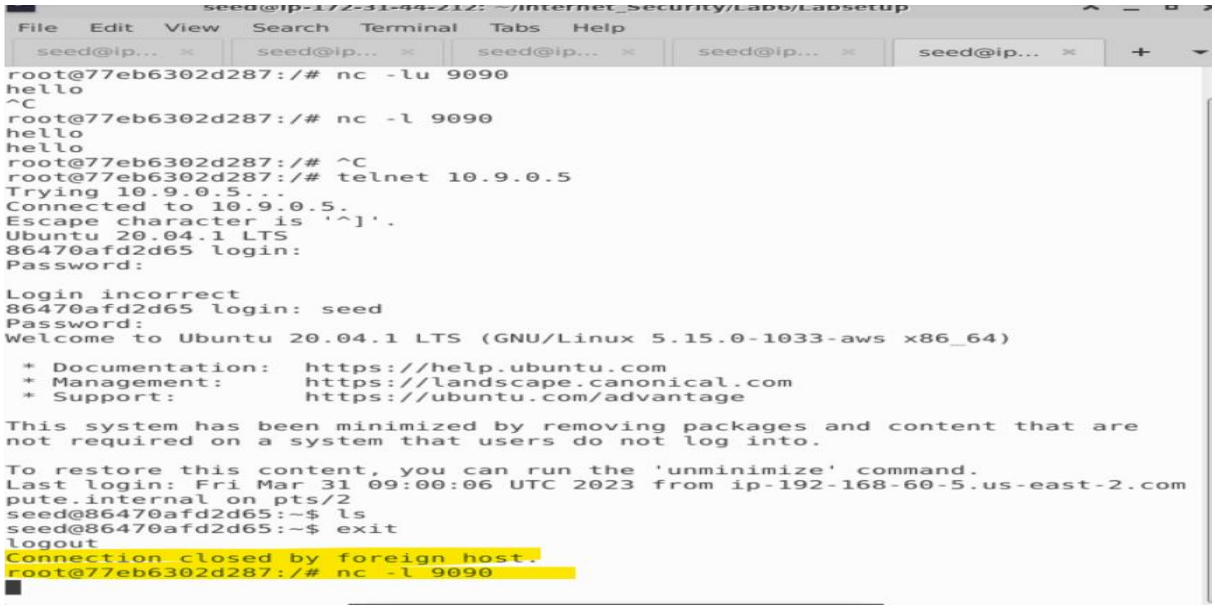


We can try other host inside the network

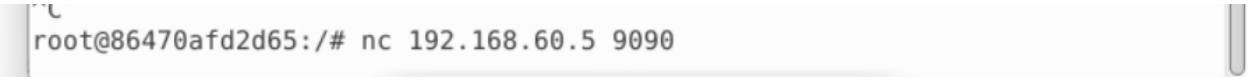
We can see it's not allowed, which is enforced by the rule but the rule, destination with the telnet service is allowed.

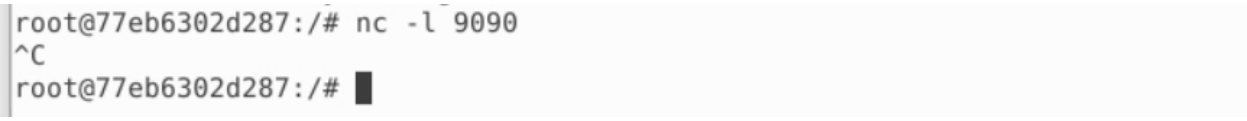
For any other service this should also be disabled, but for the inner host to the outside host any service is allowed, so you can try tcp server, we can use netcat to set up tcp server udp server.

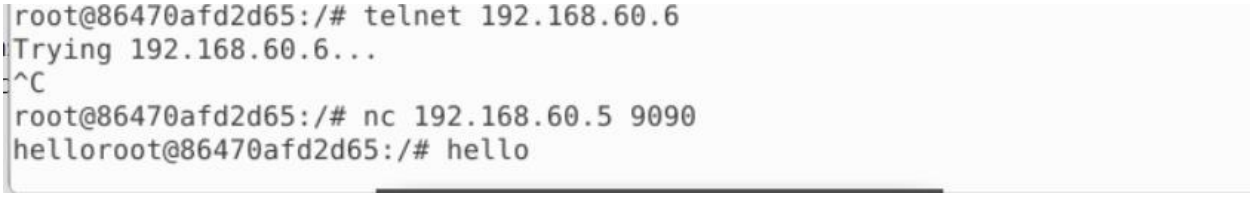
We are going to try tcp server on this host



Then on the outside host try to connect

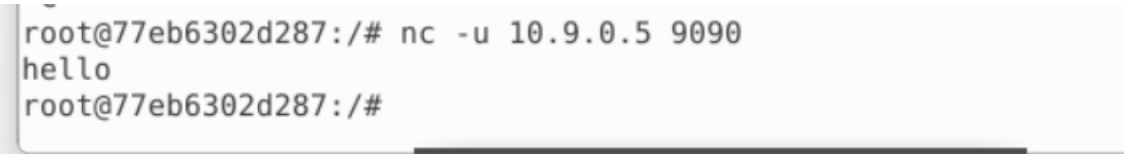




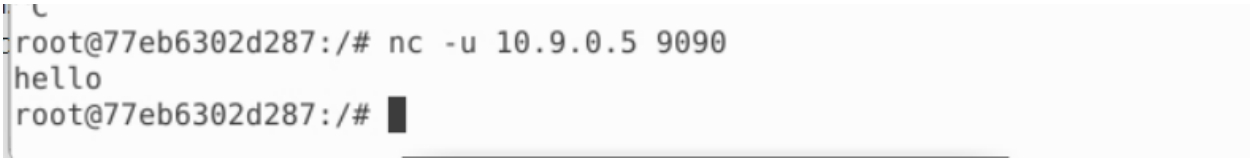


And now on the host 1 we want to access netcat udp server.

Want to connect to this netcat UDP server



We type hello on host and we have received hello



Rule allows internal host to visit any external server and we are able to see it worked we received hello.

Here we use the contract as it explains the arrangement distribution of each approach. The disadvantage of contracts is that it consumes more resources because it need to keep the connection status, however the rules are not strict as the connection status

```
root@ad4423d4610e:/# conntrack -L
icmp     1 29 src=192.168.60.11 dst=192.168.60.5 type=8 code=0 id=34 src=19
2.168.60.5 dst=192.168.60.11 type=0 code=0 id=34 use=1
conntrack v1.4.5 (conntrack-tools): 1 flow entries have been shown.
root@ad4423d4610e:/# iptables -F
root@ad4423d4610e:/# iptables -L -n
Chain INPUT (policy ACCEPT)
target     prot opt source               destination

Chain FORWARD (policy ACCEPT)
target     prot opt source               destination

Chain OUTPUT (policy ACCEPT)
target     prot opt source               destination
root@ad4423d4610e:/#
```

```
root@ad4423d4610e:/# ipatbles -P ACCEPT
bash: ipatbles: command not found
root@ad4423d4610e:/# iptables -p ACCEPT
iptables v1.8.4 (legacy): unknown protocol "accept" specified
Try `iptables -h' or 'iptables --help' for more information.
root@ad4423d4610e:/# iptables -P FORWARD ACCEPT
root@ad4423d4610e:/# iptables -A FORWARD -i eth0 -d 192.168.60.5 -p tcp --d
port 23 --syn -j ACCEPT
root@ad4423d4610e:/#
```

```
root@ad4423d4610e:/# iptables -P FORWARD ACCEPT
root@ad4423d4610e:/# iptables -A FORWARD -i eth0 -d 192.168.60.5 -p tcp --d
port 23 --syn -j ACCEPT
root@ad4423d4610e:/# iptables -A FORWARD -i eth0 -p tcp --syn -j DROP
root@ad4423d4610e:/#
```

How are the other packet will go in or go out or pass through the router

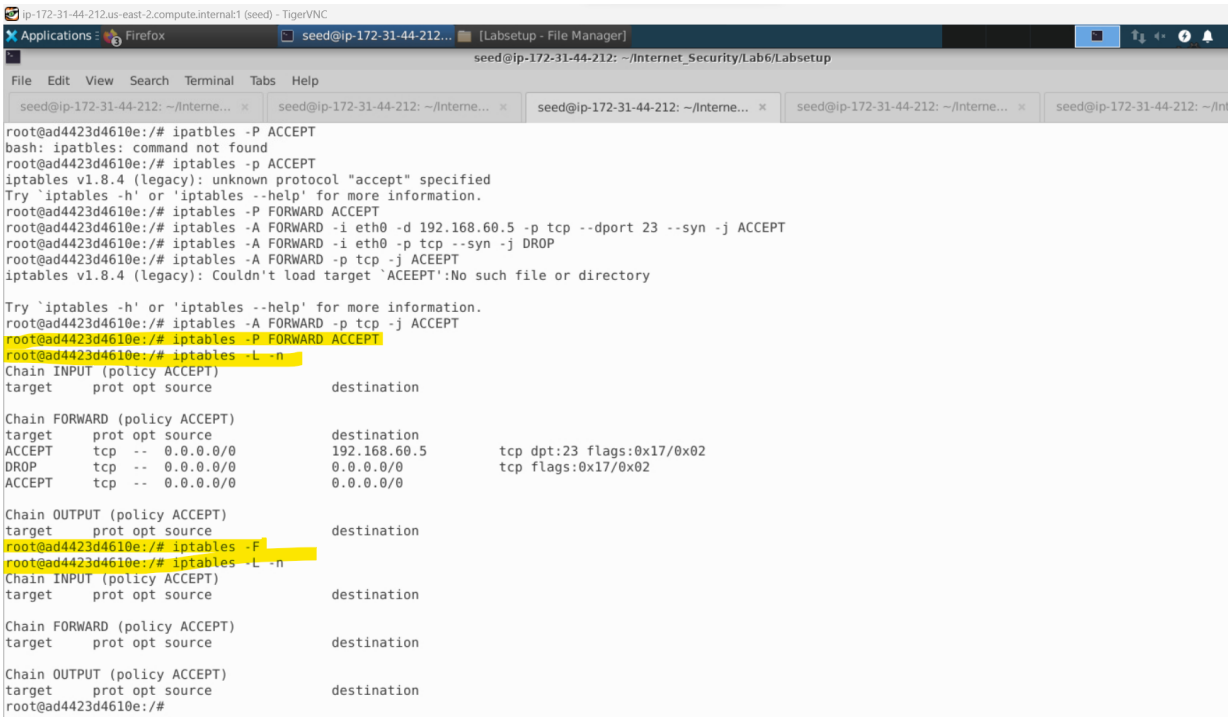
```
root@ad4423d4610e:/# iptables -A FORWARD -i eth0 -p tcp --syn -j DROP
root@ad4423d4610e:/# iptables -A FORWARD -p tcp -j ACEEPT
iptables v1.8.4 (legacy): Couldn't load target `ACEEPT':No such file or d
ectory

Try `iptables -h' or 'iptables --help' for more information.
root@ad4423d4610e:/# iptables -A FORWARD -p tcp -j ACCEPT
root@ad4423d4610e:/#
```

```
root@ad4423d4610e:/# iptables -A FORWARD -p tcp -j ACCEPT
root@ad4423d4610e:/# iptables -P FORWARD ACCEPT
root@ad4423d4610e:/# iptables -L -n
Chain INPUT (policy ACCEPT)
target     prot opt source               destination

Chain FORWARD (policy ACCEPT)
target     prot opt source               destination
ACCEPT     tcp  --  0.0.0.0/0            192.168.60.5         tcp dpt:23 fl
ags:0x17/0x02
DROP       tcp  --  0.0.0.0/0            0.0.0.0/0            tcp flags:0x1
7/0x02
ACCEPT     tcp  --  0.0.0.0/0            0.0.0.0/0

Chain OUTPUT (policy ACCEPT)
target     prot opt source               destination
root@ad4423d4610e:/#
```

Now we can test the telnet

```
root@86470afd2d65:/# telnet 192.168.60.6
Trying 192.168.60.6...
^C
root@86470afd2d65:/#
```

```
root@86470afd2d65:/# telnet 192.168.60.5
Trying 192.168.60.5...
Connected to 192.168.60.5.
Escape character is '^]'.
Ubuntu 20.04.1 LTS
77eb6302d287 login: seed
Password:
Welcome to Ubuntu 20.04.1 LTS (GNU/Linux 5.15.0-1033-aws x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/advantage

This system has been minimized by removing packages and content that are
not required on a system that users do not log into.

To restore this content, you can run the 'unminimize' command.
Last login: Fri Mar 31 22:59:28 UTC 2023 from ip-10-9-0-5.us-east-2.compute
.internal on pts/2
seed@77eb6302d287:~$
```


ip-172-31-44-212.us-east-2.compute.internal:1 (seed) - TigerVNC
Applications
Firefox
seed@ip-172-31-44-212...
[Labsetup - File Manager]
seed@ip-172-31-44-212: ~/Internet_Security/Lab6/Labsetup
File Edit View Search Terminal Tabs Help
seed@ip-172-31-44-212: ~/Interne...
seed@ip-172-31-44-212: ~/Interne...
seed@ip-172-31-44-212: ~/Interne...
seed@ip-172-31-44-212: ~/Interne...
seed@ip-172-31-44-212: ~/Int
root@ad4423d4610e:/# ipatbles -P ACCEPT
bash: ipatbles: command not found
root@ad4423d4610e:/# iptables -p ACCEPT
iptables v1.8.4 (legacy): unknown protocol "accept" specified
Try `iptables -h' or 'iptables --help' for more information.
root@ad4423d4610e:/# iptables -P FORWARD ACCEPT
root@ad4423d4610e:/# iptables -A FORWARD -i eth0 -d 192.168.60.5 -p tcp --dport 23 --syn -j ACCEPT
root@ad4423d4610e:/# iptables -A FORWARD -i eth0 -p tcp --syn -j DROP
root@ad4423d4610e:/# iptables -A FORWARD -p tcp -j ACEEPT
iptables v1.8.4 (legacy): Couldn't load target `ACEEPT':No such file or directory
Try `iptables -h' or 'iptables --help' for more information.
root@ad4423d4610e:/# iptables -A FORWARD -p tcp -j ACCEPT
root@ad4423d4610e:/# iptables -P FORWARD ACCEPT
root@ad4423d4610e:/# iptables -L -n
Chain INPUT (policy ACCEPT)
target prot opt source destination
Chain FORWARD (policy ACCEPT)
target prot opt source destination
ACCEPT tcp -- 0.0.0.0/0 192.168.60.5 tcp dpt:23 flags:0x17/0x02
DROP tcp -- 0.0.0.0/0 0.0.0.0/0 tcp flags:0x17/0x02
ACCEPT tcp -- 0.0.0.0/0 0.0.0.0/0
Chain OUTPUT (policy ACCEPT)
target prot opt source destination
root@ad4423d4610e:/# iptables -F
root@ad4423d4610e:/# iptables -L -n
Chain INPUT (policy ACCEPT)
target prot opt source destination
Chain FORWARD (policy ACCEPT)
target prot opt source destination
Chain OUTPUT (policy ACCEPT)
target prot opt source destination
root@ad4423d4610e:/#

Task 4: Limiting Network Traffic

We can also limit the packets that can pass through the firewall and this time using limit method or module of the iptables

```
root@ad4423d4610e:/# iptables -m limit -h
iptables v1.8.4

Usage: iptables -[ACD] chain rule-specification [options]
       iptables -I chain [rulenum] rule-specification [options]
       iptables -R chain rulenum rule-specification [options]
       iptables -D chain rulenum [options]
       iptables -[LS] [chain [rulenum]] [options]
       iptables -[FZ] [chain] [options]
       iptables -[NX] chain
       iptables -E old-chain-name new-chain-name
       iptables -P chain target [options]
       iptables -h (print this help information)

Commands:
```

```
root@ad4423d4610e:/# iptables -A FORWARD -s 10.9.0.5 -m limit --limit 10/mi
nute --limit-burst 5 -j ACCEPT
root@ad4423d4610e:/#
```

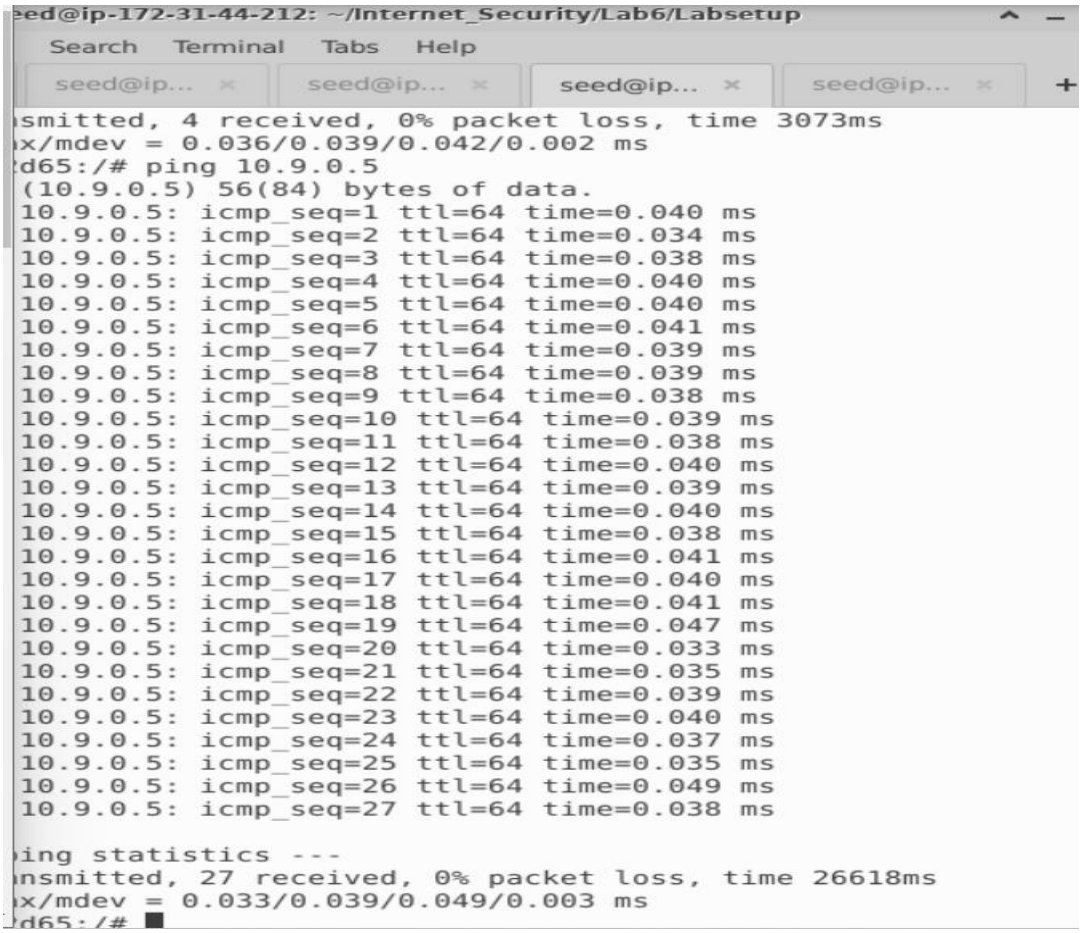
Now lets ping ping from inside host 1 to external host A

```
root@86470afd2d65:/# ping 10.9.0.5
PING 10.9.0.5 (10.9.0.5) 56(84) bytes of data.
64 bytes from 10.9.0.5: icmp_seq=1 ttl=64 time=0.040 ms
64 bytes from 10.9.0.5: icmp_seq=2 ttl=64 time=0.040 ms
64 bytes from 10.9.0.5: icmp_seq=3 ttl=64 time=0.038 ms
64 bytes from 10.9.0.5: icmp_seq=4 ttl=64 time=0.036 ms
64 bytes from 10.9.0.5: icmp_seq=5 ttl=64 time=0.035 ms
64 bytes from 10.9.0.5: icmp_seq=6 ttl=64 time=0.035 ms
64 bytes from 10.9.0.5: icmp_seq=7 ttl=64 time=0.033 ms
64 bytes from 10.9.0.5: icmp_seq=8 ttl=64 time=0.046 ms
64 bytes from 10.9.0.5: icmp_seq=9 ttl=64 time=0.040 ms
64 bytes from 10.9.0.5: icmp_seq=10 ttl=64 time=0.045 ms
64 bytes from 10.9.0.5: icmp_seq=11 ttl=64 time=0.043 ms
64 bytes from 10.9.0.5: icmp_seq=12 ttl=64 time=0.038 ms
64 bytes from 10.9.0.5: icmp_seq=13 ttl=64 time=0.039 ms
64 bytes from 10.9.0.5: icmp_seq=14 ttl=64 time=0.039 ms
64 bytes from 10.9.0.5: icmp_seq=15 ttl=64 time=0.039 ms
64 bytes from 10.9.0.5: icmp_seq=16 ttl=64 time=0.043 ms
64 bytes from 10.9.0.5: icmp_seq=17 ttl=64 time=0.040 ms
64 bytes from 10.9.0.5: icmp_seq=18 ttl=64 time=0.040 ms
^C
--- 10.9.0.5 ping statistics ---
18 packets transmitted, 18 received, 0% packet loss, time 17384ms
rtt min/avg/max/mdev = 0.033/0.039/0.046/0.003 ms
root@86470afd2d65:/#
```

We are getting the response from the host A

Those packets not in the first rule will be dropped by the 2nd rule. Finally these packets our passed where we see continuously get this response of dropping packets

```
root@ad4423d4610e:/# iptables -A FORWARD -s 10.9.0.5 -m limit --limit 10/mi
nute --limit-burst 5 -j ACCEPT
root@ad4423d4610e:/# iptables -A FORWARD -s 10.9.0.5 -j DROP
```



We can see it does not work as expected.

Which means this limit takes effect after we add the second rule without the signal. It does not work why is that?

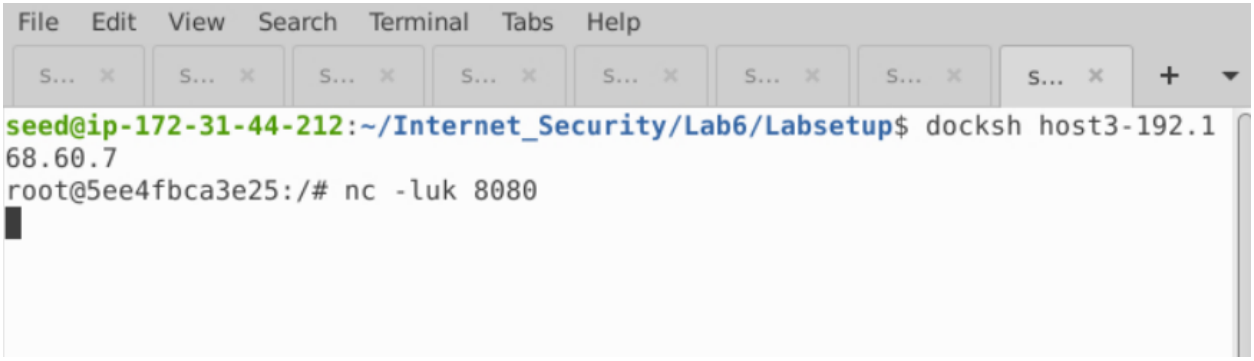
Reason: Those packets does not match this first rule without this second rule somehow they went through this router because they were not stopped for those packets not satisfied in this rule that is why we kept getting those packet just like no limit

```
root@86470afd2d65:/# iptables -F
root@86470afd2d65:/# iptables -L -n
Chain INPUT (policy ACCEPT)
target     prot opt source               destination

Chain FORWARD (policy ACCEPT)
target     prot opt source               destination

Chain OUTPUT (policy ACCEPT)
target     prot opt source               destination
root@86470afd2d65:/#
```

Task 5: Load Balancing

a)Using the nth mode (round-robin)

We need to add one rule before that we need to run the three servers host1, host2, host3



```
root@ad4423d4610e:/# iptables -t nat -A PREROUTING -p --dport 8080 -m stati
stic --mode nth --every 3 --packet 0 -j DNAT --to-destination 192.168.60.5:
8080
iptables v1.8.4 (legacy): unknown protocol "--dport" specified
Try `iptables -h' or 'iptables --help' for more information.
root@ad4423d4610e:/# iptables -t nat -A PREROUTING -p udp --dport 8080 -m s
tatistic --mode nth --every 3 --packet 0 -j DNAT --to-destination 192.168.6
0.5:8080
root@ad4423d4610e:/#
```

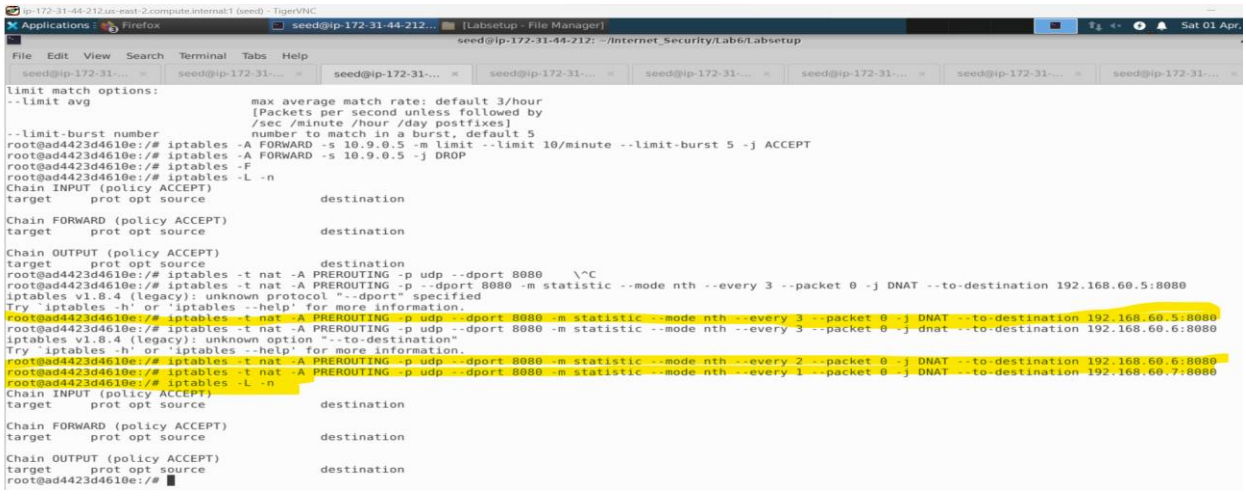
```
root@86470afd2d65:/# echo hello | nc -u 10.9.0.11 8080^C
root@86470afd2d65:/# nc -luk 8080
hello
```

```
root@86470afd2d65:/# nc -luk 8080
hello
```

Every three packet pixel first packet, here those packets do not match the rule will continue

on their journey so it looks like this packets do not match and they will not be modifies or blocked and they will come to this host.

We need to add two more rules, here if every three packet the first packet is send to a host one the we left only two so we need to change it to every two we pick the first one



The table is inside the NAT table

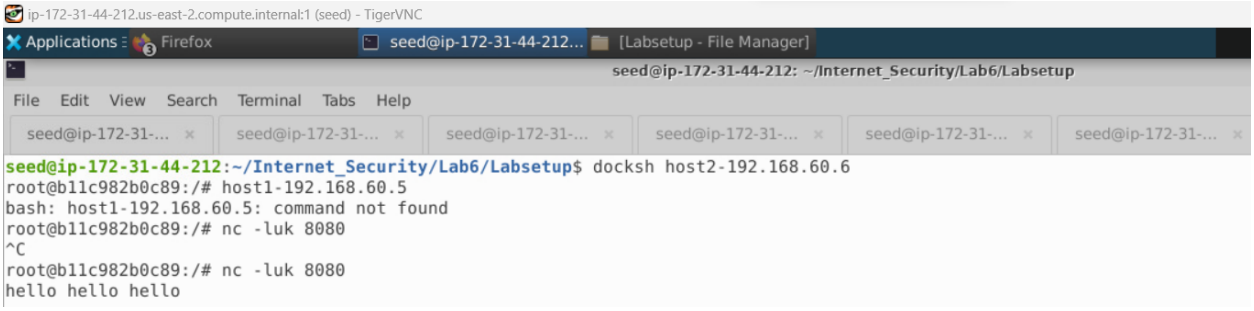
```
root@ad4423d4610e:/# iptables -t nat -L -n
Chain PREROUTING (policy ACCEPT)
target     prot opt source               destination
DNAT       udp  --  0.0.0.0/0            0.0.0.0/0            udp dpt:8080 statistic mode nth every 3 to:192.168.60.5:8080
DNAT       udp  --  0.0.0.0/0            0.0.0.0/0            udp dpt:8080 statistic mode nth every 2 to:192.168.60.6:8080
DNAT       udp  --  0.0.0.0/0            0.0.0.0/0            udp dpt:8080 statistic mode nth every 1 to:192.168.60.7:8080

Chain INPUT (policy ACCEPT)
target     prot opt source               destination

Chain OUTPUT (policy ACCEPT)
target     prot opt source               destination
DOCKER_OUTPUT  all  --  0.0.0.0/0            127.0.0.11

Chain POSTROUTING (policy ACCEPT)
target     prot opt source               destination
DOCKER_POSTROUTING  all  --  0.0.0.0/0            127.0.0.11

Chain DOCKER_OUTPUT (1 references)
target     prot opt source               destination
DNAT       tcp  --  0.0.0.0/0            127.0.0.11           tcp dpt:53 to:127.0.0.11:35949
DNAT       udp  --  0.0.0.0/0            127.0.0.11           udp dpt:53 to:127.0.0.11:53054

Chain DOCKER_POSTROUTING (1 references)
target     prot opt source               destination
SNAT       tcp  --  127.0.0.11           0.0.0.0/0            tcp spt:35949 to::53
SNAT       udp  --  127.0.0.11           0.0.0.0/0            udp spt:53054 to::53
root@ad4423d4610e:/#
```

```
root@86470afd2d65:/# echo hello | nc -u 10.9.0.11 8080
^C
root@86470afd2d65:/#
```

```
root@86470afd2d65:/# nc -luk 8080
hello
hello
```

Here we have a Single udp packet u can find the maximium payload for udp packet

```
root@ad4423d4610e:/# echo "hello hello hello" | nc -u 10.9.0.11 8080
root@ad4423d4610e:/#
```




```
root@ad4423d4610e:/# echo "hello hello hello" | nc -u 10.9.0.11 8080
root@ad4423d4610e:/# echo " hello1" | nc -u 10.9.0.11 8080
root@ad4423d4610e:/# echo " hello2" | nc -u 10.9.0.11 8080
root@ad4423d4610e:/#
```

Everytime we run the code above the source port number is chosen randomly, so we can use random source of port we can use also wireshark


```
root@ad4423d4610e:/# echo " hello3" | nc -u 10.9.0.11 8080
root@ad4423d4610e:/#
```


```
root@ad4423d4610e:/# nc -u 10.9.0.11 8080
hi1
hi2
hi3
```

Every three packet pixel first packet, here those packets do not match the rule will continue on their journey so it looks like this packets do not match and they will not be modifies or blocked and they will come to this host.

We need to add two more rules, here if every three packet the first packet is send to a host one the we left only two so we need to change it to every two we pick the first one

```
root@b11c982b0c89:/# nc -luk 8080
hello
hello
hello1
hi1
hi2
hi3
```

b) Using Random mode

We used the following command

1)iptables -t nat -A PREROUTiNG

-p udp --dport 8080 -m statistic --mode random --probability

0.33333 -j DNAT --to-destination 192.168.60.5:8080

2)iptables -t nat -A PREROUTING

-p udp --dport 8080 -m statistic --mode random --probability

0.5 -j DNAT --todestination 192.168.60.6:8080

3) /# iptables -t nat -A PREROUTING

-p udp --dport 8080 -m statistic --mode random --probability

0.33333 -j DNAT --to-destination 192.168.60.5:8080

root@ad4423d4610e:/# iptables -t nat -L -n --line-numbers

In the pre routing chain we are able to see three rules

```
root@ad4423d4610e:/# iptables -t nat -A PREROUTING -p udp --dport 8080 -m statistic --mode random --probability 0.33333 -j DNAT --to-destination 192.168.60.5:8080
root@ad4423d4610e:/# iptables -t nat -A PREROUTING -p udp --dport 8080 -m statistic --mode random --probability 0.5 -j DNAT --to-destination 192.168.60.6:8080
root@ad4423d4610e:/# iptables -t nat -A PREROUTING -p udp --dport 8080 -m statistic --mode random --probability 1 -j DNAT --to-destination 192.168.60.7:8080
root@ad4423d4610e:/# iptables -t nat -L -n --line-numbers
Chain PREROUTING (policy ACCEPT)
num  target     prot opt source               destination
1    DNAT       udp  --  0.0.0.0/0            0.0.0.0/0            udp dpt:8080 statistic mode nth every 3 to:192.168.60.5:8080
2    DNAT       udp  --  0.0.0.0/0            0.0.0.0/0            udp dpt:8080 statistic mode nth every 2 to:192.168.60.6:8080
3    DNAT       udp  --  0.0.0.0/0            0.0.0.0/0            udp dpt:8080 statistic mode nth every 1 to:192.168.60.7:8080
4    DNAT       udp  --  0.0.0.0/0            0.0.0.0/0            udp dpt:8080 statistic mode random probability 0.33332999982 to:192.168.60.5:8080
5    DNAT       udp  --  0.0.0.0/0            0.0.0.0/0            udp dpt:8080 statistic mode random probability 0.50000000000 to:192.168.60.6:8080
6    DNAT       udp  --  0.0.0.0/0            0.0.0.0/0            udp dpt:8080 statistic mode random probability 1.00000000000 to:192.168.60.7:8080

Chain INPUT (policy ACCEPT)
num  target     prot opt source               destination

Chain OUTPUT (policy ACCEPT)
num  target     prot opt source               destination
1    DOCKER_OUTPUT  all  --  0.0.0.0/0            127.0.0.11

Chain POSTROUTING (policy ACCEPT)
num  target     prot opt source               destination
1    DOCKER_POSTROUTING  all  --  0.0.0.0/0            127.0.0.11

Chain DOCKER_OUTPUT (1 references)
num  target     prot opt source               destination
1    DNAT       tcp  --  0.0.0.0/0            127.0.0.11           tcp dpt:53 to:127.0.0.11:35949
2    DNAT       udp  --  0.0.0.0/0            127.0.0.11           udp dpt:53 to:127.0.0.11:53054

Chain DOCKER_POSTROUTING (1 references)
num  target     prot opt source               destination
1    SNAT       tcp  --  127.0.0.11           0.0.0.0/0            tcp spt:35949 to::53
2    SNAT       udp  --  127.0.0.11           0.0.0.0/0            udp spt:53054 to::53
root@ad4423d4610e:/#
```

```
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup$ docksh host2-192.168.60.6
root@b11c982b0c89:/# host1-192.168.60.5
bash: host1-192.168.60.5: command not found
root@b11c982b0c89:/# nc -luk 8080
^C
root@b11c982b0c89:/# nc -luk 8080
hello hello hello
```

```
seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup$ docksh host1-192.168.60.5
root@77eb6302d287:/# nc -luk 8080
hello
```

```
root@ad4423d4610e:/# nc -u 10.9.0.11 8080
hi1
hi2
hi3
```

```
root@ad4423d4610e:/# nc -u 10.9.0.11 8080
hi1
hi2
hi3
hi4
hi5
hi6
```


seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup$ docksh host2-192.168.60.6
root@b11c982b0c89:/# host1-192.168.60.5
bash: host1-192.168.60.5: command not found
root@b11c982b0c89:/# nc -luk 8080
^C
root@b11c982b0c89:/# nc -luk 8080
hello hello hello


seed@ip-172-31-44-212:~/Internet_Security/Lab6/Labsetup$ docksh host3-192.168.60.7
root@5ee4fbca3e25:/# nc -luk 8080