

Firewall

Task 1: Using Firewall

Prevent A from doing telnet to Machine B

```
Terminal
[02/17/2019 14:52] Parth@VM:~$ sudo ufw enable
Firewall is active and enabled on system startup
[02/17/2019 14:52] Parth@VM:~$ sudo ufw deny out tcp from 10.0.2.7 to 10.0.2.9
ERROR: Wrong number of arguments
[02/17/2019 14:52] Parth@VM:~$ sudo ufw deny out proto tcp from 10.0.2.7 to 10.0.2.9
Rule added
[02/17/2019 14:52] Parth@VM:~$ sudo ufw status
Status: active
To           Action      From
--           --          --
10.0.2.9/tcp  DENY OUT   10.0.2.7/tcp

[02/17/2019 14:52] Parth@VM:~$ telnet 10.0.2.9
Trying 10.0.2.9...
^C
[02/17/2019 14:53] Parth@VM:~$
```

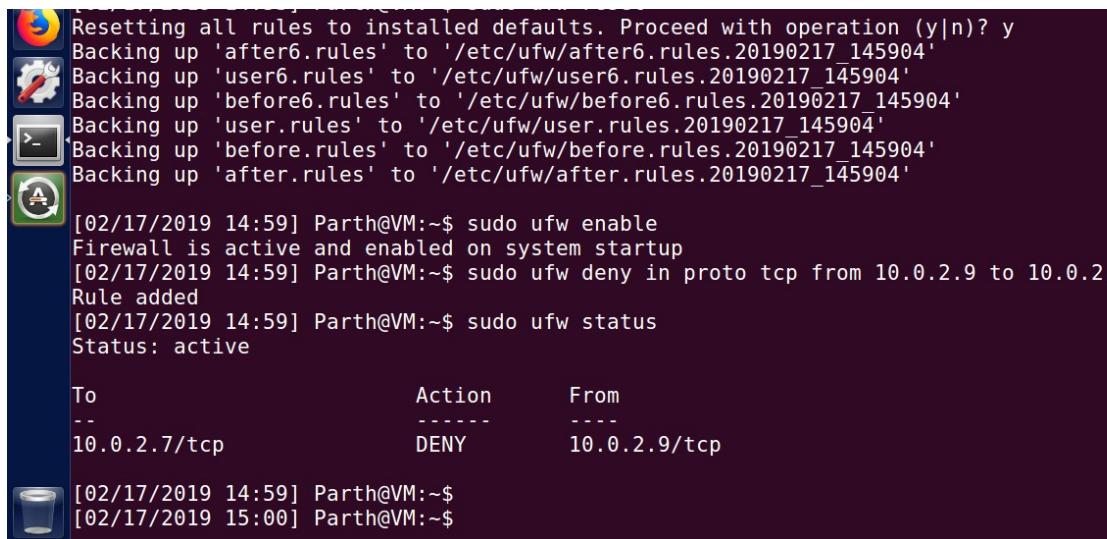
```
Terminal
[02/17/2019 14:46] Parth@VM:~$ ifconfig
enp0s3      Link encap:Ethernet  HWaddr 08:00:27:fd:ad:5b
              inet addr:10.0.2.9  Bcast:10.0.2.255  Mask:255.255.255.0
              inet6 addr: fe80::95cd:c763:81e:dfdf/64 Scope:Link
                UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
                RX packets:264 errors:0 dropped:0 overruns:0 frame:0
                TX packets:290 errors:0 dropped:0 overruns:0 carrier:0
                collisions:0 txqueuelen:1000
                RX bytes:75829 (75.8 KB)  TX bytes:26736 (26.7 KB)

lo          Link encap:Local Loopback
              inet addr:127.0.0.1  Mask:255.0.0.0
              inet6 addr: ::1/128 Scope:Host
                UP LOOPBACK RUNNING  MTU:65536  Metric:1
                RX packets:232 errors:0 dropped:0 overruns:0 frame:0
                TX packets:232 errors:0 dropped:0 overruns:0 carrier:0
                collisions:0 txqueuelen:1
                RX bytes:39825 (39.8 KB)  TX bytes:39825 (39.8 KB)

[02/17/2019 14:53] Parth@VM:~$
```

We can see from the above screenshot that we were not able to telnet from machine '10.0.2.7' to machine '10.0.2.9'

Prevent B from doing telnet to Machine A

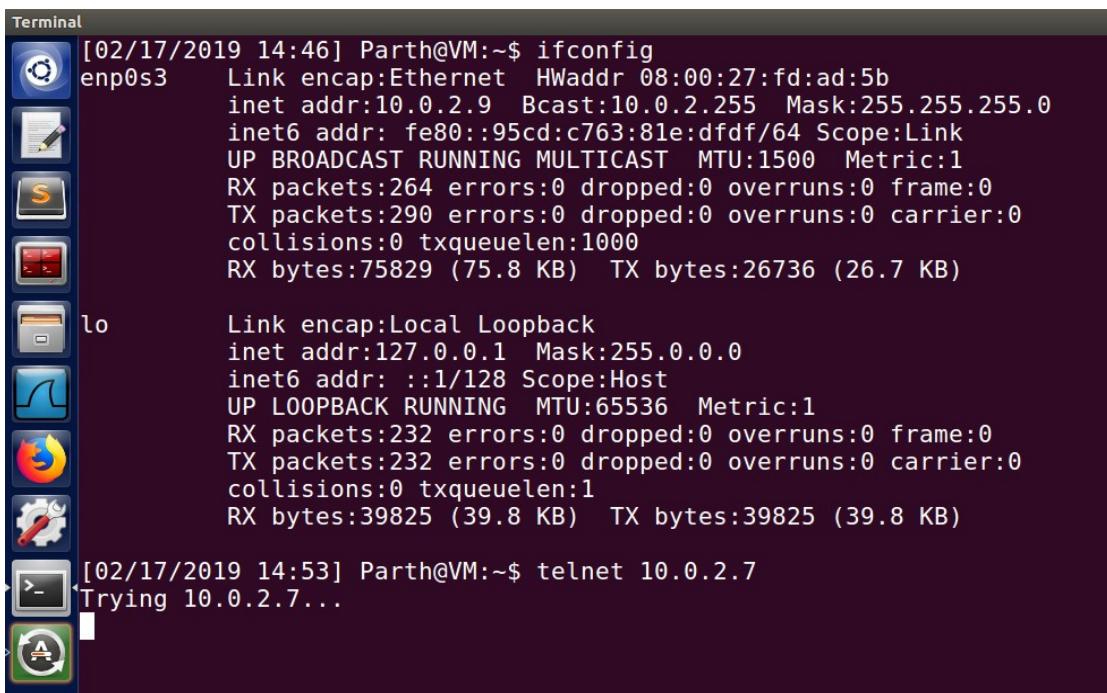


```
Resetting all rules to installed defaults. Proceed with operation (y|n)? y
Backing up 'after6.rules' to '/etc/ufw/after6.rules.20190217_145904'
Backing up 'user6.rules' to '/etc/ufw/user6.rules.20190217_145904'
Backing up 'before6.rules' to '/etc/ufw/before6.rules.20190217_145904'
Backing up 'user.rules' to '/etc/ufw/user.rules.20190217_145904'
Backing up 'before.rules' to '/etc/ufw/before.rules.20190217_145904'
Backing up 'after.rules' to '/etc/ufw/after.rules.20190217_145904'

[02/17/2019 14:59] Parth@VM:~$ sudo ufw enable
Firewall is active and enabled on system startup
[02/17/2019 14:59] Parth@VM:~$ sudo ufw deny in proto tcp from 10.0.2.9 to 10.0.2.
Rule added
[02/17/2019 14:59] Parth@VM:~$ sudo ufw status
Status: active

To                         Action      From
--                         -----      --
10.0.2.7/tcp               DENY       10.0.2.9/tcp

[02/17/2019 14:59] Parth@VM:~$
[02/17/2019 15:00] Parth@VM:~$
```



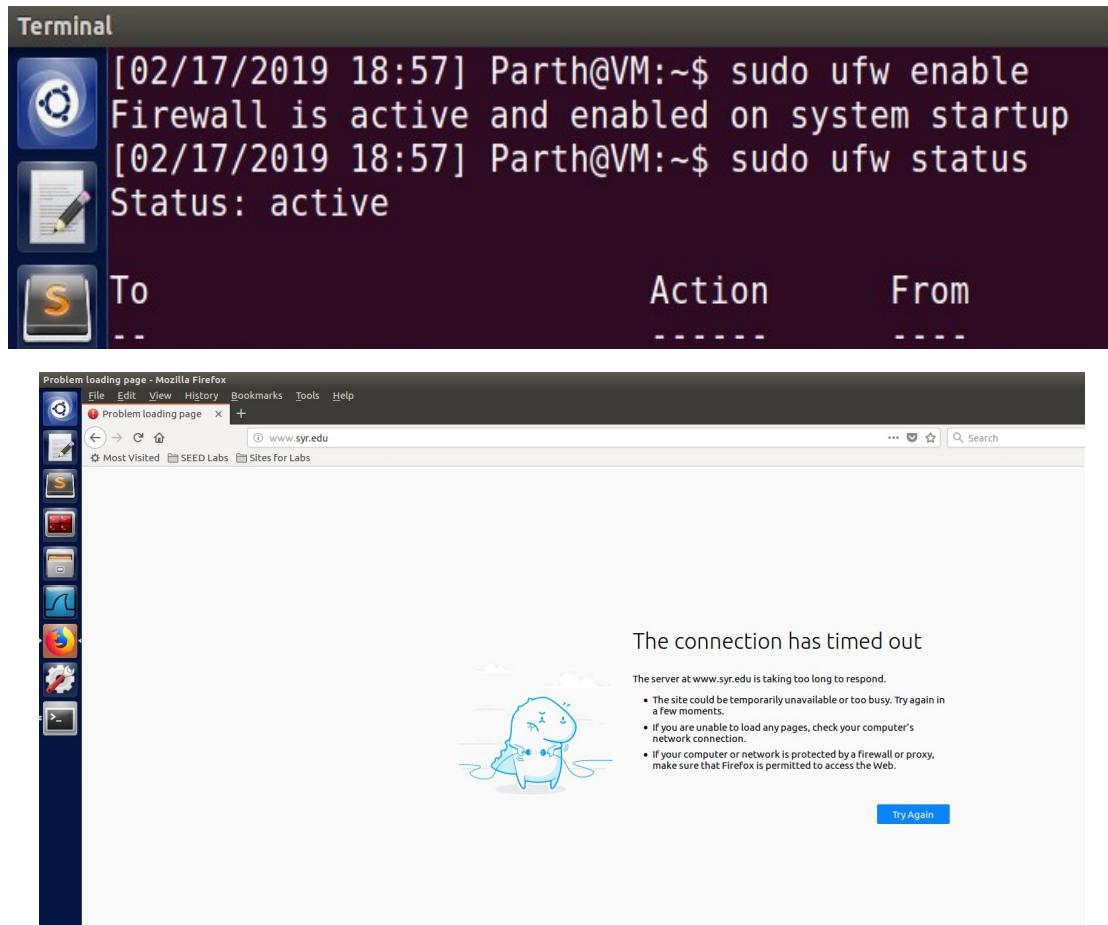
```
Terminal
[02/17/2019 14:46] Parth@VM:~$ ifconfig
enp0s3      Link encap:Ethernet HWaddr 08:00:27:fd:ad:5b
             inet addr:10.0.2.9 Bcast:10.0.2.255 Mask:255.255.255.0
                           inet6 addr: fe80::95cd:c763:81e:dfdf/64 Scope:Link
                           UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
                           RX packets:264 errors:0 dropped:0 overruns:0 frame:0
                           TX packets:290 errors:0 dropped:0 overruns:0 carrier:0
                           collisions:0 txqueuelen:1000
                           RX bytes:75829 (75.8 KB)   TX bytes:26736 (26.7 KB)

lo          Link encap:Local Loopback
             inet addr:127.0.0.1 Mask:255.0.0.0
                           inet6 addr: ::1/128 Scope:Host
                           UP LOOPBACK RUNNING MTU:65536 Metric:1
                           RX packets:232 errors:0 dropped:0 overruns:0 frame:0
                           TX packets:232 errors:0 dropped:0 overruns:0 carrier:0
                           collisions:0 txqueuelen:1
                           RX bytes:39825 (39.8 KB)   TX bytes:39825 (39.8 KB)

[02/17/2019 14:53] Parth@VM:~$ telnet 10.0.2.7
Trying 10.0.2.7...
```

From the above screenshot we can conclude that we were also not able to telnet from Machine '10.0.2.9' to Machine '10.0.2.7' after we updated the command from 'sudo ufw deny out proto tcp from 10.0.2.7 to 10.0.2.9' to 'sudo ufw deny in proto tcp from 10.0.2.7 to 10.0.2.9'

Prevent A from visiting an external web site. You can choose any web site that you like to block, but keep in mind, some web servers have multiple IP addresses.



In this task we are using the command 'sudo ufw deny out proto tcp from 10.0.2.7 to 128.230.18.198' which is the ip address of 'www.syr.edu' we can see from the above screenshot that we are not able to access the website which means that the website has been blocked successfully.

Task 2: Implementing a Simple Firewall

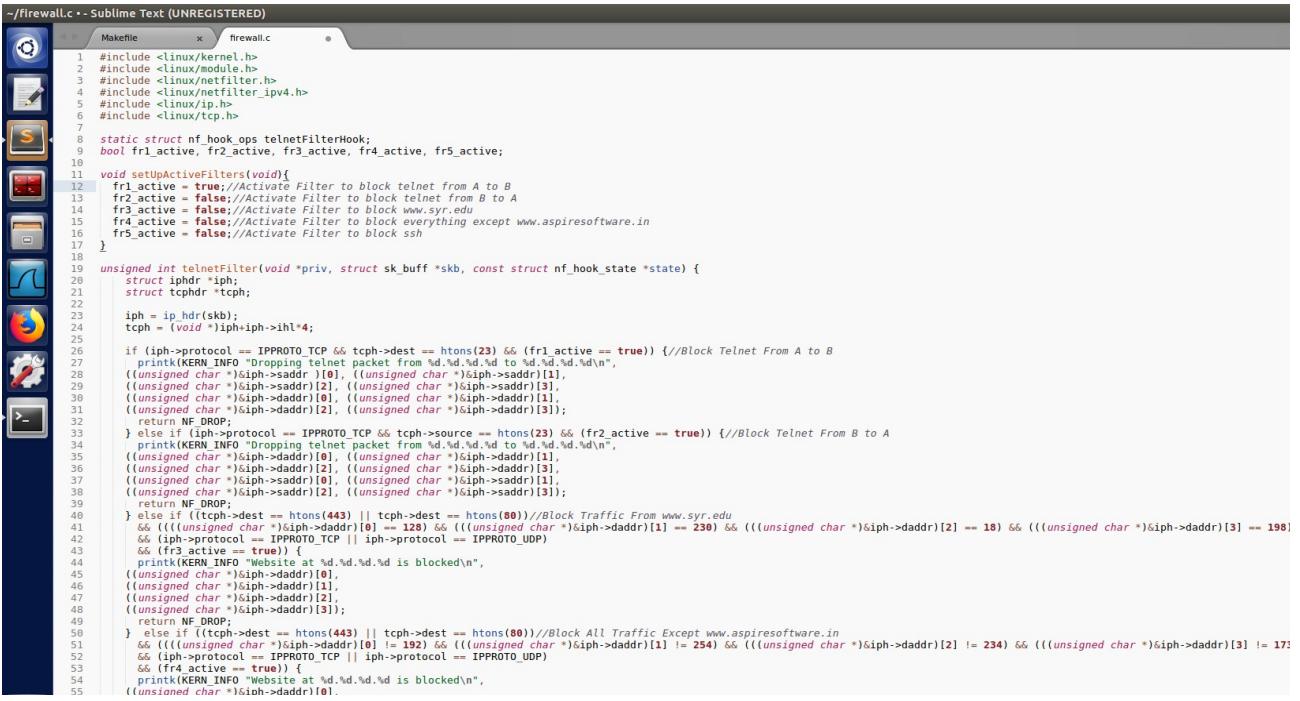
~/Makefile -- Sublime Text (UNREGISTERED)



```
1 obj-m += firewall.o
2 all:
3     make -C /lib/modules/$(shell uname -r)/build M=$(PWD) modules
4
5 clean:
6     make -C /lib/modules/$(shell uname -r)/build M=$(PWD) clean
7
```

(1)

~/firewall.c -- Sublime Text (UNREGISTERED)



```
1 #include <linux/kernel.h>
2 #include <linux/module.h>
3 #include <linux/netfilter.h>
4 #include <linux/netfilter_ipv4.h>
5 #include <linux/ip.h>
6 #include <linux/tcp.h>
7
8 static struct nf_hook_ops telnetFilterHook;
9 bool fr1_active, fr2_active, fr3_active, fr4_active, fr5_active;
10
11 void setUpActiveFilters(void){
12     fr1_active = true; //Activate Filter to block telnet from A to B
13     fr2_active = false; //Activate Filter to block telnet from B to A
14     fr3_active = false; //Activate Filter to block www.syr.edu
15     fr4_active = false; //Activate Filter to block everything except www.aspiresoftware.in
16     fr5_active = false; //Activate Filter to block ssh
17 }
18
19 unsigned int telnetFilter(void *priv, struct sk_buff *skb, const struct nf_hook_state *state) {
20     struct iphdr *iph;
21     struct tcphdr *tcph;
22
23     iph = ip_hdr(skb);
24     tcph = (void *)iph+iph->ihl*4;
25
26     if (iph->protocol == IPPROTO_TCP && tcph->dest == htons(23) && (fr1_active == true)) { //Block Telnet From A to B
27         printk(KERN_INFO "Dropping telnet packet from %d.%d.%d.%d to %d.%d.%d.%d\n",
28             ((unsigned char *)&iph->saddr)[0], ((unsigned char *)&iph->saddr)[1],
29             ((unsigned char *)&iph->saddr)[2], ((unsigned char *)&iph->saddr)[3],
30             ((unsigned char *)&iph->daddr)[0], ((unsigned char *)&iph->daddr)[1],
31             ((unsigned char *)&iph->daddr)[2], ((unsigned char *)&iph->daddr)[3]);
32         return NF_DROP;
33     } else if (iph->protocol == IPPROTO_TCP && tcph->source == htons(23) && (fr2_active == true)) { //Block Telnet From B to A
34         printk(KERN_INFO "Dropping telnet packet from %d.%d.%d.%d to %d.%d.%d.%d\n",
35             ((unsigned char *)&iph->saddr)[0], ((unsigned char *)&iph->saddr)[1],
36             ((unsigned char *)&iph->saddr)[2], ((unsigned char *)&iph->saddr)[3],
37             ((unsigned char *)&iph->daddr)[0], ((unsigned char *)&iph->daddr)[1],
38             ((unsigned char *)&iph->daddr)[2], ((unsigned char *)&iph->daddr)[3]);
39         return NF_DROP;
40     } else if (((tcph->dest == htons(443) || tcph->dest == htons(80)) //Block Traffic From www.syr.edu
41     && ((unsigned char *)&iph->daddr)[0] == 128) && (((unsigned char *)&iph->daddr)[1] == 230) && (((unsigned char *)&iph->daddr)[2] == 18) && (((unsigned char *)&iph->daddr)[3] == 198)
42     && (iph->protocol == IPPROTO_TCP || iph->protocol == IPPROTO_UDP)
43     && (fr3_active == true)) {
44         printk(KERN_INFO "Website at %d.%d.%d.%d is blocked\n",
45             ((unsigned char *)&iph->daddr)[0],
46             ((unsigned char *)&iph->daddr)[1],
47             ((unsigned char *)&iph->daddr)[2],
48             ((unsigned char *)&iph->daddr)[3]);
49         return NF_DROP;
50     } else if (((tcph->dest == htons(443) || tcph->dest == htons(80)) //Block All Traffic Except www.aspiresoftware.in
51     && (((unsigned char *)&iph->daddr)[0] != 192) && (((unsigned char *)&iph->daddr)[1] != 254) && (((unsigned char *)&iph->daddr)[2] != 234) && (((unsigned char *)&iph->daddr)[3] != 175)
52     && (iph->protocol == IPPROTO_TCP || iph->protocol == IPPROTO_UDP)
53     && (fr4_active == true)) {
54         printk(KERN_INFO "Website at %d.%d.%d.%d is blocked\n",
55             ((unsigned char *)&iph->daddr)[0]);
```

```

[02/17/2019 19:31] Parth@VM:~$ sudo insmod kMod.ko
insmod: ERROR: could not load module kMod.ko: No such file or directory
[02/17/2019 19:31] Parth@VM:~$ sudo rmod firewall
sudo: rmod: command not found
[02/17/2019 19:32] Parth@VM:~$ sudo rmmod firewall
[02/17/2019 19:32] Parth@VM:~$ make
make -C /lib/modules/4.8.0-36-generic/build M=/home/seed modules
make[1]: Entering directory '/usr/src/linux-headers-4.8.0-36-generic'
  CC [M]  /home/seed/firewall.o
Building modules, stage 2.
MODPOST 1 modules
  CC      /home/seed/firewall.mod.o
  LD [M]  /home/seed/firewall.ko
make[1]: Leaving directory '/usr/src/linux-headers-4.8.0-36-generic'
[02/17/2019 19:32] Parth@VM:~$ sudo insmod firewall.ko
[02/17/2019 19:32] Parth@VM:~$ telnet 10.0.2.8
Trying 10.0.2.8...

```

From the above screenshot we can see that we first consider `fr1_active` as true which prevents telnet from A to B.

We first insert the ‘firewall’ module which is our code name. Then we execute the make file. Once this is done and then try to telnet to 10.0.2.8 we can see that we are not able to do that which means that we were successful in the task.

(2)

```

~/firewall.c - Sublime Text (UNREGISTERED)

1 #include <linux/kernel.h>
2 #include <linux/module.h>
3 #include <linux/netfilter.h>
4 #include <linux/netfilter_ipv4.h>
5 #include <linux/ip.h>
6 #include <linux/tcp.h>
7
8 static struct nf_hook_ops telnetFilterHook;
9 boot fr1.active, fr2.active, fr3.active, fr4.active, fr5.active;
10
11 void setupActiveFilters(void){
12     fr1.active = false; //Activate Filter to block telnet from A to B
13     fr2.active = true; //Activate Filter to block telnet from B to A
14     fr3.active = false; //Activate Filter to block www.aspiresoftware.edu
15     fr4.active = false; //Activate Filter to block everything except www.aspiresoftware.in
16     fr5.active = false; //Activate Filter to block ssh
17 }
18
19 unsigned int telnetFilter(void *priv, struct sk_buff *skb, const struct nf_hook_state *state) {
20     struct iphdr *iph;
21     struct tcphdr *tcp;
22
23     iph = ip_hdr(skb);
24     tcp = (void *)iph->iph->ihl+4;
25
26     if ((iph->protocol == IPPROTO_TCP && tcp->dest == htons(23)) && (fr1.active == true)) { //Block Telnet From A to B
27         pr_info(KERN_INFO "Droped telnet from %d.%d.%d.%d to %d.%d.%d.%d\n",
28                 ((unsigned char *)iph->saddr)[0], ((unsigned char *)iph->saddr)[1],
29                 ((unsigned char *)iph->saddr)[2], ((unsigned char *)iph->saddr)[3],
30                 ((unsigned char *)iph->daddr)[0], ((unsigned char *)iph->daddr)[1],
31                 ((unsigned char *)iph->daddr)[2], ((unsigned char *)iph->daddr)[3]);
32         return NF_DROP;
33     } else if ((iph->protocol == IPPROTO_TCP && tcp->dest == htons(80)) && (fr2.active == true)) { //Block Telnet From B to A
34         pr_info(KERN_INFO "Droped telnet from %d.%d.%d.%d to %d.%d.%d.%d\n",
35                 ((unsigned char *)iph->saddr)[0], ((unsigned char *)iph->saddr)[1],
36                 ((unsigned char *)iph->saddr)[2], ((unsigned char *)iph->saddr)[3],
37                 ((unsigned char *)iph->daddr)[0], ((unsigned char *)iph->daddr)[1],
38                 ((unsigned char *)iph->daddr)[2], ((unsigned char *)iph->daddr)[3]);
39         return NF_DROP;
40     } else if ((tcp->dest == htons(443) || tcp->dest == htons(80)) //Block Traffic From www.syr.edu
41                 && (((unsigned char *)iph->daddr)[0] == 120) && (((unsigned char *)iph->daddr)[1] == 230) && (((unsigned char *)iph->daddr)[2] == 10) && (((unsigned char *)iph->daddr)[3] == 195))
42         && (fr3.active == true)) {
43         pr_info(KERN_INFO "%d.%d.%d.%d at %d.%d.%d.%d is blocked\n",
44                 ((unsigned char *)iph->saddr)[0],
45                 ((unsigned char *)iph->saddr)[1],
46                 ((unsigned char *)iph->saddr)[2],
47                 ((unsigned char *)iph->saddr)[3]);
48         return NF_DROP;
49     } else if ((tcp->dest == htons(443) || tcp->dest == htons(80)) //Block All Traffic Except www.aspiresoftware.in
50                 && (((unsigned char *)iph->daddr)[0] != 192) && (((unsigned char *)iph->daddr)[1] != 254) && (((unsigned char *)iph->daddr)[2] != 234) && (((unsigned char *)iph->daddr)[3] != 173))
51         && (fr4.active == true)) {
52         pr_info(KERN_INFO "%d.%d.%d.%d at %d.%d.%d.%d is blocked\n",
53                 ((unsigned char *)iph->saddr)[0],
54                 ((unsigned char *)iph->saddr)[1],
55                 ((unsigned char *)iph->saddr)[2],
56                 ((unsigned char *)iph->saddr)[3]);
57     }
58 }

```

```
[02/17/2019 19:32] Parth@VM:~$ ifconfig
enp0s3      Link encap:Ethernet  HWaddr 08:00:27:fd:ad:5b
              inet addr:10.0.2.9  Bcast:10.0.2.255  Mask:255.255.255
              inet6 addr: fe80::95cd:c763:81e:dfdf/64 Scope:Link
                      UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
                      RX packets:246 errors:0 dropped:0 overruns:0 frame:0
                      TX packets:170 errors:0 dropped:0 overruns:0 carrier:0
                      collisions:0 txqueuelen:1000
                      RX bytes:44424 (44.4 KB)  TX bytes:19624 (19.6 KB)

lo          Link encap:Local Loopback
              inet addr:127.0.0.1  Mask:255.0.0.0
              inet6 addr: ::1/128 Scope:Host
                      UP LOOPBACK RUNNING  MTU:65536  Metric:1
                      RX packets:291 errors:0 dropped:0 overruns:0 frame:0
                      TX packets:291 errors:0 dropped:0 overruns:0 carrier:0
                      collisions:0 txqueuelen:1
                      RX bytes:42226 (42.2 KB)  TX bytes:42226 (42.2 KB)

[02/17/2019 19:37] Parth@VM:~$ telnet 10.0.2.7
[02/17/2019 19:39] Parth@VM:~$ sudo insmod firewall.ko
[02/17/2019 19:39] Parth@VM:~$ ifconfig
enp0s3      Link encap:Ethernet  HWaddr 08:00:27:2c:d0:4f
              inet addr:10.0.2.7  Bcast:10.0.2.255  Mask:255.255.
              inet6 addr: fe80::5b:e211:fb3d:10df/64 Scope:Link
                      UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
                      RX packets:833 errors:0 dropped:0 overruns:0 frame:0
                      TX packets:852 errors:0 dropped:0 overruns:0 carrier
                      collisions:0 txqueuelen:1000
                      RX bytes:254292 (254.2 KB)  TX bytes:147001 (147.0

lo          Link encap:Local Loopback
              inet addr:127.0.0.1  Mask:255.0.0.0
              inet6 addr: ::1/128 Scope:Host
                      UP LOOPBACK RUNNING  MTU:65536  Metric:1
                      RX packets:458 errors:0 dropped:0 overruns:0 frame:0
                      TX packets:458 errors:0 dropped:0 overruns:0 carrier
                      collisions:0 txqueuelen:1
                      RX bytes:58839 (58.8 KB)  TX bytes:58839 (58.8 KB)

[02/17/2019 19:39] Parth@VM:~$
```

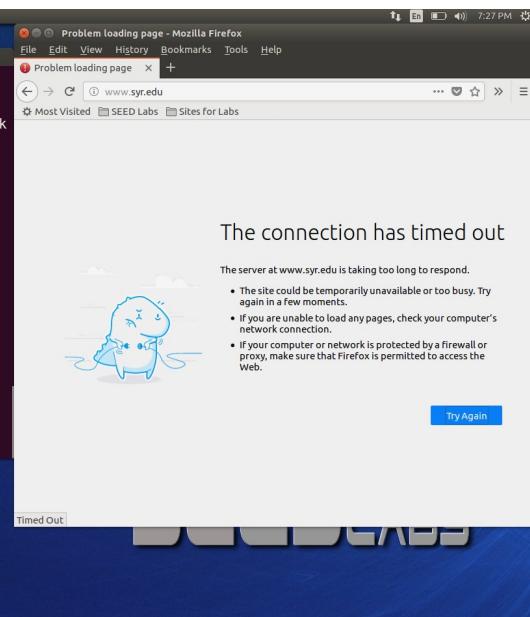
This is similar to the previous one except that in this task we are trying to telnet from machine B '10.0.2.9' to machine A '10.0.2.7'.

(3)

/firewall.c -- Sublime Text (UNREGISTERED)

```
1 #include <linux/kernel.h>
2 #include <linux/module.h>
3 #include <linux/netfilter.h>
4 #include <linux/netfilter_ipv4.h>
5 #include <linux/ip.h>
6 #include <linux/tcp.h>
7
8 static struct nf_hook_ops telnetFilterHook;
9 bool fr1_active, fr2_active, fr3_active, fr4_active, fr5_active;
10
11 void setupUpFilters(void);
12
13 fr1_active = false; //Activate Filter to block telnet from A to B
14 fr2_active = false; //Activate Filter to block telnet from B to A
15 fr3_active = true; //Activate Filter to block www.syr.edu
16 fr4_active = false; //Activate Filter to block everything except www.aspiresoftware.in
17 fr5_active = false; //Activate Filter to block ssh
18
19 unsigned int telnetFilter(void *priv, struct sk_buff *skb, const struct nf_hook_state *state) {
20     struct iphdr *iph;
21     struct tcphdr *tcpiph;
22
23     iph = ip_hdr(skb);
24     tcpiph = (void *)iph->iph->hl+4;
25
26     if (iph->protocol == IPPROTO_TCP && tcpiph->dest == htons(23) && (fr1_active == true)) { //Block Telnet From A to B
27         printk(KERN_INFO "Dropping telnet packet From %d.%d.%d.%d to %d.%d.%d.%d\n",
28               (unsigned char *)iph->saddr)[0], ((unsigned char *)iph->saddr)[1],
29               ((unsigned char *)iph->saddr)[2], ((unsigned char *)iph->saddr)[3],
30               ((unsigned char *)iph->daddr)[0], ((unsigned char *)iph->daddr)[1],
31               ((unsigned char *)iph->daddr)[2], ((unsigned char *)iph->daddr)[3]);
32
33     } else if (iph->protocol == IPPROTO_TCP && tcpiph->source == htons(23) && (fr2_active == true)) { //Block Telnet From B to A
34         printk(KERN_INFO "Dropping telnet packet From %d.%d.%d.%d to %d.%d.%d.%d\n",
35               (unsigned char *)iph->saddr)[0], ((unsigned char *)iph->saddr)[1],
36               ((unsigned char *)iph->saddr)[2], ((unsigned char *)iph->saddr)[3],
37               ((unsigned char *)iph->daddr)[0], ((unsigned char *)iph->daddr)[1],
38               ((unsigned char *)iph->daddr)[2], ((unsigned char *)iph->daddr)[3]);
39
40     } else if ((tcpiph->dest == htons(443) || tcpiph->dest == htons(80)) && (fr3_active == true)) { //Block Traffic From www.syr.edu
41         && (((unsigned char *)iph->daddr)[1] == 128) && (((unsigned char *)iph->daddr)[2] == 230) && (((unsigned char *)iph->daddr)[3] == 198));
42
43     } else if ((tcpiph->dest == htons(443) || tcpiph->dest == htons(80)) && (fr4_active == true)) { //Block All Traffic Except www.aspiresoftware.in
44         && (((unsigned char *)iph->daddr)[1] != 128) && (((unsigned char *)iph->daddr)[1] != 254) && (((unsigned char *)iph->daddr)[2] != 234) && (((unsigned char *)iph->daddr)[3] != 173));
45
46     } else if ((tcpiph->dest == IPPROTO_TCP || iph->protocol == IPPROTO_UDP) && (fr5_active == true)) { //Block ssh
47         && (((unsigned char *)iph->daddr)[0], ((unsigned char *)iph->daddr)[1],
48               ((unsigned char *)iph->daddr)[2], ((unsigned char *)iph->daddr)[3]);
49
50     } else if ((tcpiph->dest == htons(443) || tcpiph->dest == htons(80)) && (fr4_active == true)) { //Block All Traffic Except www.aspiresoftware.in
51         && (((unsigned char *)iph->daddr)[1] != 128) && (((unsigned char *)iph->daddr)[1] != 254) && (((unsigned char *)iph->daddr)[2] != 234) && (((unsigned char *)iph->daddr)[3] != 173));
52
53     } else if ((tcpiph->dest == IPPROTO_TCP || iph->protocol == IPPROTO_UDP) && (fr5_active == true)) { //Block ssh
54         && (((unsigned char *)iph->daddr)[0], ((unsigned char *)iph->daddr)[1],
55               ((unsigned char *)iph->daddr)[2], ((unsigned char *)iph->daddr)[3]));
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57 }
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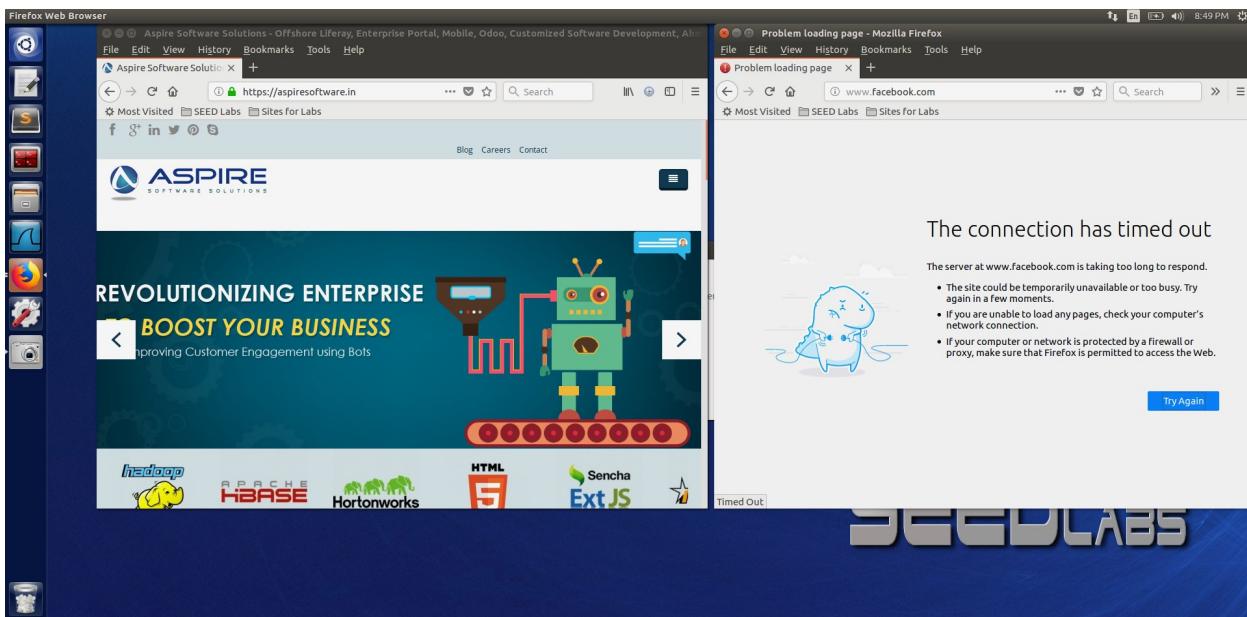
```
[02/17/2019 19:22] Parth@VM:~$ make
make -C /lib/modules/4.8.0-36-generic/build M=/home/seed modules
make[1]: Entering directory '/usr/src/linux-headers-4.8.0-36-generic'
make[2]: *** No rule to make target '/home/seed/kMod.c', needed by '/home/seed/Mod.o'. Stop.
Makefile:1491: recipe for target ' module _/home/seed' failed
make[1]: *** [_module_/_home/seed] Error 2
make[1]: Leaving directory '/usr/src/linux-headers-4.8.0-36-generic'
Makefile:3: recipe for target 'all' failed
make: *** [all] Error 2
[02/17/2019 19:22] Parth@VM:~$ make
make -C /lib/modules/4.8.0-36-generic/build M=/home/seed modules
make[1]: Entering directory '/usr/src/linux-headers-4.8.0-36-generic'
  CC [M]  /home/seed/firewall.o
  Building modules, stage 2.
  MODPOST 1 modules
  CC      /home/seed/firewall.mod.o
  LD [M]  /home/seed/firewall.ko
make[1]: Leaving directory '/usr/src/linux-headers-4.8.0-36-generic'
[02/17/2019 19:23] Parth@VM:~$ sudo insmod kMod.ko
[sudo] password for seed:
insmod: ERROR: could not load module kMod.ko: No such file or directory
[02/17/2019 19:23] Parth@VM:~$ sudo insmod firewall.ko
[02/17/2019 19:24] Parth@VM:~$ ]
```



In this task we are blocking the website ‘www.syr.edu’ whose ip address is 128.230.18.198.

As seen from the above screenshot we were not able to access the website.

(4)



In this task we are blocking all the websites except ‘www.aspiresoftware.in’ whose ip is ‘192.254.234.173’ To demonstrate that we are accessing two sites simultaneously – ‘www.aspiresoftware.in’ and ‘www.facebook.com’ we can see from the screenshot that we are able to access the ‘www.aspiresoftware.in’ but were not able to access ‘www.facebook.com’.

(5)

-/firewall.c - Sublime Text (UNREGISTERED)

```
1 #include <linux/kernel.h>
2 #include <linux/module.h>
3 #include <linux/netfilter.h>
4 #include <linux/netfilter_ipv4.h>
5 #include <linux/ip.h>
6 #include <linux/tcp.h>
7
8 static struct nf_hook_ops telnetFilterHook;
9
10 bool fr1_active, fr2_active, fr3_active, fr4_active, fr5_active;
11
12 void setActiveFilter(void)
13 {
14     fr1_active = false; //Activate Filter to block telnet from A to B
15     fr2_active = false; //Activate Filter to block telnet from B to A
16     fr3_active = false; //Activate Filter to block www.syr.edu
17     fr4_active = false; //Activate Filter to block everything except www.aspiresoftware.in
18     fr5_active = true; //Activate Filter to block ssh
19 }
20
21 unsigned int telnetFilter(void *priv, struct sk_buff *skb, const struct nf_hook_state *state)
22 {
23     struct iphdr *iph;
24     struct tcphdr *tcpiph;
25
26     iph = ip_hdr(skb);
27     tcpiph = (void *)iph->iph->ihl+4;
28
29     if (iph->protocol == IPPROTO_TCP && tcpiph->dest == htons(23) && (fr1_active == true)) { //Block Telnet From A to B
30         printk(KERN_INFO "Dropping telnet packet from %d.%d.%d.%d to %d.%d.%d.%d", (unsigned char *)iph->saddr[0], (unsigned char *)iph->saddr[1], (unsigned char *)iph->saddr[2], (unsigned char *)iph->saddr[3], (unsigned char *)iph->daddr[0], (unsigned char *)iph->daddr[1], (unsigned char *)iph->daddr[2], (unsigned char *)iph->daddr[3]);
31     }
32     else if (iph->protocol == IPPROTO_TCP && tcpiph->source == htons(23) && (fr2_active == true)) { //Block Telnet From B to A
33         printk(KERN_INFO "Dropping telnet packet from %d.%d.%d.%d to %d.%d.%d.%d", (unsigned char *)iph->daddr[0], (unsigned char *)iph->daddr[1], (unsigned char *)iph->daddr[2], (unsigned char *)iph->daddr[3], (unsigned char *)iph->saddr[0], (unsigned char *)iph->saddr[1], (unsigned char *)iph->saddr[2], (unsigned char *)iph->saddr[3]);
34     }
35     else if ((tcpiph->dest == htons(443) || tcpiph->dest == htons(80)) && (fr3_active == true)) { //Block Traffic From www.syr.edu
36         if (((unsigned char *)iph->daddr)[1] == 128) && (((unsigned char *)iph->daddr)[1] == 230) && (((unsigned char *)iph->daddr)[2] == 18) && (((unsigned char *)iph->daddr)[3] == 198))
37             if (((unsigned char *)iph->daddr)[0] == 192 && ((tcpiph->dest == htons(443)) || (tcpiph->dest == htons(80))) && (iph->protocol == IPPROTO_UDP))
38                 fr3_active = true;
39         printk(KERN_INFO "Website at %d.%d.%d.%d is blocked\n", (unsigned char *)iph->saddr[0], (unsigned char *)iph->saddr[1], (unsigned char *)iph->saddr[2], (unsigned char *)iph->saddr[3]);
40     }
41     else if ((tcpiph->dest == htons(443) || tcpiph->dest == htons(80)) && (fr4_active == true)) { //Block All Traffic Except www.aspiresoftware.in
42         if (((unsigned char *)iph->daddr)[0] != 192 && (((unsigned char *)iph->daddr)[1] != 254) && (((unsigned char *)iph->daddr)[2] != 234) && (((unsigned char *)iph->daddr)[3] != 173))
43             if (((tcpiph->dest == htons(443)) || (tcpiph->dest == htons(80))) && (iph->protocol == IPPROTO_UDP))
44                 fr4_active = true;
45         printk(KERN_INFO "Website at %d.%d.%d.%d is blocked\n", (unsigned char *)iph->saddr[0], (unsigned char *)iph->saddr[1], (unsigned char *)iph->saddr[2], (unsigned char *)iph->saddr[3]);
46     }
47 }
48
49
50
51
52
53
54
55
```

Line 16, Column 20

hook.num

Find Find Prev Find All

Spaces: 2

```
22
23     iph = ip_hdr(skb);
24     tcp = (void *)iph->ihl*4;
25
26     if (iph->protocol == IPPROTO_TCP && tcp->dest == htons(23) && (fr1.active == true)) { //Block Telnet From A to B
27         printk(KERN_INFO "Allowing telnet connection from %d.%d.%d.%d to %d.%d.%d.%d\n",
28             ((unsigned char *)iph->saddr)[0], ((unsigned char *)iph->saddr)[1],
29             ((unsigned char *)iph->saddr)[2], ((unsigned char *)iph->saddr)[3],
30             ((unsigned char *)iph->daddr)[0], ((unsigned char *)iph->daddr)[1],
31             ((unsigned char *)iph->daddr)[2], ((unsigned char *)iph->daddr)[3]);
32
33         return NF_DROP;
34     } else if (iph->protocol == IPPROTO_TCP && tcp->dest == htons(23) && (fr2_active == true)) { //Block Telnet From B to A
35         printk(KERN_INFO "Allowing telnet connection from %d.%d.%d.%d to %d.%d.%d.%d\n",
36             ((unsigned char *)iph->saddr)[0], ((unsigned char *)iph->saddr)[1],
37             ((unsigned char *)iph->saddr)[2], ((unsigned char *)iph->saddr)[3],
38             ((unsigned char *)iph->daddr)[0], ((unsigned char *)iph->daddr)[1],
39             ((unsigned char *)iph->daddr)[2], ((unsigned char *)iph->daddr)[3]);
40
41         return NF_DROP;
42     }
43     else if (iph->protocol == IPPROTO_TCP || iph->protocol == IPPROTO_UDP) {
44         if (fr1.active == true) {
45             if ((iph->saddr[0] <= 127) && ((unsigned char *)iph->daddr)[1] == 230) && (((unsigned char *)iph->daddr)[2] == 18) && (((unsigned char *)iph->daddr)[3] == 198))
46                 printk(KERN_INFO "%d.%d.%d.%d is blocked\n",
47                     ((unsigned char *)iph->saddr)[0],
48                     ((unsigned char *)iph->saddr)[1],
49                     ((unsigned char *)iph->saddr)[2],
50                     ((unsigned char *)iph->saddr)[3]);
51
52         return NF_DROP;
53     }
54     else if (tcp->dest == htons(443) || tcp->dest == htons(80)) //Block All Traffic Except www.aspiresoftware.in
55     {
56         if (fr1.active == true) {
57             if ((iph->saddr[0] <= 127) && ((unsigned char *)iph->daddr)[1] != 284 && (((unsigned char *)iph->daddr)[2] != 234) && (((unsigned char *)iph->daddr)[3] != 173))
58                 printk(KERN_INFO "%d.%d.%d.%d is blocked\n",
59                     ((unsigned char *)iph->saddr)[0],
60                     ((unsigned char *)iph->saddr)[1],
61                     ((unsigned char *)iph->saddr)[2],
62                     ((unsigned char *)iph->saddr)[3]);
63
64         return NF_DROP;
65     }
66     else if ((tcp->dest == htons(22)) //Block ssh on port 22
67             || (iph->protocol == IPPROTO_TCP || iph->protocol == IPPROTO_UDP)
68             && (fr1.active == true)) {
69         if ((iph->saddr[0] <= 127) && ((unsigned char *)iph->daddr)[1] == 102 && (((unsigned char *)iph->daddr)[2] != 234) && (((unsigned char *)iph->daddr)[3] != 173))
70             printk(KERN_INFO "%d.%d.%d.%d is blocked\n",
71                 ((unsigned char *)iph->saddr)[0],
72                 ((unsigned char *)iph->saddr)[1],
73                 ((unsigned char *)iph->saddr)[2],
74                 ((unsigned char *)iph->saddr)[3]);
75
76         return NF_DROP;
77     }
78     else if (fr1.active == true || fr2_active == true) {
79         if (fr1.active == true) {
80             printk(KERN_INFO "Allowing telnet connection from %d.%d.%d.%d to %d.%d.%d.%d\n",
81                 ((unsigned char *)iph->saddr)[0], ((unsigned char *)iph->saddr)[1],
82                 ((unsigned char *)iph->saddr)[2], ((unsigned char *)iph->saddr)[3],
83                 ((unsigned char *)iph->daddr)[0], ((unsigned char *)iph->daddr)[1],
84                 ((unsigned char *)iph->daddr)[2], ((unsigned char *)iph->daddr)[3]);
85
86         return NF_DROP;
87     }
88 }
```

```
[Terminal] Terminal [02/18/2019 19:04] Parth@VM:~$ make  
make -C /lib/modules/4.8.0-36-generic/build M=/home/seed modules  
make[1]: Entering directory '/usr/src/linux-headers-4.8.0-36-generic'  
Building modules, stage 2.  
MODPOST 1 modules  
make[1]: Leaving directory '/usr/src/linux-headers-4.8.0-36-generic'  
[02/18/2019 19:04] Parth@VM:~$ sudo insmod firewall.ko  
[02/18/2019 19:04] Parth@VM:~$ ssh 10.0.2.9 22
```

In this part we are refusing the ssh connection on port 22 from machine A to any other IP .

Task 3.a: Telnet to Machine B through the firewall

```
[02/18/2019 17:26] Parth@VM:-$ ssh -L 8000:10.0.2.8:23 10.0.2.9
seed@10.0.2.9's password:
Welcome to Ubuntu 16.04.2 LTS (GNU/Linux 4.8.0-36-generic i686)

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

3 packages can be updated.
0 updates are security updates.

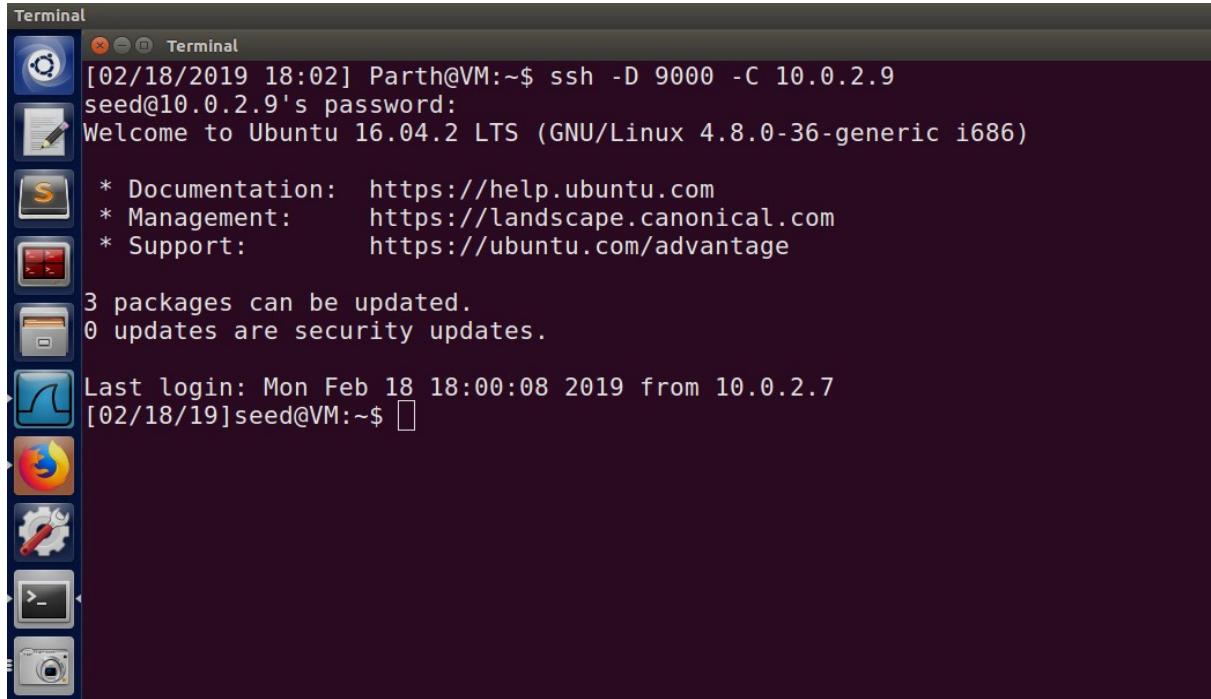
Last login: Mon Feb 18 17:24:30 2019 from 10.0.2.7
[02/18/19]seed@VM:~$ 
```

```
[02/18/2019 17:27] Parth@VM:~$ telnet localhost 8000
Trying 127.0.0.1...
Connected to localhost.
Escape character is '^'.
Ubuntu 16.04.2 LTS
VM login: seed
Password:
Last login: Mon Feb 18 17:25:10 EST 2019 from 10.0.2.9 on pts/2
Welcome to Ubuntu 16.04.2 LTS (GNU/Linux 4.8.0-36-generic i686)
```

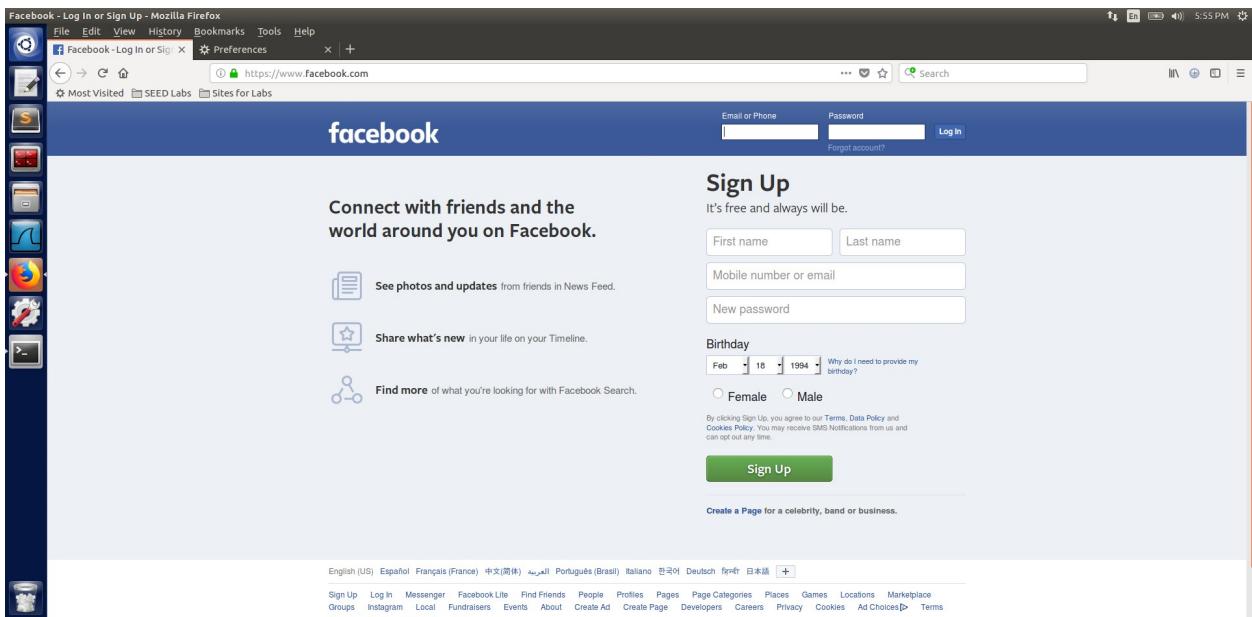
No.	Time	Source	Destination	Protocol	Length	Info
1	2019-02-18 17:39:55.9188501	10.0.2.7	10.0.2.9	SSH	104	Client: Encrypted packet (len=36)
2	2019-02-18 17:39:55.9189728	10.0.2.9	10.0.2.8	TELNET	69	Telnet Data ...
3	2019-02-18 17:39:55.9196609	10.0.2.8	10.0.2.9	TELNET	69	Telnet Data ...
4	2019-02-18 17:39:55.9196668	10.0.2.9	10.0.2.8	TCP	68	59038 - 23 [ACK] Seq=1917300860 Ack=3441300585 Win=237 Len=0 TSecr=195848 TSecv=188297
5	2019-02-18 17:39:55.9197464	10.0.2.9	10.0.2.7	SSH	104	Server: Encrypted packet (len=36)
6	2019-02-18 17:39:55.9208113	10.0.2.7	10.0.2.9	TCP	68	37070 - 22 [ACK] Seq=3286011328 Ack=1800582940 Win=305 Len=0 TSecr=201446 TSecv=195848
7	2019-02-18 17:39:56.1326454	10.0.2.7	10.0.2.9	SSH	104	Client: Encrypted packet (len=36)
8	2019-02-18 17:39:56.1329930	10.0.2.9	10.0.2.8	TELNET	69	Telnet Data ...
9	2019-02-18 17:39:56.1337883	10.0.2.8	10.0.2.9	TELNET	69	Telnet Data ...
10	2019-02-18 17:39:56.1338095	10.0.2.9	10.0.2.8	TCP	68	59038 - 23 [ACK] Seq=1917300861 Ack=3441300586 Win=237 Len=0 TSecr=195801 TSecv=188351
11	2019-02-18 17:39:56.1340115	10.0.2.9	10.0.2.7	SSH	104	Server: Encrypted packet (len=36)
12	2019-02-18 17:39:56.1343892	10.0.2.7	10.0.2.9	TCP	68	37070 - 22 [ACK] Seq=3286011364 Ack=1800582976 Win=305 Len=0 TSecr=201499 TSecv=195901
13	2019-02-18 17:39:56.2876241	10.0.2.7	10.0.2.8	SSH	104	Client: Encrypted packet (len=36)
	rx 981824.18 17:40:04.9871434	10.0.2.8	10.0.2.8	TELNET	69	Rd Telnet Data

In this task we are using the command ‘ssh -L 8000:10.0.2.8:23 10.0.2.9’ this command establishes a SSH connection between the localhost and 10.0.2.9 from ‘10.0.2.9’ the packets are forwarded to 10.0.2.8 on port 23. Similarly the reply will take a reverse path and eventually will reach the telnet client. Since, we are not able to build a connection from telnet client to telnet server therefore, we are first creating SSH tunnel from localhost to 10.0.2.9. From there we are connecting to 10.0.2.8.

Task 3.b: Connect to Facebook using SSH Tunnel.



A screenshot of a Linux desktop environment, specifically Ubuntu 16.04.2 LTS. A terminal window titled "Terminal" is open, displaying the command `ssh -D 9000 -C 10.0.2.9` and the password for the user "seed". The terminal also shows system updates, last login information, and a prompt for the user "seed". The desktop background is dark, and the taskbar at the bottom has icons for various applications like a file manager, browser, and terminal.



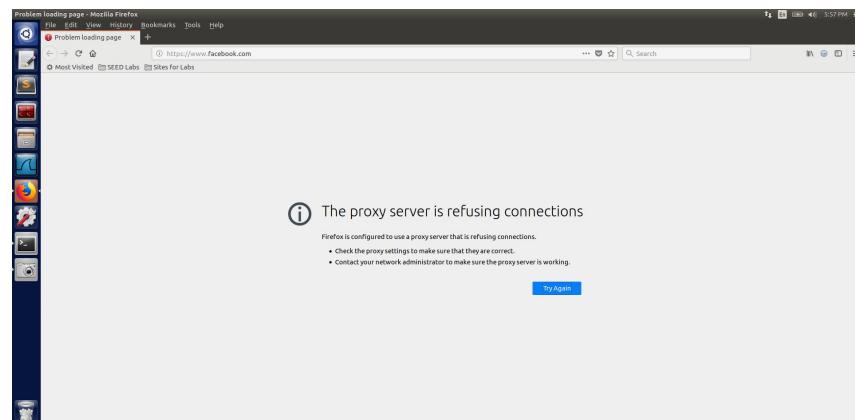
Terminal

```
[02/18/2019 17:56] Parth@VM:~$ ssh -D 9000 -C 10.0.2.9
seed@10.0.2.9's password:
Welcome to Ubuntu 16.04.2 LTS (GNU/Linux 4.8.0-36-generic)

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

3 packages can be updated.
0 updates are security updates.

Last login: Mon Feb 18 17:55:17 2019 from 10.0.2.7
[02/18/19]seed@VM:~$ exit
logout
Connection to 10.0.2.9 closed.
[02/18/2019 17:57] Parth@VM:~$
```

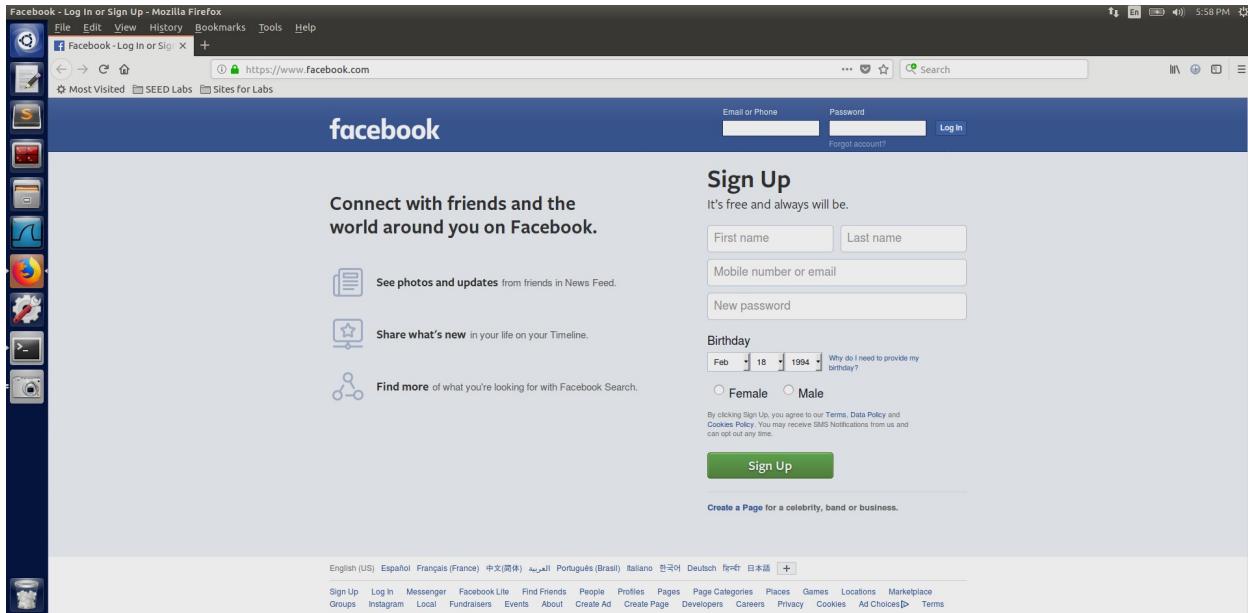


Capturing from any

No.	Time	Source	Destination	Protocol	Length	Info
2	2019-02-18 18:11:28.1855571...	10.0.2.7	10.0.2.9	SSH	1696	Client: Encrypted packet (len=1628)
3	2019-02-18 18:11:28.1855847...	10.0.2.9	10.0.2.7	TCP	68 22 - 37750	[ACK] Seq=1649231516 Ack=1605386689 Win=1332 Len=0 TSval=668914 TSecr=674525
4	2019-02-18 18:11:28.1856729...	10.0.2.9	31.13.71.36	TLSv1.2	1642	Application Data, Application Data
5	2019-02-18 18:11:28.1857953...	10.0.2.7	10.0.2.9	SSH	4064	Client: Encrypted packet (len=3996)
6	2019-02-18 18:11:28.1858699...	10.0.2.9	10.0.2.7	TCP	68 22 - 37750	[ACK] Seq=1649231516 Ack=1605390685 Win=1332 Len=0 TSval=668914 TSecr=674525
7	2019-02-18 18:11:28.1859346...	10.0.2.9	31.13.71.36	TCP	2976	[TCP segment of a reassembled PDU]
8	2019-02-18 18:11:28.1859848...	10.0.2.9	31.13.71.36	TLSv1.2	1085	Application Data
9	2019-02-18 18:11:28.1860138...	31.13.71.36	10.0.2.9	TCP	62 443 - 35970	[ACK] Seq=353309 Ack=1003880977 Win=32768 Len=0
10	2019-02-18 18:11:28.1861846...	31.13.71.36	10.0.2.9	TCP	62 443 - 35970	[ACK] Seq=353309 Ack=1003883897 Win=32768 Len=0
11	2019-02-18 18:11:28.1884853...	10.0.2.7	10.0.2.9	SSH	136	Client: Encrypted packet (len=68)
12	2019-02-18 18:11:28.1886123...	10.0.2.9	31.13.71.36	TLSv1.2	91	Application Data
13	2019-02-18 18:11:28.1887270...	31.13.71.36	10.0.2.9	TCP	62 443 - 35970	[ACK] Seq=353309 Ack=1003884961 Win=31704 Len=0
14	2019-02-18 18:11:28.1974283...	10.0.2.7	10.0.2.9	SSH	184	Client: Encrypted packet (len=116)
15	2019-02-18 18:11:28.1975315...	10.0.2.9	10.0.2.7	TCP	68 22 - 37750	[ACK] Seq=1649231516 Ack=1605390869 Win=1332 Len=0 TSval=668917 TSecr=674526

► Frame 4: 1642 bytes on wire (13136 bits), 1642 bytes captured (13136 bits) on interface 0

► Linux cooked capture



We can see that at first we were able to connect to facebook.com. Later, when we break the ssh and try to connect to facebook the proxy server refuses the connection. Now, when we again SSH tunnel we can again connect to facebook .

From the wirehsark we can see that 10.0.2.7 is creating ssh to 10.0.2.9. And then when we are browsing to facebook.com, it is getting execute from 10.0.2.9 and the reply is taking the reverse path to 10.0.2.7.

Task 4: Evading Ingress Filtering

```
Terminal
[02/18/2019 18:20] Parth@VM:~$ sudo ufw deny in http
Rule added
Rule added (v6)
[02/18/2019 18:21] Parth@VM:~$ sudo ufw status
Status: active
To          Action      From
--          -----      -----
80          DENY       Anywhere
80 (v6)    DENY       Anywhere (v6)

[02/18/2019 18:21] Parth@VM:~$ /etc/init.d/apache
apache2      apache-htcacheclean
[02/18/2019 18:21] Parth@VM:~$ /etc/init.d/apache
apache2      apache-htcacheclean
[02/18/2019 18:21] Parth@VM:~$ /etc/init.d/apache2 start
[ ok ] Starting apache2 (via systemctl): apache2.service.
[02/18/2019 18:22] Parth@VM:~$ sudo ufw deny in 23/tcp
Rule added
Rule added (v6)
[02/18/2019 18:24] Parth@VM:~$ sudo ufw status
Status: active
To          Action      From
--          -----      -----
80          DENY       Anywhere
23/tcp     DENY       Anywhere
80 (v6)    DENY       Anywhere (v6)
23/tcp (v6) DENY       Anywhere (v6)

[02/18/2019 18:24] Parth@VM:~$ sudo ufw deny in 22/tcp
Rule added
Rule added (v6)
[02/18/2019 18:24] Parth@VM:~$ ssh -R 8000:localhost:80 seed@10.0.2.9
seed@10.0.2.9's password:
Welcome to Ubuntu 16.04.2 LTS (GNU/Linux 4.8.0-36-generic i686)
```

Terminal

```
[02/18/2019 18:21] Parth@VM:~$ /etc/init.d/apache2 apache-htcacheclean
[02/18/2019 18:21] Parth@VM:~$ /etc/init.d/apache2 apache-htcacheclean
[02/18/2019 18:21] Parth@VM:~$ /etc/init.d/apache2 start
[ ok ] Starting apache2 (via systemctl): apache2.service.
[02/18/2019 18:22] Parth@VM:~$ sudo ufw deny in 23/tcp
Rule added
Rule added (v6)
[02/18/2019 18:24] Parth@VM:~$ sudo ufw status
Status: active

To                         Action      From
--                         DENY       Anywhere
80                         DENY       Anywhere
23/tcp                      DENY       Anywhere (v6)
80 (v6)                     DENY       Anywhere (v6)
23/tcp (v6)                 DENY       Anywhere (v6)

[02/18/2019 18:24] Parth@VM:~$ sudo ufw deny in 22/tcp
Rule added
Rule added (v6)
[02/18/2019 18:24] Parth@VM:~$ ssh -R 8000:localhost:80 seed@10.0.2.9
seed@10.0.2.9's password:
Welcome to Ubuntu 16.04.2 LTS (GNU/Linux 4.8.0-36-generic i686)

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

3 packages can be updated.
0 updates are security updates.

Last login: Mon Feb 18 18:02:30 2019 from 10.0.2.7
[02/18/19]seed@VM:~$ 
```

Authenticate

Terminal

```
[02/18/19]seed@VM:~$ ifconfig
enp0s3   Link encap:Ethernet HWaddr 08:00:27:fd:ad:5b
          inet addr:10.0.2.9 Bcast:10.0.2.255 Mask:255.255.255.0
          inet6 addr: fe80::95cd:c763:81e:dfdf/64 Scope:Link
             UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
             RX packets:7001 errors:0 dropped:0 overruns:0 frame:0
             TX packets:7987 errors:0 dropped:0 overruns:0 carrier:0
             collisions:0 txqueuelen:1000
             RX bytes:4003276 (4.0 MB)  TX bytes:6325132 (6.3 MB)

lo        Link encap:Local Loopback
          inet addr:127.0.0.1 Mask:255.0.0.0
          inet6 addr: ::1/128 Scope:Host
             UP LOOPBACK RUNNING MTU:65536 Metric:1
             RX packets:491 errors:0 dropped:0 overruns:0 frame:0
             TX packets:491 errors:0 dropped:0 overruns:0 carrier:0
             collisions:0 txqueuelen:1
             RX bytes:59588 (59.5 KB)  TX bytes:59588 (59.5 KB)

[02/18/19]seed@VM:~$ PS1='[`date "+%x %H:%M"] Parth@\h:\w\$ '
[02/18/2019 18:29] Parth@VM:~$ /etc/init.d/apache2 stop
[....] Stopping apache2 (via systemctl): apache2.service
```

Authenticate

Authentication is required to stop 'apache2.service'.
An application is attempting to perform an action that requires privileges. Authentication is required to perform this action.

Password:

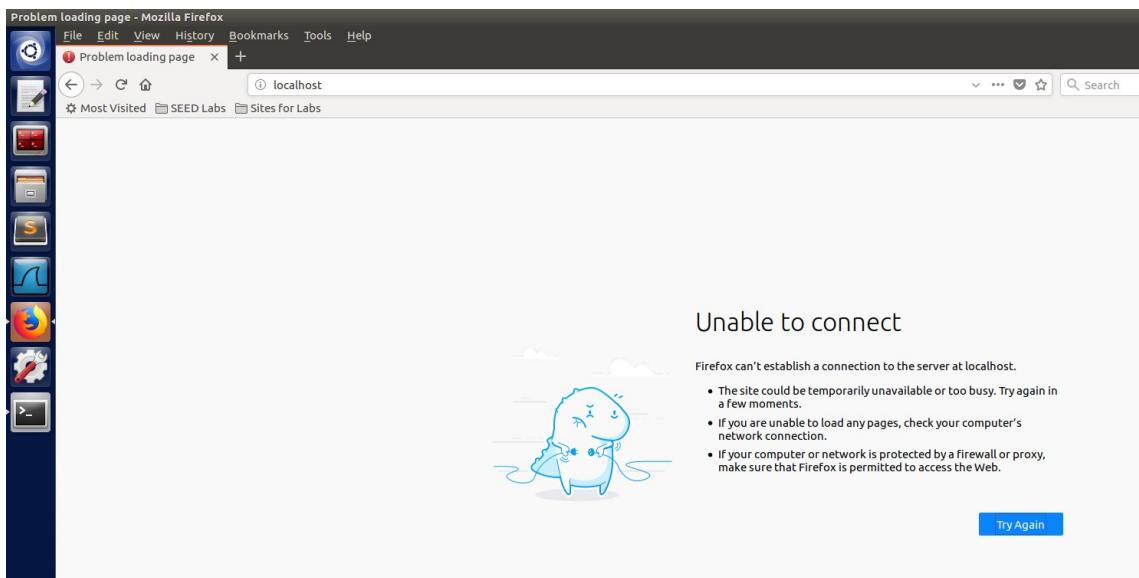
Details Cancel Authenticate

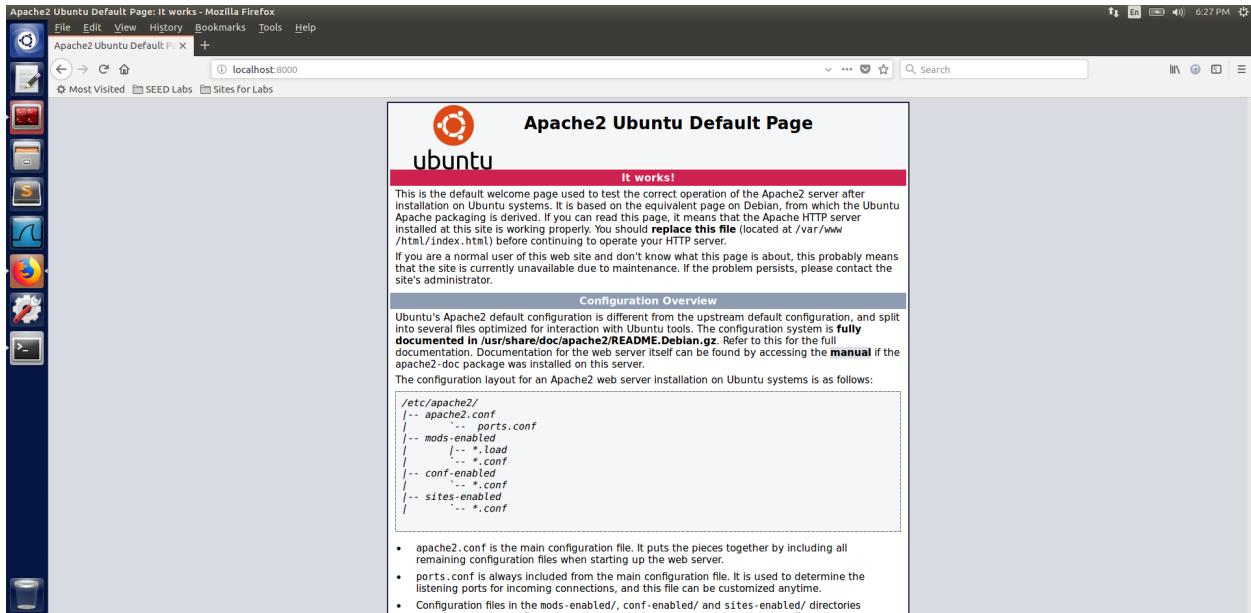
Terminal

```
[02/18/19]seed@VM:~$ ifconfig
enp0s3      Link encap:Ethernet HWaddr 08:00:27:fd:ad:5b
             inet addr:10.0.2.9  Bcast:10.0.2.255  Mask:255.255.255.0
             inet6 addr: fe80::95cd:c763:81e:dfdf/64 Scope:Link
                   UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
                   RX packets:7001 errors:0 dropped:0 overruns:0 frame:0
                   TX packets:7987 errors:0 dropped:0 overruns:0 carrier:0
                   collisions:0 txqueuelen:1000
                   RX bytes:4003276 (4.0 MB)  TX bytes:6325132 (6.3 MB)

lo          Link encap:Local Loopback
             inet addr:127.0.0.1  Mask:255.0.0.0
             inet6 addr: ::1/128 Scope:Host
                   UP LOOPBACK RUNNING  MTU:65536  Metric:1
                   RX packets:491 errors:0 dropped:0 overruns:0 frame:0
                   TX packets:491 errors:0 dropped:0 overruns:0 carrier:0
                   collisions:0 txqueuelen:1
                   RX bytes:59588 (59.5 KB)  TX bytes:59588 (59.5 KB)

[02/18/19]seed@VM:~$ PS1='[`date "+%x %H:%M" `] Parth@\h:\w\$ '
[02/18/2019 18:29] Parth@VM:~$ /etc/init.d/apache2 stop
[ ok ] Stopping apache2 (via systemctl): apache2.service.
[02/18/2019 18:30] Parth@VM:~$ 
```





From Machine A (10.0.2.7) we are first denying all the http request (port 80 and 22). Then we create a reverse shell to machine B using the command `ssh -R 8000:localhost:80 seed@10.0.2.9`. Now, just to make sure that the apache of machine B does not show up when we try to connect to machine A from B, we first stop the machine B's apache as seen from the above screenshot. And then to verify that we type in the browser 'localhost' which displays that we are not able to connect. Now when we type `localhost:8000` we can see the Apache2 ubuntu default page which indicates that we are connected to machine B from A.