Lab 6 Linux Firewall Exploration

Task 1: Using Firewall

虚拟机信息

虚拟机	IP
SEED	192.168.11.140
SEED 1	192.168.11.143

调整默认条目，防止被丢弃

```
 9 # Set the default input policy to ACCEPT, DROP, or REJECT. Please not
   e that if
10 # you change this you will most likely want to adjust your rules.
11 DEFAULT INPUT POLICY="ACCEPT"
```

首先观察双方可互相telnet

```
[09/17/20]seed@VM:~$ telnet 192.168.11.143
Trying 192.168.11.143...
Connected to 192.168.11.143.
Escape character is '^]'.
Ubuntu 16.04.2 LTS
VM login: seed
Password:
/usr/lib/update-notifier/update-motd-fsck-at-reboot:[:59: integer express
ion expected:            0
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

1 package can be updated.
0 updates are security updates.


The programs included with the Ubuntu system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
applicable law.

[09/17/20]seed@VM:~$ ls
android        Desktop    examples.desktop  Music     source
bin            Documents  get-pip.py        Pictures  Templates
Customization  Downloads  lib               Public    Videos
[09/17/20]seed@VM:~$ cd Desktop/
[09/17/20]seed@VM:~/Desktop$ ls
Server  VMwareTools-10.3.10-13959562.tar.gz  vmware-tools-distrib
[09/17/20]seed@VM:~/Desktop$ exit
logout
Connection closed by foreign host.
```

```
[09/17/20]seed@VM:~$ telnet 192.168.11.140
Trying 192.168.11.140...
Connected to 192.168.11.140.
Escape character is '^]'.
Ubuntu 16.04.2 LTS
VM login: seed
Password:
Last login: Thu Sep 17 05:56:42 EDT 2020 from 192.168.11.143 on pts/19
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

1 package can be updated.
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[09/17/20]seed@VM:~$ exit
logout
Connection closed by foreign host.
```

- 阻止A对B发起telnet

```
$ sudo iptables -A OUTPUT -p tcp --dport 23 -j DROP
```

```
[09/17/20]seed@VM:~$ sudo iptables -A OUTPUT -p tcp --dport 23 -j DROP
[09/17/20]seed@VM:~$ sudo 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
DROP       tcp  --  0.0.0.0/0            0.0.0.0/0           tcp dpt:23
[09/17/20]seed@VM:~$ telnet 192.168.11.143
Trying 192.168.11.143...
telnet: Unable to connect to remote host: Connection timed out
```

```
$ sudo ufw deny out proto tcp to any port 23
```

- 阻止B对A发起telnet

```
$ sudo iptables -A INPUT -p tcp --dport 23 -j DROP
```

```
[09/17/20]seed@VM:~$ telnet 192.168.11.140
Trying 192.168.11.140...
telnet: Unable to connect to remote host: Connection timed out
```

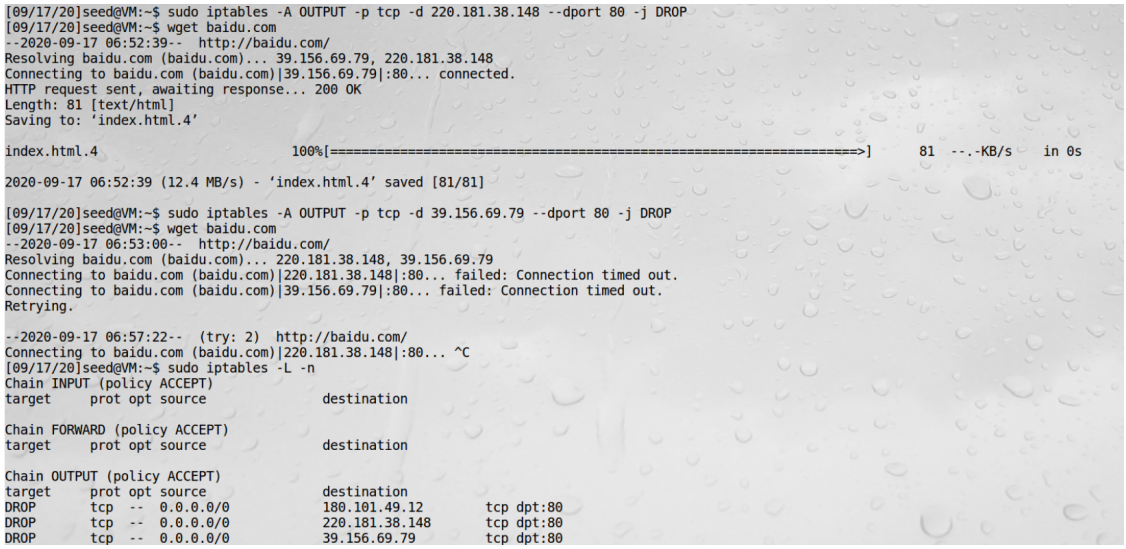
```
$ sudo ufw deny 23
```

```
[09/17/20]seed@VM:~$ telnet 192.168.11.140
Trying 192.168.11.140...
telnet: Unable to connect to remote host: Connection timed out
```

- 阻止A访问外部网站

```
$ sudo iptables -A OUTPUT -p tcp -d ***.***.***.*** --dport 80 -j DROP
```

```
$ sudo ufw deny out proto tcp to ***.***.***.*** port 80
```



```
[09/17/20]seed@VM:~$ sudo iptables -A OUTPUT -p tcp -d 220.181.38.148 --dport 80 -j DROP
[09/17/20]seed@VM:~$ wget baidu.com
--2020-09-17 06:52:39--  http://baidu.com/
Resolving baidu.com (baidu.com)... 39.156.69.79, 220.181.38.148
Connecting to baidu.com (baidu.com)|39.156.69.79|:80... connected.
HTTP request sent, awaiting response... 200 OK
Length: 81 [text/html]
Saving to: 'index.html.4'

index.html.4                        100%[=================================================================>]      81  --.-KB/s    in 0s

2020-09-17 06:52:39 (12.4 MB/s) - 'index.html.4' saved [81/81]

[09/17/20]seed@VM:~$ sudo iptables -A OUTPUT -p tcp -d 39.156.69.79 --dport 80 -j DROP
[09/17/20]seed@VM:~$ wget baidu.com
--2020-09-17 06:53:00--  http://baidu.com/
Resolving baidu.com (baidu.com)... 220.181.38.148, 39.156.69.79
Connecting to baidu.com (baidu.com)|220.181.38.148|:80... failed: Connection timed out.
Connecting to baidu.com (baidu.com)|39.156.69.79|:80... failed: Connection timed out.
Retrying.

--2020-09-17 06:57:22--  (try: 2)  http://baidu.com/
Connecting to baidu.com (baidu.com)|220.181.38.148|:80... ^C
[09/17/20]seed@VM:~$ sudo 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
DROP       tcp  --  0.0.0.0/0            180.101.49.12        tcp dpt:80
DROP       tcp  --  0.0.0.0/0            220.181.38.148       tcp dpt:80
DROP       tcp  --  0.0.0.0/0            39.156.69.79         tcp dpt:80
```

Task 2: Implementing a Simple Firewall

- nf.c

```c
#include <linux/module.h>
#include <linux/kernel.h>
#include <linux/netfilter.h>
#include <linux/netfilter_ipv4.h>
#include <linux/ip.h>
#include <linux/tcp.h>
#include <linux/skbuff.h>
#include <linux/icmp.h>
#include <linux/udp.h>

/* This is the structure we shall use to register our function */
static struct nf_hook_ops nfho;
/* This is the hook function itself */
unsigned int hook_func(void *priv, struct sk_buff *skb, const struct
nf_hook_state *state)
{
    /* This is where you can inspect the packet contained in
     * the structure pointed by skb, and decide whether to accept
     * or drop it. You can even modify the packet */
    // In this example, we simply drop all packets
    // return NF_DROP; /* Drop ALL packets */
    struct iphdr *iph;
    struct tcphdr *tcph;

    iph = ip_hdr(skb);
    tcph = (void *)iph+iph->ihl*4;

    if (
            (iph->protocol == IPPROTO_TCP && tcph->dest == htons(23))
              || (iph->protocol == IPPROTO_TCP && tcph->dest == htons(80))
              || (iph->protocol == IPPROTO_TCP && tcph->dest == htons(8080))
          || (iph->protocol == IPPROTO_TCP && tcph->dest == htons(22))
          || (iph->protocol == IPPROTO_TCP && tcph->dest == htons(443))
                                          )
    {
        printk(KERN_INFO "Dropping tcp packet to %d.%d.%d.%d\n",
                ((unsigned char *) &iph->daddr)[0],
```

```
                ((unsigned char *) &iph->daddr)[1],
                ((unsigned char *) &iph->daddr)[2],
                ((unsigned char *) &iph->daddr)[3]);
        return NF_DROP;
    }else{
        printk("I got it.");
        return NF_ACCEPT;
    }

}
/* Initialization routine */
int setUpFilter(void)
{   /* Fill in our hook structure */
    printk("Hello, Groot.");
    nfho.hook = hook_func; /* Handler function */
    nfho.hooknum = NF_INET_POST_ROUTING; /* First hook for IPv4 */
    nfho.pf = PF_INET;
    nfho.priority = NF_IP_PRI_FIRST; /* Make our function first */

    nf_register_hook(&nfho);
    return 0;
}
/* Cleanup routine */
void removeFilter(void)
{
    printk("So long, Groot.");
    nf_unregister_hook(&nfho);
}

module_init(setUpFilter);
module_exit(removeFilter);
```

- Makefile

```
obj-m += nf.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
```

make后执行命令可在dmesg中看到printk的结果

```
$ sudo insmod mymod.ko      (inserting a module)
$ lsmod                     (list all modules)
$ sudo rmmod mymod.ko       (remove the module)
```

```
[ 2310.952198] Hello, Groot
[ 2963.702993] So long, Groot.
```

限制生效，并用dmesg查看

```
[09/17/20]seed@VM:~/.../PF$ telnet 192.168.11.143
Trying 192.168.11.143...
telnet: Unable to connect to remote host: Connection timed out
```

```
[ 5993.876140] Hello, Groot.
[ 6006.861179] Dropping tcp packet to 192.168.11.143
[ 6007.877068] Dropping tcp packet to 192.168.11.143
[ 6009.892446] Dropping tcp packet to 192.168.11.143
[ 6013.924630] Dropping tcp packet to 192.168.11.143
[ 6022.117129] Dropping tcp packet to 192.168.11.143
[ 6038.244602] Dropping tcp packet to 192.168.11.143
[ 6071.269074] Dropping tcp packet to 192.168.11.143
```

```
[09/17/20]seed@VM:~/.../PF$ wget www.baidu.com
--2020-09-17 13:55:03--  http://www.baidu.com/
Resolving www.baidu.com (www.baidu.com)... 180.101.49.12, 180.101.49.11
Connecting to www.baidu.com (www.baidu.com)|180.101.49.12|:80...
```

```
[ 6415.953208] Dropping tcp packet to 180.101.49.12
[ 6416.964546] Dropping tcp packet to 180.101.49.12
[ 6418.980304] Dropping tcp packet to 180.101.49.12
[ 6423.012423] Dropping tcp packet to 180.101.49.12
[ 6431.204739] Dropping tcp packet to 180.101.49.12
[ 6447.332504] Dropping tcp packet to 180.101.49.12
```

Task 3: Evading Egress Filtering

添加ufw规则

```
$ sudo ufw deny out proto tcp to any port 23
$ sudo ufw deny out proto tcp to 220.181.38.148
```

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

利用SSH连接Server 192.168.11.143，并telnet localhost，成功绕过

```
[09/17/20]seed@VM:~/.../PF$ ssh -L 8000:192.168.11.140:23 seed@192.168.11
.143
seed@192.168.11.143'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

1 package can be updated.
0 updates are security updates.

Last login: Thu Sep 17 14:07:45 2020 from 192.168.11.140
[09/17/20]seed@VM:~$ cd Desktop/
[09/17/20]seed@VM:~/Desktop$ ls
Server  VMwareTools-10.3.10-13959562.tar.gz  vmware-tools-distrib
[09/17/20]seed@VM:~/Desktop$ telnet 192.168.11.143 8000
Trying 192.168.11.143...
telnet: Unable to connect to remote host: Connection refused
[09/17/20]seed@VM:~/Desktop$ telnet 192.168.11.143
Trying 192.168.11.143...
Connected to 192.168.11.143.
Escape character is '^]'.
Ubuntu 16.04.2 LTS
VM login: seed
Password:
Last login: Thu Sep 17 14:22:57 EDT 2020 from 192.168.11.143 on pts/19
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

1 package can be updated.
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```
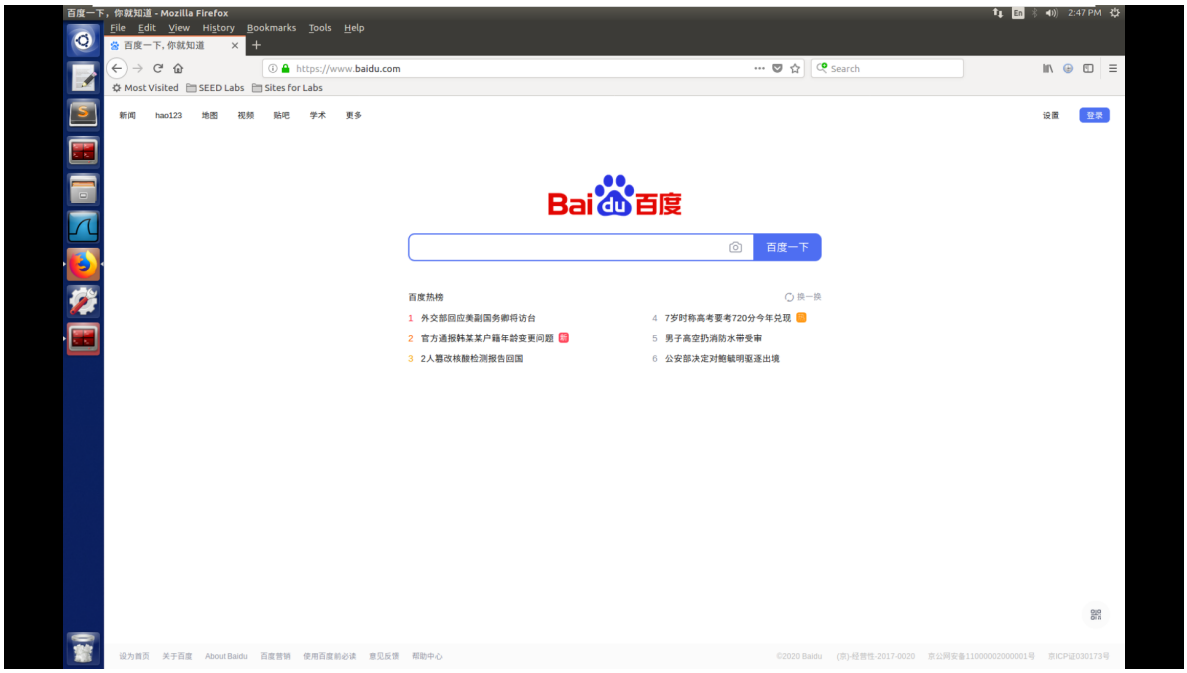

Task 3.b: Connect to Baidu using SSH Tunnel

因为Facebook.com是不存在的网址，SEU官网有异常，所以改用baidu.com的IP：220.181.38.148

虚拟机A 192.168.11.140不能正常访问百度，虚拟机B 192.168.11.143可以正常访问百度

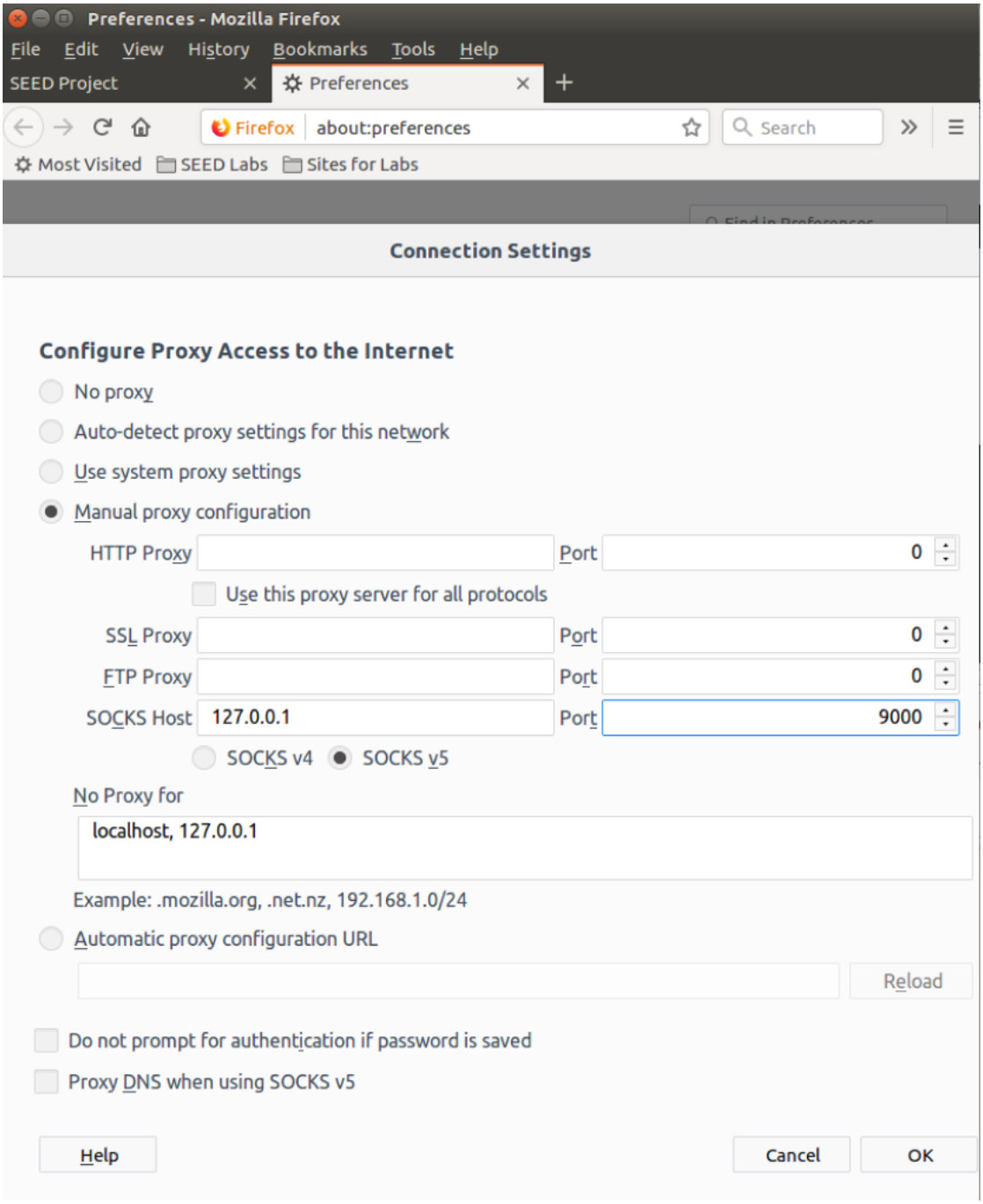


建立A->B的SSH连接

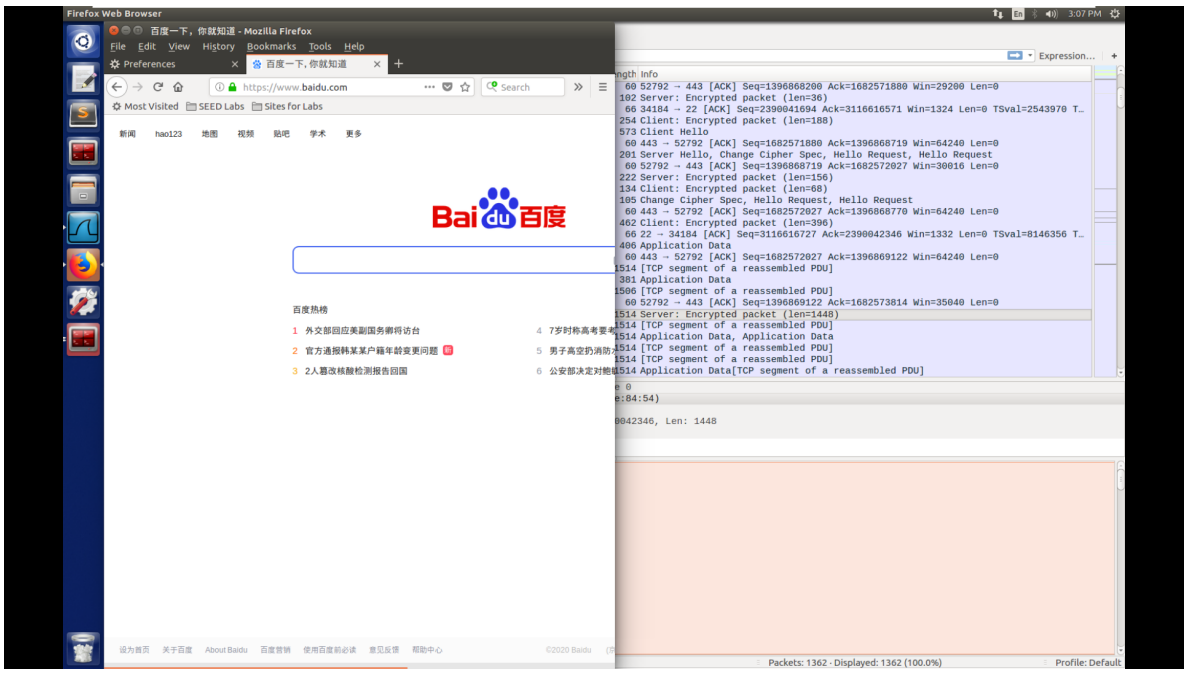
```
$ ssh -D 9000 -C seed@machine_B
```

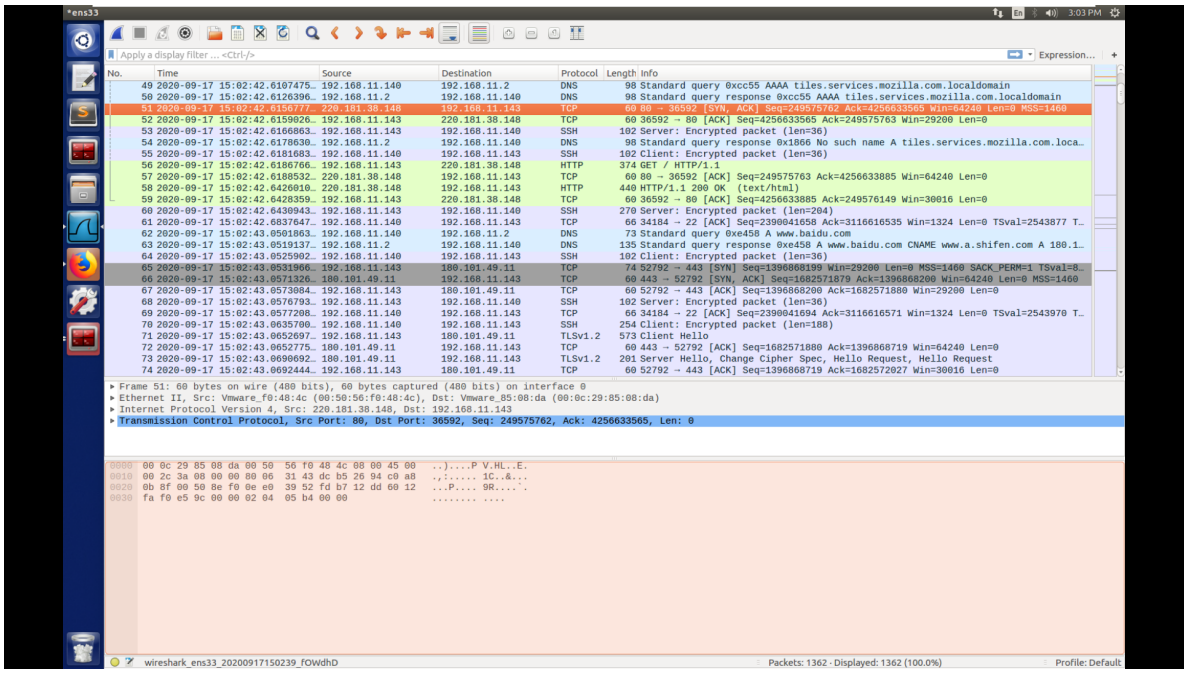
```
[09/17/20]seed@VM:~/.../PF$ ssh -D 9000 -C seed@192.168.11.143
seed@192.168.11.143's password:
Welcome to Ubuntu 16.04.2 LTS (GNU/Linux 4.8.0-36-generic i686)

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

1 package can be updated.
0 updates are security updates.

Last login: Thu Sep 17 14:49:39 2020 from 192.168.11.143
[09/17/20]seed@VM:~$
```

Firefox设置代理

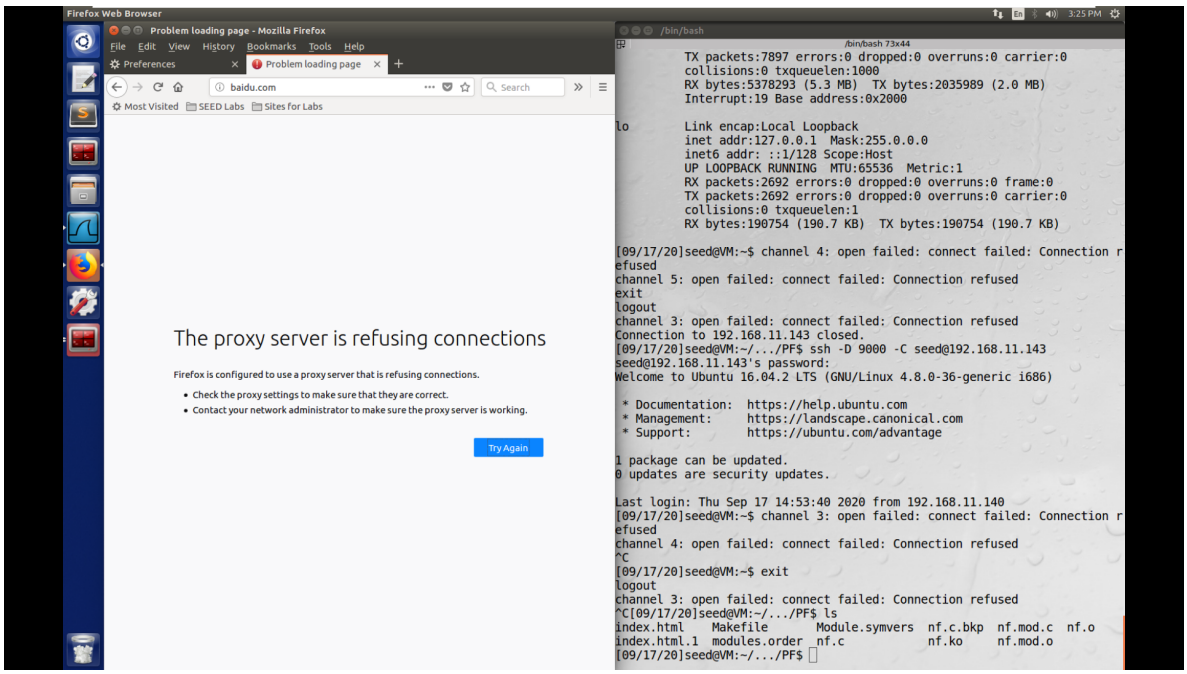


代理后可以正常访问百度，利用Wireshark可以发现，虚拟机A(192.168.11.140)与百度(220.181.38.148)之间是通过虚拟机B(192.168.11.143)进行转发的

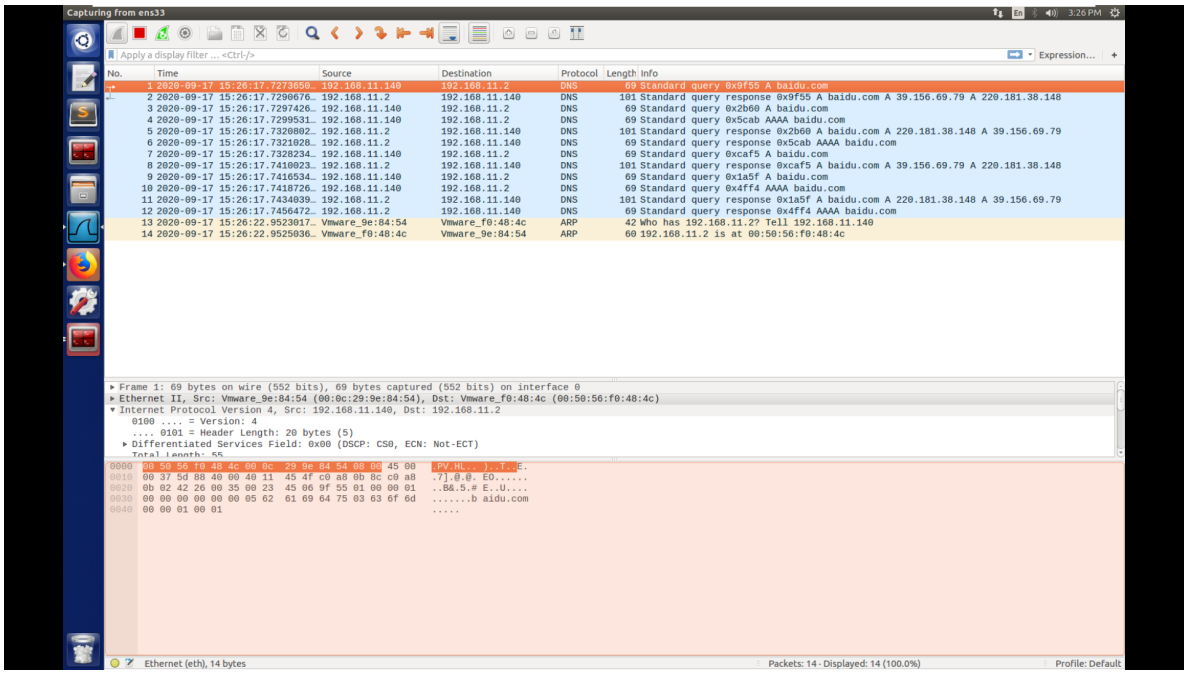




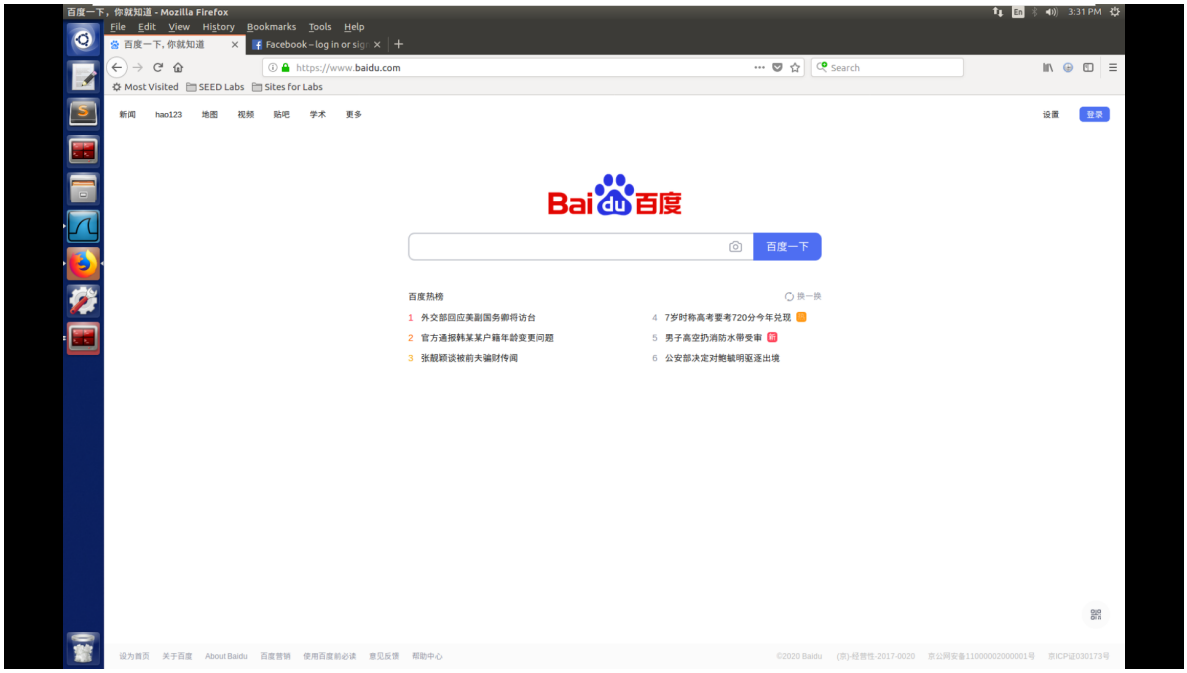
清除Cache并断开SSH后，又不能正常访问百度



在Wireshark中没有发现发往外网的报文，认为是ufw将报文拦截



恢复SSH后看到又能够正常访问百度，证明了可以通过SSH连接防火墙外部主机进而间接绕过防火墙的拦截



Task 4: Evading Ingress Filtering

先设置A中的限制规则

```
[09/17/20]seed@VM:~/.../PF$ sudo ufw status
Status: active

To                         Action      From
--                         ------      ----
22                         REJECT      Anywhere
80                         REJECT      Anywhere
22 (v6)                    REJECT      Anywhere (v6)
80 (v6)                    REJECT      Anywhere (v6)
```

在A端向B发起反向SSH隧道

```
$ ssh -fCNR 192.168.11.140:8024:192.168.11.143:80 seed@192.168.11.140
```

```
[09/17/20]seed@VM:~$ wget 192.168.11.143:80
--2020-09-17 19:48:39--  http://192.168.11.143/
Connecting to 192.168.11.143:80... connected.
HTTP request sent, awaiting response... 200 OK
Length: 11321 (11K) [text/html]
Saving to: 'index.html'

index.html          100%[==============>]  11.06K  --.-KB/s    in 0s

2020-09-17 19:48:39 (211 MB/s) - 'index.html' saved [11321/11321]
```

发现B端已经可以获取http请求的回复。