Linux Firewall Explorationn Lab

57117231 农禄 2020/09/19

实验环境

开启防火墙的操作系统：ubuntu 16.04(target 192.168.248.132)
其他主机：ubuntu 16.04(dxq 192.168.248.128)、ubuntu 16.04(third 192.168.248.133)
虚拟机载体：vmware

Task1: Using Firewall

用虚拟机 target 开启防火墙，ip：192.168.248.132
用虚拟机 dxq 访问 target，ip：192.168.248.128
使用 iptables 创建防火墙
通过 man ufw(或 ufw -h)命令查看 ufw 的帮助文档
修改配置文件/etc/default/ufw 文件，默认对入方向的包进行 ACCEPT 操作

```
# Set the default input policy to ACCEPT, DROP, or REJECT. Please note that if
# you change this you will most likely want to adjust your rules.
DEFAULT_INPUT_POLICY="ACCEPT"
```

1. 阻止 target 对 dxq 的 telnet 连接

```
root@VM:/home/seed# ufw deny out to 192.168.248.128 port 23
Rule added
root@VM:/home/seed#
```

```
root@VM:/home/seed# ufw deny out to 192.168.248.128 port 23
Rule added
root@VM:/home/seed# telnet 192.168.248.128
Trying 192.168.248.128...
```

此时无法向 dxq 发起连接

2. 阻止 dxq 对 target 的 telnet 连接

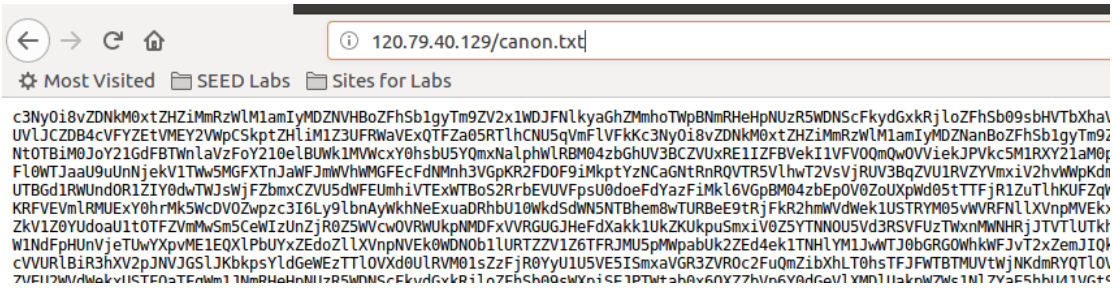
```
root@VM:/home/seed# ufw deny proto tcp from 192.168.248.128 to 192.168.248.132 port 23
Rule added
root@VM:/home/seed#
```

```
root@VM:/home/seed/Course# telnet 192.168.248.132
Trying 192.168.248.132...
```

此时 dxq 也无法向 target 发起连接

3. 阻止 target 访问网站 120.79.40.129

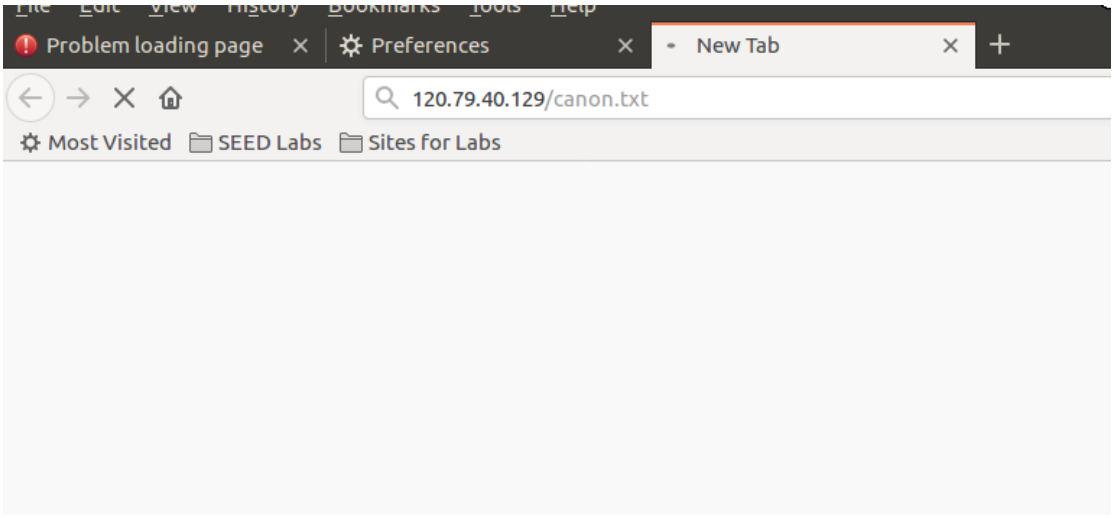
添加规则前正常访问



添加规则

```
root@VM:/home/seed# ufw deny proto tcp from 192.168.248.132 to 120.79.40.129
Rule added
root@VM:/home/seed#
```

清空缓存，访问 120.79.40.129



访问失败

Task2: Implementing a Simple Firewall

进入过滤在 NF_IP_PRE_ROUTING、 NF_IP_LOCAL_IN、NF_IP_FORWARD 放置监测点。外出过滤在 NF_IP_POST_ROUTING、NF_IP_LOCAL_OUT 放置监测点。
利用 LKM 和 Netfilter 实现防火墙规则
先将 ufw 关闭
尝试编写 LKM

```c
#include <linux/module.h>
#include <linux/kernel.h>
#include <linux/init.h>

static int kmodule_init(void) {
        printk(KERN_INFO "Initializing this module\n");
        return 0;
}

static void kmodule_exit(void) {
        printk(KERN_INFO "Module cleanup\n");
}

module_init(kmodule_init);
module_exit(kmodule_exit);

MODULE_LICENSE("GPL");
~
~
~
```

编写 Makefile

```
obj-m :=test.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
~
~
```

编译模块

```
root@VM:/home/seed/code# make
make -C /lib/modules/4.8.0-36-generic/build M=/home/seed/code modules
make[1]: Entering directory '/usr/src/linux-headers-4.8.0-36-generic'
  CC [M]  /home/seed/code/test.o
  Building modules, stage 2.
  MODPOST 1 modules
  CC      /home/seed/code/test.mod.o
  LD [M]  /home/seed/code/test.ko
make[1]: Leaving directory '/usr/src/linux-headers-4.8.0-36-generic'
```

安装模块

```
root@VM:/home/seed/code# insmod test.ko
root@VM:/home/seed/code# lsmod | grep test
test                   16384  0
root@VM:/home/seed/code#
```

```
root@VM:/home/seed/code# dmesg
```

```
[65542.136100] Initializing this module
root@VM:/home/seed/code#
```

编写 Netfilter，drop 掉所有 telnet 报文

头文件

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

定义 hook

```
static struct nf_hook_ops telnetFilterHook;
```

```
unsigned int telnetFilter(void *priv, struct sk_buff *skb,
                const struct nf_hook_state *state)
{
        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)){
                printk(KERN_INFO "Dropping telnet 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{
                return NF_ACCEPT;
        }
}
```

```
int setUpFilter(void) {
        printk(KERN_INFO "Registering a Telnet filter.\n");
        telnetFilterHook.hook = telnetFilter;
        telnetFilterHook.hooknum = NF_INET_POST_ROUTING;
        telnetFilterHook.pf = PF_INET;
        telnetFilterHook.priority = NF_IP_PRI_FIRST;


        //register the hook.
        nf_register_hook(&telnetFilterHook);
        return 0;
}

void removeFilter(void) {
        printk(KERN_INFO "Telnet filter is being removed.\n");
        nf_unregister_hook(&telnetFilterHook);
}

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

编译并安装

尝试进行 telnet 连接

```
root@VM:/home/seed/code# insmod telnetFilter.ko
root@VM:/home/seed/code# telnet 192.168.248.128
Trying 192.168.248.128...
```

用 dmesg 命令查看内核日志

```
[68905.386648] Registering a Telnet filter.
[68906.892171] Dropping telnet packet to 192.168.248.128
[68907.910807] Dropping telnet packet to 192.168.248.128
root@VM:/home/seed/code#
```

连接失败

卸载 telnetFilter，重新尝试 telnet 连接

```
root@VM:/home/seed/code# rmmod telnetFilter
root@VM:/home/seed/code# telnet 192.168.248.128
Trying 192.168.248.128...
Connected to 192.168.248.128.
Escape character is '^]'.
Ubuntu 16.04.7 LTS
VM login:
```

连接迅速得到响应

Task3: Evading Egress Filtering

利用 ssh 隧道穿越防火墙

设置禁止向外建立 telnet 连接

```
root@VM:/home/seed/code# ufw deny out to any port 23
Skipping adding existing rule
Skipping adding existing rule (v6)
root@VM:/home/seed/code#
```

设置禁止访问 www.syr.com（128.230.18.200）

```
root@VM:/home/seed/code# ufw deny out to 128.230.18.200
Rule added
root@VM:/home/seed/code# ufw status
Status: active

To                         Action      From
--                         ------      ----
23                         DENY OUT    Anywhere
128.230.18.200             DENY OUT    Anywhere
23 (v6)                    DENY OUT    Anywhere (v6)
```

Tast3.a Telnet to Machine B through the firewall

直接尝试 telnet 连接，失败

```
root@VM:/home/seed/code# telnet 192.168.248.128
Trying 192.168.248.128...
```

使用 ssh tunnel 绕过防火墙进行 telnet 连接。将本地端口 8000 与 192.168.248.132 建立 ssh 连接，通过 192.168.248.132 代理，向 192.168.248.132 发起 telnet 连接

```
root@VM:/home/seed/code# ssh -L 8000:192.168.248.128:23 seed@192.168.248.133
```

ssh 登录后，开启一个新终端

输入命令 telnet localhost 8000 进行 telnet 登录，登录成功。观察 wireshark 的数据

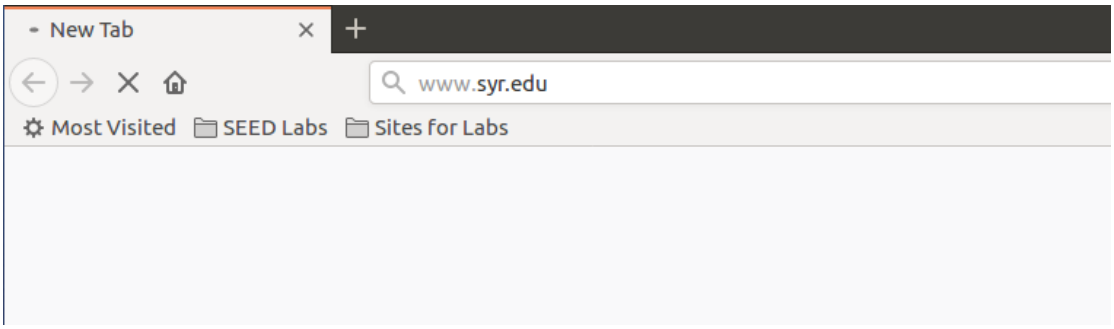
1	0.000000	192.168.248.132	192.168.248.133	SSH	166	Client: Encrypted packet (len=100)
2	0.000518	192.168.248.133	192.168.248.128	TCP	74	41310 → 23 [SYN] Seq=0 Win=29200 Len=0 MSS=1460 SACK_PERM=1 TSva
3	0.000884	192.168.248.128	192.168.248.133	TCP	74	23 → 41310 [SYN, ACK] Seq=0 Ack=1 Win=65160 Len=0 MSS=1460 SACK_
4	0.001202	192.168.248.133	192.168.248.128	TCP	66	41310 → 23 [ACK] Seq=1 Ack=1 Win=29312 Len=0 TSval=4891883 TSecr
5	0.001298	192.168.248.133	192.168.248.132	SSH	110	Server: Encrypted packet (len=44)

可以看到 132 向 133 发送 ssh 数据，133 再将数据转发给 128。然后 128 与 133 通信，133 再将结果发送给 132。这样 132 就实现了通过隧道与 128 建立 telnet 连接。

Task3.b: Connect to Facebook using SSH Tunnel

使用动态端口转发技术

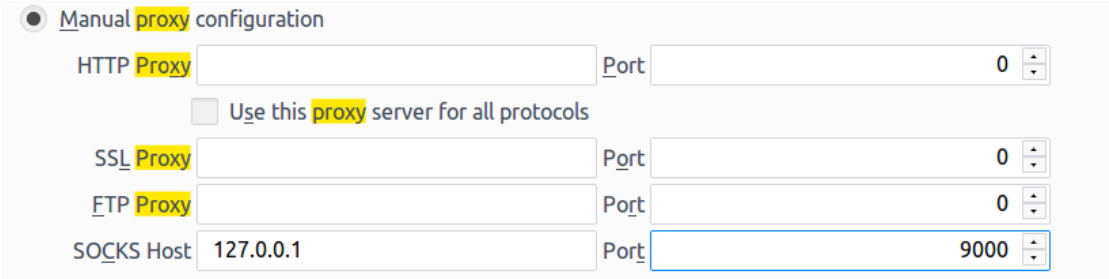
建立隧道前，连接失败



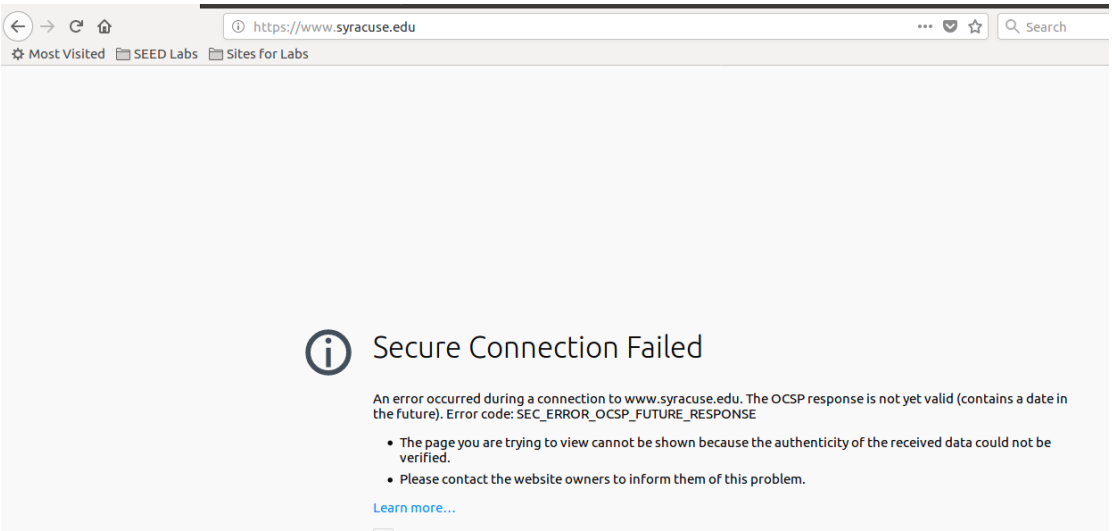
建立隧道

```
root@VM:/home/seed/code# ssh -D 9000 -C seed@192.168.248.133
```

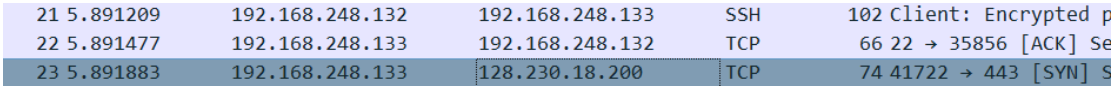
设置浏览器将数据转发至 9000 端口



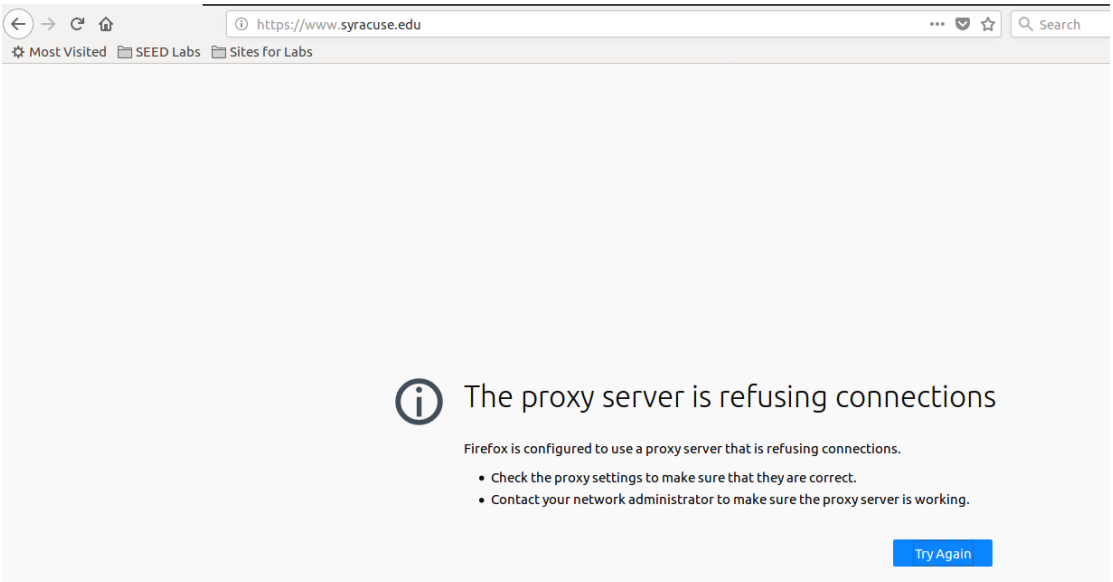
访问 www.syr.edu，不再超时，说明现在能够绕过防火墙访问 www.syr.edu，但存在安全问题(其他原因导致)



观察 wireshark 的数据流，132 通过 133 的代理访问 128.230.18.200。



关闭 ssh 隧道，代理随即关闭



Task4: Evading Ingress Filtering

添加规则，禁止 192.168.248.133 访问 192.168.248.132 的 80 端口和 22 端口

```
root@VM:/etc/bind# ssh seed@192.168.248.132
```

此时 192.168.248.133 向 192.168.248.132 发起 ssh 连接失败

在 192.168.248.132 设置反向代理，建立 192.168.248.133 的 8000 端口与 192.168.248.132 的 22 端口之间的隧道，也就是将 192.168.248.132 的 22 端口暴露给 192.168.248.133

```
root@VM:/home/seed/code# ssh -R 192.168.248.133:8000:192.168.248.132:22 seed@192
.168.248.133
seed@192.168.248.133'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 21:51:46 2020 from 192.168.248.132
[09/17/20]seed@VM:~$
```

在 192.168.248.133 主机上向 8000 端口发起 ssh 连接

```
root@VM:/etc/bind# ssh -p 8000 seed@localhost
seed@localhost'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: Fri Sep 11 09:13:30 2020 from 192.168.248.132
[09/11/20]seed@VM:~$ ip a | grep inet
    inet 127.0.0.1/8 scope host lo
    inet6 ::1/128 scope host
    inet 192.168.248.132/24 brd 192.168.248.255 scope global dynamic ens33
    inet6 fe80::5f49:3b64:7277:c7c4/64 scope link
[09/11/20]seed@VM:~$
```

成功通过反向代理向防火墙内的 192.168.248.132 发起 ssh 连接!