Computer Network Laboratory

Firewall and NAT Report Team 10

Members

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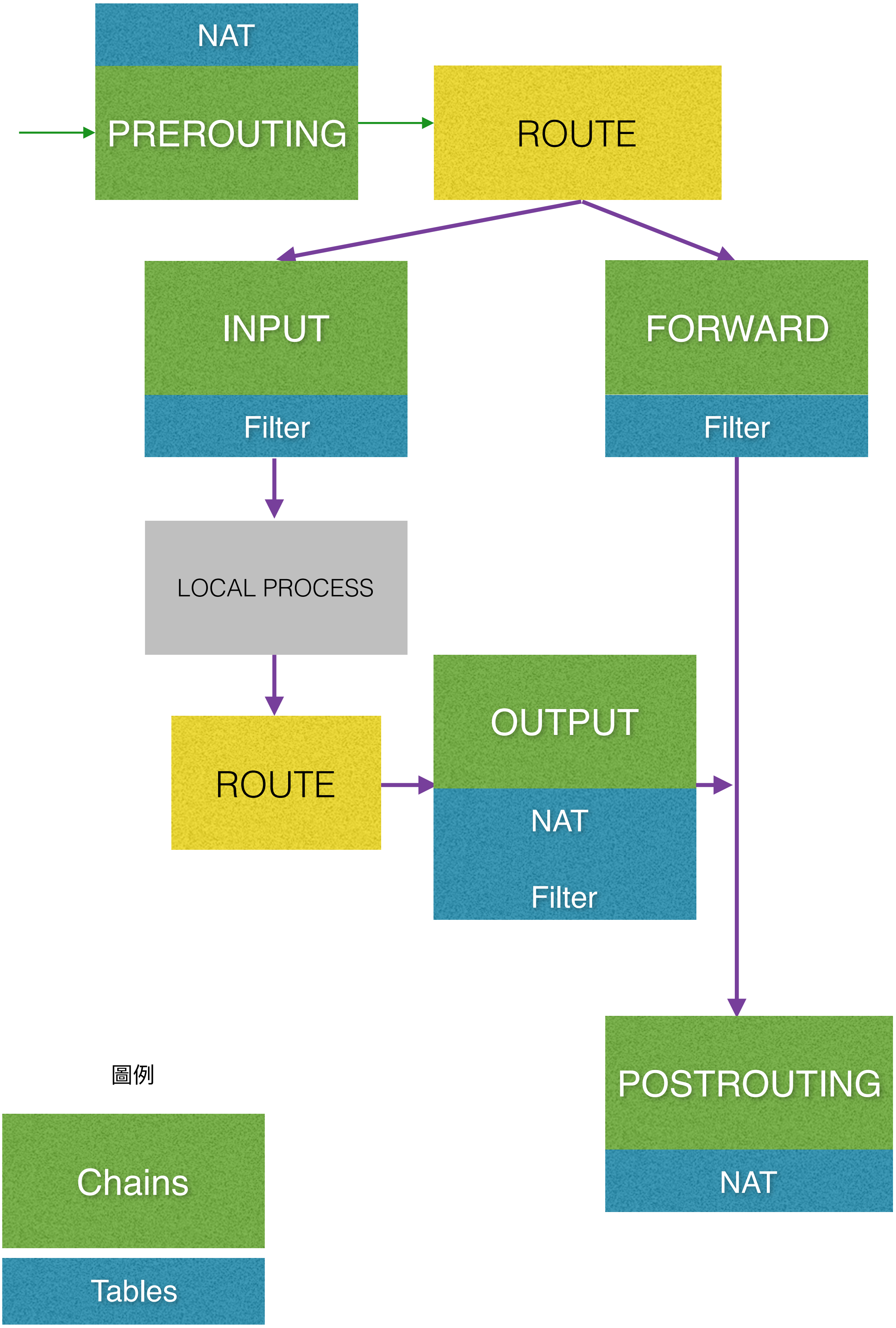
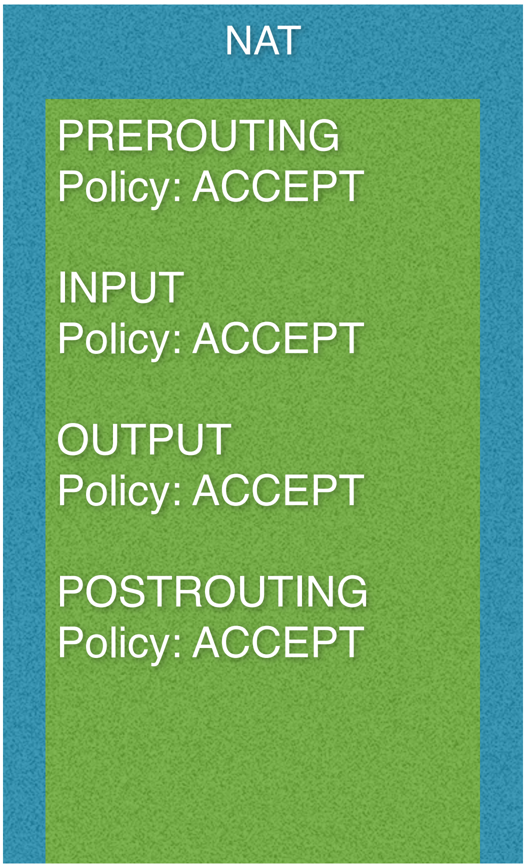
0. 簡介

在這次的實驗中我們使用Linux系統中的 iptables 指令來實作Firewall以及NAT server，並且設定DHCP server。我們使用兩台虛擬機器(Linux Ubuntu 14.04)，第一台機器 A 作為主要的NAT與DHCP server，並且寫入一些規則；第二台機器 B 則是一台測試機，主要從 A 取得分發的ip並且上網。在VirtualBox的設定中，A 有兩張網卡，第一張作為向外上網使用；第二張則是作為DHCP發放IP的網卡。在Firewall的規則中，我們必須阻擋除了HTTP、DNS、FTP、ICMP、Telnet、POP3/SMTP以外的服務。主要的實作方法是在 iptables 中把 FORWARD 的 default 設定成REJECT，之後再加上可以開放的 PORT 即可。

1. 流程圖


NAT
PREROUTING
ROUTE
INPUT
Filter
FORWARD
Filter
LOCAL PROCESS
ROUTE
OUTPUT
NAT
Filter
POSTROUTING
NAT
圖例
Chains
Tables



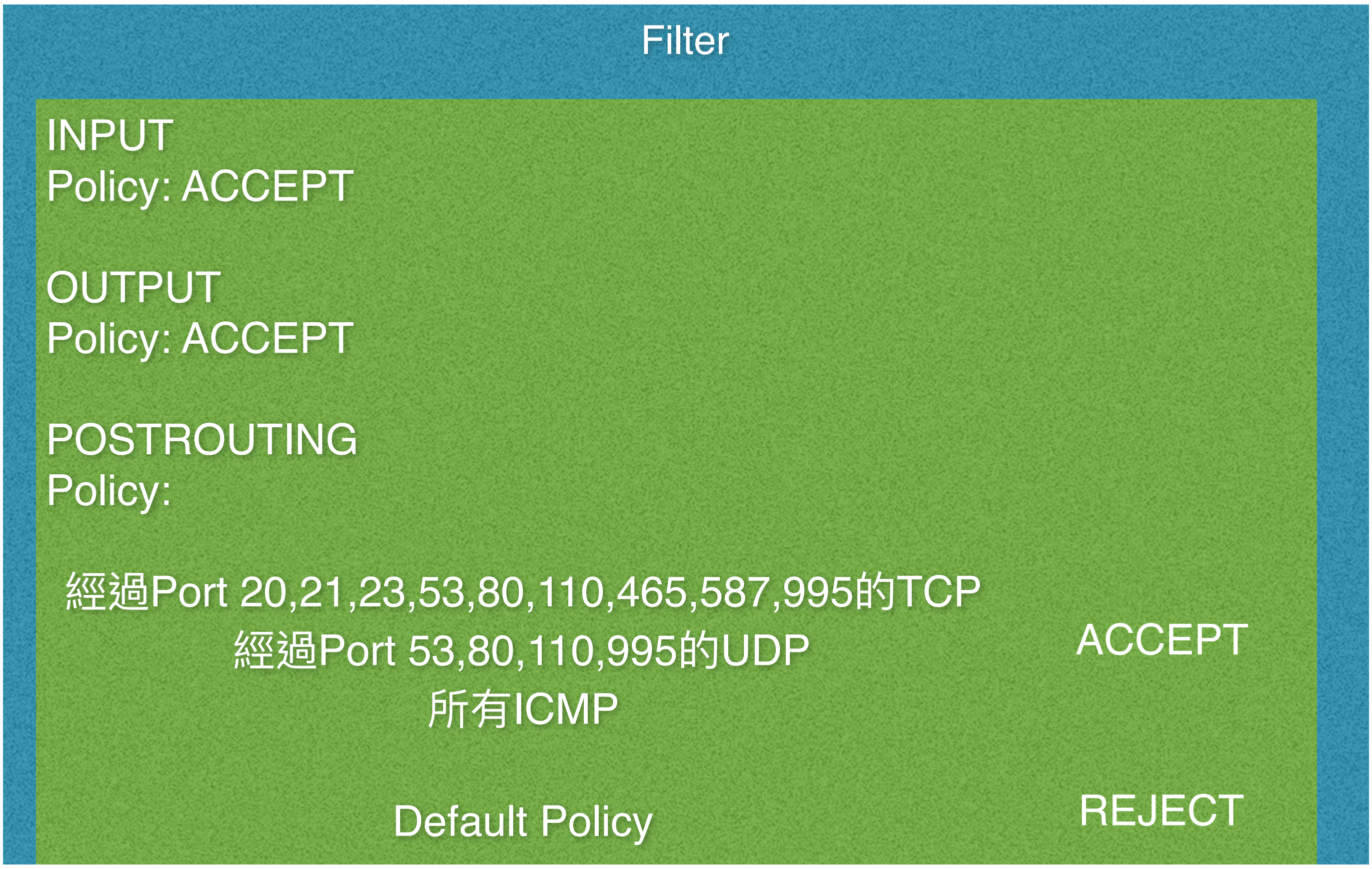
NAT

PREROUTING
Policy: ACCEPT

INPUT
Policy: ACCEPT

OUTPUT
Policy: ACCEPT

POSTROUTING
Policy: ACCEPT



Filter

INPUT
Policy: ACCEPT

OUTPUT
Policy: ACCEPT

POSTROUTING
Policy:

經過Port 20,21,23,53,80,110,465,587,995的TCP
經過Port 53,80,110,995的UDP
所有ICMP

ACCEPT

Default Policy

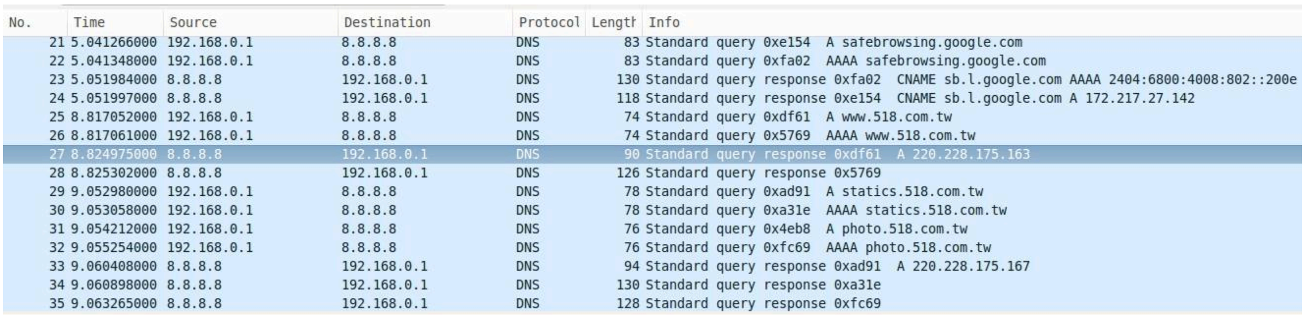
REJECT

2. Shell Script

```
#clear nat rules
iptables -t nat -F
iptables -t nat -X
iptables -t nat -Z

#clear filter rules
iptables -t filter -F
iptables -t filter -X
iptables -t filter -Z

#forwarding
iptables -t nat -A POSTROUTING -s 192.168.0.0/16 -o eth0 -j MASQUERADE

#accept some port
iptables -A FORWARD -p TCP -m multiport -i eth1 --dport
20,21,23,25,53,80,110,465,587,995 -j ACCEPT
iptables -A FORWARD -p TCP -m multiport -i eth1 --sport
20,21,23,25,53,80,110,465,587,995 -j ACCEPT
iptables -A FORWARD -p UDP -m multiport -i eth1 --dport 53,80,110,995 -j ACCEPT
iptables -A FORWARD -p UDP -m multiport -i eth1 --sport 53,80,110,995 -j ACCEPT
iptables -A FORWARD -p icmp -j ACCEPT

#reject others
iptables -A FORWARD -i eth1 -j REJECT

echo "1" > /proc/sys/net/ipv4/ip_forward
```

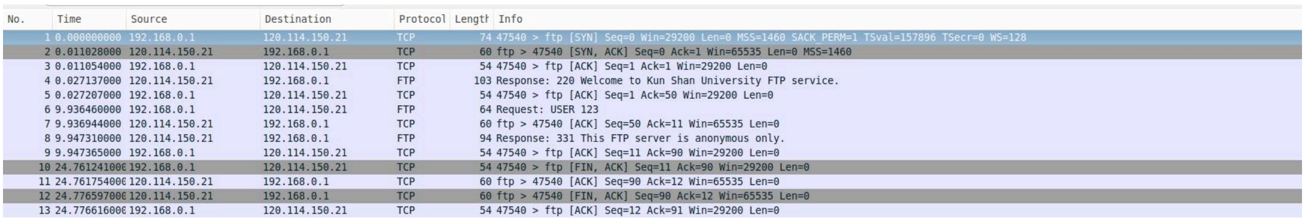
3. Wireshark Verification

DNS



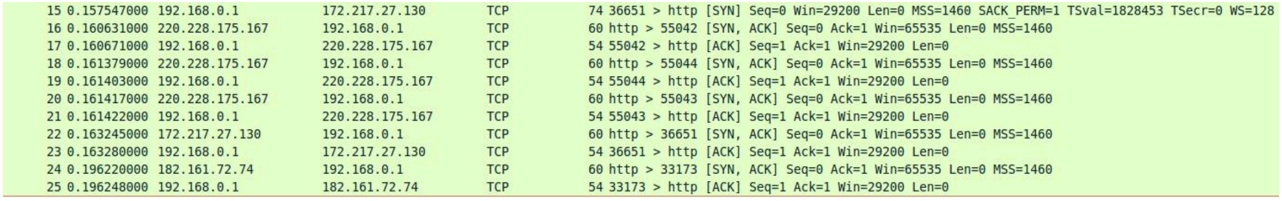
No.	Time	Source	Destination	Protocol	Length	Info
21	5.041266000	192.168.0.1	8.8.8.8	DNS	83	Standard query 0xe154 A safebrowsing.google.com
22	5.041348000	192.168.0.1	8.8.8.8	DNS	83	Standard query 0xfa02 AAAA safebrowsing.google.com
23	5.051984000	8.8.8.8	192.168.0.1	DNS	130	Standard query response 0xfa02 CNAME sb.l.google.com AAAA 2404:6800:4008:802::200e
24	5.051997000	8.8.8.8	192.168.0.1	DNS	118	Standard query response 0xe154 CNAME sb.l.google.com A 172.217.27.142
25	8.817052000	192.168.0.1	8.8.8.8	DNS	74	Standard query 0xdf61 A www.518.com.tw
26	8.817061000	192.168.0.1	8.8.8.8	DNS	74	Standard query 0x5769 AAAA www.518.com.tw
27	8.824975000	8.8.8.8	192.168.0.1	DNS	90	Standard query response 0xdf61 A 220.228.175.163
28	8.825302000	8.8.8.8	192.168.0.1	DNS	126	Standard query response 0x5769
29	9.052980000	192.168.0.1	8.8.8.8	DNS	78	Standard query 0xad91 A statics.518.com.tw
30	9.053058000	192.168.0.1	8.8.8.8	DNS	78	Standard query 0xa31e AAAA statics.518.com.tw
31	9.054212000	192.168.0.1	8.8.8.8	DNS	76	Standard query 0x4eb8 A photo.518.com.tw
32	9.055254000	192.168.0.1	8.8.8.8	DNS	76	Standard query 0xfc69 AAAA photo.518.com.tw
33	9.060408000	8.8.8.8	192.168.0.1	DNS	94	Standard query response 0xad91 A 220.228.175.167
34	9.060898000	8.8.8.8	192.168.0.1	DNS	130	Standard query response 0xa31e
35	9.063265000	8.8.8.8	192.168.0.1	DNS	128	Standard query response 0xfc69

FTP



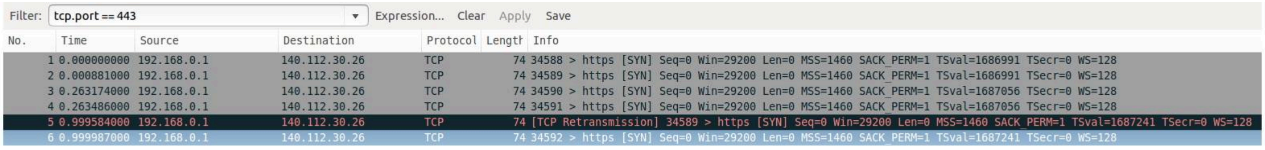
No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000000	192.168.0.1	120.114.150.21	TCP	74	47540 > ftp [SYN] Seq=0 Win=29200 Len=0 MSS=1460 SACK_PERM=1 TSval=157896 TSecr=0 WS=128
2	0.011028000	120.114.150.21	192.168.0.1	TCP	60	ftp > 47540 [SYN, ACK] Seq=0 Ack=1 Win=65535 Len=0 MSS=1460
3	0.011054000	192.168.0.1	120.114.150.21	TCP	54	47540 > ftp [ACK] Seq=1 Ack=1 Win=29200 Len=0
4	0.027137000	120.114.150.21	192.168.0.1	FTP	103	Response: 220 Welcome to Kun Shan University FTP service.
5	0.027207000	192.168.0.1	120.114.150.21	TCP	54	47540 > ftp [ACK] Seq=1 Ack=50 Win=29200 Len=0
6	9.936460000	192.168.0.1	120.114.150.21	FTP	64	Request: USER 123
7	9.936944000	120.114.150.21	192.168.0.1	TCP	60	ftp > 47540 [ACK] Seq=50 Ack=11 Win=65535 Len=0
8	9.947310000	120.114.150.21	192.168.0.1	FTP	94	Response: 331 This FTP server is anonymous only.
9	9.947365000	192.168.0.1	120.114.150.21	TCP	54	47540 > ftp [ACK] Seq=11 Ack=90 Win=29200 Len=0
10	24.76124100	192.168.0.1	120.114.150.21	TCP	54	47540 > ftp [FIN, ACK] Seq=11 Ack=90 Win=29200 Len=0
11	24.76175400	120.114.150.21	192.168.0.1	TCP	60	ftp > 47540 [ACK] Seq=90 Ack=12 Win=65535 Len=0
12	24.77659700	120.114.150.21	192.168.0.1	TCP	60	ftp > 47540 [FIN, ACK] Seq=90 Ack=12 Win=65535 Len=0
13	24.77661600	192.168.0.1	120.114.150.21	TCP	54	47540 > ftp [ACK] Seq=12 Ack=91 Win=29200 Len=0

HTTP



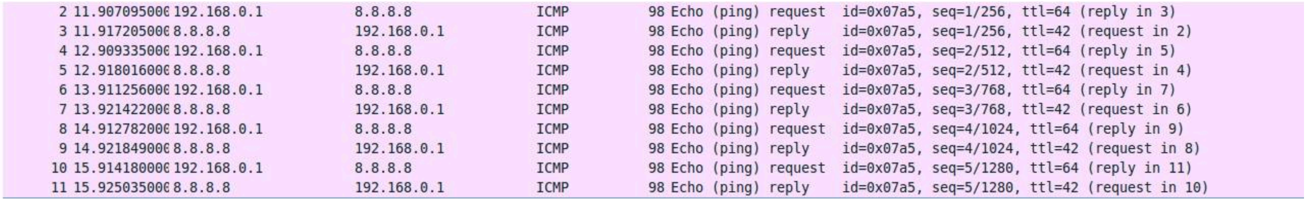
```
15 0.157547000 192.168.0.1       172.217.27.130    TCP    74 36651 > http [SYN] Seq=0 Win=29200 Len=0 MSS=1460 SACK_PERM=1 TSval=1828453 TSecr=0 WS=128
16 0.160631000 220.228.175.167   192.168.0.1       TCP    60 http > 55042 [SYN, ACK] Seq=0 Ack=1 Win=65535 Len=0 MSS=1460
17 0.160671000 192.168.0.1       220.228.175.167   TCP    54 55042 > http [ACK] Seq=1 Ack=1 Win=29200 Len=0
18 0.161379000 220.228.175.167   192.168.0.1       TCP    60 http > 55044 [SYN, ACK] Seq=0 Ack=1 Win=65535 Len=0 MSS=1460
19 0.161403000 192.168.0.1       220.228.175.167   TCP    54 55044 > http [ACK] Seq=1 Ack=1 Win=29200 Len=0
20 0.161417000 220.228.175.167   192.168.0.1       TCP    60 http > 55043 [SYN, ACK] Seq=0 Ack=1 Win=65535 Len=0 MSS=1460
21 0.161422000 192.168.0.1       220.228.175.167   TCP    54 55043 > http [ACK] Seq=1 Ack=1 Win=29200 Len=0
22 0.163245000 172.217.27.130    192.168.0.1       TCP    60 http > 36651 [SYN, ACK] Seq=0 Ack=1 Win=65535 Len=0 MSS=1460
23 0.163280000 192.168.0.1       172.217.27.130    TCP    54 36651 > http [ACK] Seq=1 Ack=1 Win=29200 Len=0
24 0.196220000 182.161.72.74     192.168.0.1       TCP    60 http > 33173 [SYN, ACK] Seq=0 Ack=1 Win=65535 Len=0 MSS=1460
25 0.196248000 192.168.0.1       182.161.72.74     TCP    54 33173 > http [ACK] Seq=1 Ack=1 Win=29200 Len=0
```

HTTPS



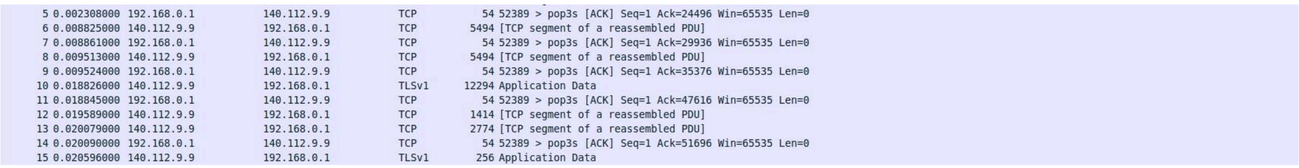
```
Filter: tcp.port == 443
No.  Time        Source        Destination      Protocol Length Info
   1 0.000000000 192.168.0.1   140.112.30.26    TCP      74 34588 > https [SYN] Seq=0 Win=29200 Len=0 MSS=1460 SACK_PERM=1 TSval=1686991 TSecr=0 WS=128
   2 0.000881000 192.168.0.1   140.112.30.26    TCP      74 34589 > https [SYN] Seq=0 Win=29200 Len=0 MSS=1460 SACK_PERM=1 TSval=1686991 TSecr=0 WS=128
   3 0.263174000 192.168.0.1   140.112.30.26    TCP      74 34590 > https [SYN] Seq=0 Win=29200 Len=0 MSS=1460 SACK_PERM=1 TSval=1687056 TSecr=0 WS=128
   4 0.263486000 192.168.0.1   140.112.30.26    TCP      74 34591 > https [SYN] Seq=0 Win=29200 Len=0 MSS=1460 SACK_PERM=1 TSval=1687056 TSecr=0 WS=128
   5 0.999584000 192.168.0.1   140.112.30.26    TCP      74 [TCP Retransmission] 34589 > https [SYN] Seq=0 Win=29200 Len=0 MSS=1460 SACK_PERM=1 TSval=1687241 TSecr=0 WS=128
   6 0.999987000 192.168.0.1   140.112.30.26    TCP      74 34592 > https [SYN] Seq=0 Win=29200 Len=0 MSS=1460 SACK_PERM=1 TSval=1687241 TSecr=0 WS=128
```

ICMP



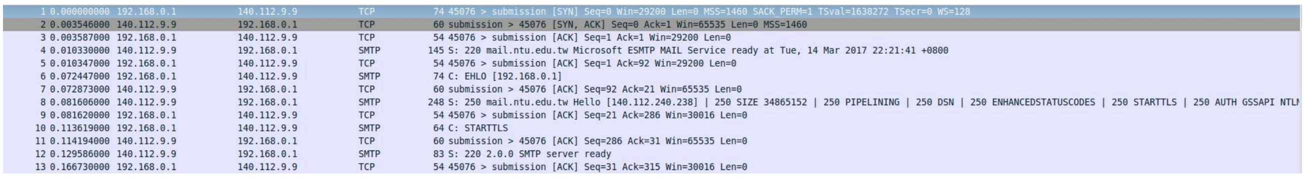
```
 2 11.907095000 192.168.0.1   8.8.8.8        ICMP   98 Echo (ping) request  id=0x07a5, seq=1/256, ttl=64 (reply in 3)
 3 11.917205000 8.8.8.8       192.168.0.1    ICMP   98 Echo (ping) reply    id=0x07a5, seq=1/256, ttl=42 (request in 2)
 4 12.909335000 192.168.0.1   8.8.8.8        ICMP   98 Echo (ping) request  id=0x07a5, seq=2/512, ttl=64 (reply in 5)
 5 12.918016000 8.8.8.8       192.168.0.1    ICMP   98 Echo (ping) reply    id=0x07a5, seq=2/512, ttl=42 (request in 4)
 6 13.911256000 192.168.0.1   8.8.8.8        ICMP   98 Echo (ping) request  id=0x07a5, seq=3/768, ttl=64 (reply in 7)
 7 13.921422000 8.8.8.8       192.168.0.1    ICMP   98 Echo (ping) reply    id=0x07a5, seq=3/768, ttl=42 (request in 6)
 8 14.912782000 192.168.0.1   8.8.8.8        ICMP   98 Echo (ping) request  id=0x07a5, seq=4/1024, ttl=64 (reply in 9)
 9 14.921849000 8.8.8.8       192.168.0.1    ICMP   98 Echo (ping) reply    id=0x07a5, seq=4/1024, ttl=42 (request in 8)
10 15.914180000 192.168.0.1   8.8.8.8        ICMP   98 Echo (ping) request  id=0x07a5, seq=5/1280, ttl=64 (reply in 11)
11 15.925035000 8.8.8.8       192.168.0.1    ICMP   98 Echo (ping) reply    id=0x07a5, seq=5/1280, ttl=42 (request in 10)
```

POP3



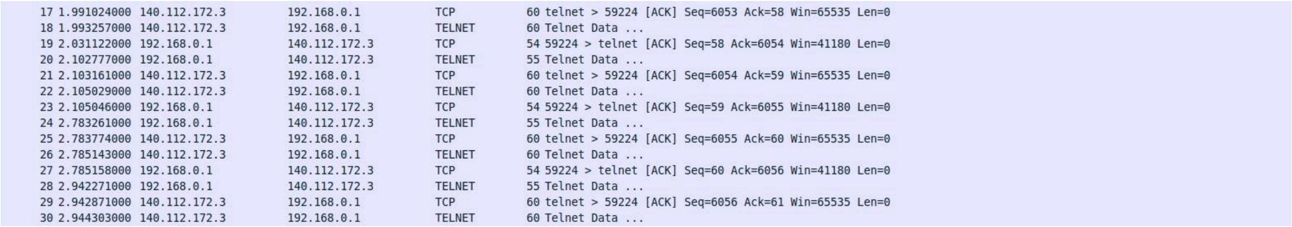
```
 5 0.002308000 192.168.0.1    140.112.9.9    TCP       54 52389 > pop3s [ACK] Seq=1 Ack=24496 Win=65535 Len=0
 6 0.008825000 140.112.9.9    192.168.0.1    TCP     5494 [TCP segment of a reassembled PDU]
 7 0.008861000 192.168.0.1    140.112.9.9    TCP       54 52389 > pop3s [ACK] Seq=1 Ack=29936 Win=65535 Len=0
 8 0.009513000 140.112.9.9    192.168.0.1    TCP     5494 [TCP segment of a reassembled PDU]
 9 0.009524000 192.168.0.1    140.112.9.9    TCP       54 52389 > pop3s [ACK] Seq=1 Ack=35376 Win=65535 Len=0
10 0.018826000 140.112.9.9    192.168.0.1    TLSv1  12294 Application Data
11 0.018845000 192.168.0.1    140.112.9.9    TCP       54 52389 > pop3s [ACK] Seq=1 Ack=47616 Win=65535 Len=0
12 0.019589000 140.112.9.9    192.168.0.1    TCP     1414 [TCP segment of a reassembled PDU]
13 0.020079000 140.112.9.9    192.168.0.1    TCP     2774 [TCP segment of a reassembled PDU]
14 0.020090000 192.168.0.1    140.112.9.9    TCP       54 52389 > pop3s [ACK] Seq=1 Ack=51696 Win=65535 Len=0
15 0.020596000 140.112.9.9    192.168.0.1    TLSv1    256 Application Data
```

SMTP



```
 1 0.000000000 192.168.0.1   140.112.9.9   TCP    74 45076 > submission [SYN] Seq=0 Win=29200 Len=0 MSS=1460 SACK_PERM=1 TSval=1638272 TSecr=0 WS=128
 2 0.003546000 140.112.9.9   192.168.0.1   TCP    60 submission > 45076 [SYN, ACK] Seq=0 Ack=1 Win=65535 Len=0 MSS=1460
 3 0.003587000 192.168.0.1   140.112.9.9   TCP    54 45076 > submission [ACK] Seq=1 Ack=1 Win=29200 Len=0
 4 0.010330000 140.112.9.9   192.168.0.1   SMTP  145 S: 220 mail.ntu.edu.tw Microsoft ESMTP MAIL Service ready at Tue, 14 Mar 2017 22:21:41 +0800
 5 0.010347000 192.168.0.1   140.112.9.9   TCP    54 45076 > submission [ACK] Seq=1 Ack=92 Win=29200 Len=0
 6 0.072447000 192.168.0.1   140.112.9.9   SMTP   74 C: EHLO [192.168.0.1]
 7 0.072873000 140.112.9.9   192.168.0.1   TCP    60 submission > 45076 [ACK] Seq=92 Ack=21 Win=65535 Len=0
 8 0.081606000 140.112.9.9   192.168.0.1   SMTP  248 S: 250 mail.ntu.edu.tw Hello [140.112.240.238] | 250 SIZE 34865152 | 250 PIPELINING | 250 DSN | 250 ENHANCEDSTATUSCODES | 250 STARTTLS | 250 AUTH GSSAPI NTLM
 9 0.081620000 192.168.0.1   140.112.9.9   TCP    54 45076 > submission [ACK] Seq=21 Ack=286 Win=30016 Len=0
10 0.113619000 192.168.0.1   140.112.9.9   SMTP   64 C: STARTTLS
11 0.114194000 140.112.9.9   192.168.0.1   TCP    60 submission > 45076 [ACK] Seq=286 Ack=31 Win=65535 Len=0
12 0.129586000 140.112.9.9   192.168.0.1   SMTP   83 S: 220 2.0.0 SMTP server ready
13 0.166730000 192.168.0.1   140.112.9.9   TCP    54 45076 > submission [ACK] Seq=31 Ack=315 Win=30016 Len=0
```

Telnet



```
17 1.991024000 140.112.172.3   192.168.0.1     TCP     60 telnet > 59224 [ACK] Seq=6053 Ack=58 Win=65535 Len=0
18 1.993257000 140.112.172.3   192.168.0.1     TELNET  60 Telnet Data ...
19 2.031122000 192.168.0.1     140.112.172.3   TCP     54 59224 > telnet [ACK] Seq=58 Ack=6054 Win=41180 Len=0
20 2.102777000 192.168.0.1     140.112.172.3   TELNET  55 Telnet Data ...
21 2.103161000 140.112.172.3   192.168.0.1     TCP     60 telnet > 59224 [ACK] Seq=6054 Ack=59 Win=65535 Len=0
22 2.105029000 140.112.172.3   192.168.0.1     TELNET  60 Telnet Data ...
23 2.105046000 192.168.0.1     140.112.172.3   TCP     54 59224 > telnet [ACK] Seq=59 Ack=6055 Win=41180 Len=0
24 2.783261000 192.168.0.1     140.112.172.3   TELNET  55 Telnet Data ...
25 2.783774000 140.112.172.3   192.168.0.1     TCP     60 telnet > 59224 [ACK] Seq=6055 Ack=60 Win=65535 Len=0
26 2.785143000 140.112.172.3   192.168.0.1     TELNET  60 Telnet Data ...
27 2.785158000 192.168.0.1     140.112.172.3   TCP     54 59224 > telnet [ACK] Seq=60 Ack=6056 Win=41180 Len=0
28 2.942271000 192.168.0.1     140.112.172.3   TELNET  55 Telnet Data ...
29 2.942871000 140.112.172.3   192.168.0.1     TCP     60 telnet > 59224 [ACK] Seq=6056 Ack=61 Win=65535 Len=0
30 2.944303000 140.112.172.3   192.168.0.1     TELNET  60 Telnet Data ...
```

4. Application

firewall：當你以後成為台大資工系某程式設計課的老師，你希望可以在考試的三個小時裡關閉所有的連線，只能連上自己的Online Judge/Judgegirl System時，你可以使用firewall 擋下除了OJ以外的所有東西。設定Router讓此時FORWARD的IP只有Online Judge可以通過，其他的封包一律DROP。並且可以設定timer，在考試結束後就清空規則。

ex:

```
iptables -A FORWARD -p TCP -s 140.112.xxx.xxx -j ACCEPT
iptables -A FORWARD -i eth1 -j REJECT
sleep 10800
iptables -t filter -F
iptables -t filter -X
iptables -t filter -Z
```