山东大学 计算机 学院

计算机网络 课程实验报告

学号：	姓名：	班级：
实验题目： 实验七 NAT		
实验学时：2h	实验日期：2023.04.10	
实验目的： 学习 NAT 的相关内容，		
硬件环境： Windows10 家庭版		
软件环境： Wireshark		

实验步骤与内容：

实验内容：

1. What is the IP address of the client?

2. The client actually communicates with several different Google servers in order to implement “safe browsing.” (See extra credit section at the end of this lab). The main Google server that will serve up the main Google web page has IP address 64.233.169.104. In order to display only those frames containing HTTP messages that are sent to/from this Google, server, enter the expression “http && ip.addr == 64.233.169.104” (without quotes) into the Filter: field in Wireshark .

3. Consider now the HTTP GET sent from the client to the Google server (whose IP address is IP address 64.233.169.104) at time 7.109267. What are the source and destination IP addresses and TCP source and destination ports on the IP datagram carrying this HTTP GET?

4. At what time4 is the corresponding 200 OK HTTP message received from the Google server? What are the source and destination IP addresses and TCP source and destination ports on the IP datagram carrying this HTTP 200 OK message?

5. Recall that before a GET command can be sent to an HTTP server, TCP must first set up a connection using the three-way SYN/ACK handshake. At what time is the client-to-server TCP SYN segment sent that sets up the connection used by the GET sent at time 7.109267? What are the source and destination IP addresses and source and destination ports for the TCP SYN segment? What are the source and destination IP addresses and source and destination ports of the ACK sent in response to the SYN. At what time is this ACK received at the client? (Note: to find these segments you will need to clear the Filter expression you entered above in step 2. If you enter the filter “tcp”, only TCP segments will be displayed by Wireshark).

6. In the NAT_ISP_side trace file, find the HTTP GET message was sent from the client

to the Google server at time 7.109267 (where t=7.109267 is time at which this was sent as recorded in the NAT_home_side trace file). At what time does this message appear in the NAT_ISP_side trace file? What are the source and destination IP addresses and TCP source and destination ports on the IP datagram carrying this HTTP GET (as recording in the NAT_ISP_side trace file)? Which of these fields are the same, and which are different, than in your answer to question 3 above?

7. Are any fields in the HTTP GET message changed? Which of the following fields in the IP datagram carrying the HTTP GET are changed: Version, Header Length, Flags, Checksum. If any of these fields have changed, give a reason (in one sentence) stating why this field needed to change.

8. In the NAT_ISP_side trace file, at what time is the first 200 OK HTTP message received from the Google server? What are the source and destination IP addresses and TCP source and destination ports on the IP datagram carrying this HTTP 200 OK message? Which of these fields are the same, and which are different than your answer to question 4 above?

9. In the NAT_ISP_side trace file, at what time were the client-to-server TCP SYN segment and the server-to-client TCP ACK segment corresponding to the segments in question 5 above captured? What are the source and destination IP addresses and source and destination ports for these two segments? Which of these fields are the same, and which are different than your answer to question 5 above? Figure 4.25 in the text shows the NAT translation table in the NAT router.

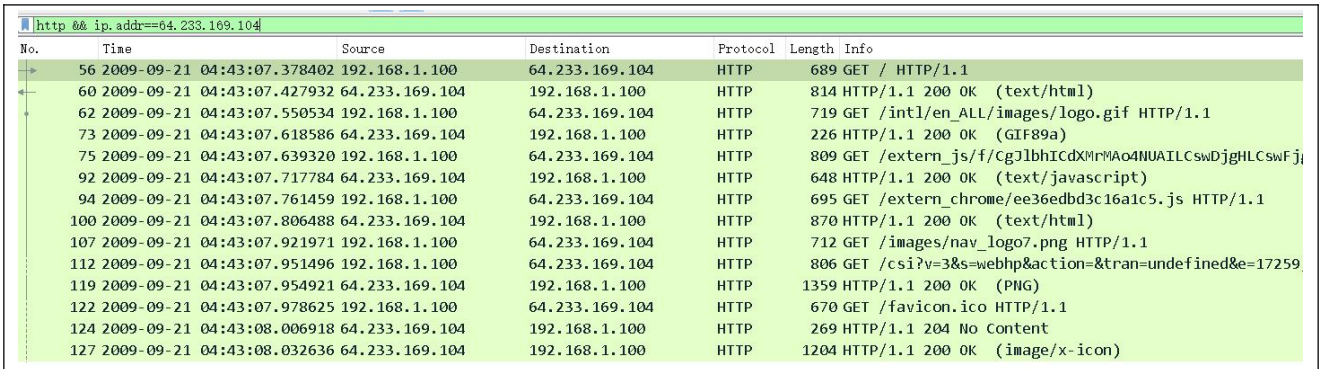
10. Using your answers to 1-8 above, fill in the NAT translation table entries for HTTP connection considered in questions 1-8 above.

实验步骤：
本实验主要学习 NAT，我们先下载实验指导书给出的文件，然后使用 Wireshark 打开相应的文件，并查看相应的封包。

1. 客户端的 IP 地址为 192.168.1.100。

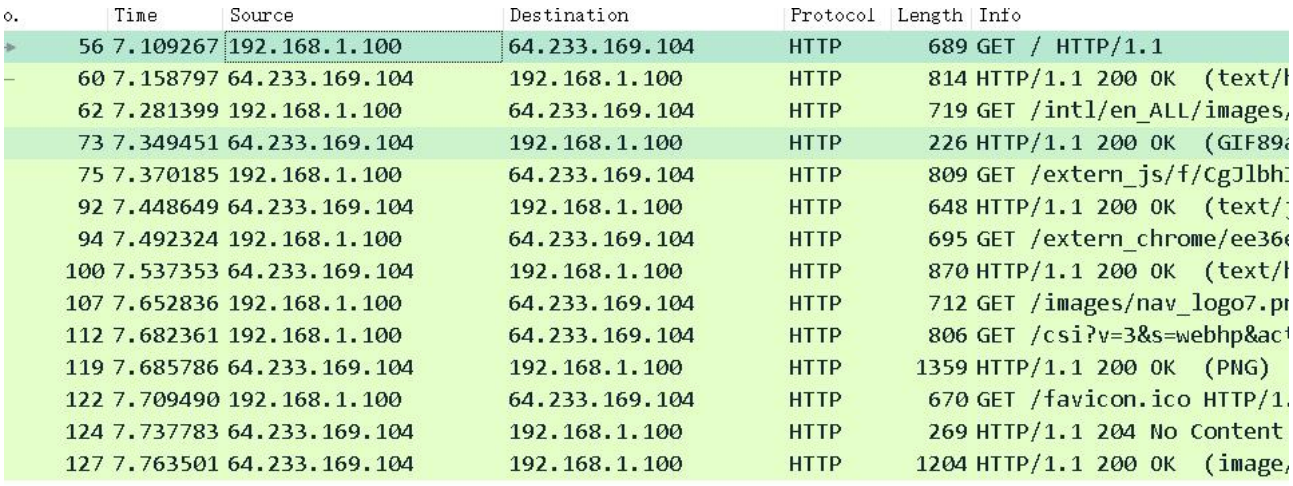
7	2009-09-21 04:43:01.477175	192.168.1.100	74.125.91.113	HTTP	1035	POST /safebrowsing/
11	2009-09-21 04:43:01.543197	74.125.91.113	192.168.1.100	HTTP	853	HTTP/1.1 200 OK (a
20	2009-09-21 04:43:01.841450	192.168.1.100	74.125.106.31	HTTP	767	GET /safebrowsing/r
39	2009-09-21 04:43:01.946914	74.125.106.31	192.168.1.100	HTTP	651	HTTP/1.1 200 OK (a
41	2009-09-21 04:43:02.246131	192.168.1.100	74.125.106.31	HTTP	772	GET /safebrowsing/r
42	2009-09-21 04:43:02.269764	74.125.106.31	192.168.1.100	HTTP	881	HTTP/1.1 200 OK (a
43	2009-09-21 04:43:02.283240	192.168.1.100	74.125.106.31	HTTP	776	GET /safebrowsing/r
44	2009-09-21 04:43:02.307382	74.125.106.31	192.168.1.100	HTTP	526	HTTP/1.1 200 OK (a
45	2009-09-21 04:43:02.313886	192.168.1.100	74.125.106.31	HTTP	776	GET /safebrowsing/r
46	2009-09-21 04:43:02.334012	74.125.106.31	192.168.1.100	HTTP	1089	HTTP/1.1 200 OK (a
56	2009-09-21 04:43:07.378402	192.168.1.100	64.233.169.104	HTTP	689	GET / HTTP/1.1

2.

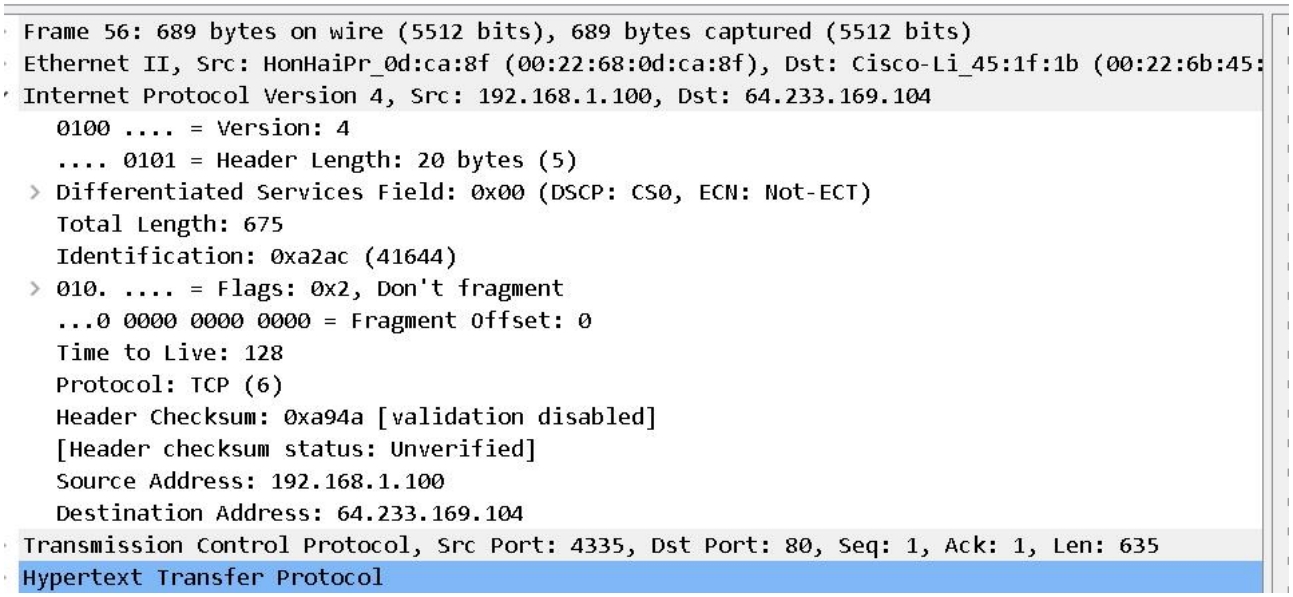


No.	Time	Source	Destination	Protocol	Length	Info
56	2009-09-21 04:43:07.378402	192.168.1.100	64.233.169.104	HTTP	689	GET / HTTP/1.1
60	2009-09-21 04:43:07.427932	64.233.169.104	192.168.1.100	HTTP	814	HTTP/1.1 200 OK (text/html)
62	2009-09-21 04:43:07.550534	192.168.1.100	64.233.169.104	HTTP	719	GET /intl/en_ALL/images/logo.gif HTTP/1.1
73	2009-09-21 04:43:07.618586	64.233.169.104	192.168.1.100	HTTP	226	HTTP/1.1 200 OK (GIF89a)
75	2009-09-21 04:43:07.639320	192.168.1.100	64.233.169.104	HTTP	809	GET /extern_js/f/CgJlbhICdXMrMAo4NUAILCswDjgHLCswFj
92	2009-09-21 04:43:07.717784	64.233.169.104	192.168.1.100	HTTP	648	HTTP/1.1 200 OK (text/javascript)
94	2009-09-21 04:43:07.761459	192.168.1.100	64.233.169.104	HTTP	695	GET /extern_chrome/ee36edbd3c16a1c5.js HTTP/1.1
100	2009-09-21 04:43:07.806488	64.233.169.104	192.168.1.100	HTTP	870	HTTP/1.1 200 OK (text/html)
107	2009-09-21 04:43:07.921971	192.168.1.100	64.233.169.104	HTTP	712	GET /images/nav_logo7.png HTTP/1.1
112	2009-09-21 04:43:07.951496	192.168.1.100	64.233.169.104	HTTP	806	GET /csi?v=3&s=webhp&action=&tran=undefined&e=17259
119	2009-09-21 04:43:07.954921	64.233.169.104	192.168.1.100	HTTP	1359	HTTP/1.1 200 OK (PNG)
122	2009-09-21 04:43:07.978625	192.168.1.100	64.233.169.104	HTTP	670	GET /favicon.ico HTTP/1.1
124	2009-09-21 04:43:08.006918	64.233.169.104	192.168.1.100	HTTP	269	HTTP/1.1 204 No Content
127	2009-09-21 04:43:08.032636	64.233.169.104	192.168.1.100	HTTP	1204	HTTP/1.1 200 OK (image/x-icon)

3. 源 IP 地址是 192.168.1.100，源端口号是 4335，目的 IP 地址是 64.233.169.104，目的端口号是 80。

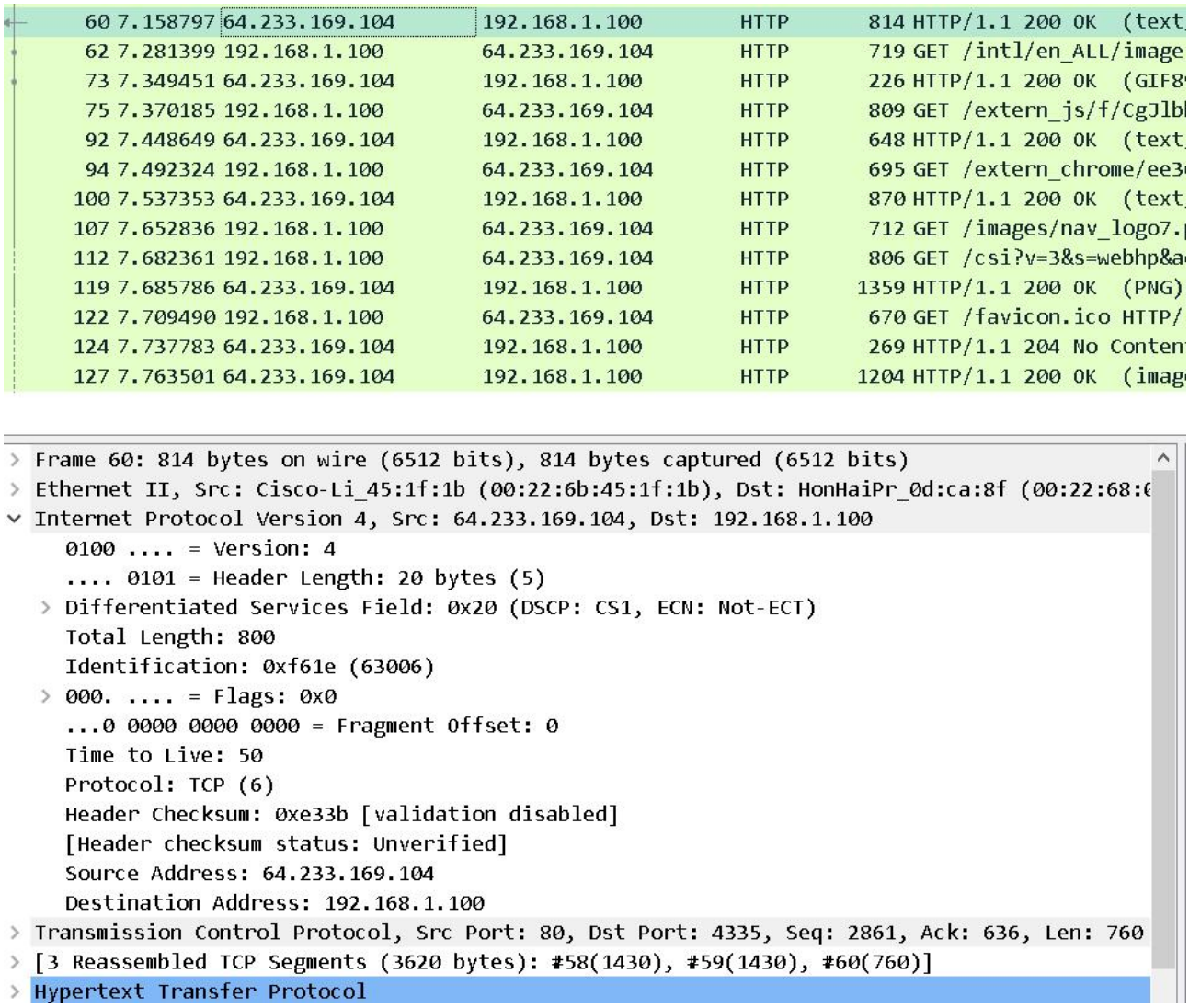


o.	Time	Source	Destination	Protocol	Length	Info
56	7.109267	192.168.1.100	64.233.169.104	HTTP	689	GET / HTTP/1.1
60	7.158797	64.233.169.104	192.168.1.100	HTTP	814	HTTP/1.1 200 OK (text/h
62	7.281399	192.168.1.100	64.233.169.104	HTTP	719	GET /intl/en_ALL/images/
73	7.349451	64.233.169.104	192.168.1.100	HTTP	226	HTTP/1.1 200 OK (GIF89a
75	7.370185	192.168.1.100	64.233.169.104	HTTP	809	GET /extern_js/f/CgJlbhI
92	7.448649	64.233.169.104	192.168.1.100	HTTP	648	HTTP/1.1 200 OK (text/j
94	7.492324	192.168.1.100	64.233.169.104	HTTP	695	GET /extern_chrome/ee36e
100	7.537353	64.233.169.104	192.168.1.100	HTTP	870	HTTP/1.1 200 OK (text/h
107	7.652836	192.168.1.100	64.233.169.104	HTTP	712	GET /images/nav_logo7.pn
112	7.682361	192.168.1.100	64.233.169.104	HTTP	806	GET /csi?v=3&s=webhp&act
119	7.685786	64.233.169.104	192.168.1.100	HTTP	1359	HTTP/1.1 200 OK (PNG)
122	7.709490	192.168.1.100	64.233.169.104	HTTP	670	GET /favicon.ico HTTP/1.
124	7.737783	64.233.169.104	192.168.1.100	HTTP	269	HTTP/1.1 204 No Content
127	7.763501	64.233.169.104	192.168.1.100	HTTP	1204	HTTP/1.1 200 OK (image/



```
Frame 56: 689 bytes on wire (5512 bits), 689 bytes captured (5512 bits)
Ethernet II, Src: HonHaiPr_0d:ca:8f (00:22:68:0d:ca:8f), Dst: Cisco-Li_45:1f:1b (00:22:6b:45:
Internet Protocol Version 4, Src: 192.168.1.100, Dst: 64.233.169.104
    0100 .... = Version: 4
    .... 0101 = Header Length: 20 bytes (5)
  > Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
    Total Length: 675
    Identification: 0xa2ac (41644)
  > 010. .... = Flags: 0x2, Don't fragment
    ...0 0000 0000 0000 = Fragment Offset: 0
    Time to Live: 128
    Protocol: TCP (6)
    Header Checksum: 0xa94a [validation disabled]
    [Header checksum status: Unverified]
    Source Address: 192.168.1.100
    Destination Address: 64.233.169.104
Transmission Control Protocol, Src Port: 4335, Dst Port: 80, Seq: 1, Ack: 1, Len: 635
Hypertext Transfer Protocol
```

4. 时间是 7.158798s，源 IP 地址是 64.233.169.104，目的 IP 地址是 192.168.1.100，源端口号是 80，目的端口号是 4335。



5. TCP SYN 报文源 IP 地址是 192.168.1.100，源端口号是 4335，目标 IP 地址是 64.233.169.104，目标端口号是 80，时间是 7.075657。

```
 47 2.178596 192.168.1.100   74.125.106.31     TCP      54 4331 → 80 [ACK] Seq=2876
 53 7.075657 192.168.1.100   64.233.169.104   TCP      66 4335 → 80 [SYN] Seq=0 Wi
 54 7.108986 64.233.169.104  192.168.1.100    TCP      66 80 → 4335 [SYN, ACK] Seq
 55 7.109053 192.168.1.100   64.233.169.104   TCP      54 4335 → 80 [ACK] Seq=1 Ac
 56 7.109267 192.168.1.100   64.233.169.104   HTTP    689 GET / HTTP/1.1
 57 7.140728 64.233.169.104  192.168.1.100    TCP      60 80 → 4335 [ACK] Seq=1 Ac
 58 7.158432 64.233.169.104  192.168.1.100    TCP    1484 80 → 4335 [ACK] Seq=1 Ac
 59 7.158761 64.233.169.104  192.168.1.100    TCP    1484 80 → 4335 [ACK] Seq=1431
 60 7.158797 64.233.169.104  192.168.1.100    HTTP    814 HTTP/1.1 200 OK  (text/h
 61 7.158844 192.168.1.100   64.233.169.104   TCP      54 4335 → 80 [ACK] Seq=636
 62 7.281399 192.168.1.100   64.233.169.104   HTTP    719 GET /intl/en_ALL/images/
 63 7.315019 64.233.169.104  192.168.1.100    TCP      309 80 → 4335 [PSH, ACK] Seq
```

```
> Frame 53: 66 bytes on wire (528 bits), 66 bytes captured (528 bits)
> Ethernet II, Src: HonHaiPr_0d:ca:8f (00:22:68:0d:ca:8f), Dst: Cisco-Li_45:1f:1b (00:22:6b:45:
v Internet Protocol Version 4, Src: 192.168.1.100, Dst: 64.233.169.104
    0100 .... = Version: 4
    .... 0101 = Header Length: 20 bytes (5)
  > Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
    Total Length: 52
    Identification: 0xa2aa (41642)
  > 010. .... = Flags: 0x2, Don't fragment
    ...0 0000 0000 0000 = Fragment Offset: 0
    Time to Live: 128
    Protocol: TCP (6)
    Header Checksum: 0xabbb [validation disabled]
    [Header checksum status: Unverified]
    Source Address: 192.168.1.100
    Destination Address: 64.233.169.104
> Transmission Control Protocol, Src Port: 4335, Dst Port: 80, Seq: 0, Len: 0
```

ACK 报文源 IP 地址是 64.233.169.104，源端口号是 80，目标 IP 地址是 192.168.1.100，目标端口号是 4335，客户端在 7.108986s 处收到。

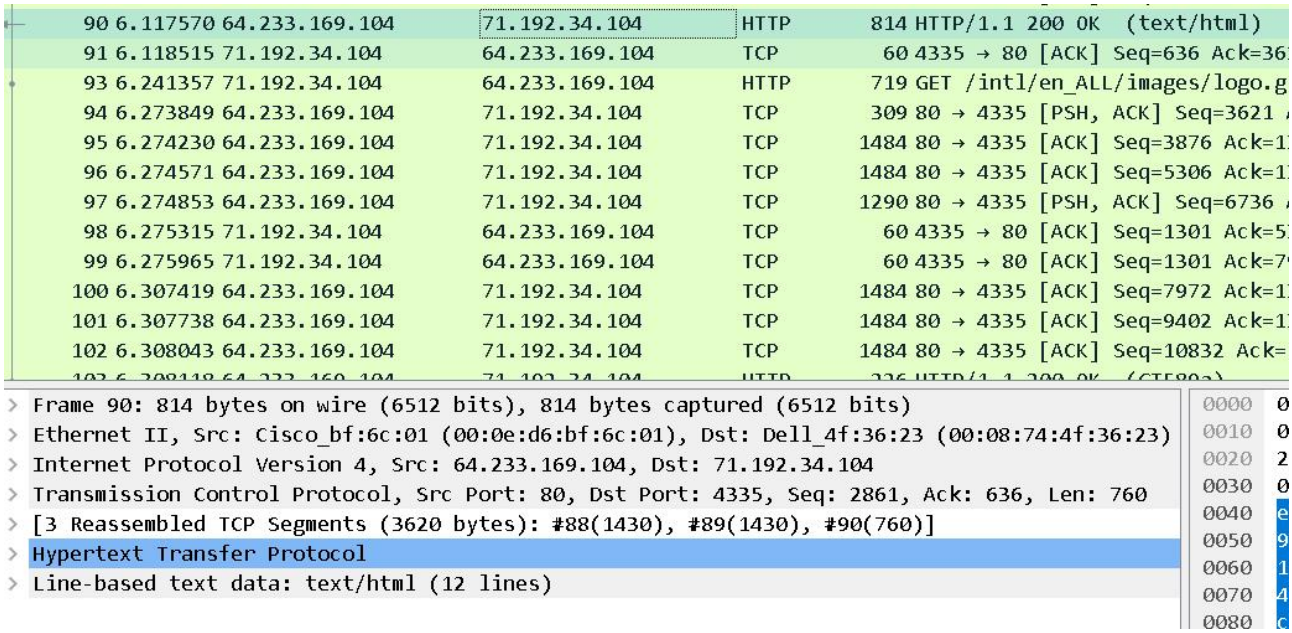
```
53 7.075657 192.168.1.100   64.233.169.104   TCP      66 4335 → 80 [SYN] Seq=0 Win=65535 Len=0 MSS=1460 WS=4 SACK_PERM
54 7.108986 64.233.169.104  192.168.1.100    TCP      66 80 → 4335 [SYN, ACK] Seq=0 Ack=1 Win=5720 Len=0 MSS=1430 SACK_PERM WS=64
55 7.109053 192.168.1.100   64.233.169.104   TCP      54 4335 → 80 [ACK] Seq=1 Ack=1 Win=260176 Len=0
56 7.109267 192.168.1.100   64.233.169.104   HTTP    689 GET / HTTP/1.1
57 7.140728 64.233.169.104  192.168.1.100    TCP      60 80 → 4335 [ACK] Seq=1 Ack=636 Win=7040 Len=0
58 7.158432 64.233.169.104  192.168.1.100    TCP    1484 80 → 4335 [ACK] Seq=1 Ack=636 Win=7040 Len=1430 [TCP segment of a reassembled PDU]
59 7.158761 64.233.169.104  192.168.1.100    TCP    1484 80 → 4335 [ACK] Seq=1431 Ack=636 Win=7040 Len=1430 [TCP segment of a reassembled PDU]
60 7.158797 64.233.169.104  192.168.1.100    HTTP    814 HTTP/1.1 200 OK  (text/html)
61 7.158844 192.168.1.100   64.233.169.104   TCP      54 4335 → 80 [ACK] Seq=636 Ack=3621 Win=260176 Len=0
62 7.281399 192.168.1.100   64.233.169.104   HTTP    719 GET /intl/en_ALL/images/logo.gif HTTP/1.1
63 7.315019 64.233.169.104  192.168.1.100    TCP      309 80 → 4335 [PSH, ACK] Seq=3621 Ack=1301 Win=8320 Len=255 [TCP segment of a reassembled PDU
64 7.315576 64.233.169.104  192.168.1.100    TCP    1484 80 → 4335 [ACK] Seq=3876 Ack=1301 Win=8320 Len=1430 [TCP segment of a reassembled PDU]
65 7.315641 192.168.1.100   64.233.169.104   TCP      54 4335 → 80 [ACK] Seq=1301 Ack=5306 Win=260176 Len=0
66 7.315920 64.233.169.104  192.168.1.100    TCP    1484 80 → 4335 [ACK] Seq=5306 Ack=1301 Win=8320 Len=1430 [TCP segment of a reassembled PDU]
```

6. 出现的时间是 6.069168s，源 IP 地址是 71.192.34.104，源端口号是 4335，目标 IP 地址是 64.233.169.104，目标端口号是 80，与问题 3 源 IP 地址不同。

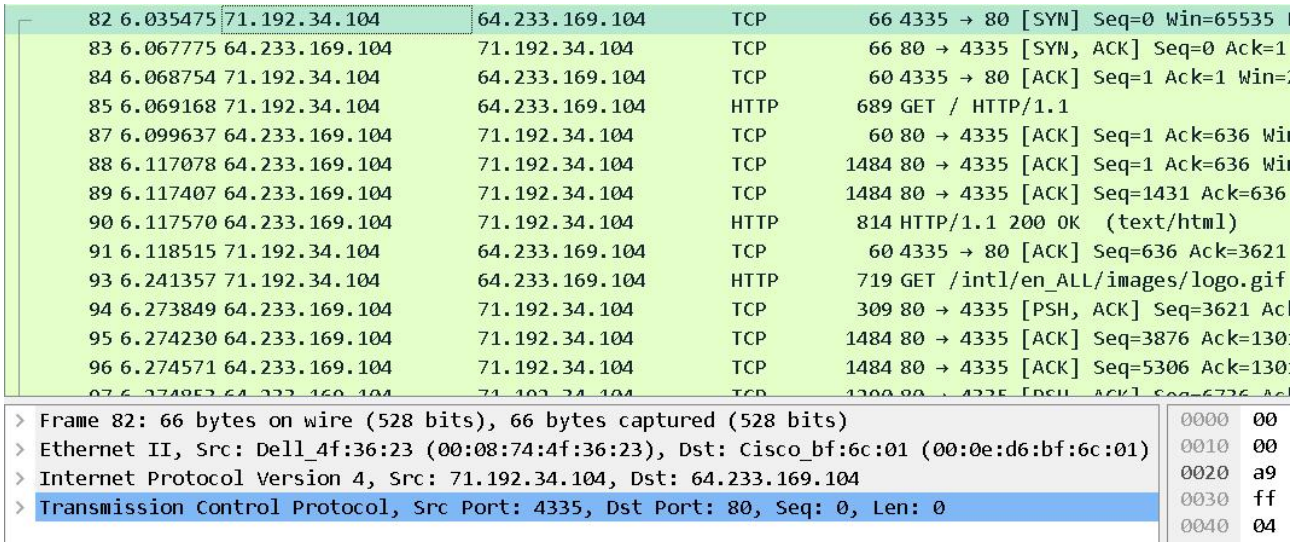
```
 85 6.069168 71.192.34.104   64.233.169.104   HTTP    689 GET / HTTP/1.1
 90 6.117570 64.233.169.104  71.192.34.104    HTTP    814 HTTP/1.1 200 OK  (text/html)
 93 6.241357 71.192.34.104   64.233.169.104   HTTP    719 GET /intl/en_ALL/images/logo.gif HTTP/1.1
103 6.308118 64.233.169.104  71.192.34.104    HTTP    226 HTTP/1.1 200 OK  (GIF89a)
106 6.330131 71.192.34.104   64.233.169.104   HTTP    809 GET /extern_js/f/CgJlbhICdXMrMAo4NUAILCswD
121 6.407366 64.233.169.104  71.192.34.104    HTTP    648 HTTP/1.1 200 OK  (text/javascript)
125 6.452270 71.192.34.104   64.233.169.104   HTTP    695 GET /extern_chrome/ee36edbd3c16a1c5.js HTT
131 6.496234 64.233.169.104  71.192.34.104    HTTP    870 HTTP/1.1 200 OK  (text/html)
135 6.533219 71.192.34.104   74.125.91.113    HTTP    709 GET /generate_204 HTTP/1.1
137 6.590706 74.125.91.113   71.192.34.104    HTTP    179 HTTP/1.1 204 No Content
139 6.612801 71.192.34.104   64.233.169.104   HTTP    712 GET /images/nav_logo7.png HTTP/1.1
144 6.642308 71.192.34.104   64.233.169.104   HTTP    806 GET /csi?v=3&s=webhp&action=&tran=undefine
149 6.644609 64.233.169.104  71.192.34.104    HTTP   1359 HTTP/1.1 200 OK  (PNG)
154 6.669397 71.192.34.104   64.233.169.104   HTTP    670 GET /favicon.ico HTTP/1.1
```

7. 只有 Checksum 发生了改变，这是因为源 IP 地址发送了改变，而 Checksum 包括了源 IP 地址，所以 Checksum 也会发生改变。

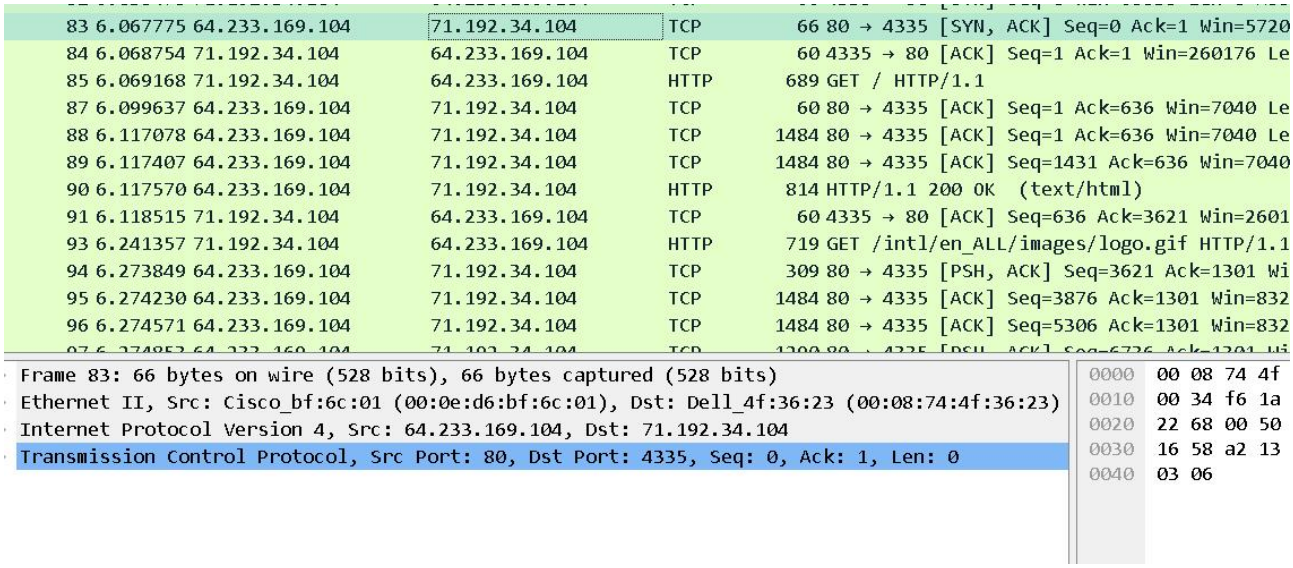
8. 时间是 6.117570s，源 IP 地址是 64.233.169.104，目标 IP 地址是 71.192.34.104，源端口号是 80，目标端口号是 4335。与问题 4 相比目标 IP 地址不同。



9. TCP SYN 段是在 6.035475s 捕获，源 IP 地址是 71.192.34.104，源端口号是 4335，目的 IP 是 64.233.169.104，目的端口号是 80，与问题 5 相比源 IP 地址不同。



ACK 段是在 6.067775s 捕获，源 IP 地址是 64.233.169.104，源端口号是 80，目的 IP 地址是 71.192.34.104，目的源端口号是 4335，与问题 5 相比目的 IP 地址不同。



10.

WAN 端：71. 192. 34. 104， 4335，**LAN 端：**192. 168. 1. 100， 4335。

结论分析与体会：

学习了 NAT 的相关内容，巩固了课堂所学，对路由转化有了进一步的了解，通过查看具体的包中的内容，来学习 NAT 的知识，对 NAT 相关知识的记忆更加清晰。