

- School of Computer Science and Technology, Shandong University

- Lab Report on Computer Networking

| Student Number | Name | Class | Lab Title | Period | Date |
|----------------|------|-------|-----------|--------|--------------|
| 201900170249 | 李阳 | 智能19 | DHCP v8.0 | 2h | May 11, 2021 |

Hardware Environment

- Lenovo Legion Y7000P 2020H(Intel Core i7-10750H, 16GB DDR4)
- Windows 10 Home, Chinese Version

Software Environment

- Wireshark-win64-3.44

Purpose

- Take a quick look at DHCP and answer the questions after it.

Experimental Records

To observe DHCP in action, we'll perform several DHCP-related commands and capture the DHCP messages exchanged as a result of executing these commands.

- Open the Windows Command Prompt application, enter "ipconfig /release". This command releases the current IP address.
- Start up the Wireshark packet sniffer and begin Wireshark packet capture.
- Go back to the Windows Command Prompt and enter "ipconfig /renew". This instructs host to obtain a network configuration, including a new IP address.
- Wait until the "ipconfig /renew" has terminated. Then enter the same command "ipconfig /renew" again. When the second "ipconfig /renew" terminates, enter the command "ipconfig /release" to release the previously-allocated IP address to computer.
- Finally, enter "ipconfig /renew" to again be allocated an IP address for computer and stop Wireshark packet capture.

After the command "ipconfig /release"

```
无线局域网适配器 WLAN:

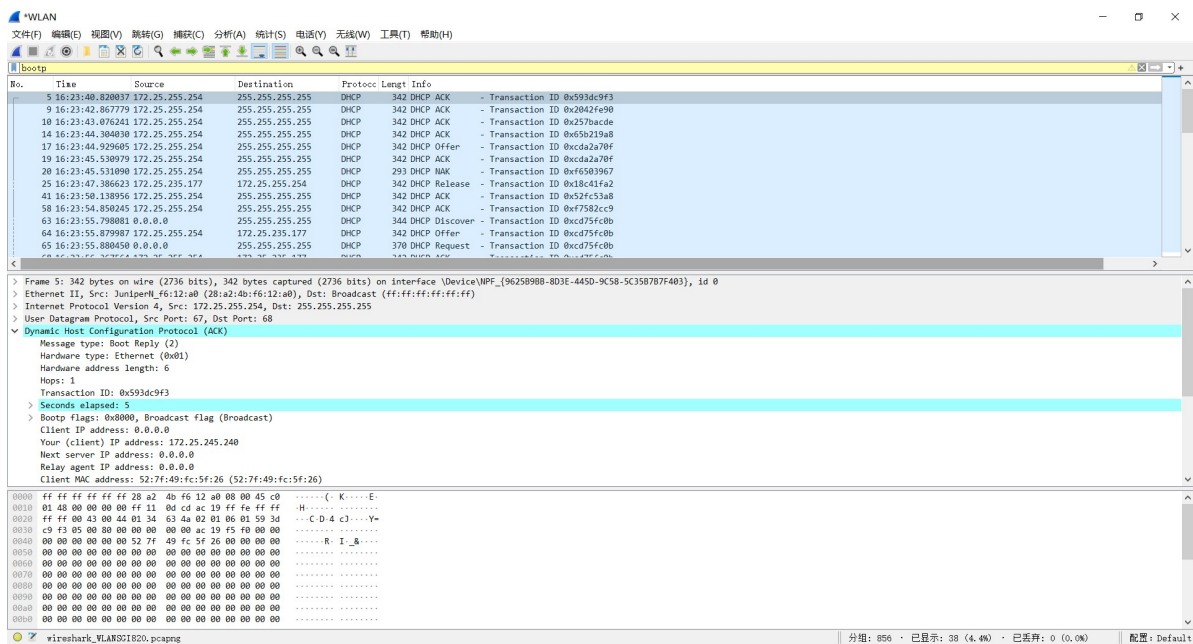
   连接特定的 DNS 后缀 . . . . . : 
   IPv6 地址 . . . . . : 2001:250:5800:1002::4324:46f3
   本地链接 IPv6 地址. . . . . : fe80::313c:324a:d9be:8884%17
   默认网关. . . . . : fe80::2aa2:4bff:fef6:12a0%17
```

After the command "ipconfig /renew"

```
无线局域网适配器 WLAN:

   连接特定的 DNS 后缀 . . . . . : 
   IPv6 地址 . . . . . : 2001:250:5800:1002::4324:46f3
   本地链接 IPv6 地址. . . . . : fe80::313c:324a:d9be:8884%17
   IPv4 地址 . . . . . : 172.25.235.177
   子网掩码 . . . . . : 255.255.128.0
   默认网关. . . . . : fe80::2aa2:4bff:fef6:12a0%17
                        172.25.255.254
```

- Take a look at the resulting Wireshark window, enter “bootp” in the filter to see only the DHCP packets.



Answer to Questions

1. DHCP messages sent over UDP.

```
Internet Protocol Version 4, Src: 172.25.255.254, Dst: 255.255.255.255
  0100 .... = Version: 4
  .... 0101 = Header Length: 20 bytes (5)
  > Differentiated Services Field: 0xc0 (DSCP: CS6, ECN: Not-ECT)
    Total Length: 328
    Identification: 0x0000 (0)
    > Flags: 0x00
      Fragment Offset: 0
      Time to Live: 255
      Protocol: UDP (17)
    Header Checksum: 0x0dcd [validation disabled]
    [Header checksum status: Unverified]
    Source Address: 172.25.255.254
```

2. For DHCP Discover and DHCP Request, source port number is 68, destination port number is 67. For DHCP Offer and DHCP ACK, source port number is 67, destination port number is 68. The port numbers are the same as in the example given in this lab assignment.

| No. | Time | Source | Destination | Protocol | Length | Info |
|-----|-----------------|----------------|-----------------|----------|--------|---|
| 20 | 16:23:45.531090 | 172.25.255.254 | 255.255.255.255 | DHCP | 293 | DHCP NAK - Transaction ID 0xf6503967 |
| 25 | 16:23:47.386623 | 172.25.235.177 | 172.25.255.254 | DHCP | 342 | DHCP Release - Transaction ID 0x18c41fa2 |
| 41 | 16:23:50.138956 | 172.25.255.254 | 255.255.255.255 | DHCP | 342 | DHCP ACK - Transaction ID 0x52fc53a8 |
| 58 | 16:23:54.850245 | 172.25.255.254 | 255.255.255.255 | DHCP | 342 | DHCP ACK - Transaction ID 0xf7582c9 |
| 63 | 16:23:55.798081 | 0.0.0.0 | 255.255.255.255 | DHCP | 344 | DHCP Discover - Transaction ID 0xcd75fc0b |
| 64 | 16:23:55.879987 | 172.25.255.254 | 172.25.235.177 | DHCP | 342 | DHCP Offer - Transaction ID 0xcd75fc0b |
| 65 | 16:23:55.880450 | 0.0.0.0 | 255.255.255.255 | DHCP | 370 | DHCP Request - Transaction ID 0xcd75fc0b |
| 68 | 16:23:56.367564 | 172.25.255.254 | 172.25.235.177 | DHCP | 342 | DHCP ACK - Transaction ID 0xcd75fc0b |
| 249 | 16:24:00.074223 | 172.25.255.254 | 255.255.255.255 | DHCP | 342 | DHCP ACK - Transaction ID 0xc5bc1e76 |
| 286 | 16:24:03.656057 | 172.25.255.254 | 255.255.255.255 | DHCP | 342 | DHCP ACK - Transaction ID 0xaa8e46f9 |
| 322 | 16:24:09.711105 | 172.25.235.177 | 172.25.255.254 | DHCP | 358 | DHCP Request - Transaction ID 0x94e95585 |

3. 3c:58:c2:d2:73:b4

| | | | | | | |
|-----|-----------------|----------------|-----------------|------|-----|---|
| 63 | 16:23:55.798081 | 0.0.0.0 | 255.255.255.255 | DHCP | 344 | DHCP Discover - Transaction ID 0xcd75fc0b |
| 64 | 16:23:55.879987 | 172.25.255.254 | 172.25.235.177 | DHCP | 342 | DHCP Offer - Transaction ID 0xcd75fc0b |
| 65 | 16:23:55.880450 | 0.0.0.0 | 255.255.255.255 | DHCP | 370 | DHCP Request - Transaction ID 0xcd75fc0b |
| 68 | 16:23:56.367564 | 172.25.255.254 | 172.25.235.177 | DHCP | 342 | DHCP ACK - Transaction ID 0xcd75fc0b |
| 249 | 16:24:00.074223 | 172.25.255.254 | 255.255.255.255 | DHCP | 342 | DHCP ACK - Transaction ID 0xc5bc1e76 |
| 286 | 16:24:03.656057 | 172.25.255.254 | 255.255.255.255 | DHCP | 342 | DHCP ACK - Transaction ID 0xaa8e46f9 |
| 322 | 16:24:09.711105 | 172.25.235.177 | 172.25.255.254 | DHCP | 358 | DHCP Request - Transaction ID 0x94e95585 |


```

> Frame 63: 344 bytes on wire (2752 bits), 344 bytes captured (2752 bits) on interface \Device\NPF_{9625B98B-8D3E-445D-9C58-5C35B7B7F403}, id 0
> Ethernet II, Src: IntelCor_d2:73:b4 (3c:58:c2:d2:73:b4), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
  > Destination: Broadcast (ff:ff:ff:ff:ff:ff)
  > Source: IntelCor_d2:73:b4 (3c:58:c2:d2:73:b4)
    Address: IntelCor_d2:73:b4 (3c:58:c2:d2:73:b4)
    ....0. .... = LG bit: Globally unique address (factory default)
    ....0. .... = IG bit: Individual address (unicast)
  Type: IPv4 (0x0800)
  > Internet Protocol Version 4, Src: 0.0.0.0, Dst: 255.255.255.255
  > User Datagram Protocol, Src Port: 68, Dst Port: 67
  > Dynamic Host Configuration Protocol (Discover)
  
```

4. DHCP Request message includes two more options, DHCP Server Identifier and Client Fully Qualified Domain Name.

| | | | | | | |
|-----|-----------------|----------------|-----------------|------|-----|--|
| 65 | 16:23:55.880450 | 0.0.0.0 | 255.255.255.255 | DHCP | 370 | DHCP Request - Transaction ID 0xcd75fc0b |
| 68 | 16:23:56.367564 | 172.25.255.254 | 172.25.235.177 | DHCP | 342 | DHCP ACK - Transaction ID 0xcd75fc0b |
| 249 | 16:24:00.074223 | 172.25.255.254 | 255.255.255.255 | DHCP | 342 | DHCP ACK - Transaction ID 0xc5bc1e76 |
| 286 | 16:24:03.656057 | 172.25.255.254 | 255.255.255.255 | DHCP | 342 | DHCP ACK - Transaction ID 0xaa8e46f9 |
| 322 | 16:24:09.711105 | 172.25.235.177 | 172.25.255.254 | DHCP | 358 | DHCP Request - Transaction ID 0x94e95585 |
| 323 | 16:24:09.784963 | 172.25.255.254 | 172.25.235.177 | DHCP | 342 | DHCP ACK - Transaction ID 0x94e95585 |
| 346 | 16:24:12.360732 | 172.25.255.254 | 255.255.255.255 | DHCP | 342 | DHCP ACK - Transaction ID 0x614390cf |
| 368 | 16:24:19.427256 | 172.25.255.254 | 255.255.255.255 | DHCP | 342 | DHCP ACK - Transaction ID 0x614390cf |


```

Your (client) IP address: 0.0.0.0
Next server IP address: 0.0.0.0
Relay agent IP address: 0.0.0.0
Client MAC address: IntelCor_d2:73:b4 (3c:58:c2:d2:73:b4)
Client hardware address padding: 00000000000000000000
Server host name not given
Boot file name not given
Magic cookie: DHCP
> Option: (53) DHCP Message Type (Request)
> Option: (61) Client Identifier
> Option: (50) Requested IP Address (172.25.235.177)
> Option: (54) DHCP Server Identifier (172.25.255.254)
> Option: (12) Host Name
> Option: (81) Client Fully Qualified Domain Name
> Option: (60) Vendor class identifier
> Option: (55) Parameter Request List
> Option: (255) End
0000 ff ff ff ff ff ff 3c 58 c2 d2 73 b4 00 00 45 00 .....
0010 01 64 cd aa 00 00 00 11 00 00 00 00 00 ff ff .....
0020 ff ff 00 44 00 43 01 50 0c ab 01 01 06 00 cd 75 .....
0030 fc 0b 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0040 00 00 00 00 00 00 3c 58 c2 d2 73 b4 00 00 00 00 .....
  > Bootp flags: 0x0000 (Unicast)
  Client IP address: 0.0.0.0
  Your (client) IP address: 0.0.0.0
  Next server IP address: 0.0.0.0
  Relay agent IP address: 0.0.0.0
  Client MAC address: IntelCor_d2:73:b4 (3c:58:c2:d2:73:b4)
  Client hardware address padding: 00000000000000000000
  Server host name not given
  Boot file name not given
  Magic cookie: DHCP
  > Option: (53) DHCP Message Type (Discover)
  > Option: (61) Client identifier
  > Option: (50) Requested IP Address (172.25.235.177)
  > Option: (12) Host Name
  > Option: (60) Vendor class identifier
  > Option: (55) Parameter Request List
  > Option: (255) End
  
```

5. The value of the Transaction-ID in the first four(Discover/Offer/Request/ACK) DHCP messages is 0xcd75fc0b, and the values of the Transaction-ID in the second set (Request/ACK) set of DHCP messages is 0x94e95585.

The Transaction-ID field can avoid DHCP message reception chaos on multiple clients.

| | | | | | | |
|-----|-----------------|----------------|-----------------|------|-----|---|
| 322 | 16:24:09.711105 | 172.25.235.177 | 172.25.255.254 | DHCP | 358 | DHCP Request - Transaction ID 0x94e95585 |
| 323 | 16:24:09.784963 | 172.25.255.254 | 172.25.235.177 | DHCP | 342 | DHCP ACK - Transaction ID 0x94e95585 |
| 346 | 16:24:12.360732 | 172.25.255.254 | 255.255.255.255 | DHCP | 344 | DHCP Discover - Transaction ID 0xcd75fc0b |
| 368 | 16:24:19.427256 | 172.25.255.254 | 255.255.255.255 | DHCP | 342 | DHCP Offer - Transaction ID 0xcd75fc0b |
| 65 | 16:23:55.880450 | 0.0.0.0 | 255.255.255.255 | DHCP | 370 | DHCP Request - Transaction ID 0xcd75fc0b |
| 68 | 16:23:56.367564 | 172.25.255.254 | 172.25.235.177 | DHCP | 342 | DHCP ACK - Transaction ID 0xcd75fc0b |
| 249 | 16:24:00.074223 | 172.25.255.254 | 255.255.255.255 | DHCP | 342 | DHCP ACK - Transaction ID 0xc5bc1e76 |
| 286 | 16:24:03.656057 | 172.25.255.254 | 255.255.255.255 | DHCP | 342 | DHCP ACK - Transaction ID 0xaa8e46f9 |
| 322 | 16:24:09.711105 | 172.25.235.177 | 172.25.255.254 | DHCP | 358 | DHCP Request - Transaction ID 0x94e95585 |


```

> Ethernet II, Src: IntelCor_d2:73:b4 (3c:58:c2:d2:73:b4), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
> Internet Protocol Version 4, Src: 172.25.235.177, Dst: 255.255.255.255
> User Datagram Protocol, Src Port: 68, Dst Port: 67
> Dynamic Host Configuration Protocol (Request)
  Message type: Boot Request (1)
  Hardware type: Ethernet (0x01)
  Hardware address length: 6
  Hops: 0
  Transaction ID: 0x94e95585
  Seconds elapsed: 0
  > Bootp flags: 0x0000 (Unicast)
  Client IP address: 172.25.235.177
  Your (client) IP address: 0.0.0.0
  Next server IP address: 0.0.0.0
  0000 28 a2 4b f6 12 a0 3c 58 c2 d2 73 b4 00 00 45 00 .....
  0010 01 58 7d 7f 00 00 00 11 00 00 ac 19 eb b1 ac 19 .....
  0020 ff fe 00 44 00 43 01 44 45 39 01 01 06 00 94 e9 .....
  0030 55 85 00 00 00 00 ac 19 eb b1 00 00 00 00 00 00 .....
  0040 00 00 00 00 00 00 3c 58 c2 d2 73 b4 00 00 00 00 .....
  > Ethernet II, Src: IntelCor_d2:73:b4 (3c:58:c2:d2:73:b4), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
  > Internet Protocol Version 4, Src: 0.0.0.0, Dst: 255.255.255.255
  > User Datagram Protocol, Src Port: 68, Dst Port: 67
  > Dynamic Host Configuration Protocol (Discover)
    Message type: Boot Request (1)
    Hardware type: Ethernet (0x01)
    Hardware address length: 6
    Hops: 0
    Transaction ID: 0xcd75fc0b
    Seconds elapsed: 0
    > Bootp flags: 0x0000 (Unicast)
    Client IP address: 0.0.0.0
    Your (client) IP address: 0.0.0.0
    Next server IP address: 0.0.0.0
  
```


6. Stream index is used in the IP datagrams in the four-message exchange. The value of the Stream index in the DHCP Discovery and Request messages is 14, the value of the Stream index in the DHCP Offer and ACK messages is 3.

| | | | | | | | |
|-----|-----------------|----------------|-----------------|------|-----|---------------|-----------------------------|
| 63 | 16:23:55.798081 | 0.0.0.0 | 255.255.255.255 | DHCP | 344 | DHCP Discover | - Transaction ID 0xcd75fc0b |
| 64 | 16:23:55.879987 | 172.25.255.254 | 172.25.235.177 | DHCP | 342 | DHCP Offer | - Transaction ID 0xcd75fc0b |
| 65 | 16:23:55.880450 | 0.0.0.0 | 255.255.255.255 | DHCP | 370 | DHCP Request | - Transaction ID 0xcd75fc0b |
| 68 | 16:23:56.367564 | 172.25.255.254 | 172.25.235.177 | DHCP | 342 | DHCP ACK | - Transaction ID 0xcd75fc0b |
| 249 | 16:24:00.074223 | 172.25.255.254 | 255.255.255.255 | DHCP | 342 | DHCP ACK | |
| 286 | 16:24:03.656057 | 172.25.255.254 | 255.255.255.255 | DHCP | 342 | DHCP ACK | |
| 322 | 16:24:09.711105 | 172.25.235.177 | 172.25.255.254 | DHCP | 358 | DHCP Request | |

| | |
|--|--|
| > Frame 64: 342 bytes on wire (2736 bits) > Ethernet II, Src: JuniperN_f6:12:a0 (28:00:00:00:00:00), Dst: 01:00:5e:00:00:00 > Internet Protocol Version 4, Src: 172.25.255.254, Dst: 255.255.255.255 > User Datagram Protocol, Src Port: 67, Dst Port: 68 Source Port: 67 Destination Port: 68 Length: 308 Checksum: 0xbe2e [unverified] [Checksum Status: Unverified] [Stream index: 3] > [Timestamps] UDP payload (300 bytes) > Dynamic Host Configuration Protocol (DHCP) | > Frame 63: 344 bytes on wire (2752 bits), 344 bytes captured (2752 bits) on interface \Device\NPF{...} > Ethernet II, Src: IntelCor_d2:73:b4 (3c:58:c2:d2:73:b4), Dst: Broadcast (ff:ff:ff:ff:ff:ff) > Internet Protocol Version 4, Src: 0.0.0.0, Dst: 255.255.255.255 > User Datagram Protocol, Src Port: 68, Dst Port: 67 Source Port: 68 Destination Port: 67 Length: 310 Checksum: 0x2b5f [unverified] [Checksum Status: Unverified] [Stream index: 14] > [Timestamps] UDP payload (302 bytes) |
|--|--|

7. 172.25.255.254

8. 172.25.235.177

| No. | Time | Source | Destination | Protocol | Length | Info |
|-----|-----------------|----------------|-----------------|----------|--------|---------------|
| 20 | 16:23:45.531090 | 172.25.255.254 | 255.255.255.255 | DHCP | 293 | DHCP NAK |
| 25 | 16:23:47.386623 | 172.25.235.177 | 172.25.255.254 | DHCP | 342 | DHCP Release |
| 41 | 16:23:50.138956 | 172.25.255.254 | 255.255.255.255 | DHCP | 342 | DHCP ACK |
| 58 | 16:23:54.850245 | 172.25.255.254 | 255.255.255.255 | DHCP | 342 | DHCP ACK |
| 63 | 16:23:55.798081 | 0.0.0.0 | 255.255.255.255 | DHCP | 344 | DHCP Discover |
| 64 | 16:23:55.879987 | 172.25.255.254 | 172.25.235.177 | DHCP | 342 | DHCP Offer |
| 65 | 16:23:55.880450 | 0.0.0.0 | 255.255.255.255 | DHCP | 370 | DHCP Request |
| 68 | 16:23:56.367564 | 172.25.255.254 | 172.25.235.177 | DHCP | 342 | DHCP ACK |
| 249 | 16:24:00.074223 | 172.25.255.254 | 255.255.255.255 | DHCP | 342 | DHCP ACK |
| 286 | 16:24:03.656057 | 172.25.255.254 | 255.255.255.255 | DHCP | 342 | DHCP ACK |
| 322 | 16:24:09.711105 | 172.25.235.177 | 172.25.255.254 | DHCP | 358 | DHCP Request |

```

Client IP address: 0.0.0.0
Your (client) IP address: 172.25.235.177
Next server IP address: 0.0.0.0
Relay agent IP address: 0.0.0.0
Client MAC address: IntelCor_d2:73:b4 (3c:58:c2:d2:73:b4)
Client hardware address padding: 00000000000000000000
Server host name not given
Boot file name not given
Magic cookie: DHCP
  
```

9. Relay agent IP address is 0.0.0.0
10. The router line indicates to the client what its default gateway should be. The subnet mask line tells the client which subnet mask it should use.
11. The client accept the IP address.

| No. | Time | Source | Destination | Protocol | Length | Info |
|-----|-----------------|----------------|-----------------|----------|--------|-----------------|
| 20 | 16:23:45.531090 | 172.25.255.254 | 255.255.255.255 | DHCP | 293 | DHCP NAK - |
| 25 | 16:23:47.386623 | 172.25.235.177 | 172.25.255.254 | DHCP | 342 | DHCP Release - |
| 41 | 16:23:50.138956 | 172.25.255.254 | 255.255.255.255 | DHCP | 342 | DHCP ACK - |
| 58 | 16:23:54.850245 | 172.25.255.254 | 255.255.255.255 | DHCP | 342 | DHCP ACK - |
| 63 | 16:23:55.798081 | 0.0.0.0 | 255.255.255.255 | DHCP | 344 | DHCP Discover - |
| 64 | 16:23:55.879987 | 172.25.255.254 | 172.25.235.177 | DHCP | 342 | DHCP Offer - |
| 65 | 16:23:55.880450 | 0.0.0.0 | 255.255.255.255 | DHCP | 370 | DHCP Request - |
| 68 | 16:23:56.367564 | 172.25.255.254 | 172.25.235.177 | DHCP | 342 | DHCP ACK - |
| 249 | 16:24:00.074223 | 172.25.255.254 | 255.255.255.255 | DHCP | 342 | DHCP ACK - |

> Option: (53) DHCP Message Type (Request)
 > Option: (61) Client identifier
 ✓ Option: (50) Requested IP Address (172.25.235.177)
 Length: 4
 Requested IP Address: 172.25.235.177
 > Option: (54) DHCP Server Identifier (172.25.255.254)
 > Option: (12) Host Name
 > Option: (81) Client Fully Qualified Domain Name
 > Option: (60) Vendor class identifier
 > Option: (55) Parameter Request List
 > Option: (255) End

12. The lease time is the amount of time the DHCP server assigns an IP address to a client. During the lease time, the DHCP server will not assign the IP given to the client to another client, unless it is released by the client. Once the lease time has expired, the IP address can be reused by the DHCP server to give to another client.

In my experiment, the lease time is 1 hour.

✓ Option: (51) IP Address Lease Time
 Length: 4
 IP Address Lease Time: (3600s) 1 hour

13. The client sends a DHCP Release message to cancel its lease on the IP address given to it by the DHCP server. The DHCP server does not send a message back to the client acknowledging the DHCP Release message. If the DHCP Release message from the client is lost, the DHCP server would have to wait until the lease period is over for that IP address until it could reuse it for another client.
14. After receive the DHCP Request messages an ARP packet will be broadcast, which can detect if IP conflicts occur.

| | | | | | | |
|----|-----------------|-------------------|-----------------|------|-----|---|
| 63 | 16:23:55.798081 | 0.0.0.0 | 255.255.255.255 | DHCP | 344 | DHCP Discover - Transaction ID 0xcd75fc0b |
| 64 | 16:23:55.879987 | 172.25.255.254 | 172.25.235.177 | DHCP | 342 | DHCP Offer - Transaction ID 0xcd75fc0b |
| 65 | 16:23:55.880450 | 0.0.0.0 | 255.255.255.255 | DHCP | 370 | DHCP Request - Transaction ID 0xcd75fc0b |
| 66 | 16:23:56.069135 | IntelCor_d2:73:b4 | Broadcast | ARP | 42 | Who has 169.254.136.132? (ARP Probe) |
| 67 | 16:23:56.143921 | 112.53.36.20 | 172.25.235.177 | SSL | 95 | Continuation Data |
| 68 | 16:23:56.367564 | 172.25.255.254 | 172.25.235.177 | DHCP | 342 | DHCP ACK - Transaction ID 0xcd75fc0b |

| | | | | | | |
|-----|-----------------|-------------------|-----------------|------|-----|---|
| 466 | 16:24:46.848637 | 0.0.0.0 | 255.255.255.255 | DHCP | 344 | DHCP Discover - Transaction ID 0xe9a4584f |
| 467 | 16:24:46.920941 | 172.25.255.254 | 172.25.235.177 | DHCP | 342 | DHCP Offer - Transaction ID 0xe9a4584f |
| 468 | 16:24:46.921410 | 0.0.0.0 | 255.255.255.255 | DHCP | 370 | DHCP Request - Transaction ID 0xe9a4584f |
| 469 | 16:24:47.068588 | IntelCor_d2:73:b4 | Broadcast | ARP | 42 | Who has 169.254.136.132? (ARP Probe) |
| 470 | 16:24:47.516115 | 172.25.255.254 | 172.25.235.177 | DHCP | 342 | DHCP ACK - Transaction ID 0xe9a4584f |