Spring
99

Wireshark CA#1

COMPUTER NETWORKS

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INTRODUCTION

In this Computer Assignment the goal is to explore 3 important Network Protocols :

- HTTP in the Application Layer
- ARP in the Data link layer
- DHCP Also running in the Application Layer

- In Each Part we will analyze the Source and Destination Addresses (MAC, IP), Message Types, headers, timing parameters, etc.

Part 1

1.1:

The source address indicates the address which my PC has been given according to the Internet Protocol .

The destination address is the address of “ ece.ut.ac.ir “ according to the Internet Protocol .

Source IP address	Destination IP address
192.168.1.8	80.66.179.158

Table 1.1

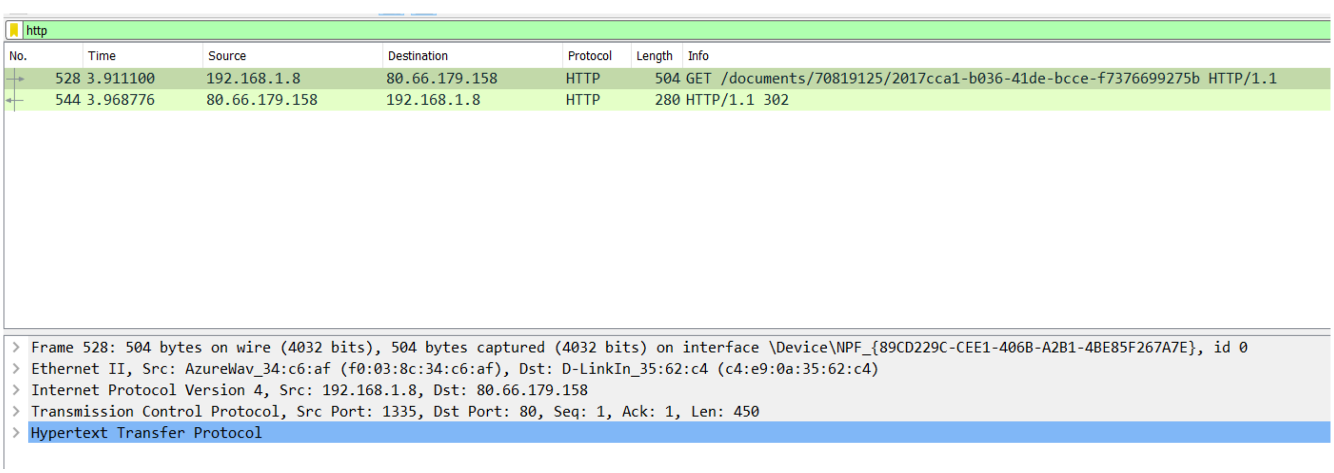


Figure 1.1

1.2 :

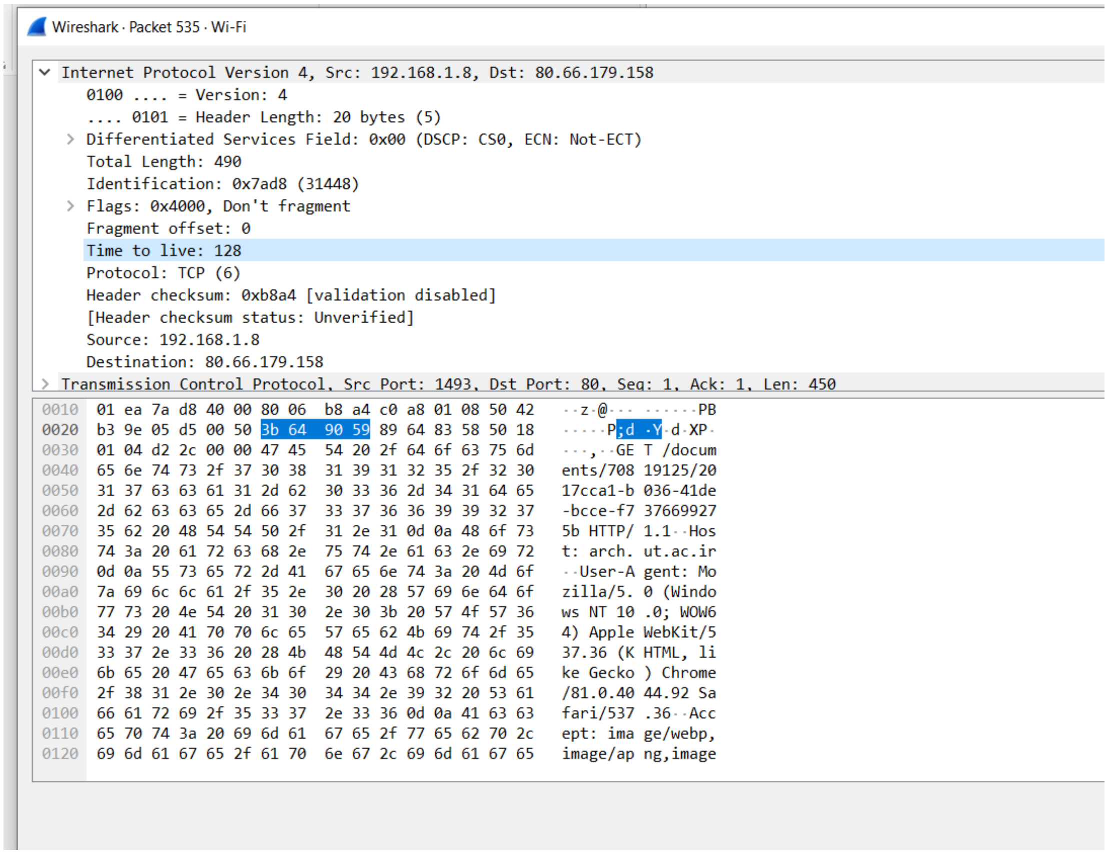


Figure 1.2

Time to live : 128

- **Time to live (TLL)** also known as **“ Hop Limit “** is a kind of mechanism which **limits the lifespan of data** in a computer network. Whenever this time is reached the data is either **discarded** or **revalidated**.

- **TLL** can be **implemented** in data packets as a **counter attached to data** frames or **embedded in the data**.

- Under the Internet Protocol, TLL is an **8-bit field** in the **IPv4 header**.[1]

---

[1] In theory TLL (under the IPv4 protocol) is mentioned in seconds

- The **purpose** of the TTL field is to **avoid** a situation in which an **undeliverable datagram** keeps **circulating** on an Internet system. The TTL field is **set by the sender** of the datagram, and **reduced by every router on the route** to its destination. If the TTL field reaches zero before the datagram arrives at its destination, then the datagram is discarded and an **Internet Control Message Protocol (ICMP) error datagram** is sent back to the sender.

1.3,1.4 :

The 48-bit address of user's computer is indicated in Hexa-Decimal (12 hexa-decimal digits seperated pairwise, The Second 12 digits of the first row) – Displayed in **Figure 1.3**

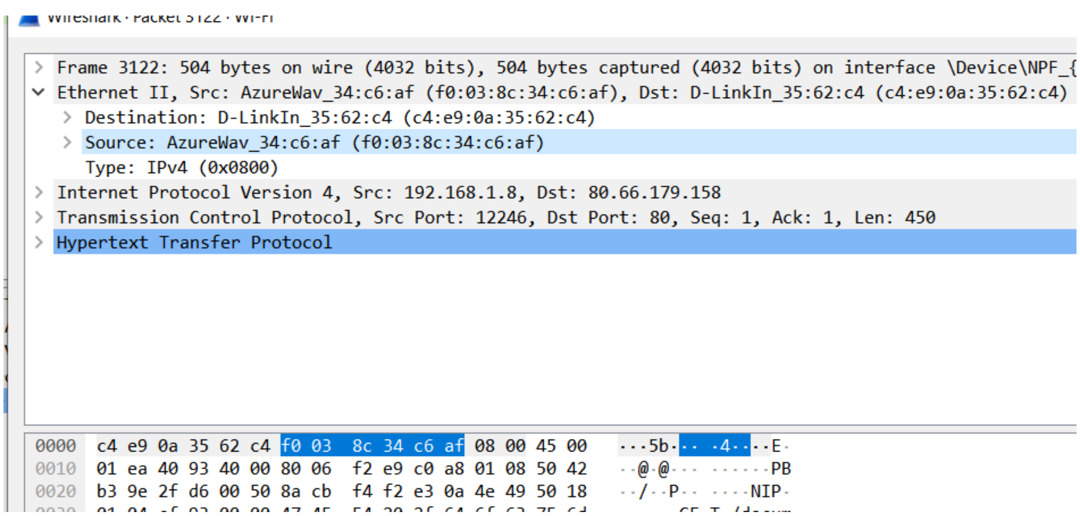


Figure 1.3

The 48-bit address of destination is aslo indicated in Hexa-Decimal (12 hexa-decimal digits seperated pairwise, The First 12 digits of the first row) Displayed in **Figure 1.4**

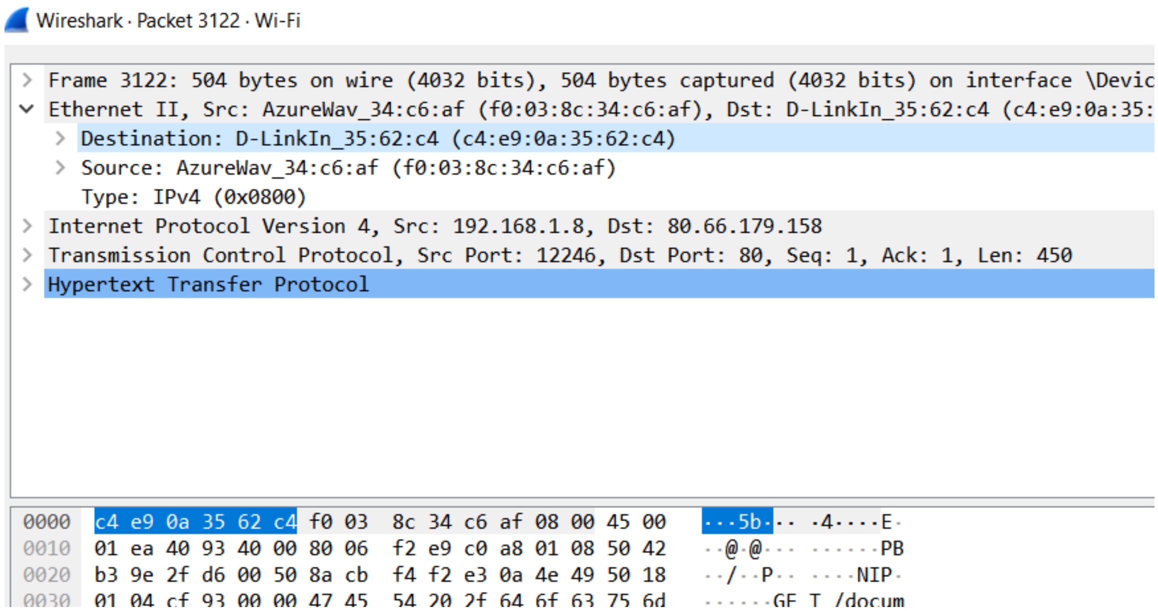


Figure 1.4

1.5 : Header Size : 20 bytes (Both TCP & IP headers are 20 bytes long)

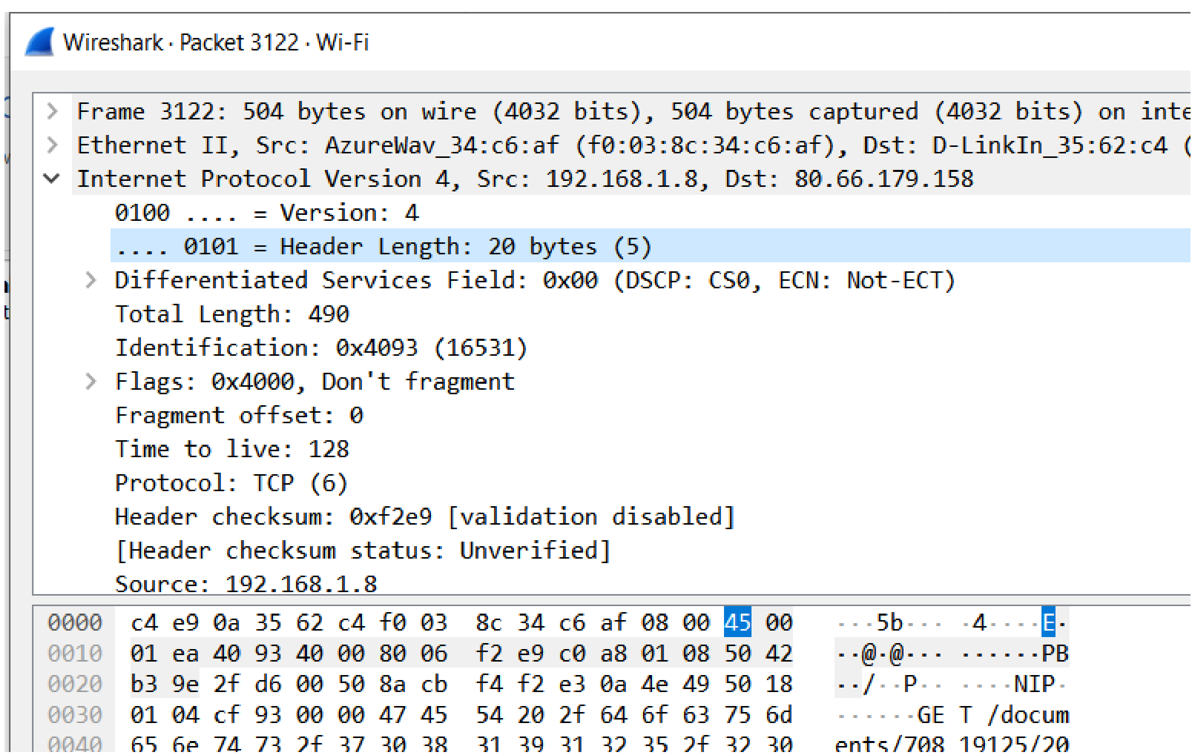


Figure 1.5

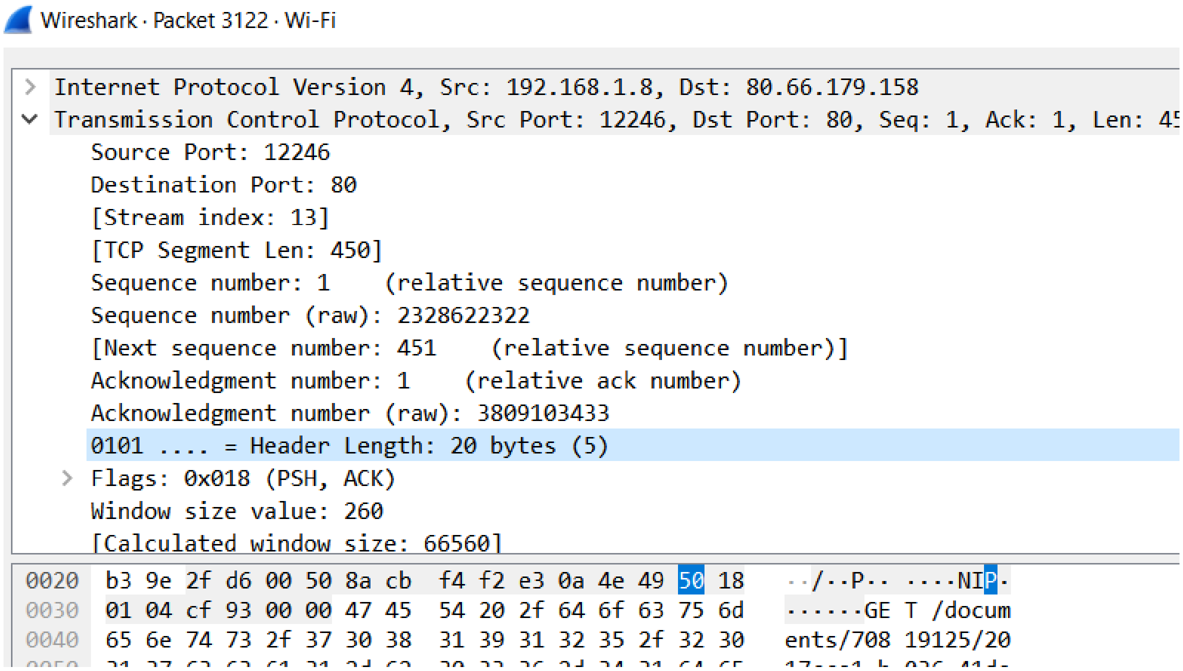


Figure 1.6

1.6 :

The “O” in the “OK” response consumes the first 52 bytesnod the Ethernet frame , and after 14 Ethernet frame bytes, IP Header comes in 20 bytes and TCP Header in 20 bytes also. Then the Data (HTTP) comes in the frame.

Part 2

Introducing the ARP protocol:

The ARP protocol functionally consists of 2 main parts:

- 1: The part which determines a physical address when sending a packet
- 2: The Other part answers requests from other machines

So ARP provides method for hosts to send message to destination address on a physical network.

Ethernet hosts must convert a 32-bit IP address into a 48-bit Ethernet address. The host checks its ARP cache to see if address mapping from IP to physical address is known:

- If mapping is known, physical address is placed in frame and sent (Destination is recognized)
- If mapping is not known, broadcast message is sent and awaits a reply
- Target machine, recognizing IP address matches its own, returns answer

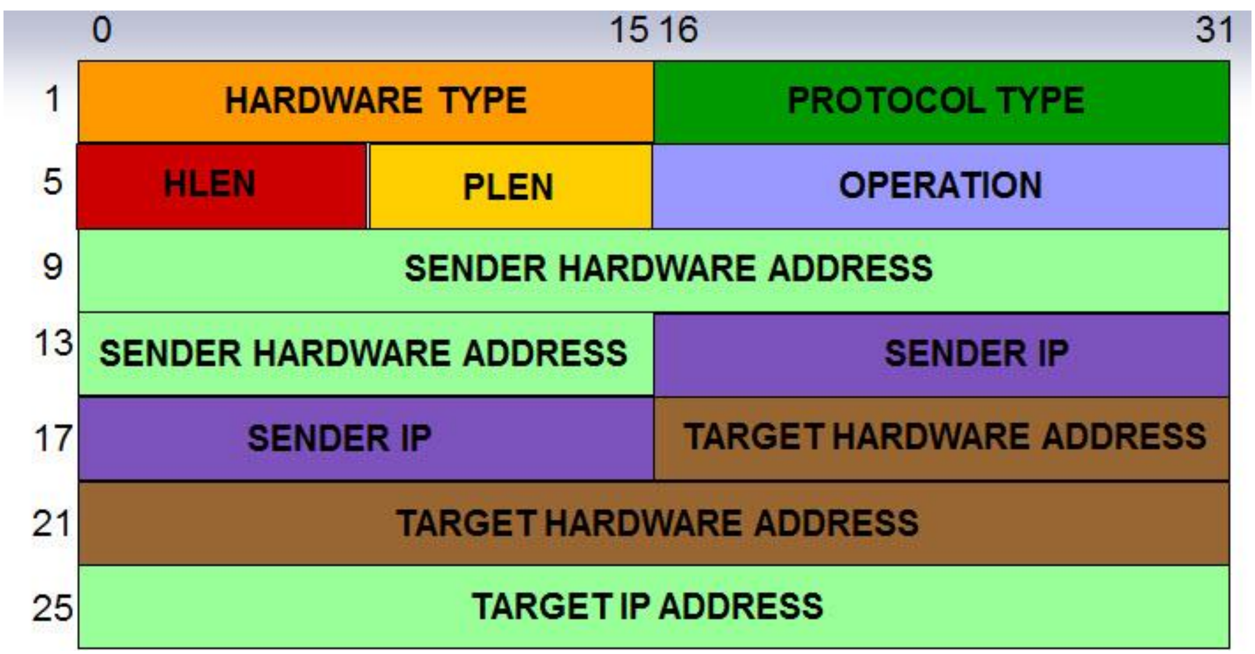


Figure 2.1 : ARP Protocol Format

2.1:

The first column shows the IP addresses in the ARP cache. The second column shows the physical (MAC) addresses (48 bit Ethernet Address) and the last column shows the type of ARP entries :

ARP entries can be **Dynamic** or **Static :**

Dynamic :

Which means that the ARP entry (the Ethernet MAC to IP address link) has been learned (usually from the default gateway) and is kept on a device for some period of time, as long as it is being used.

Static :

A **static** ARP entry is the opposite of a dynamic ARP entry. With a static ARP entry, the computer is manually entering the link between the Ethernet MAC address and the IP address. Software in your computer will predefine these static entries such as multicast addresses and broadcast addresses.

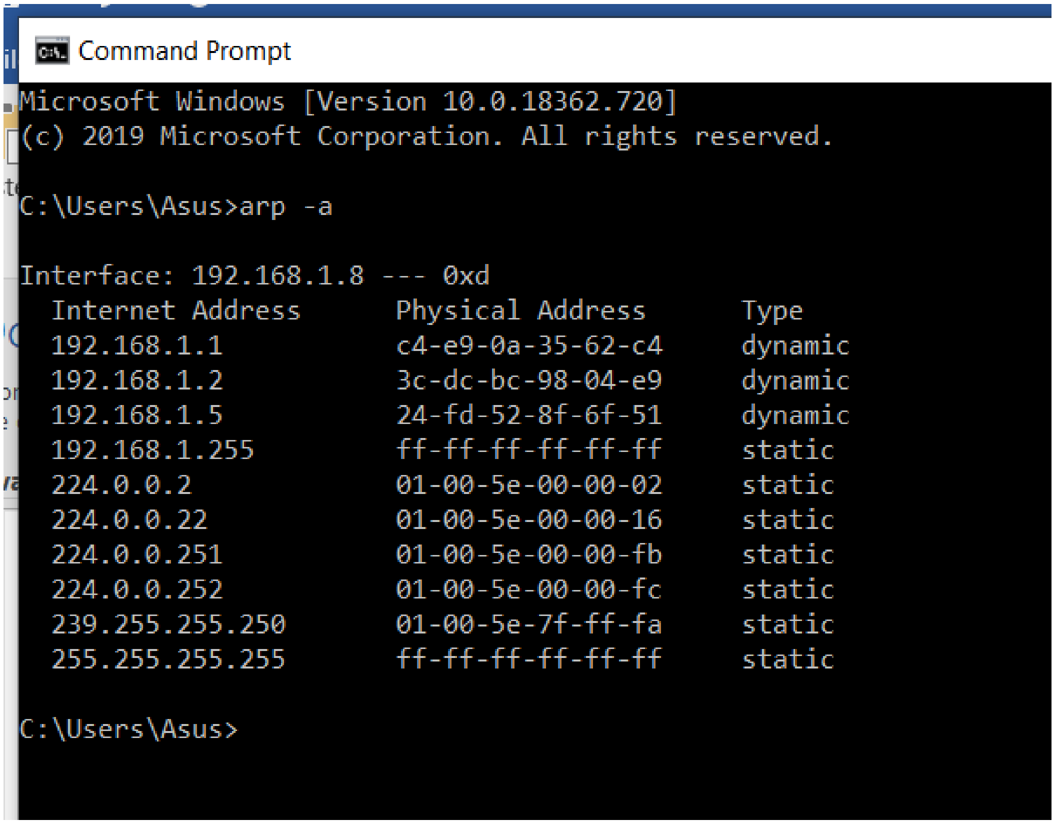


Figure 2.2

2.2:

a,b)

The Hexadecimal Values of the Source and Destination are shown in Figure 2.4 :

ARP is a protocol which belongs to the Datalink layer and it saves the Translations (Mappings) of IP address(Network Layer) (The Upper Layer) to MAC(Physical) address (Physical Layer) (The Layer below), So ARP corresponds to IP Protocols.

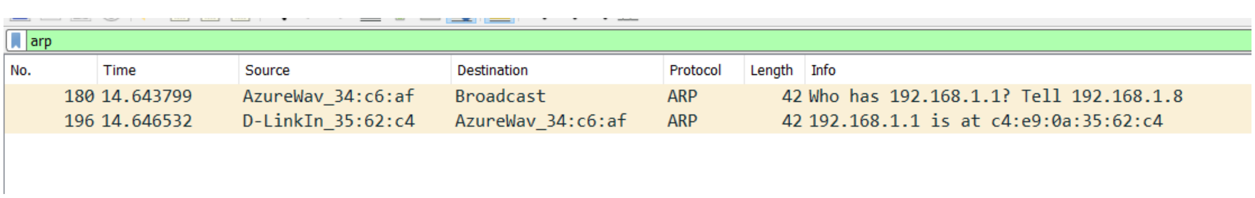


Figure 2.3

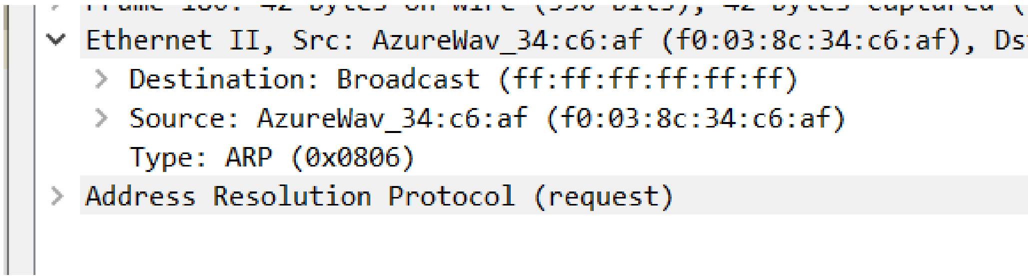


Figure 2.4

c)

The value of the opcode field within the ARP-Payload part of the Ethernet frame : 0001

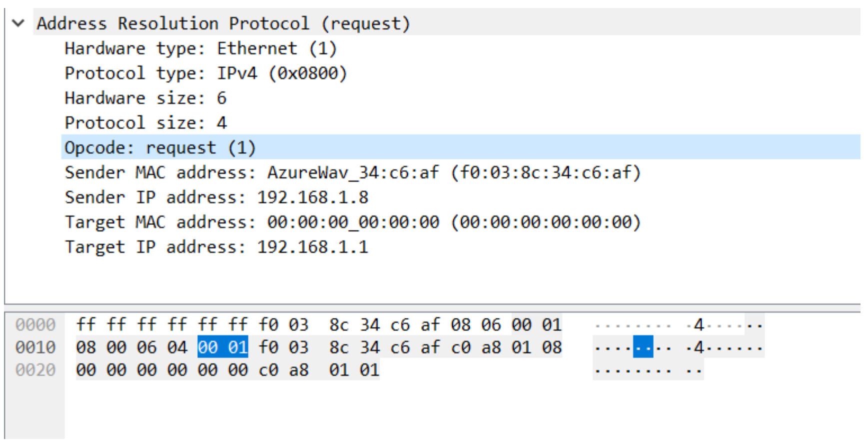


Figure 2.5

d)

The Sender’s IP address is shoen in the figure below : 192.168.1.8

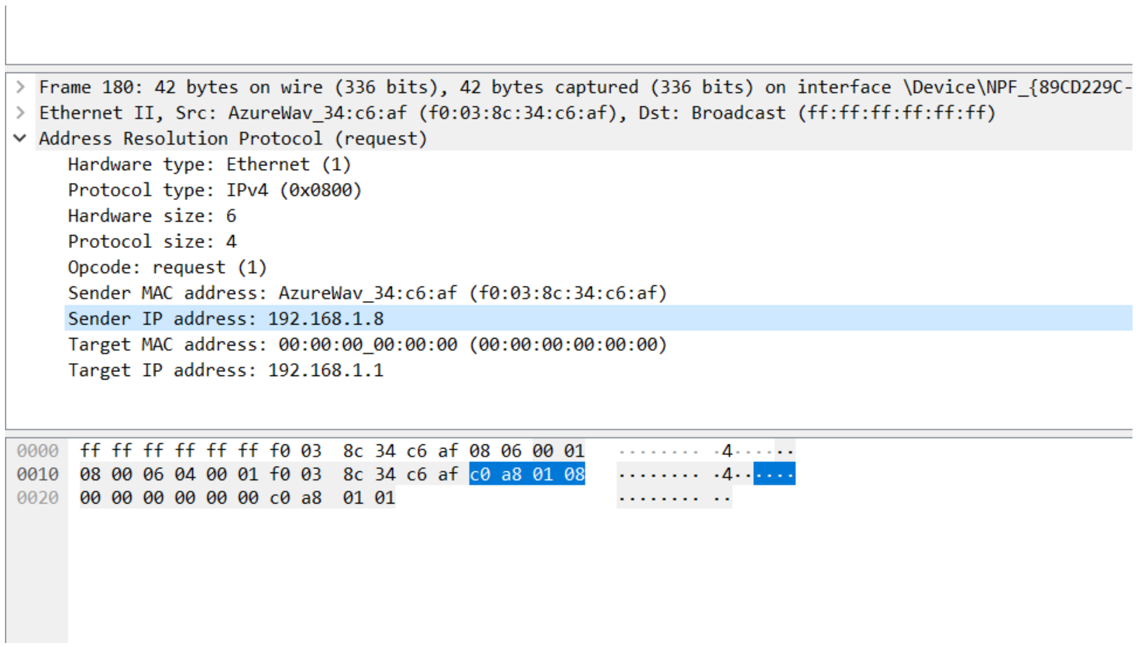


Figure 2.6

e)

In the field: Target MAC address (Figure2.6): All digits are equal to zero because sender A doesn’t know B (Destination’s) MAC address;

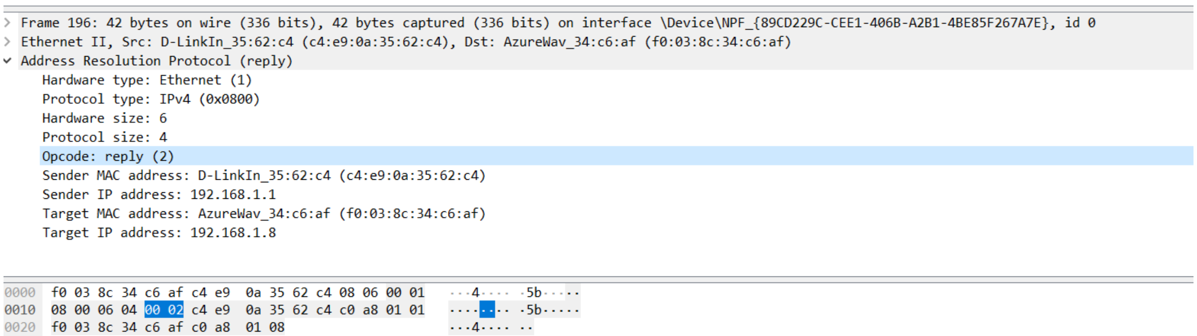
So it broadcast its IP address for the whole networks, B gives response when he sees his IP and then it puts his MAC address in the response. After A (Sender) has received the MAC address it wll be saved in the ARP cache for next communications.

2.3:

Response of device B :

a)

The value of the opcode field : 2

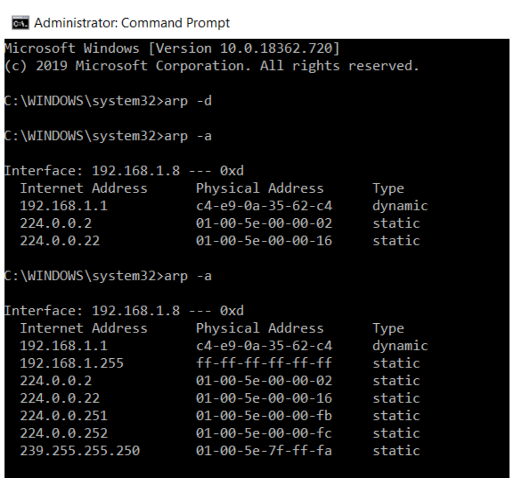


```
> Frame 196: 42 bytes on wire (336 bits), 42 bytes captured (336 bits) on interface \Device\NPF_{89CD229C-CEE1-406B-A2B1-4BE85F267A7E}, id 0
> Ethernet II, Src: D-LinkIn_35:62:c4 (c4:e9:0a:35:62:c4), Dst: AzureWav_34:c6:af (f0:03:8c:34:c6:af)
v Address Resolution Protocol (reply)
    Hardware type: Ethernet (1)
    Protocol type: IPv4 (0x0800)
    Hardware size: 6
    Protocol size: 4
    Opcode: reply (2)
    Sender MAC address: D-LinkIn_35:62:c4 (c4:e9:0a:35:62:c4)
    Sender IP address: 192.168.1.1
    Target MAC address: AzureWav_34:c6:af (f0:03:8c:34:c6:af)
    Target IP address: 192.168.1.8

0000  f0 03 8c 34 c6 af c4 e9  0a 35 62 c4 08 06 00 01   ···4·····5b·····
0010  08 00 06 04 00 02 c4 e9  0a 35 62 c4 c0 a8 01 01   ·········5b·····
0020  f0 03 8c 34 c6 af c0 a8  01 08                     ···4······
```

Figure 2.7

By running the “arp –a” command, we can see the list of arp entries has been extended after receiving the response message which contains the Destinations MAC address :



```
Administrator: Command Prompt
Microsoft Windows [Version 10.0.18362.720]
(c) 2019 Microsoft Corporation. All rights reserved.

C:\WINDOWS\system32>arp -d

C:\WINDOWS\system32>arp -a

Interface: 192.168.1.8 --- 0xd
  Internet Address      Physical Address      Type
  192.168.1.1           c4-e9-0a-35-62-c4     dynamic
  224.0.0.2             01-00-5e-00-00-02     static
  224.0.0.22            01-00-5e-00-00-16     static

C:\WINDOWS\system32>arp -a

Interface: 192.168.1.8 --- 0xd
  Internet Address      Physical Address      Type
  192.168.1.1           c4-e9-0a-35-62-c4     dynamic
  192.168.1.255         ff-ff-ff-ff-ff-ff     static
  224.0.0.2             01-00-5e-00-00-02     static
  224.0.0.22            01-00-5e-00-00-16     static
  224.0.0.251           01-00-5e-00-00-fb     static
  224.0.0.252           01-00-5e-00-00-fc     static
  239.255.255.250       01-00-5e-7f-ff-fa     static
```

Figure 2.8

b,c)

The Answer appears in the field “Sender MAC address as its the destination’s response to the message Sender has Broadcasted in the Network:

- Sender(Destination’s) MAC address (the answer):

c4:e9:0a:35:62:c4

- Source(the “Target” in the response message) hexadecimal MAC address :

f0:03:8c:34:c6:af

- IP addresses for the Source(Target) in hexadecimal:

c0:a8:01:01

- IP addresses for the Destination(Sender) in hexadecimal:

c0:a8:01:08

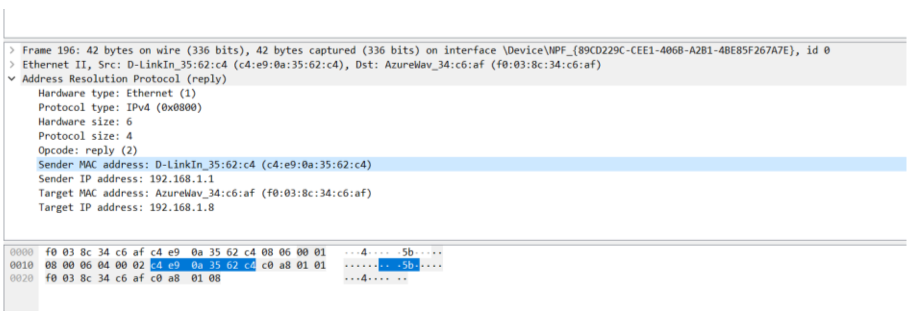


Figure 2.9

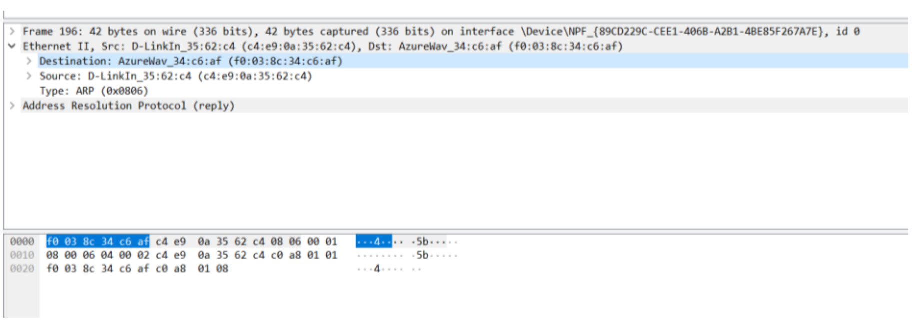


Figure 2.10

Part 3

3.1:

The Timing Datagram is displayed in the Figure below :

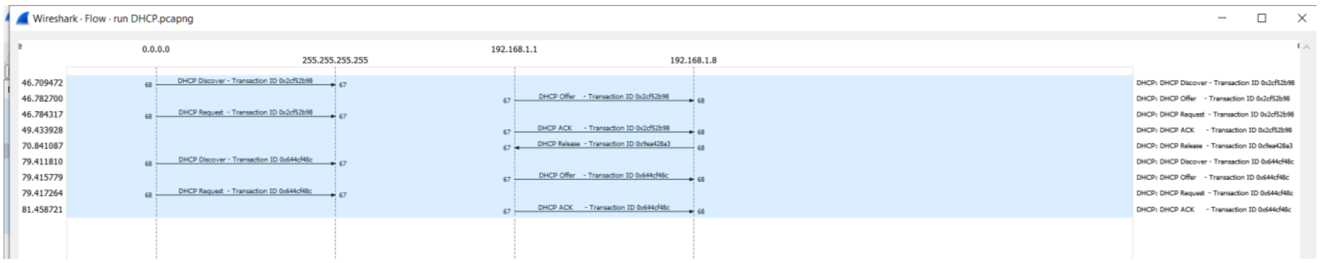


Figure 3.1

3.2:

Option 53 indicates the values which the message type sets and are different in request and discover messages despite same Source and Destination IP addresses and other same specifications.

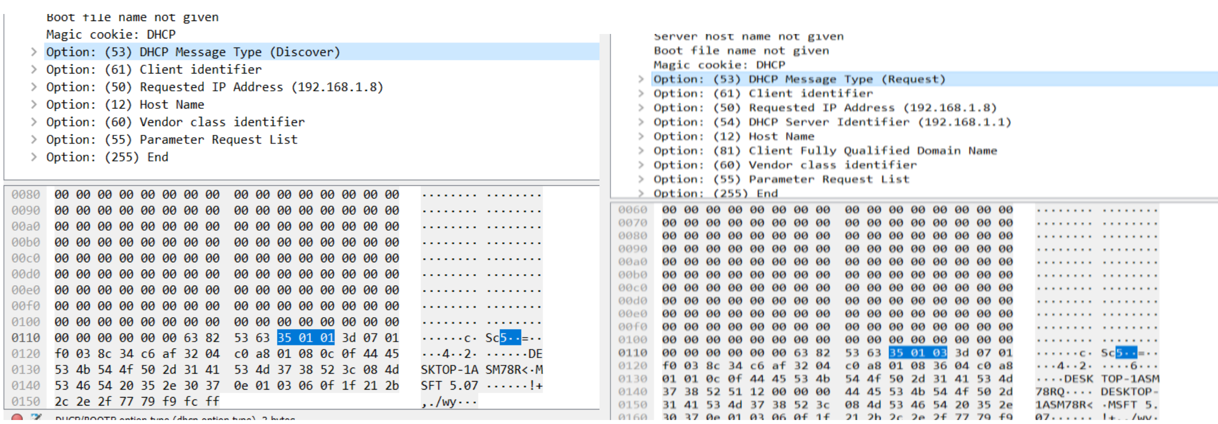


Figure 3.2

3.3:

The transaction ID (xid) is chosen by the client (usually randomly) and is copied by the server in the responses. It has a client specific function, which is usually to allow the client to recognize which "DHCP" response to which request has been associated.

First set :

We Can see that all of the Transaction ID's of the first set are the same . that's because all are associated to the same client request

Transaction-ID for "Discover" : 0x 2cf52b98

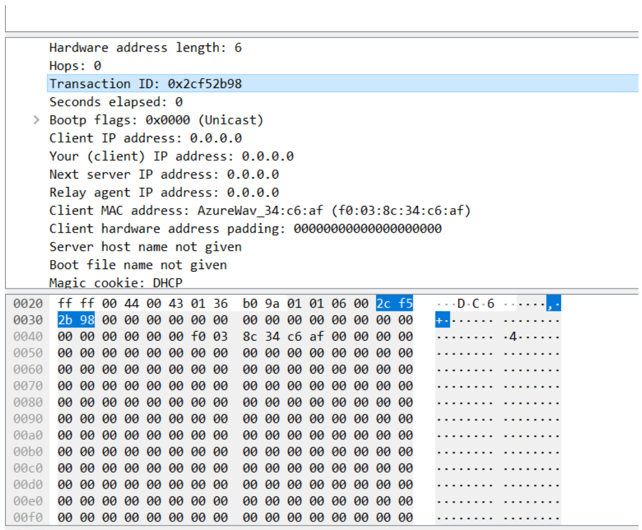


Figure 3.3

Transaction-ID for "Offer" : 0x 2cf52b98

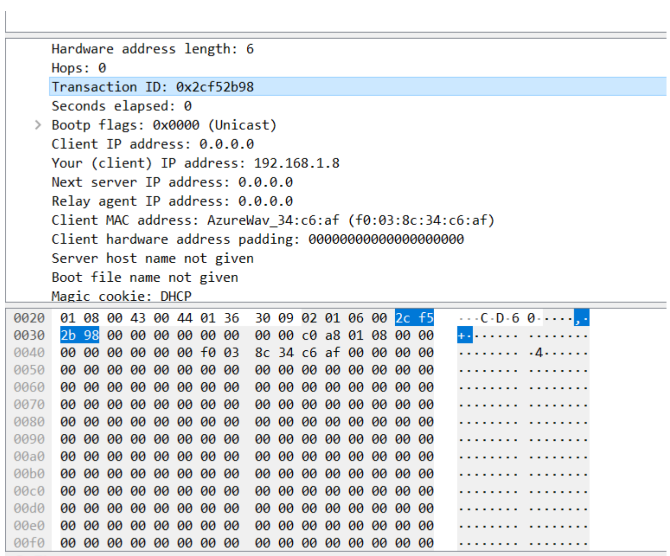


Figure 3.4

Transaction-ID for “Request” : 0x 2cf52b98

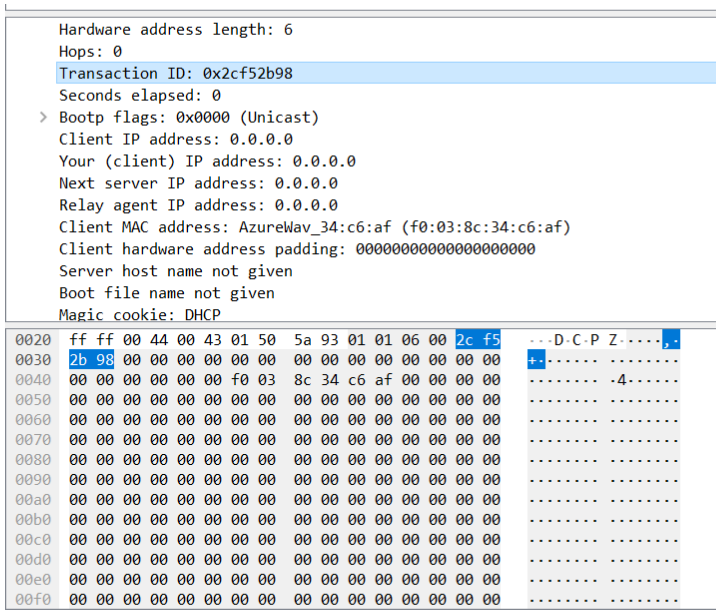


Figure 3.5

Transaction-ID for “ACK” : 0x 2cf52b98

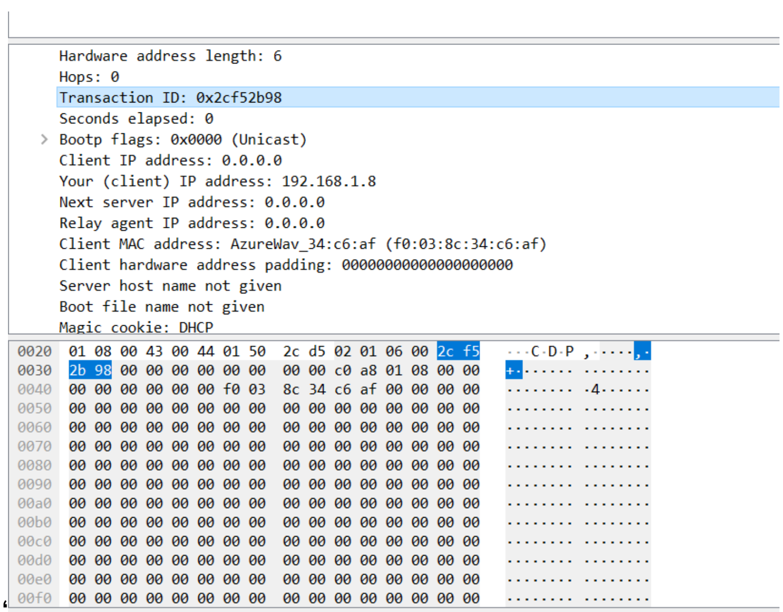


Figure 3.6

Second set :

We observe that all of the transaction ID's of the second set are the same too.but they differ from the TransactionID's of the first set and that's because they're all associated to a different request from the client.

Transaction-ID for "Discover" : 0x 644cf48c

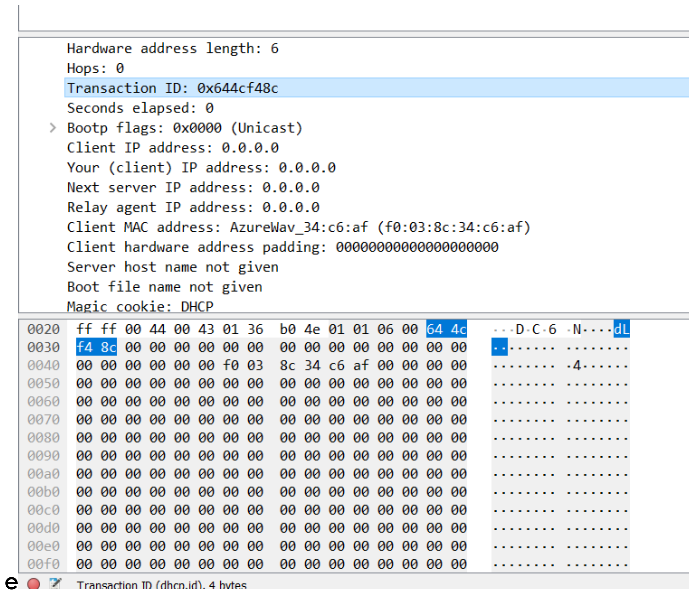


Figure 3.7

Transaction-ID for "Offer" : 0x 644cf48c

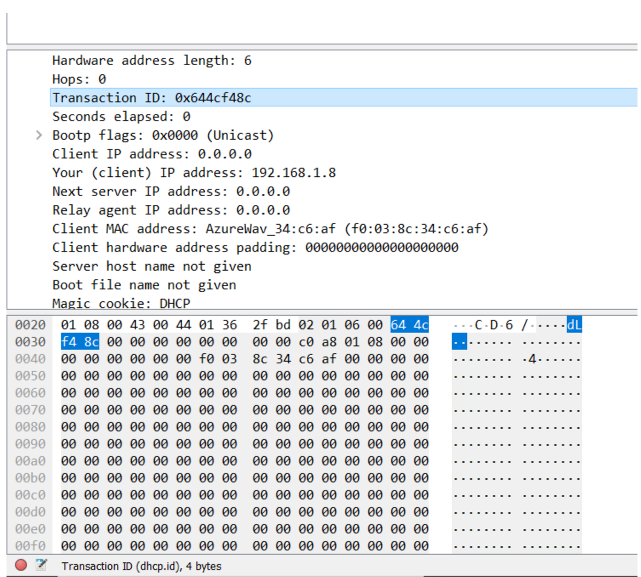


Figure 3.8

Transaction-ID for “Request” : 0x 644cf48c

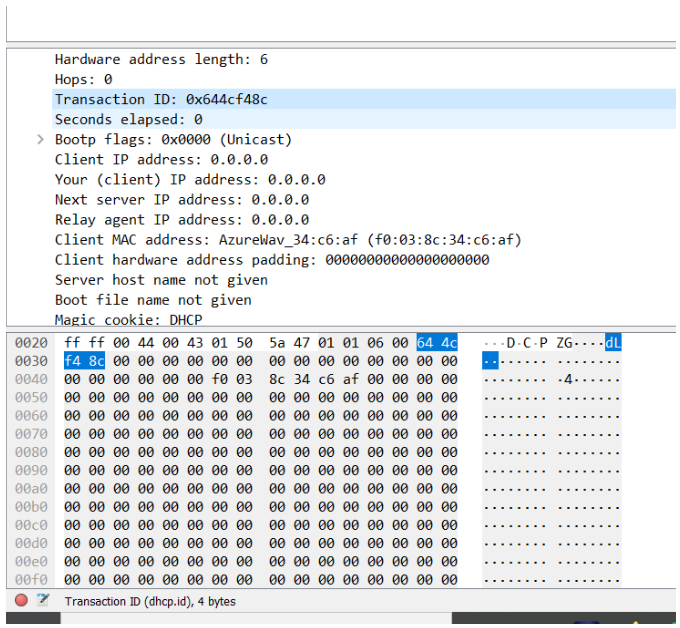


Figure 3.9

Transaction-ID for “ACK” : 0x 644cf48c‘

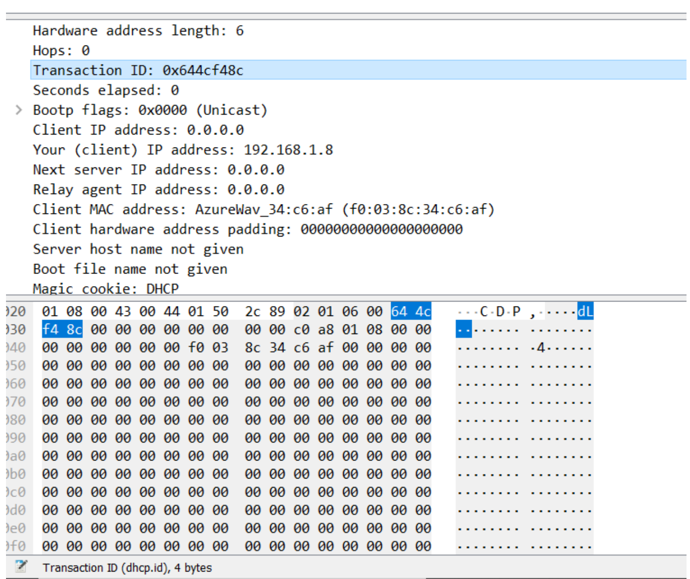


Figure 3.10

3.4:

According to the Figure below which was shown previously in Figure 3.1 as the "Timing Datagram" the Source and Destination IP adresses of the 4 DHCP messages of both sets are shown **on the Datagram** (The arrows show the message flow from Source to Destination)

Discover and Request :

Source IP : 0.0.0.0

Destination IP : 255.255.255.255 (means message is sent broadcast)

Offer and ACK :

Source IP : 192.168.1.1

Destination IP : 192.168.1.8

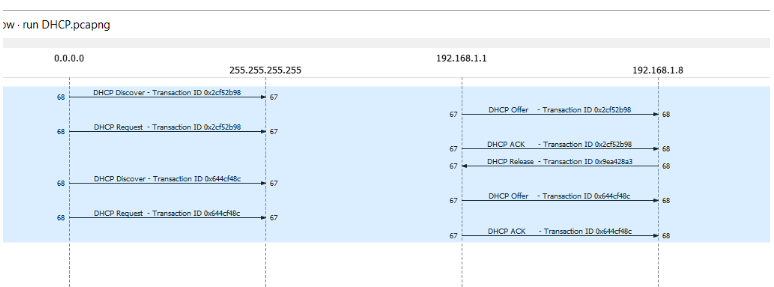


Figure 3.11

3.5 :

The IP address of the DHCP server is shown in the offer message for the first time (As the request message is a broadcast message in order to find the DHCP server and request an IP from it) :

bootp

	Time	Source	Destination	Protocol	Length	Info
241	46.709472	0.0.0.0	255.255.255.255	DHCP	344	DHCP Discover - Transaction ID 0x2cf52b98
242	46.782700	192.168.1.1	192.168.1.8	DHCP	344	DHCP Offer - Transaction ID 0x2cf52b98
243	46.784317	0.0.0.0	255.255.255.255	DHCP	370	DHCP Request - Transaction ID 0x2cf52b98
257	49.433928	192.168.1.1	192.168.1.8	DHCP	370	DHCP ACK - Transaction ID 0x2cf52b98

Figure 3.12

DHCP IP address : 192.168.1.1

3.6:

The IP address that the DHCP server offers to the client(my computer which doesn't have IP address currently; my IP : 0.0.0.0) is shown in the "Offer" message :

Your(Client) IP address : 192.168.1.8 (Shown in the figure below)

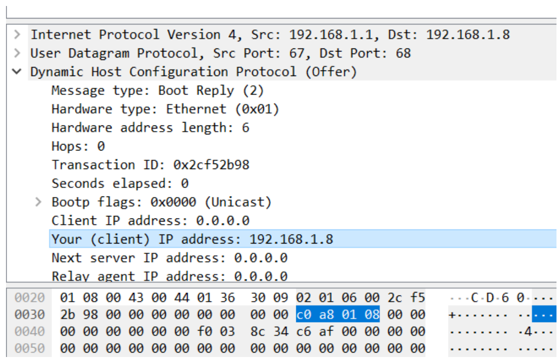


Figure 3.13

2.7:

The client accepts the offered IP address from the DHCP server :

This IP (192.168.1.8) is shown in the Option 50 of the "Request" message

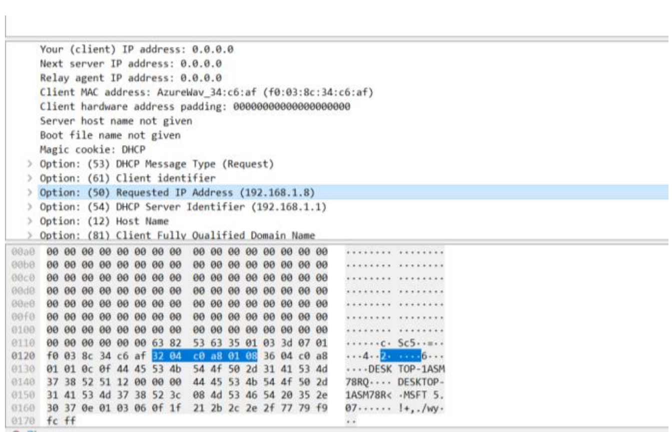


Figure 3.14

2.8:

In short, DHCP Lease Time is the amount of time in minutes or seconds a network device can use an IP Address in a network.

The IP Address is reserved for that device until the reservation expires. The DHCP server is responsible for assigning every device a unique address.

Time to lease in my experiment (in sec): 86400 sec (equals 24 hours (One Day))

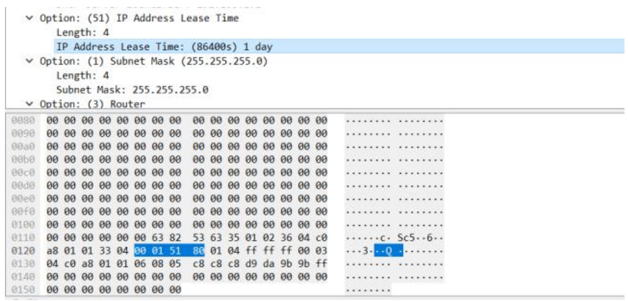


Figure 3.15

References:

1- *https://www.cellstream.com/reference-reading*

2- *https://wiki.wireshark.org/Hyper_Text_Transfer_Protocol*

3- *https://www.quora.com/What-is-IP-lease-time-in-DHCP*