VILNIUS UNIVERSITY
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PROGRAMŲ SISTEMOS BACHELOR STUDY PROGRAMME

Software engineering

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Computer Networks
Laboratory work No.6
DHCP

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Laboratory Work Report

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1. *Are DHCP messages sent over UDP or TCP?*

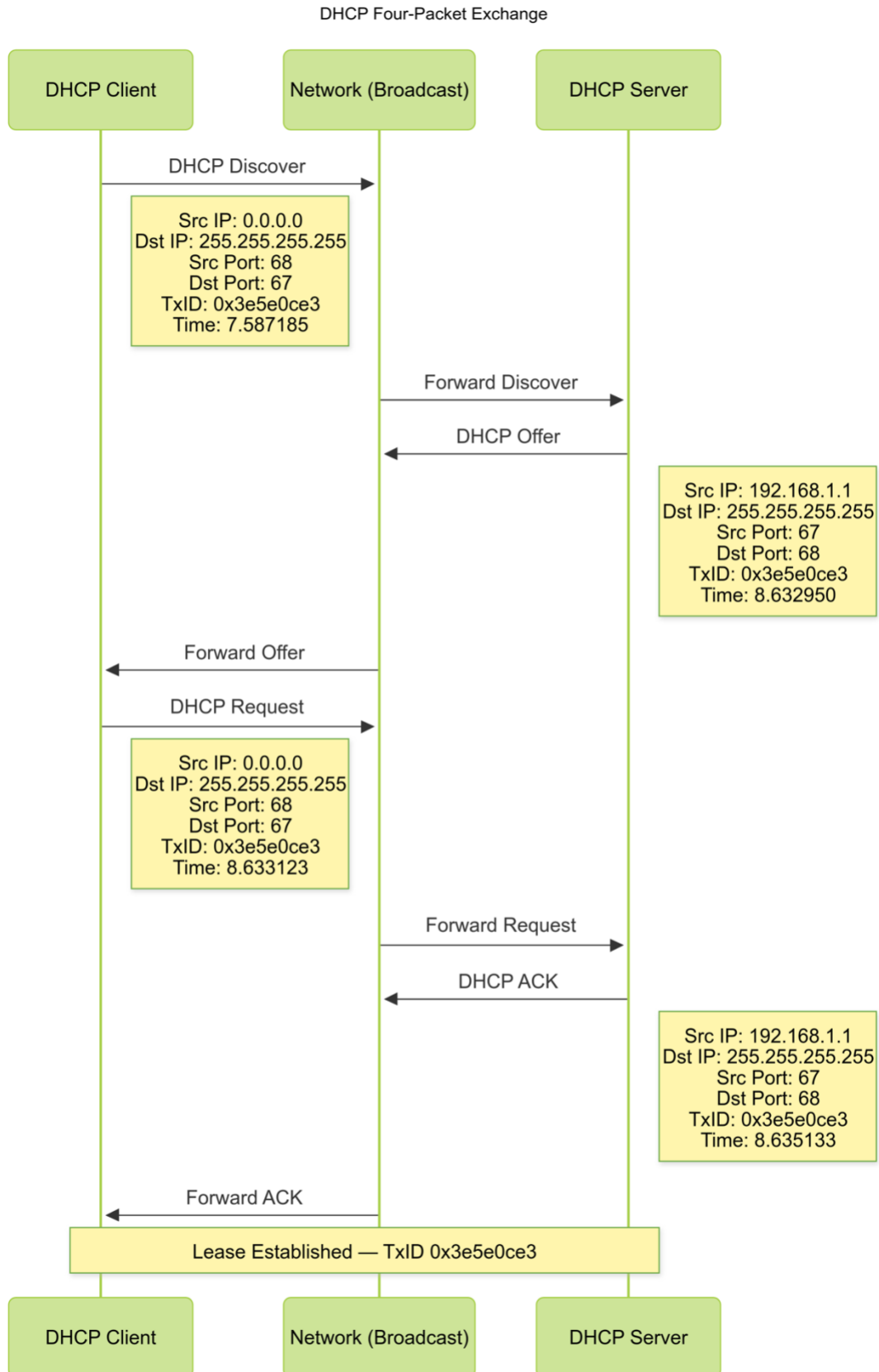| No.	Time	Source	Destination	Protocol	Length	Info
2	7.587185	0.0.0.0	255.255.255.255	DHCP	342	DHCP Discover – Transaction ID 0x3e5e0ce3
5	8.633123	0.0.0.0	255.255.255.255	DHCP	342	DHCP Request – Transaction ID 0x3e5e0ce3
42	30.869153	0.0.0.0	255.255.255.255	DHCP	342	DHCP Discover – Transaction ID 0x3a5df7d9
45	31.908304	0.0.0.0	255.255.255.255	DHCP	342	DHCP Request – Transaction ID 0x3a5df7d9

Answer: DHCP messages are sent over UDP, not TCP

2. *Draw a timing datagram illustrating the sequence of the first four-packet Discover/Offer/Request/ACK DHCP exchange between the client and server.*
   *For each packet, indicated the **source** and **destination port numbers**.*
   Are the port numbers the same as in the example given in this lab assignment?

   Answer:

DHCP Four-Packet Exchange

DHCP Client → Network (Broadcast): **DHCP Discover**

> Src IP: 0.0.0.0
> Dst IP: 255.255.255.255
> Src Port: 68
> Dst Port: 67
> TxID: 0x3e5e0ce3
> Time: 7.587185

Network (Broadcast) → DHCP Server: **Forward Discover**

DHCP Server → Network (Broadcast): **DHCP Offer**

> Src IP: 192.168.1.1
> Dst IP: 255.255.255.255
> Src Port: 67
> Dst Port: 68
> TxID: 0x3e5e0ce3
> Time: 8.632950

Network (Broadcast) → DHCP Client: **Forward Offer**

DHCP Client → Network (Broadcast): **DHCP Request**

> Src IP: 0.0.0.0
> Dst IP: 255.255.255.255
> Src Port: 68
> Dst Port: 67
> TxID: 0x3e5e0ce3
> Time: 8.633123

Network (Broadcast) → DHCP Server: **Forward Request**

DHCP Server → Network (Broadcast): **DHCP ACK**

> Src IP: 192.168.1.1
> Dst IP: 255.255.255.255
> Src Port: 67
> Dst Port: 68
> TxID: 0x3e5e0ce3
> Time: 8.635133

Network (Broadcast) → DHCP Client: **Forward ACK**

Lease Established — TxID 0x3e5e0ce3

DHCP Client   Network (Broadcast)   DHCP Server

3. *What is the link-layer (e.g., Ethernet) address of your host?*

Answer: the link-layer address of my host is **00:08:74:4f:36:23**

4. *What values in the DHCP **discover** message differentiate this message from the DHCP **request** message?*

Answer:
   a. DHCP Message Type (Option 53):

   Discover: Option: (53) DHCP Message Type (Discover)

   Request: Option: (53) DHCP Message Type (Request)

b. Requested IP Address (Option 50):
Discover: doesn't have this field
Request: `Option: (50) Requested IP Address (192.168.1.101)`

c. Server Identifier (Option 54):
Discover: doesn't have this field
Request: `Option: (54) DHCP Server Identifier (192.168.1.1)`

5. *What is the value of the Transaction-ID in each of the first four (Discover/Offer/Request/ACK) DHCP messages?*

No.	Time	Source	Destination	Protocol	Length	Ethernet
Info						
2 7.587185		0.0.0.0	255.255.255.255	DHCP	342	✓
DHCP Discover – Transaction ID `0x3e5e0ce3`						
No.	Time	Source	Destination	Protocol	Length	Ethernet
Info						
4 8.632950		192.168.1.1	255.255.255.255	DHCP	590	✓
DHCP Offer – Transaction ID `0x3e5e0ce3`						
No.	Time	Source	Destination	Protocol	Length	Ethernet
Info						
5 8.633123		0.0.0.0	255.255.255.255	DHCP	342	✓
DHCP Request – Transaction ID `0x3e5e0ce3`						
No.	Time	Source	Destination	Protocol	Length	Ethernet
Info						
6 8.635133		192.168.1.1	255.255.255.255	DHCP	590	✓
DHCP ACK – Transaction ID `0x3e5e0ce3`						

What are the values of the Transaction-ID in the second set (Request/ACK) set of DHCP messages?

No.	Time	Source	Destination	Protocol	Length	Ethernet
Info						
36 20.134178		192.168.1.101	192.168.1.1	DHCP	342	✓
DHCP Request – Transaction ID `0x257e55a3`						
No.	Time	Source	Destination	Protocol	Length	Ethernet
Info						
37 20.135930		192.168.1.1	255.255.255.255	DHCP	590	✓
DHCP ACK – Transaction ID `0x257e55a3`						

What is the purpose of the Transaction-ID field?

Answer:
  a. For each of the first four (Discover/Offer/Request/ACK) DHCP messages the value of the Transaction-ID is **0x3e5e0ce3.**
  b. The values of the Transaction-ID in the second set (Request/ACK) set of DHCP messages are **0x257e55a3.**
  c. The Transaction ID is a randomly generated number chosen by the client. It is used by both the client and the

DHCP server to match and track related messages and responses throughout the DHCP communication process.

6. *A host uses DHCP to obtain an IP address, among other things. But a host's IP address is not confirmed until the end of the four-message exchange!*

If the IP address is not set until the end of the four-message exchange, then what values are used in the IP datagrams in the four-message exchange?

For each of the four DHCP messages (Discover/Offer/Request/ACK DHCP), indicate the source and destination IP addresses that are carried in the encapsulating IP datagram.

```
No.     Time            Source                  Destination            Protocol Length Ethernet
Info
     2 7.587185        0.0.0.0                  255.255.255.255         DHCP     342      ✓
DHCP Discover – Transaction ID 0x3e5e0ce3
No.     Time            Source                  Destination            Protocol Length Ethernet
Info
     4 8.632950        192.168.1.1              255.255.255.255         DHCP     590      ✓
DHCP Offer    – Transaction ID 0x3e5e0ce3
No.     Time            Source                  Destination           Protocol Length Ethernet
Info
     5 8.633123        0.0.0.0                  255.255.255.255         DHCP     342      ✓
DHCP Request  – Transaction ID 0x3e5e0ce3

Info
     6 8.635133        192.168.1.1              255.255.255.255         DHCP     590      ✓
DHCP ACK      – Transaction ID 0x3e5e0ce3
```

Answer:

a. **Discover and Request:**
   Source: **0.0.0.0**
   Destination: **255. 255. 255. 255**

   Offer and ACK:
   Source: **192.168.1.1**
   Destination: **255. 255. 255. 255**

b. Until the DHCP exchange is completed, the client does not yet have an IP address. Therefore, it uses **0.0.0.0** as the source IP and the broadcast address **255.255.255.255** as the destination IP to reach the DHCP server within the local network.

7. *What is the IP address of your DHCP server?*

Option: (54) DHCP Server Identifier (192.168.1.1)

Answer: the IP address of your DHCP server is **192.168.1.1**

8. *What IP address is the DHCP server offering to your host in the DHCP Offer message?*
Indicate which DHCP message contains the offered DHCP address.

```
Info
     4 8.632950          192.168.1.1             255.255.255.255      DHCP      590    ✓
DHCP Offer    - Transaction ID 0x3e5e0ce3
Frame 4: 590 bytes on wire (4720 bits), 590 bytes captured (4720 bits)
Ethernet II, Src: 00:06:25:da:af:73, Dst: ff:ff:ff:ff:ff:ff
Internet Protocol Version 4, Src: 192.168.1.1, Dst: 255.255.255.255
User Datagram Protocol, Src Port: 67, Dst Port: 68
Dynamic Host Configuration Protocol (Offer)
    Message type: Boot Reply (2)
    Hardware type: Ethernet (0x01)
    Hardware address length: 6
    Hops: 0
    Transaction ID: 0x3e5e0ce3
    Seconds elapsed: 0
    Bootp flags: 0x0000 (Unicast)
    Client IP address: 0.0.0.0
    Your (client) IP address: 192.168.1.101
```

Answer: The DHCP server is offering the IP address **192.168.1.101** to the host. This offer appears in the DHCP Offer message with Transaction ID **0x3e5e0ce3**.

9. *In the example screenshot in this assignment, there is no relay agent between the host and the DHCP server.*

What values in the trace indicate the absence of a relay agent?
Is there a relay agent in your experiment?
If so what is the IP address of the agent?

Answer: Relay agent IP address : **0.0.0.0** - which means no DHCP relay is used.

No relay agent was used in my experiments.

10. *Explain the purpose of the router and subnet mask lines in the DHCP offer message.*

   On the basis of the router names, can you guess the location of the two routers on the end of this link?


```
DHCP Offer    - Transaction ID 0x3e5e0ce3
Frame 4: 590 bytes on wire (4720 bits), 590 bytes captured (4720 bits)
Ethernet II, Src: 00:06:25:da:af:73, Dst: ff:ff:ff:ff:ff:ff
Internet Protocol Version 4, Src: 192.168.1.1, Dst: 255.255.255.255
User Datagram Protocol, Src Port: 67, Dst Port: 68
Dynamic Host Configuration Protocol (Offer)
    Message type: Boot Reply (2)
    Hardware type: Ethernet (0x01)
    Hardware address length: 6
    Hops: 0
    Transaction ID: 0x3e5e0ce3
    Seconds elapsed: 0
    Bootp flags: 0x0000 (Unicast)
    Client IP address: 0.0.0.0
    Your (client) IP address: 192.168.1.101
    Next server IP address: 0.0.0.0
    Relay agent IP address: 0.0.0.0
    Client MAC address: 00:08:74:4f:36:23
    Client hardware address padding: 00000000000000000000
    Server host name not given
    Boot file name not given
    Magic cookie: DHCP
    Option: (53) DHCP Message Type (Offer)
    Option: (1) Subnet Mask (255.255.255.0)
    Option: (3) Router
```

Answer:

a. The **router** line in the DHCP Offer message tells the client where to send packets destined for other networks.

    The **subnet mask** defines the size of the local network and determines which IP addresses are considered local.

b. It's not possible to determine the geographical location of the routers based on their IP addresses in this case, because the addresses (192.168.1.1) are private. These addresses are used only within a local network and are not associated with a specific physical location on the internet.

11. In the DHCP trace file noted in footnote 2, the DHCP server offers a specific IP address to the client (see also question 8. above).
    In the client's response to the first server OFFER message, does the client accept this IP address?
    Where in the client's RESPONSE is the client's requested address?

```
No.     Time           Source              Destination          Protocol Length Ethernet
Info
      4 8.632950        192.168.1.1          255.255.255.255       DHCP      590     ✓
DHCP Offer      - Transaction ID 0x3e5e0ce3
Frame 4: 590 bytes on wire (4720 bits), 590 bytes captured (4720 bits)
Ethernet II, Src: 00:06:25:da:af:73, Dst: ff:ff:ff:ff:ff:ff
```

/Users/centr/Desktop/networks/wireshark-traces/dhcp-ethereal-trace-1 63 total packets, 11 shown

```
    Internet Protocol Version 4, Src: 192.168.1.1, Dst: 255.255.255.255
    User Datagram Protocol, Src Port: 67, Dst Port: 68
    Dynamic Host Configuration Protocol (Offer)
        Message type: Boot Reply (2)
        Hardware type: Ethernet (0x01)
        Hardware address length: 6
        Hops: 0
        Transaction ID: 0x3e5e0ce3
        Seconds elapsed: 0
        Bootp flags: 0x0000 (Unicast)
        Client IP address: 0.0.0.0
        Your (client) IP address: 192.168.1.101
```

```
DHCP Request   - Transaction ID 0x3e5e0ce3
Frame 5: 342 bytes on wire (2736 bits), 342 bytes captured (2736 bits)
Ethernet II, Src: 00:08:74:4f:36:23, Dst: 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 (Request)
    Message type: Boot Request (1)
    Hardware type: Ethernet (0x01)
    Hardware address length: 6
    Hops: 0
    Transaction ID: 0x3e5e0ce3
    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
    Relay agent IP address: 0.0.0.0
    Client MAC address: 00:08:74:4f:36:23
```

/Users/centr/Desktop/networks/wireshark-traces/dhcp-ethereal-trace-1 63 total packets, 11 shown

```
    Client hardware address padding: 00000000000000000000
    Server host name not given
    Boot file name not given
    Magic cookie: DHCP
    Option: (53) DHCP Message Type (Request)
        Length: 1
        DHCP: Request (3)
    Option: (61) Client identifier
        Length: 7
        Hardware type: Ethernet (0x01)
        Client MAC address: 00:08:74:4f:36:23
    Option: (50) Requested IP Address (192.168.1.101)
```

Answer: Yes, the client accepts the IP address offered by the DHCP server. In the client's DHCP Request message (packet No. 5), the client requests the same IP address that was offered in the DHCP Offer message (packet No. 4), which is 192.168.1.101.

The requested IP address is located in the client's response under:

```
Option: (50) Requested IP Address (192.168.1.101)
```

12. *Explain the purpose of the lease time.*
    How long is the lease time in your experiment?
    Answer:

a. The lease time defines how long the IP address is valid for the client. After this time, the client must renew the lease or request a new one.

b. In my experiment, the lease time is **1 day (86400)** in all of the packets it appears (ACK and Offer)

```
Option: (51) IP Address Lease Time
    Length: 4
    IP Address Lease Time: 1 day (86400)
```

13. What is the purpose of the DHCP release message?
    Does the DHCP server issue an acknowledgment of receipt of the client's DHCP request?
    What would happen if the client's DHCP release message is lost?

    Answer:

    a. The primary purpose of a DHCP Release message is for a DHCP client to relinquish its assigned IP address back to the DHCP server.

    b. The DHCP server does issue an acknowledgment (DHCP ACK) when it receives a client's DHCP Request message.

2 7.587185	0.0.0.0	255.255.255.255	DHCP	342 ✓	DHCP Discover	– Transaction ID 0x3e5e0ce3
4 8.632950	192.168.1.1	255.255.255.255	DHCP	590 ✓	DHCP Offer	– Transaction ID 0x3e5e0ce3
5 8.633123	0.0.0.0	255.255.255.255	DHCP	342 ✓	DHCP Request	– Transaction ID 0x3e5e0ce3
6 8.635133	192.168.1.1	255.255.255.255	DHCP	590 ✓	DHCP ACK	– Transaction ID 0x3e5e0ce3
36 20.134178	192.168.1.101	192.168.1.1	DHCP	342 ✓	DHCP Request	– Transaction ID 0x257e55a3
37 20.135930	192.168.1.1	255.255.255.255	DHCP	590 ✓	DHCP ACK	– Transaction ID 0x257e55a3
41 25.073867	192.168.1.101	192.168.1.1	DHCP	342 ✓	DHCP Release	– Transaction ID 0xb7a32733
42 30.869153	0.0.0.0	255.255.255.255	DHCP	342 ✓	DHCP Discover	– Transaction ID 0x3a5df7d9
44 31.908133	192.168.1.1	255.255.255.255	DHCP	590 ✓	DHCP Offer	– Transaction ID 0x3a5df7d9
45 31.908304	0.0.0.0	255.255.255.255	DHCP	342 ✓	DHCP Request	– Transaction ID 0x3a5df7d9
46 31.910313	192.168.1.1	255.255.255.255	DHCP	590 ✓	DHCP ACK	– Transaction ID 0x3a5df7d9

    c. If the DHCP Release message is lost, the server will eventually recover the IP address after the lease time expires.

14. Clear the **bootp** filter from your Wireshark window.
    Were any ARP packets sent or received during the DHCP packet-exchange period?
    If so, explain the purpose of those ARP packets.

5 8.633123	0.0.0.0	255.255.255.255	DHCP	342 ✓	DHCP Request – Transaction ID 0x3e5e0ce3
6 8.635133	192.168.1.1	255.255.255.255	DHCP	590 ✓	DHCP ACK – Transaction ID 0x3e5e0ce3
7 8.638148	00:08:74:4f:36:23	ff:ff:ff:ff:ff:ff	ARP	42 ✓	ARP Announcement for 192.168.1.101
8 9.285757	00:08:74:4f:36:23	ff:ff:ff:ff:ff:ff	ARP	42 ✓	ARP Announcement for 192.168.1.101
9 10.285814	00:08:74:4f:36:23	ff:ff:ff:ff:ff:ff	ARP	42 ✓	ARP Announcement for 192.168.1.101
10 11.309600	192.168.1.101	224.0.0.22	IGMPv3	54 ✓	Membership Report / Join group 239.255.255.250 for a
11 11.311090	00:06:25:da:af:73	ff:ff:ff:ff:ff:ff	ARP	60 ✓	Who has 192.168.1.101? Tell 192.168.1.1
12 11.311102	00:08:74:4f:36:23	00:06:25:da:af:73	ARP	42 ✓	192.168.1.101 is at 00:08:74:4f:36:23
13 11.311569	192.168.1.1	192.168.1.101	ICMP	74 ✓	Destination unreachable (Protocol unreachable)
14 11.364272	192.168.1.101	192.168.1.255	NBNS	110 ✓	Registration NB NOHO<00>
15 11.895281	192.168.1.101	224.0.0.22	IGMPv3	54 ✓	Membership Report / Join group 239.255.255.250 for a
16 11.896474	192.168.1.1	192.168.1.101	ICMP	74 ✓	Destination unreachable (Protocol unreachable)
17 12.114052	192.168.1.101	192.168.1.255	NBNS	110 ✓	Registration NB NOHO<00>
18 12.864085	192.168.1.101	192.168.1.255	NBNS	110 ✓	Registration NB NOHO<00>
19 13.614118	192.168.1.101	192.168.1.255	NBNS	110 ✓	Registration NB NOHO<00>
20 14.364381	192.168.1.101	192.168.1.255	NBNS	110 ✓	Registration NB WORKGROUP<00>
21 15.114199	192.168.1.101	192.168.1.255	NBNS	110 ✓	Registration NB WORKGROUP<00>
22 15.864226	192.168.1.101	192.168.1.255	NBNS	110 ✓	Registration NB WORKGROUP<00>
23 16.130580	00:08:74:4f:36:23	ff:ff:ff:ff:ff:ff	ARP	42 ✓	Who has 192.168.1.117? Tell 192.168.1.101
24 16.131598	00:10:83:0d:c8:06	00:08:74:4f:36:23	ARP	60 ✓	192.168.1.117 is at 00:10:83:0d:c8:06
25 16.131605	192.168.1.101	192.168.1.117	SNMP	120 ✓	get-request 1.3.6.1.2.1.25.3.2.1.5.1 1.3.6.1.2.1.25.
26 16.183883	192.168.1.117	192.168.1.101	SNMP	123 ✓	get-response 1.3.6.1.2.1.25.3.2.1.5.1 1.3.6.1.2.1.25
27 16.614269	192.168.1.101	192.168.1.255	NBNS	110 ✓	Registration NB WORKGROUP<00>
28 17.364596	192.168.1.101	192.168.1.255	NBNS	110 ✓	Registration NB NOHO<20>
29 17.364847	192.168.1.101	192.168.1.255	NBNS	110 ✓	Registration NB WORKGROUP<1e>
30 18.114347	192.168.1.101	192.168.1.255	NBNS	110 ✓	Registration NB NOHO<20>
31 18.114383	192.168.1.101	192.168.1.255	NBNS	110 ✓	Registration NB WORKGROUP<1e>
32 18.864372	192.168.1.101	192.168.1.255	NBNS	110 ✓	Registration NB NOHO<20>
33 18.864410	192.168.1.101	192.168.1.255	NBNS	110 ✓	Registration NB WORKGROUP<1e>
34 19.614408	192.168.1.101	192.168.1.255	NBNS	110 ✓	Registration NB NOHO<20>
35 19.614445	192.168.1.101	192.168.1.255	NBNS	110 ✓	Registration NB WORKGROUP<1e>
36 20.134178	192.168.1.101	192.168.1.1	DHCP	342 ✓	DHCP Request – Transaction ID 0x257e55a3
37 20.135930	192.168.1.1	255.255.255.255	DHCP	590 ✓	DHCP ACK – Transaction ID 0x257e55a3

Answer:

a. Yes, there were ARP packets sent or received during the DHCP packet-exchange period.

b. The DHCP server sends ARP requests before offering an IP address to a client. This is done to check if the IP address is already in use by another device.