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We have presented the solution for the first two tasks on the last lesson (we are group 1), so here are solutoins for task 3 and 4:

Task 3:

My ip: 156.17.237.32

```
Ethernet adapter Ethernet:

   Connection-specific DNS Suffix  . : 5-6.t19.ds.pwr.wroc.pl
   Link-local IPv6 Address . . . . . : fe80::8cc2:e86d:d0d4:1ef9%17
   IPv4 Address. . . . . . . . . . . : 156.17.237.32
   Subnet Mask . . . . . . . . . . . : 255.255.255.128
   Default Gateway . . . . . . . . . : 156.17.237.126
```

Partners ip: 156.17.237.52

```
Адаптер Ethernet Ethernet:

   DNS-суффикс подключения . . . . . : 5-6.t19.ds.pwr.wroc.pl
   Локальный IPv6-адрес канала . . . : fe80::68c8:f357:3962:e72c%17
   IPv4-адрес. . . . . . . . . . . . : 156.17.237.52
   Маска подсети . . . . . . . . . . : 255.255.255.128
   Основной шлюз. . . . . . . . . : 156.17.237.126
```

- When looking into the arp table I can find the address of my partner there:

```
  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
  255.255.255.255       ff-ff-ff-ff-ff-ff     static

Interface: 192.168.56.1 --- 0x10
  Internet Address      Physical Address      Type
  192.168.56.255        ff-ff-ff-ff-ff-ff     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

Interface: 156.17.237.32 --- 0x11
  Internet Address      Physical Address      Type
  156.17.237.33         98-da-c4-2b-cb-23     dynamic
  156.17.237.52         88-d7-f6-1e-12-2b     dynamic
  156.17.237.53         74-da-88-32-7b-df     dynamic
  156.17.237.75         20-25-64-87-84-84     dynamic
  156.17.237.109        18-d6-c7-ec-d2-e5     dynamic
  156.17.237.126        00-15-f9-7b-2f-c7     dynamic
  156.17.237.127        ff-ff-ff-ff-ff-ff     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
  255.255.255.255       ff-ff-ff-ff-ff-ff     static

c:\Users\danyl>
```

- Now cleaning the arp table and viewing it shows:

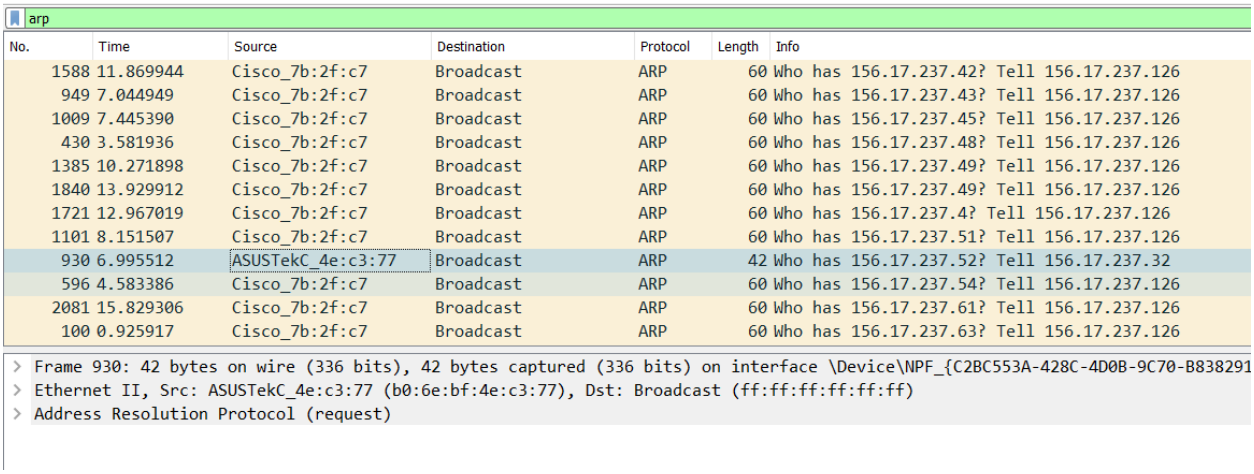
```
C:\Windows\system32>arp -d *

C:\Windows\system32>arp -a

Interface: 25.30.154.246 --- 0xd
  Internet Address      Physical Address      Type
  224.0.0.22            01-00-5e-00-00-16     static

Interface: 192.168.56.1 --- 0x10
  Internet Address      Physical Address      Type
  224.0.0.22            01-00-5e-00-00-16     static

Interface: 156.17.237.32 --- 0x11
  Internet Address      Physical Address      Type
  156.17.237.126        00-15-f9-7b-2f-c7     dynamic
  224.0.0.22            01-00-5e-00-00-16     static

C:\Windows\system32>
```

It's much shorter

- Pinging goes just fine:

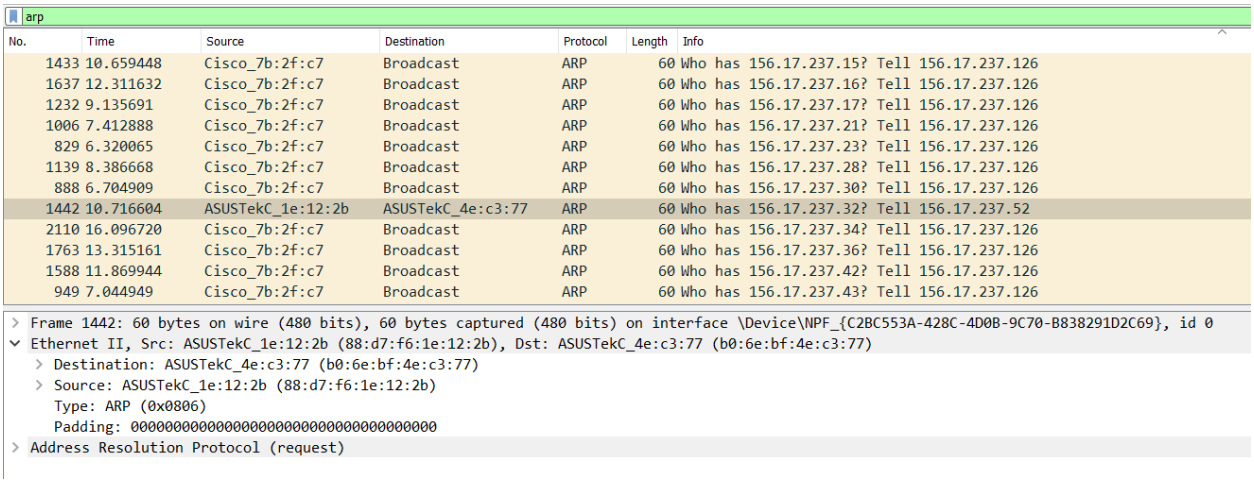
```
C:\Windows\system32>ping 156.17.237.32

Pinging 156.17.237.32 with 32 bytes of data:
Reply from 156.17.237.32: bytes=32 time<1ms TTL=128
Reply from 156.17.237.32: bytes=32 time<1ms TTL=128
Reply from 156.17.237.32: bytes=32 time<1ms TTL=128
Reply from 156.17.237.32: bytes=32 time<1ms TTL=128

Ping statistics for 156.17.237.32:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\Windows\system32>
```

But if we clean the table again and capture the packets in wireshark we will see:



The packet that I selected is an ARP packet sent from my computer.

This is used to find the host's nic's MAC address when knowing the ip. The packet is first send to broadcast (everybody), and when the needed host recieves this packet it replies directly to the initial computer(my computer), as here:



The selected packet is a reply in which the other host shares it's MAC address. We can see from the ethernet header fields the MAC addresses of the two machines:

My mac address: b0:6e:bf:4e:c3:77

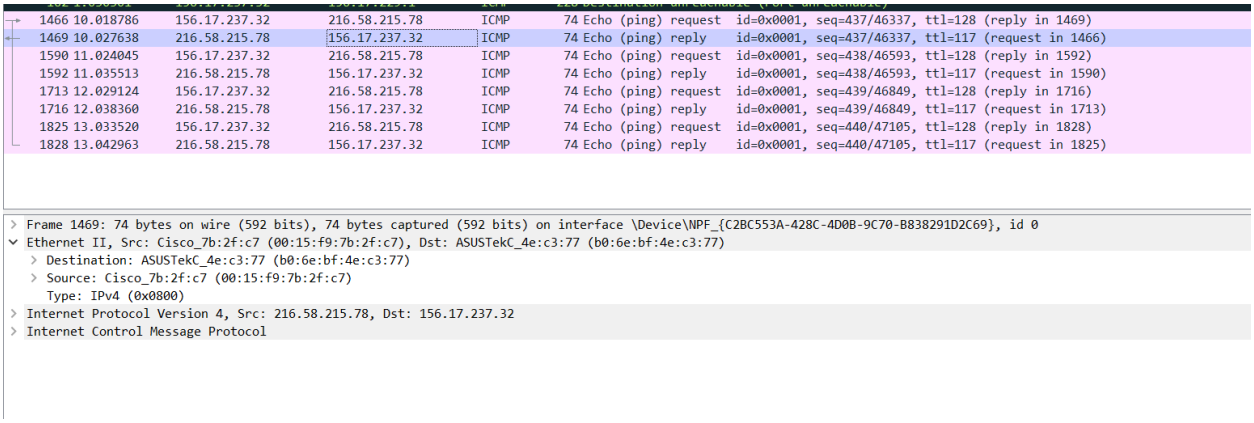
Partner's mac address: 88:d7:f6:1e:12:2b

The address resolution answer contains:

```
Address Resolution Protocol (request)
    Hardware type: Ethernet (1)
    Protocol type: IPv4 (0x0800)
    Hardware size: 6
    Protocol size: 4
    Opcode: request (1)
    Sender MAC address: ASUSTekC_1e:12:2b (88:d7:f6:1e:12:2b)
    Sender IP address: 156.17.237.52
    Target MAC address: ASUSTekC_4e:c3:77 (b0:6e:bf:4e:c3:77)
    Target IP address: 156.17.237.32
```

B)

We can ping google.pl or some other site on external network, but when sending the packets to the website, the mac (physical address) is only used to connect to the local router, and the router de-encapsulates the part with physical address and changes it. Now the destination address becomes the next router and the source is our router. And the same thing is done throughout the next hops. So even when the remote website sends us the packet the source ip is the ip of the website, but the source physical address is the address of the router we are connected to.



The Physical address in the ethernet header is still out routers address.

For that reason arp table doesn’t contain google.pl address.

Task 4:

We have debian linux installed on virtual machine, so we ping the real computer from the virtual machine:

```
stud@deb10:~$ ping 192.168.56.1
PING 192.168.56.1 (192.168.56.1) 56(84) bytes of data.
64 bytes from 192.168.56.1: icmp_seq=1 ttl=128 time=0.558 ms
64 bytes from 192.168.56.1: icmp_seq=2 ttl=128 time=0.555 ms
64 bytes from 192.168.56.1: icmp_seq=3 ttl=128 time=0.340 ms
64 bytes from 192.168.56.1: icmp_seq=4 ttl=128 time=0.285 ms
64 bytes from 192.168.56.1: icmp_seq=5 ttl=128 time=0.325 ms
64 bytes from 192.168.56.1: icmp_seq=6 ttl=128 time=0.448 ms
64 bytes from 192.168.56.1: icmp_seq=7 ttl=128 time=0.368 ms
^C
--- 192.168.56.1 ping statistics ---
7 packets transmitted, 7 received, 0% packet loss, time 169ms
rtt min/avg/max/mdev = 0.285/0.411/0.558/0.103 ms
stud@deb10:~$ _
```

We captured the traffic sent from linux in wireshark installed on windows machine (the one which we pinged from linux):

4	5.621285	192.168.56.101	192.168.56.1	ICMP	98	Echo (ping) request id=0x01b4, seq=1/256, ttl=64 (reply in 5)
5	5.621361	192.168.56.1	192.168.56.101	ICMP	98	Echo (ping) reply id=0x01b4, seq=1/256, ttl=128 (request in 4)
6	6.632195	192.168.56.101	192.168.56.1	ICMP	98	Echo (ping) request id=0x01b4, seq=2/512, ttl=64 (reply in 7)
7	6.632340	192.168.56.1	192.168.56.101	ICMP	98	Echo (ping) reply id=0x01b4, seq=2/512, ttl=128 (request in 6)
8	7.660364	192.168.56.101	192.168.56.1	ICMP	98	Echo (ping) request id=0x01b4, seq=3/768, ttl=64 (reply in 9)
9	7.660434	192.168.56.1	192.168.56.101	ICMP	98	Echo (ping) reply id=0x01b4, seq=3/768, ttl=128 (request in 8)
10	8.679487	192.168.56.101	192.168.56.1	ICMP	98	Echo (ping) request id=0x01b4, seq=4/1024, ttl=64 (reply in 11)
11	8.679552	192.168.56.1	192.168.56.101	ICMP	98	Echo (ping) reply id=0x01b4, seq=4/1024, ttl=128 (request in 10)
12	9.726150	192.168.56.101	192.168.56.1	ICMP	98	Echo (ping) request id=0x01b4, seq=5/1280, ttl=64 (reply in 13)
13	9.726220	192.168.56.1	192.168.56.101	ICMP	98	Echo (ping) reply id=0x01b4, seq=5/1280, ttl=128 (request in 12)
16	10.781068	192.168.56.101	192.168.56.1	ICMP	98	Echo (ping) request id=0x01b4, seq=6/1536, ttl=64 (reply in 17)
17	10.781214	192.168.56.1	192.168.56.101	ICMP	98	Echo (ping) reply id=0x01b4, seq=6/1536, ttl=128 (request in 16)

```
> Frame 4: 98 bytes on wire (784 bits), 98 bytes captured (784 bits) on interface \Device\NPF_{AA5496CF-A557-4674-959C-526102899113}, id 0
> Ethernet II, Src: PcsCompu_64:ff:a6 (08:00:27:64:ff:a6), Dst: 0a:00:27:00:00:10 (0a:00:27:00:00:10)
v Internet Protocol Version 4, Src: 192.168.56.101, Dst: 192.168.56.1
    0100 .... = Version: 4
    .... 0101 = Header Length: 20 bytes (5)
  > Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
    Total Length: 84
    Identification: 0x9bb0 (39856)
  > Flags: 0x4000, Don't fragment
    Fragment offset: 0
    Time to live: 64
    Protocol: ICMP (1)
    Header checksum: 0xad41 [validation disabled]
```

```
0000  0a 00 27 00 00 10 08 00  27 64 ff a6 08 00 45 00   ··'····· 'd····E·
0010  00 54 9b b0 40 00 40 01  ad 41 c0 a8 38 65 c0 a8   ·T··@·@· ·A··8e··
0020  38 01 08 00 d7 a3 01 b4  00 01 3c 3c 99 5f 00 00   8·······  ··<<·_··
0030  00 00 84 38 06 00 00 00  00 00 10 11 12 13 14 15   ···8····  ········
0040  16 17 18 19 1a 1b 1c 1d  1e 1f 20 21 22 23 24 25   ········  ·· !"#$%
0050  26 27 28 29 2a 2b 2c 2d  2e 2f 30 31 32 33 34 35   &'()*+,- ./012345
0060  36 37                                             67
```

- These are the ethernet header fields:

```
v Ethernet II, Src: PcsCompu_64:ff:a6 (08:00:27:64:ff:a6), Dst: 0a:00:27:00:00:10 (0a:00:27:00:00:10)
  > Destination: 0a:00:27:00:00:10 (0a:00:27:00:00:10)
  > Source: PcsCompu_64:ff:a6 (08:00:27:64:ff:a6)
    Type: IPv4 (0x0800)
```

Their size In bytes are:

Destination: 6 bytes,

Source: 6 bytes,

Type: 2 bytes

All together : 14 bytes

- Because the total size of header fields is 14 bytes and the whole frame is 98 bytes, data is 98 – 14 = 84 bytes:

```
> Frame 4: 98 bytes on wire (784 bits), 98 bytes captured (784 bits) on interface \Device\NPF_{AA5496CF-A557-4674-959C-526102899113}, id 0
> Ethernet II, Src: PcsCompu_64:ff:a6 (08:00:27:64:ff:a6), Dst: 0a:00:27:00:00:10 (0a:00:27:00:00:10)
> Internet Protocol Version 4, Src: 192.168.56.101, Dst: 192.168.56.1
> Internet Control Message Protocol
```

- Contents of data field:

```
00 00 84 38 06 00 00 00  00 00 10 11 12 13 14 15   ··8····· ········
16 17 18 19 1a 1b 1c 1d  1e 1f 20 21 22 23 24 25   ········ ·· !"#$%
26 27 28 29 2a 2b 2c 2d  2e 2f 30 31 32 33 34 35   &'()*+,- ./012345
36 37                                              67
```

Looks alike the contents of asccii table.

- Source and destination mac addresses:

```
> Destination: 0a:00:27:00:00:10 (0a:00:27:00:00:10)
> Source: PcsCompu_64:ff:a6 (08:00:27:64:ff:a6)
  Type: IPv4 (0x0800)
```