Wireshark Lab: IP & ARPAssignment

1. Select the first UDP segment sent by your computer via the traceroute command to gaia.cs.umass.edu. (Hint: this is 44th packet in the trace file in the ipwireshark-trace1-1.pcapng file in footnote 2). Expand the Internet Protocol part of the packet in the packet details window. What is the IP address of your computer?

My computer IP address is 192.168.86.61 that is shown in the screenshot below.

```
    Identification: 0xfda1 (64929)
  > Flags: 0x00
    ...0 0000 0000 0000 = Fragment Offset: 0
  > Time to Live: 1
    Protocol: UDP (17)
    Header Checksum: 0x2faa [validation disabled]
    [Header checksum status: Unverified]
    Source Address: 192.168.86.61
    Destination Address: 128.119.245.12
> User Datagram Protocol, Src Port: 64928, Dst Port: 33435
> Data (28 bytes)
```

2. What is the value in the time-to-live (TTL) field in this IPv4 datagram's header?

Time to Live: 1 that is shown in the screenshot below.

```
    Identification: 0xfda1 (64929)
  > Flags: 0x00
    ...0 0000 0000 0000 = Fragment Offset: 0
  > Time to Live: 1
    Protocol: UDP (17)
    Header Checksum: 0x2faa [validation disabled]
    [Header checksum status: Unverified]
    Source Address: 192.168.86.61
    Destination Address: 128.119.245.12
> User Datagram Protocol, Src Port: 64928, Dst Port: 33435
> Data (28 bytes)
```

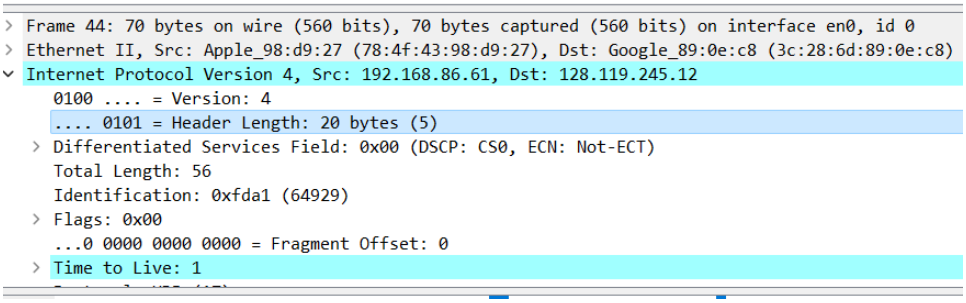
3. What is the value in the upper layer protocol field in this IPv4 datagram's header? [Note: the answers for Linux/MacOS differ from Windows here].

UDP value is 17 that is shown in the screenshot below.

```
    Identification: 0xfda1 (64929)
  > Flags: 0x00
    ...0 0000 0000 0000 = Fragment Offset: 0
  > Time to Live: 1
    Protocol: UDP (17)
    Header Checksum: 0x2faa [validation disabled]
    [Header checksum status: Unverified]
    Source Address: 192.168.86.61
    Destination Address: 128.119.245.12
> User Datagram Protocol, Src Port: 64928, Dst Port: 33435
> Data (28 bytes)
```

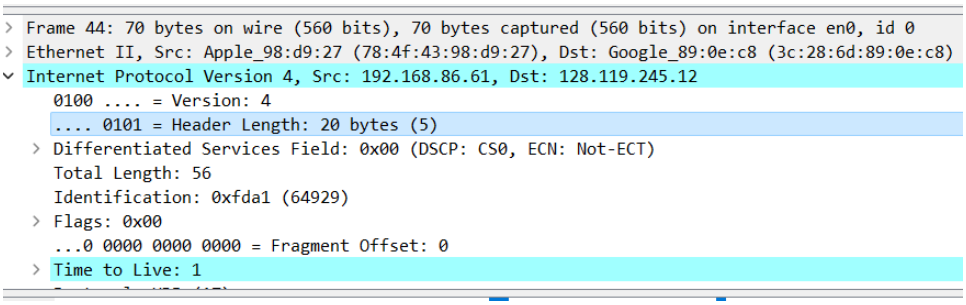
4. How many bytes are in the IP header?

Header Length: 20 Bytes (5) that is shown in the screenshot below.



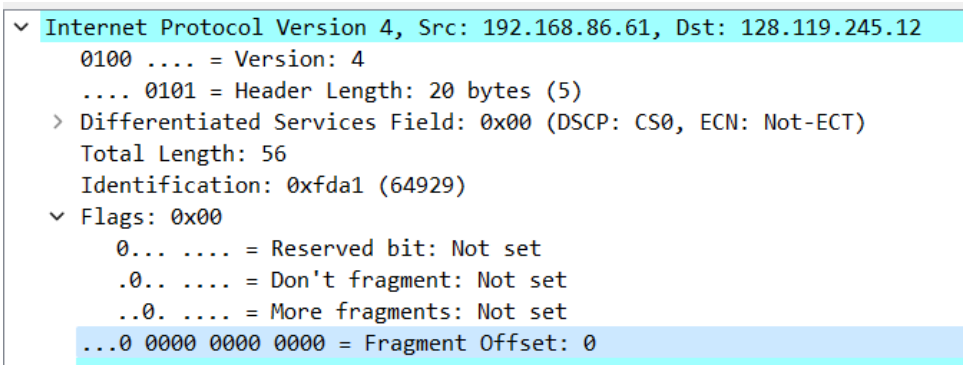
5. How many bytes are in the payload of the IP datagram? Explain how you determined the number of payload bytes.

There are 20 bytes in the IP header which leaves 36 bytes for the payload of the IP datagram because we were sending a packet of length 56 bytes. It is shown in the screenshot below.



6. Has this IP datagram been fragmented? Explain how you determined whether or not the datagram has been fragmented.

The fragment offset is set to 0, therefore, the packet has not been fragmented.?????

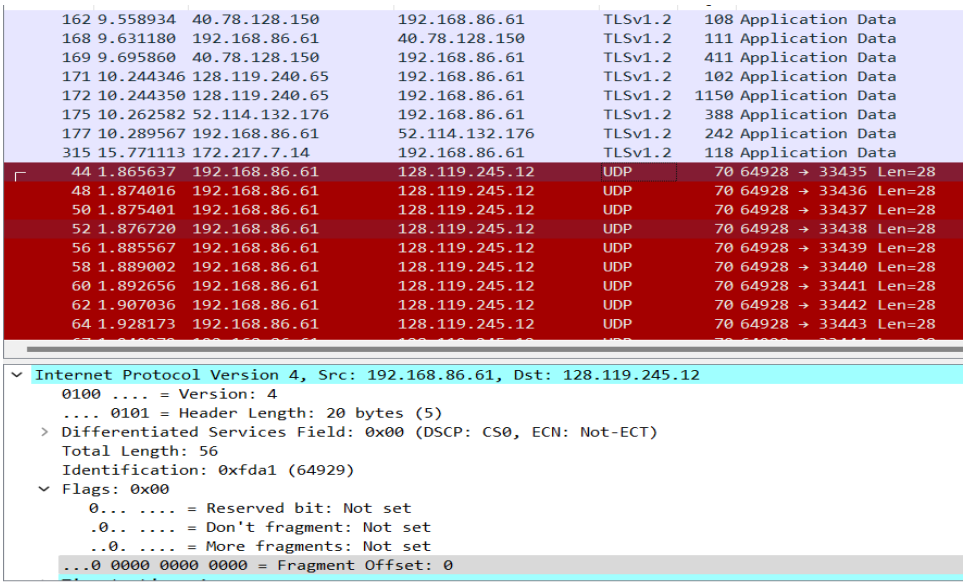


7. Which fields in the IP datagram always change from one datagram to the next within this series of UDP segments sent by your computer destined to 128.119.245.12, via traceroute? Why?

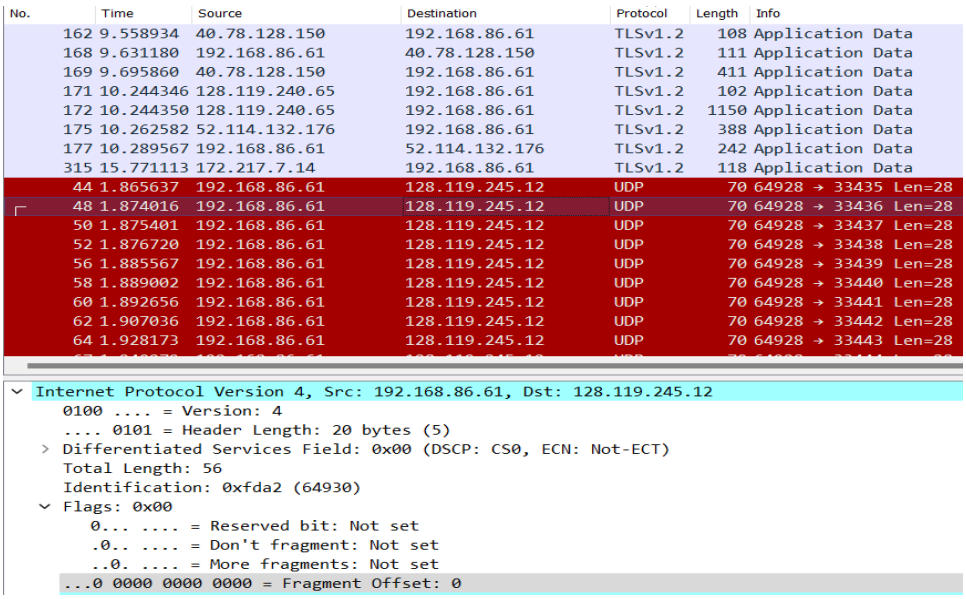
Fields that must change:

The header checksum is always changing because header changes and identification is always changing to verify packets. Time to live is also changing but not always.

First datagram – identification: 0xfda1, Header Checksum: 0x2faa,



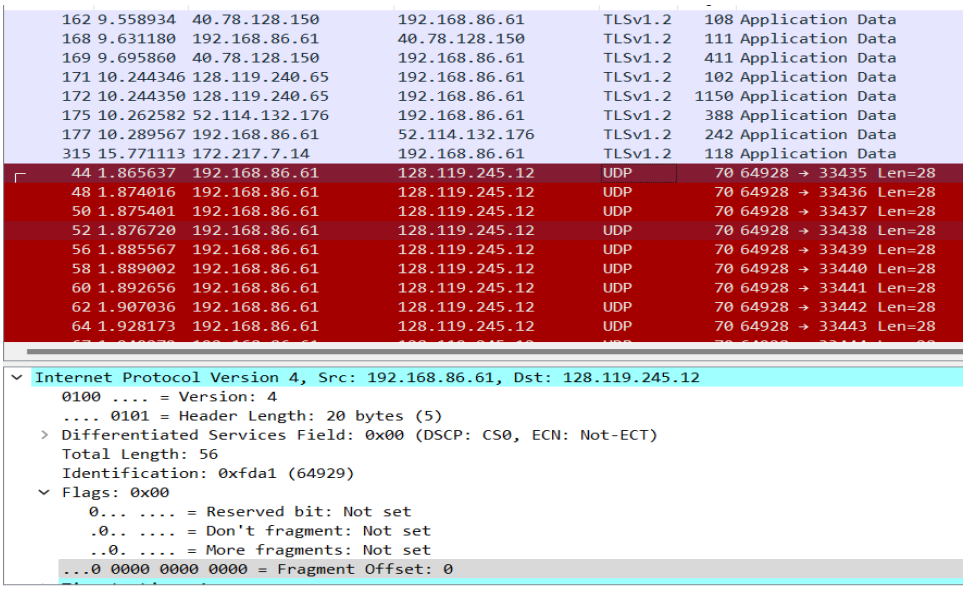
Secon datagram - identification: 0xfda1, Header Checksum: 0x2fa9



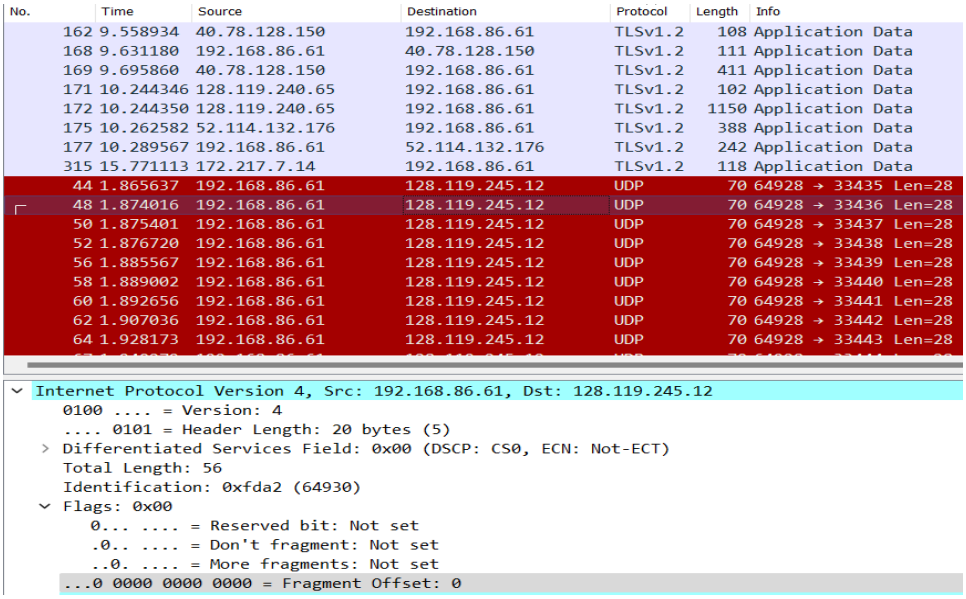
8. Which fields in this sequence of IP datagrams (containing UDP segments) stay constant? Why?

The fields that stay constant are; version (since we are using IPv4), header length (since these are UDP packets), source IP (since all packets are sent from my computer), destination IP (since we are sending to the same host), Differentiated Services (since all packets are UDP), Upper Layer Protocol (since these are UDP packets). When we compare this value based on the screenshot below, we can receive that they stay constant.

First datagram



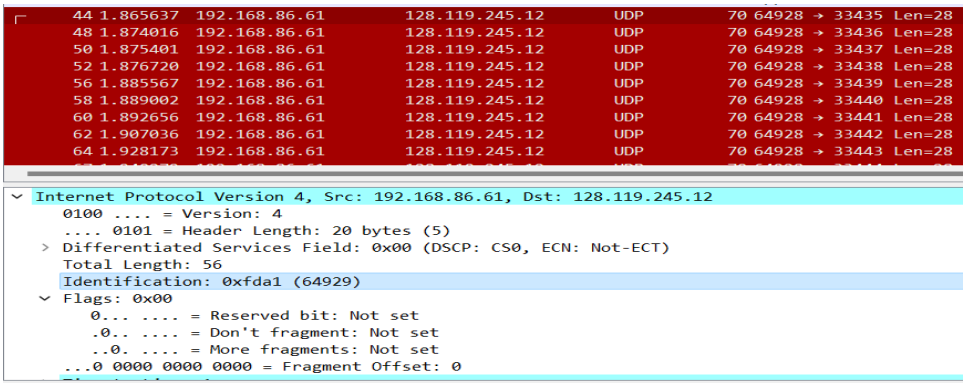
Second datagram



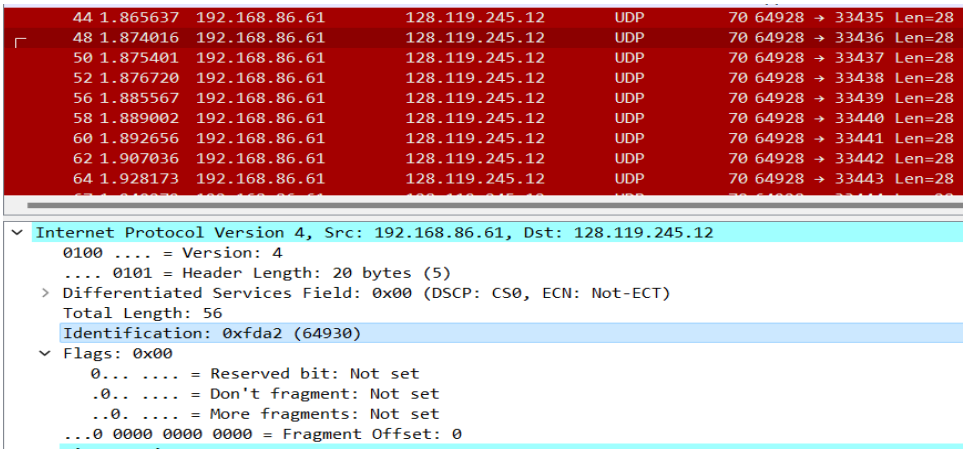
9. Describe the pattern you see in the values in the Identification field of the IP datagrams being sent by your computer.

According to below two screenshots, the pattern is the IP header Identification field increment with each UDP request and the field increases by one in each strand of echo requests.

First datagram - Identification: 0xfda1 (64929)

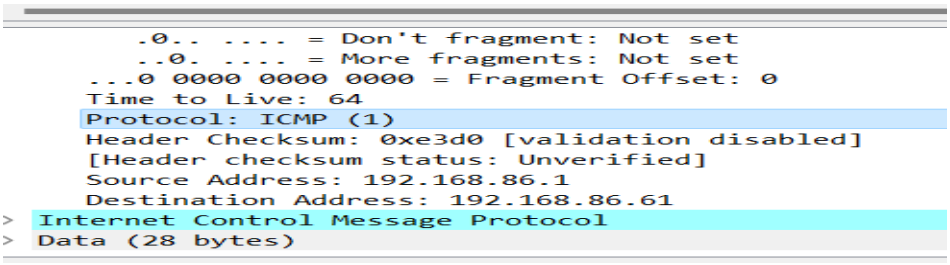


Second datagram - Identification: 0xfda2 (64930)



10. What is the upper layer protocol specified in the IP datagrams returned from the routers? [Note: the answers for Linux/MacOS differ from Windows here].

The upper layer protocol is ICMP (1) in the IP datagrams returned from the routers. It is shown in the screenshot below.



11. Are the values in the Identification fields (across the sequence of all of ICMP packets from all of the routers) similar in behavior to your answer to question 9 above?

No, the values in the identification fields are not similar across sequence of all ICMP packets they are; - 1. 0x6889 2. 0x688a 3. 0x688b 4. 0xd5c3. In question 9, all of the identification fields were in order however ICMP packets' identification fields are not in order. Identification fields of first and 4th are shown in the screenshot below.

First - Identification: 0x6889 (26761)

```
> Frame 45: 98 bytes on wire (784 bits), 98 bytes captured (784 bits) on interface en0, id 0
> Ethernet II, Src: Google_89:0e:c8 (3c:28:6d:89:0e:c8), Dst: Apple_98:d9:27 (78:4f:43:98:d9:27)
v Internet Protocol Version 4, Src: 192.168.86.1, Dst: 192.168.86.61
    0100 .... = Version: 4
    .... 0101 = Header Length: 20 bytes (5)
  > Differentiated Services Field: 0xc0 (DSCP: CS6, ECN: Not-ECT)
    Total Length: 84
    Identification: 0x6889 (26761)
  > Flags: 0x00
    ...0 0000 0000 0000 = Fragment Offset: 0
    Time to Live: 64
```

Fourth - Identification: 0xd5c3 (54723)

```
> Frame 53: 98 bytes on wire (784 bits), 98 bytes captured (784 bits) on interface en0, id 0
> Ethernet II, Src: Google_89:0e:c8 (3c:28:6d:89:0e:c8), Dst: Apple_98:d9:27 (78:4f:43:98:d9:27)
v Internet Protocol Version 4, Src: 10.0.0.1, Dst: 192.168.86.61
    0100 .... = Version: 4
    .... 0101 = Header Length: 20 bytes (5)
  > Differentiated Services Field: 0xc0 (DSCP: CS6, ECN: Not-ECT)
    Total Length: 84
    Identification: 0xd5c3 (54723)
  > Flags: 0x00
    ...0 0000 0000 0000 = Fragment Offset: 0
    Time to Live: 63
```

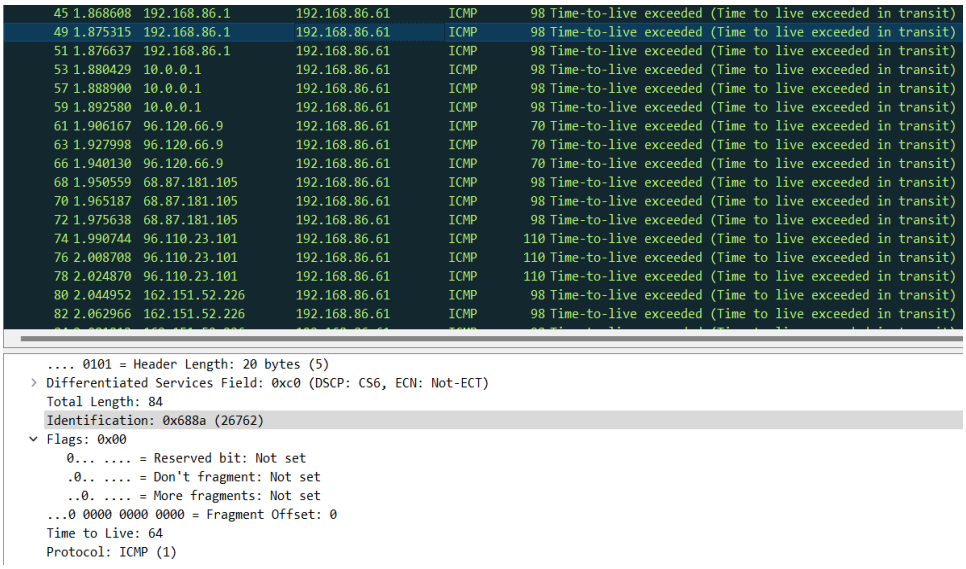
12. Are the values of the TTL fields similar, across all of ICMP packets from all of the routers?

No, the values of TTL fields are not similar across all of ICMP packets the first five values of TTL from ICMP packets are; 1. 64, 2. 64, 3. 64, 4. 63, 5. 61. We can receive top two datagrams' TTL.

First datagram - Time to Live: 64

```
    45 1.868608  192.168.86.1    192.168.86.61   ICMP     98 Time-to-live exceeded (Time to live exceeded in transit)
    49 1.875315  192.168.86.1    192.168.86.61   ICMP     98 Time-to-live exceeded (Time to live exceeded in transit)
    51 1.876637  192.168.86.1    192.168.86.61   ICMP     98 Time-to-live exceeded (Time to live exceeded in transit)
    53 1.880429  10.0.0.1        192.168.86.61   ICMP     98 Time-to-live exceeded (Time to live exceeded in transit)
    57 1.888900  10.0.0.1        192.168.86.61   ICMP     98 Time-to-live exceeded (Time to live exceeded in transit)
    59 1.892580  10.0.0.1        192.168.86.61   ICMP     98 Time-to-live exceeded (Time to live exceeded in transit)
    61 1.906167  96.120.66.9     192.168.86.61   ICMP     70 Time-to-live exceeded (Time to live exceeded in transit)
    63 1.927998  96.120.66.9     192.168.86.61   ICMP     70 Time-to-live exceeded (Time to live exceeded in transit)
    66 1.940130  96.120.66.9     192.168.86.61   ICMP     70 Time-to-live exceeded (Time to live exceeded in transit)
    68 1.950559  68.87.181.105   192.168.86.61   ICMP     98 Time-to-live exceeded (Time to live exceeded in transit)
    70 1.965187  68.87.181.105   192.168.86.61   ICMP     98 Time-to-live exceeded (Time to live exceeded in transit)
    72 1.975638  68.87.181.105   192.168.86.61   ICMP     98 Time-to-live exceeded (Time to live exceeded in transit)
    74 1.990744  96.110.23.101   192.168.86.61   ICMP    110 Time-to-live exceeded (Time to live exceeded in transit)
    76 2.008708  96.110.23.101   192.168.86.61   ICMP    110 Time-to-live exceeded (Time to live exceeded in transit)
    78 2.024870  96.110.23.101   192.168.86.61   ICMP    110 Time-to-live exceeded (Time to live exceeded in transit)
    80 2.044952  162.151.52.226  192.168.86.61   ICMP     98 Time-to-live exceeded (Time to live exceeded in transit)
    82 2.062966  162.151.52.226  192.168.86.61   ICMP     98 Time-to-live exceeded (Time to live exceeded in transit)
    .... 0101 = Header Length: 20 bytes (5)
  > Differentiated Services Field: 0xc0 (DSCP: CS6, ECN: Not-ECT)
    Total Length: 84
    Identification: 0x6889 (26761)
  v Flags: 0x00
      0... .... = Reserved bit: Not set
      .0.. .... = Don't fragment: Not set
      ..0. .... = More fragments: Not set
    ...0 0000 0000 0000 = Fragment Offset: 0
    Time to Live: 64
    Protocol: ICMP (1)
```

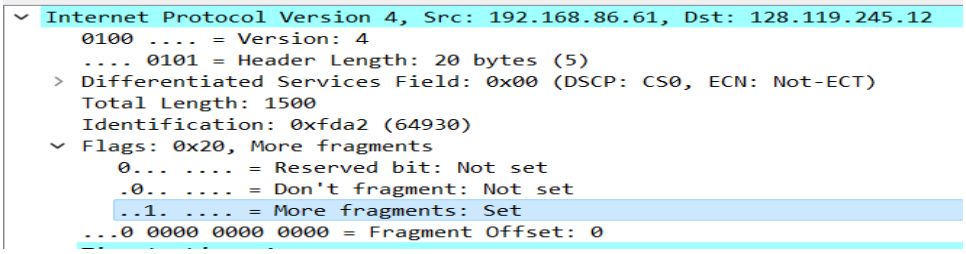
Second datagram - Time to Live: 64



13. Find the first IP datagram containing the first part of the segment sent to 128.119.245.12 sent by your computer via the traceroute command to gaia.cs.umass.edu, after you specified that the traceroute packet length should be 3000. (Hint: This is packet 179 in the ip-wireshark-trace1-1.pcapng trace file in footnote 2. Packets 179, 180, and 181 are three IP datagrams created by fragmenting the first single 3000-byte UDP segment sent to 128.119.145.12). Has that segment been fragmented across more than one IP datagram? (Hint: the answer is yes2!)

Yes, that segment been fragmented across more than one IP datagram. The first fragment offset is 0 that means it is first fragment and more fragment is set which means more fragments will follow. It is shown in the screenshot below.

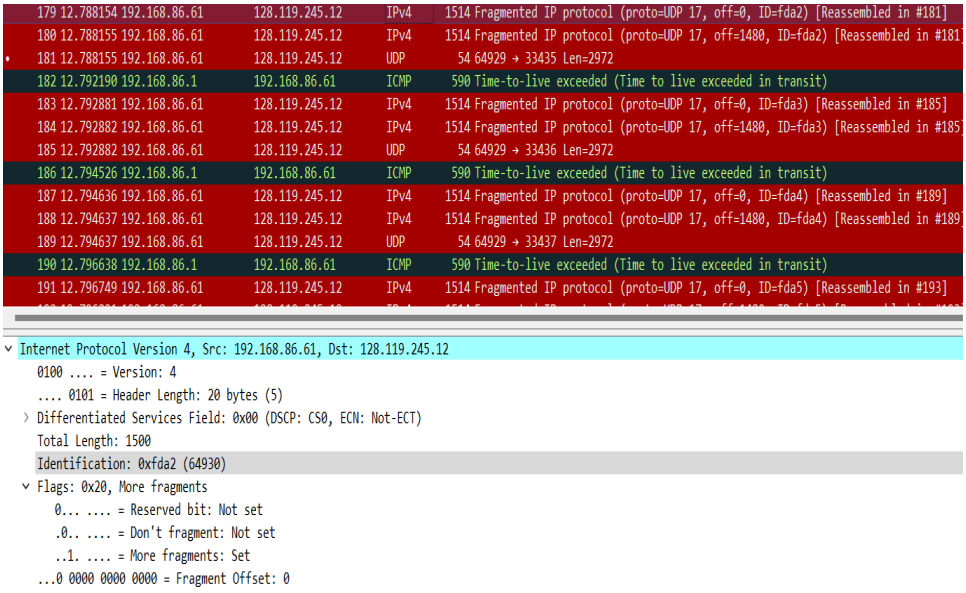
First datagram



Also, the screenshot below shows that this segment is fragmented.

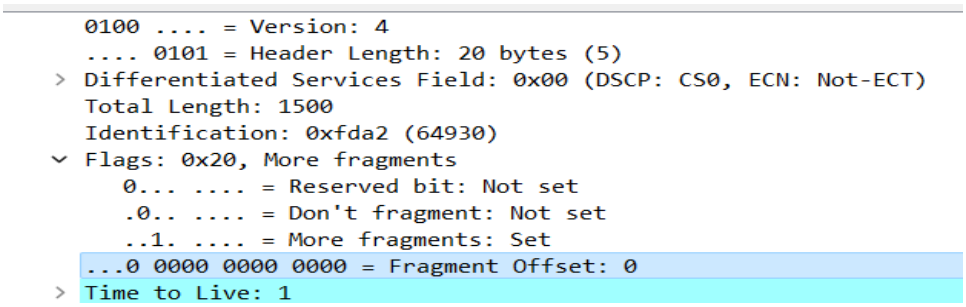
14. What information in the IP header indicates that this datagram been fragmented?

For 179 More fragments: Set. If more fragments value is set then it means it is fragmented.



15. What information in the IP header for this packet indicates whether this is the first fragment versus a latter fragment?

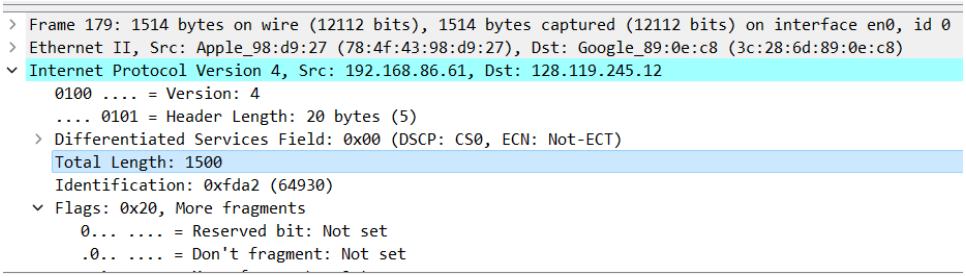
When we look at the fragment offset value for 179 offset value is 0 so 179 is the first fragment. 0 0000 0000 0000 = Fragment Offset: 0.



16. How many bytes are there in is this IP datagram (header plus payload)?

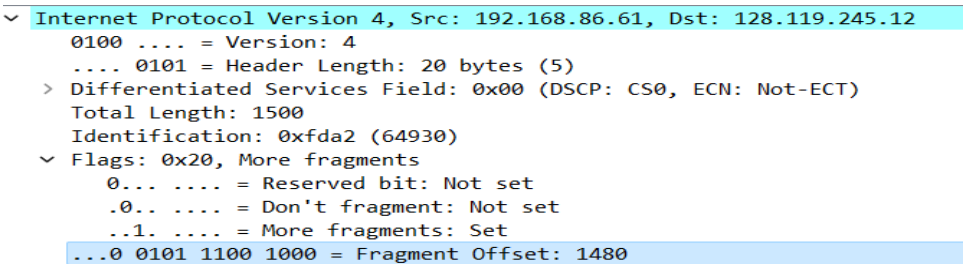
There are 20 bytes in the IP header which leaves 1480 bytes for the payload of the IP

datagram because we were sending a packet of length 1500 bytes



17. Now inspect the datagram containing the second fragment of the fragmented UDP segment. What information in the IP header indicates that this is not the first datagram fragment?

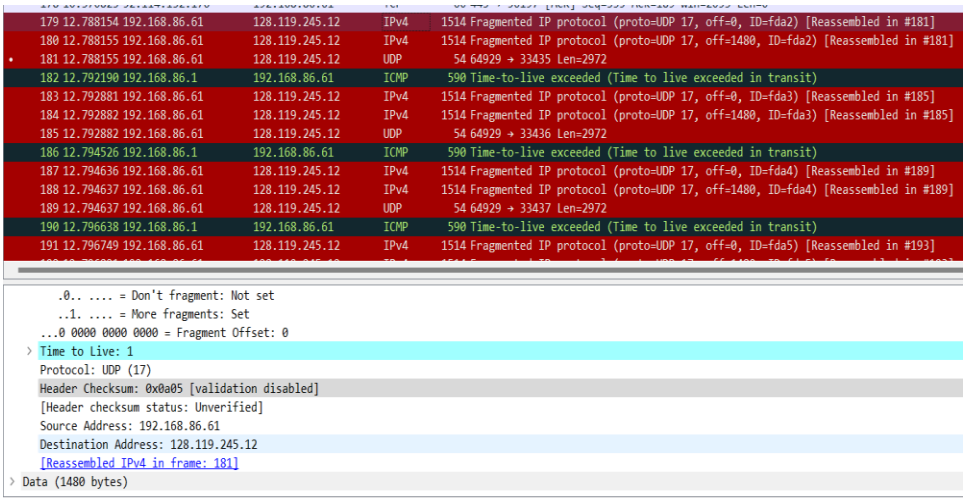
Its fragment offset is 1480 which is 20 bytes lower than 1500 bytes that total length of second fragment. It is shown in the screenshot below.



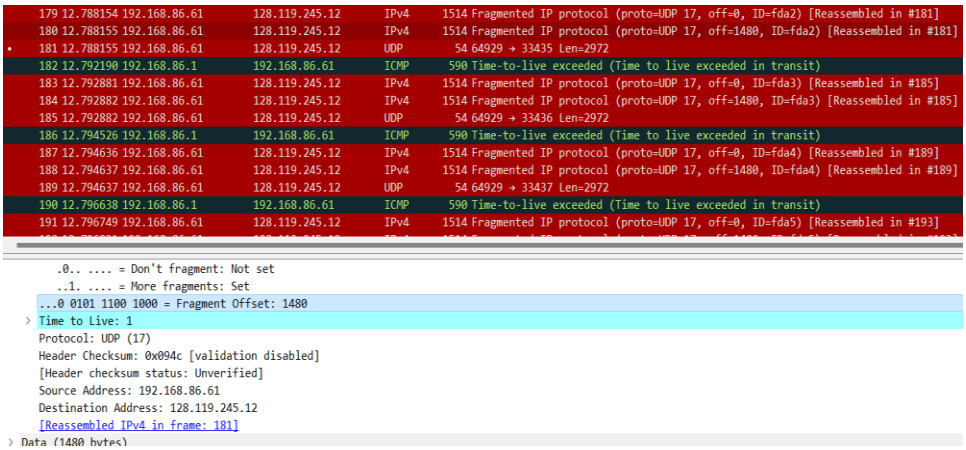
18. What fields change in the IP header between the first and second fragment?

Frame offset and header checksum values are changing. It is shown in the screenshot below.

First fragement – Header Checksum: 0x0a05



Second fragment – Header Checksum: 0x094c



19. Now find the IP datagram containing the third fragment of the original UDP segment. What information in the IP header indicates that this is the last fragment of that segment?

The fragment offset is 2960 which means it is not the first fragment and the more fragments flag is not set.

```
Internet Protocol Version 4, Src: 192.168.86.61, Dst: 128.119.245.12
    0100 .... = Version: 4
    .... 0101 = Header Length: 20 bytes (5)
  > Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
    Total Length: 40
    Identification: 0xfda2 (64930)
  v Flags: 0x01
      0... .... = Reserved bit: Not set
      .0.. .... = Don't fragment: Not set
      ..0. .... = More fragments: Not set
    ...0 1011 1001 0000 = Fragment Offset: 2960
```

20. How many entries are stored in your ARP cache?

As the below screenshot shows, 7 Entries – 6 Static and 1 Dynamic are stored.

```
Command Prompt
Microsoft Windows [Version 10.0.22000.1219]
(c) Microsoft Corporation. All rights reserved.

C:\Users\msiip>arp -a

Interface: 10.185.242.61 --- 0x15
  Internet Address      Physical Address      Type
  10.185.242.1          74-4d-28-93-31-44     dynamic
  10.185.243.255        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
  255.255.255.255       ff-ff-ff-ff-ff-ff     static

C:\Users\msiip>
```

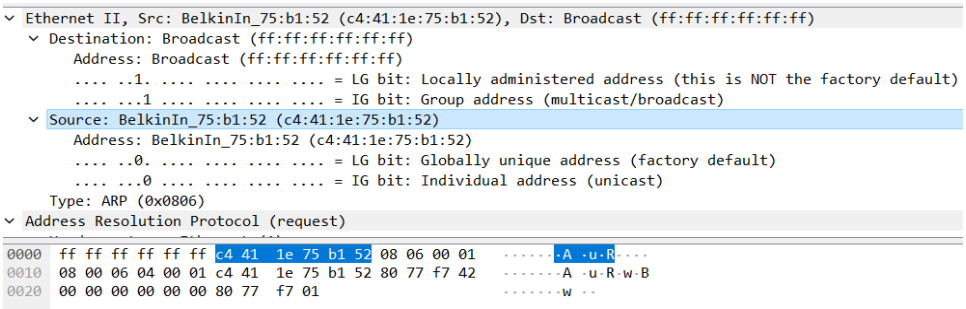
21. What is contained in each displayed entry of the ARP cache?

As the below screenshot shows, ARP cache contained in each displayed entry IP addresses, types and MAC address.

```
Command Prompt
Microsoft Windows [Version 10.0.22000.1219]
(c) Microsoft Corporation. All rights reserved.

C:\Users\msiip>arp -a

Interface: 10.185.242.61 --- 0x15
  Internet Address      Physical Address      Type
  10.185.242.1          74-4d-28-93-31-44     dynamic
  10.185.243.255        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
  255.255.255.255       ff-ff-ff-ff-ff-ff     static

C:\Users\msiip>
```

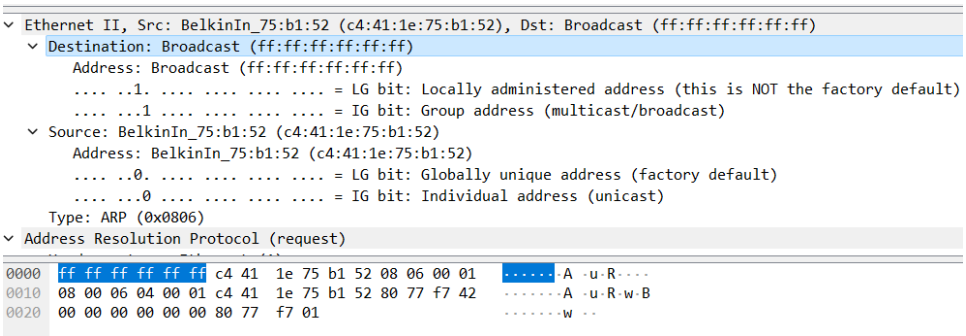
22. What is the hexadecimal value of the source address in the Ethernet frame containing the ARP request message sent out by your computer?

The hexadecimal value of Source: BelkinIn_75:b1:52 (c4:41:1e:75:b1:52). It is shown in the screenshot below.



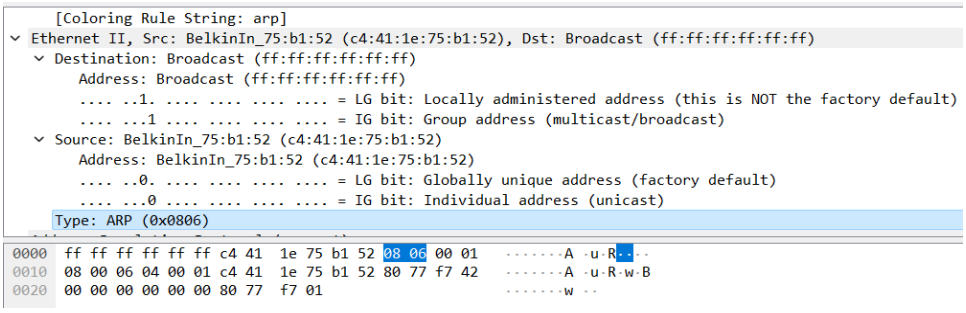
23. What is the hexadecimal value of the destination addresses in the Ethernet frame containing the ARP request message sent out by your computer? And what device (if any) corresponds to that address (e.g,, client, server, router, switch or otherwise...)?

The hexadecimal value of Destination: Broadcast (ff:ff:ff:ff:ff:ff). It is shown in the screenshot below.



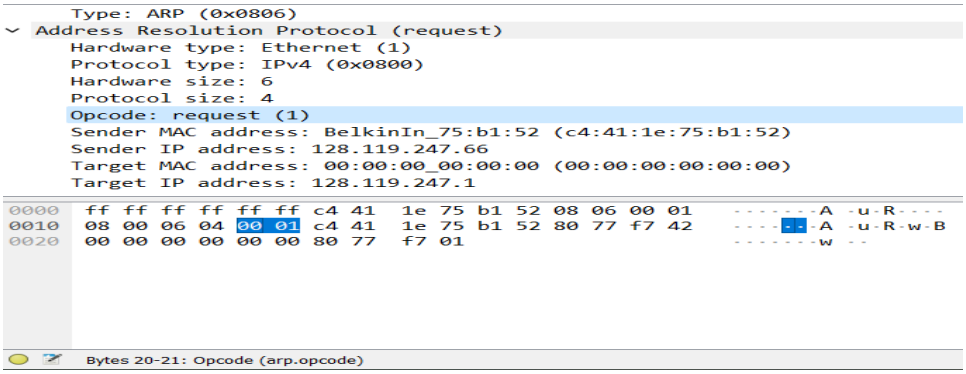
24. What is the hexadecimal value for the two-byte Ethernet Frame type field. What upper layer protocol does this correspond to?

The hex value for the two-byte Ethernet frame is **ARP (0x0806)**, the corresponding upper layer protocol is ARP. It is shown in the screenshot below.



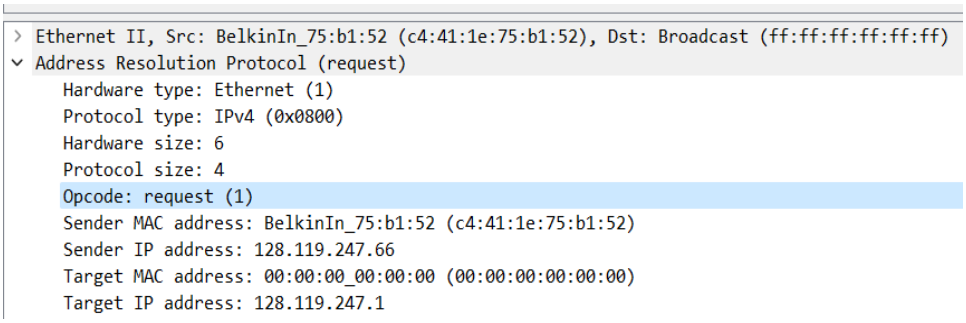
25. How many bytes from the very beginning of the Ethernet frame does the ARP opcode field begin?

There are 20 bytes from the very beginning of the Ethernet frame does the ARP opcode field begin. It is shown in the screenshot below.



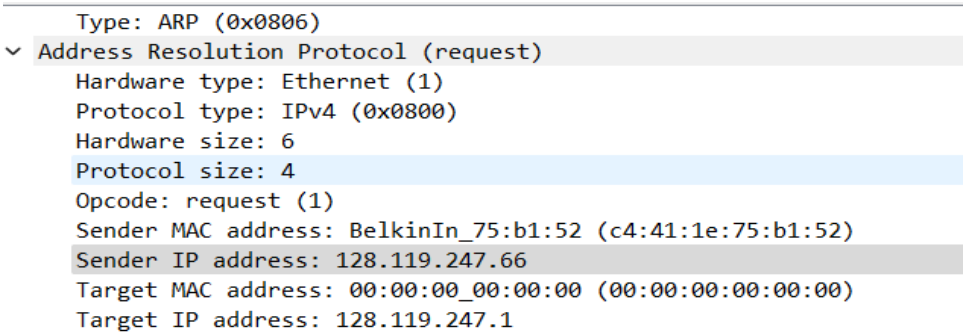
26. What is the value of the opcode field within the ARP request message sent by your computer?

Opcode request value is 1 which is shown in the screenshot below.



27. Does the ARP request message contain the IP address of the sender? If the answer is yes, what is that value?

Yes, ARP request message contains Sender IP address: 128.119.247.66. It is shown in the screenshot below.



28. What is the IP address of the device whose corresponding Ethernet address is being requested in the ARP request message sent by your computer?

It is Target IP address: 128.119.247.1 which is shown in the screenshot below.

```
    Type: ARP (0x0806)
v Address Resolution Protocol (request)
    Hardware type: Ethernet (1)
    Protocol type: IPv4 (0x0800)
    Hardware size: 6
    Protocol size: 4
    Opcode: request (1)
    Sender MAC address: BelkinIn_75:b1:52 (c4:41:1e:75:b1:52)
    Sender IP address: 128.119.247.66
    Target MAC address: 00:00:00_00:00:00 (00:00:00:00:00:00)
    Target IP address: 128.119.247.1
```

29. What is the value of the opcode field within the ARP reply message received by your computer?

Opcode reply value is 2 which is shown in the screenshot below.

```
    Padding: 00000000000000000000000000000000
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: 3ComEuro_7e:d9:01 (00:1e:c1:7e:d9:01)
    Sender IP address: 128.119.247.1
    Target MAC address: BelkinIn_75:b1:52 (c4:41:1e:75:b1:52)
    Target IP address: 128.119.247.66
```

30. Finally (!), let's look at the answer to the ARP request message! What is the Ethernet address corresponding to the IP address that was specified in the ARP request message sent by your computer (see question 18)?

Target MAC address: BelkinIn_75:b1:52 (c4:41:1e:75:b1:52). It is shown in the screenshot below.

```
    Padding: 00000000000000000000000000000000
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: 3ComEuro_7e:d9:01 (00:1e:c1:7e:d9:01)
    Sender IP address: 128.119.247.1
    Target MAC address: BelkinIn_75:b1:52 (c4:41:1e:75:b1:52)
    Target IP address: 128.119.247.66
```