COMPUTER NETWORK
Lab 4a

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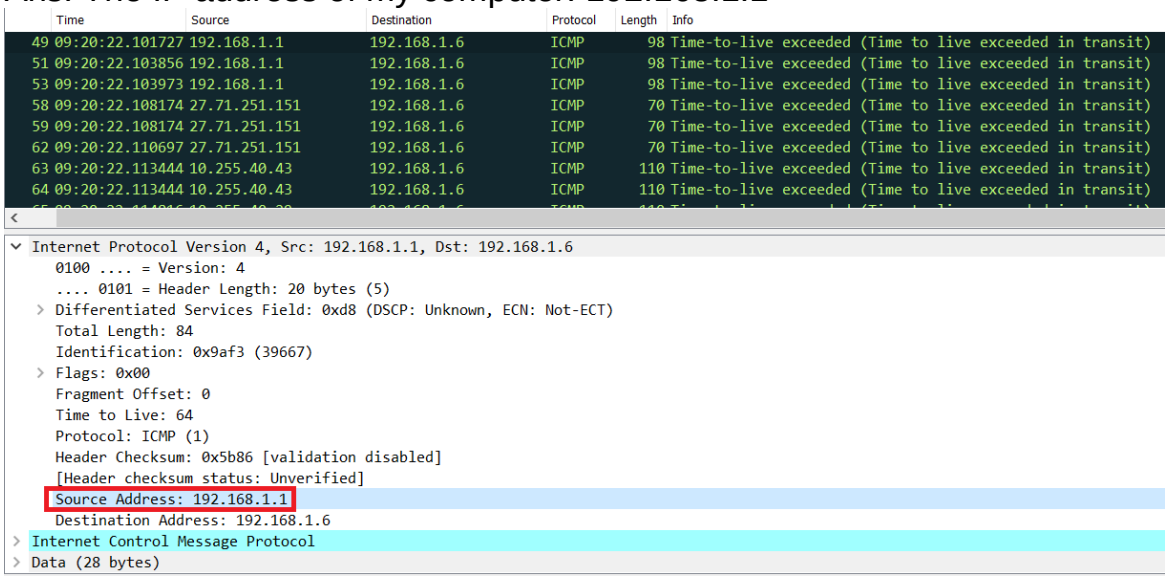
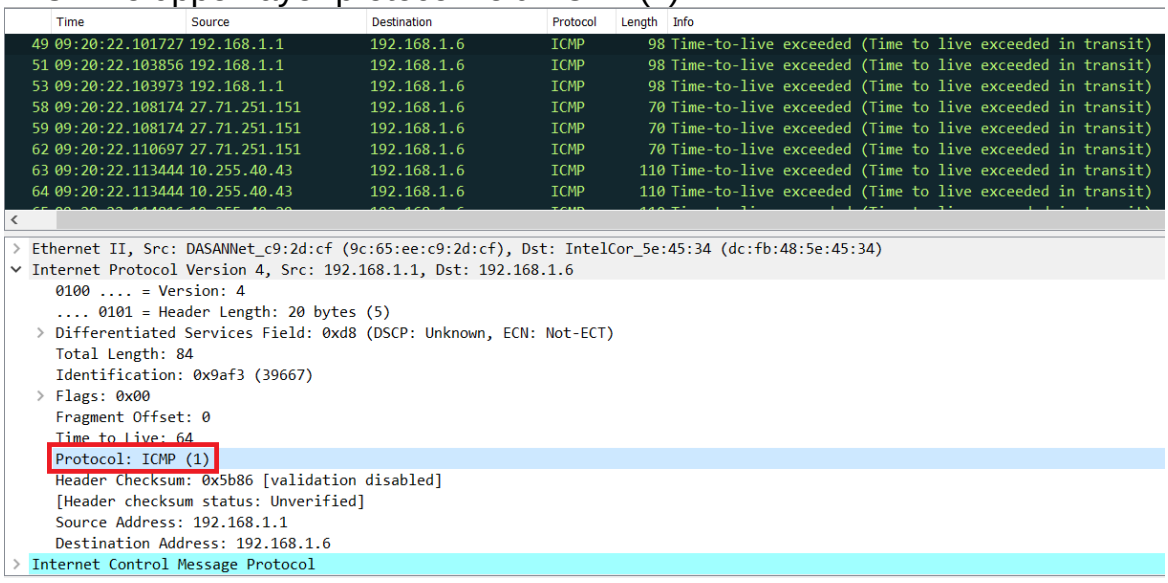
1. Select the first ICMP Echo Request message sent by your computer, and expand the Internet Protocol part of the packet in the packet details window. What is the IP address of your computer?
   Ans: The IP address of my computer: 192.168.1.1

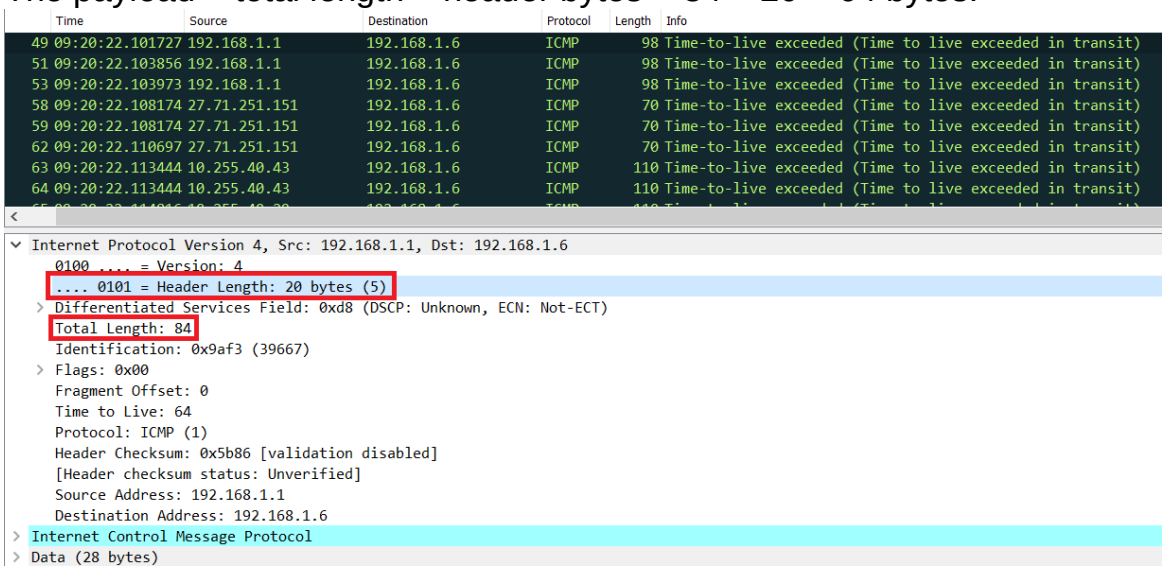


2. Within the IP packet header, what is the value in the upper layer protocol field?
   Ans: The upper layer protocol field: ICMP(1)

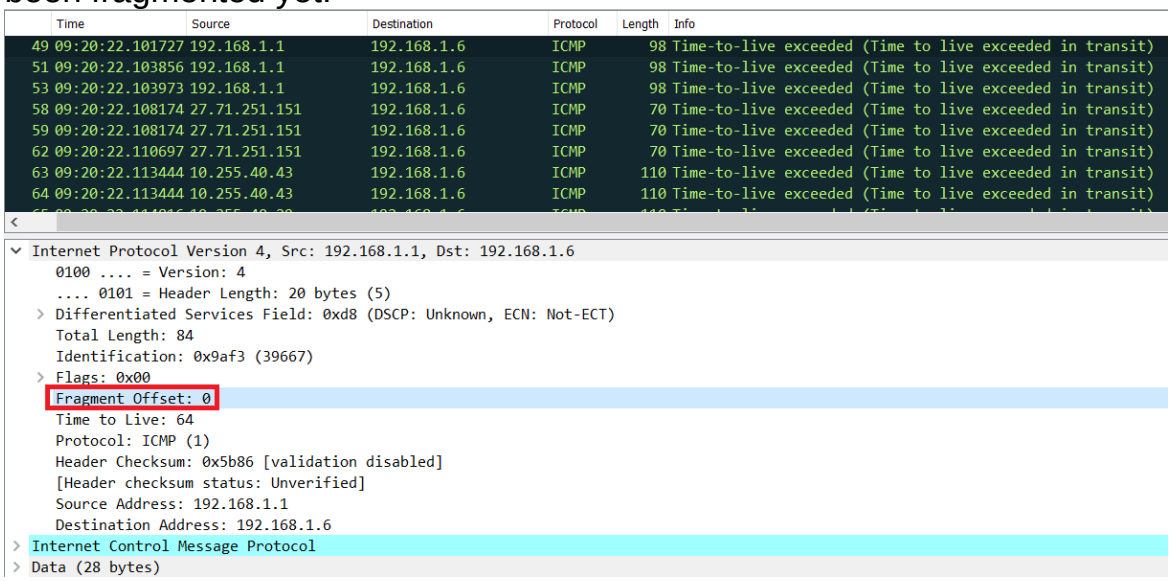


3. How many bytes are in the IP header? How many bytes are in the payload of the IP datagram? Explain how you determined the number of payload bytes.
   Ans:

The IP header: 20 bytes.
The payload = total length – header bytes = 84 – 20 = 64 bytes.



4. Has this IP datagram been fragmented? Explain how you determined whether or not the datagram has been fragmented.
   Ans: As you can see the fragment offset = 0, so this IP datagram has not been fragmented yet.



5. Which fields in the IP datagram always change from one datagram to the next within this series of ICMP messages sent by your computer?
   Ans: Identification, Time to live and Header checksum always change from one datagram to the next.

6. Which fields stay constant? Which of the fields must stay constant? Which fields must change? Why?
   Ans:
   The fields that stay constant:
   - Version (since we are using IPv4 for all packets)

- header length (since these are ICMP packets)
- source IP (since we are sending from the same source)
- destination IP (since we are sending to the same destination)
- Differentiated Services (since all packets are ICMP they use the same type of Service class)
- Upper Layer Protocol (sinice these are ICMP packets)

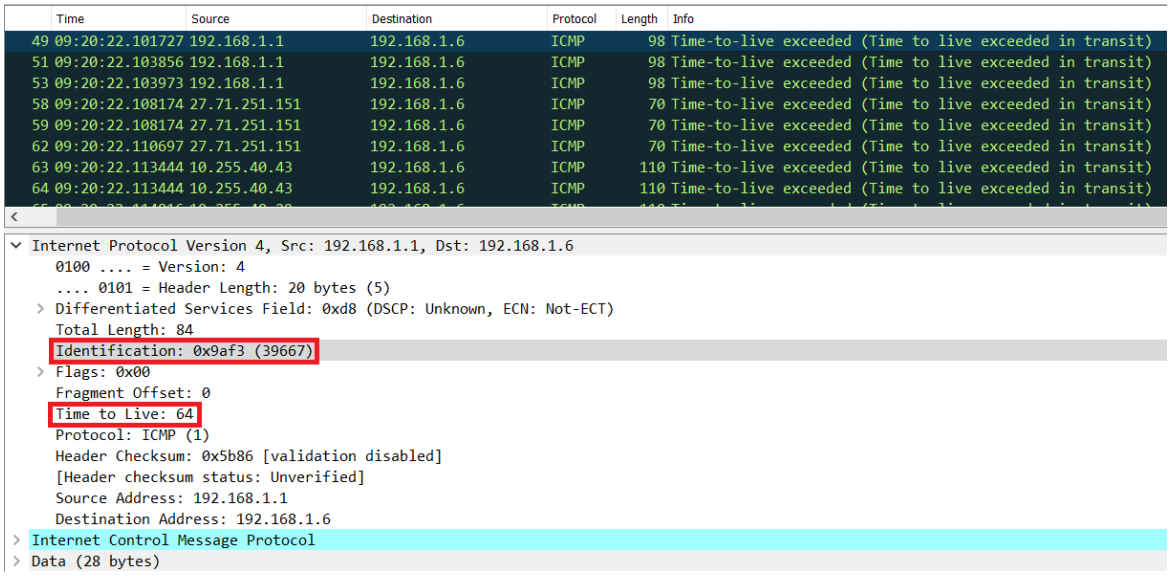
The fields that must stay constant is the same to the fields that stay constant.

The fields that must change:

- Identification (IP packets must have different IDs)
- Time to live (traceroute increments each subsequent packet)
- Header checksum (since header changes, so the checksum must change)

7. Describe the pattern you see in the values in the Identification field of the IP datagram
   Ans: The pattern I see in the values in the Identification field is that the IP header Identification fields increment with each ICMP request.

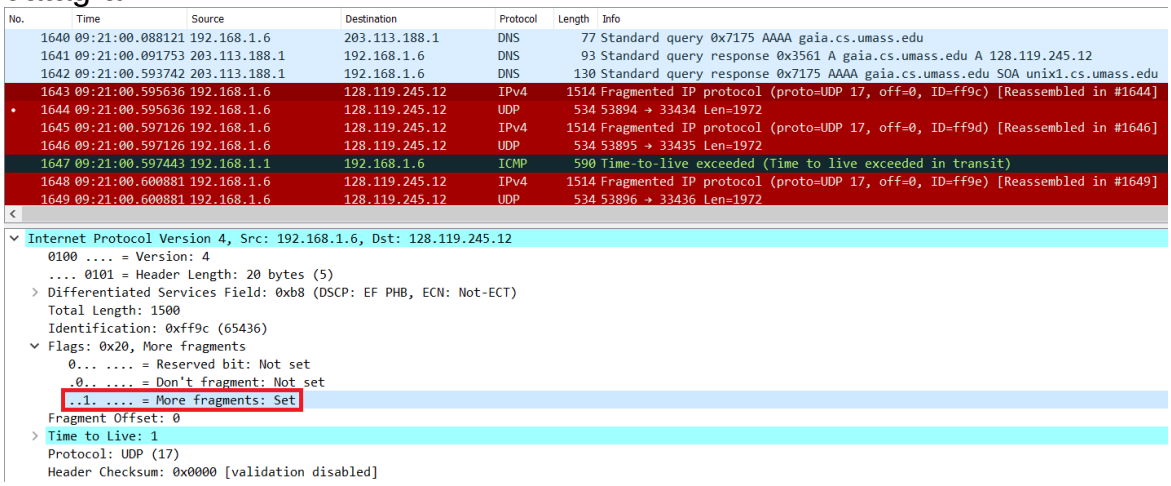
8. What is the value in the Identification field and the TTL field?
   Ans:
   The Identification field: 39667
   The TTL field: 64



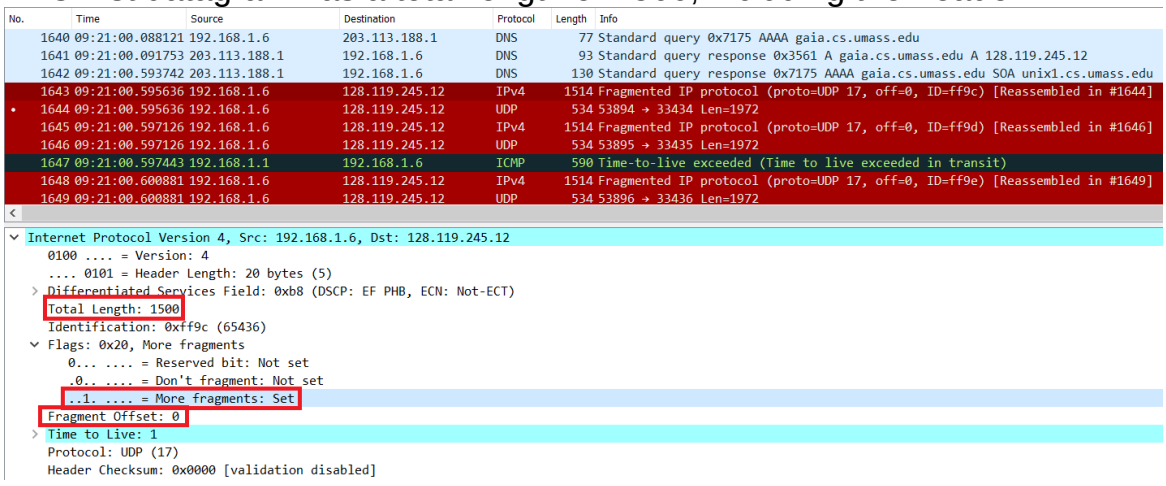
9. Do these values remain unchanged for all of the ICMP TTL-exceeded replies sent to your computer by the nearest (first hop) router? Why?
   Ans:
   The Identification field changes for all the ICMP TTL-exceeded replies because the Identification field is a unique value. When two or more IP datagrams have the same identification value, then it means that these IP datagrams are fragments of a single large IP datagram.

The TTL field remains unchanged because the TTL for the first hop router is always the same.

10. Find the first ICMP Echo Request message that was sent by your computer after you changed the Packet Size in pingplotter to be 2000. Has that message been fragmented across more than one IP datagram?
Ans: Yes, the message has been fragmented across more than one IP datagram.

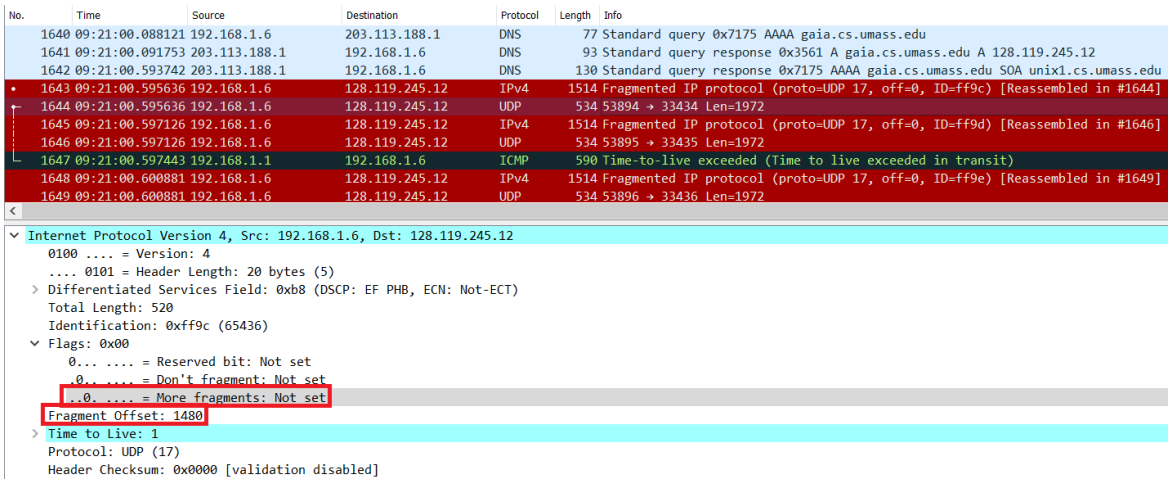


11. What information in the IP header indicates that the datagram been fragmented? What information in the IP header indicates whether this is the first fragment versus a latter fragment? How long is this IP datagram?
Ans:
The Flags bit for more fragments is set, indicating that the datagram has been fragmented.
Since the fragment offset is 0, we know that this is the first fragment.
This first datagram has a total length of 1500, including the header.



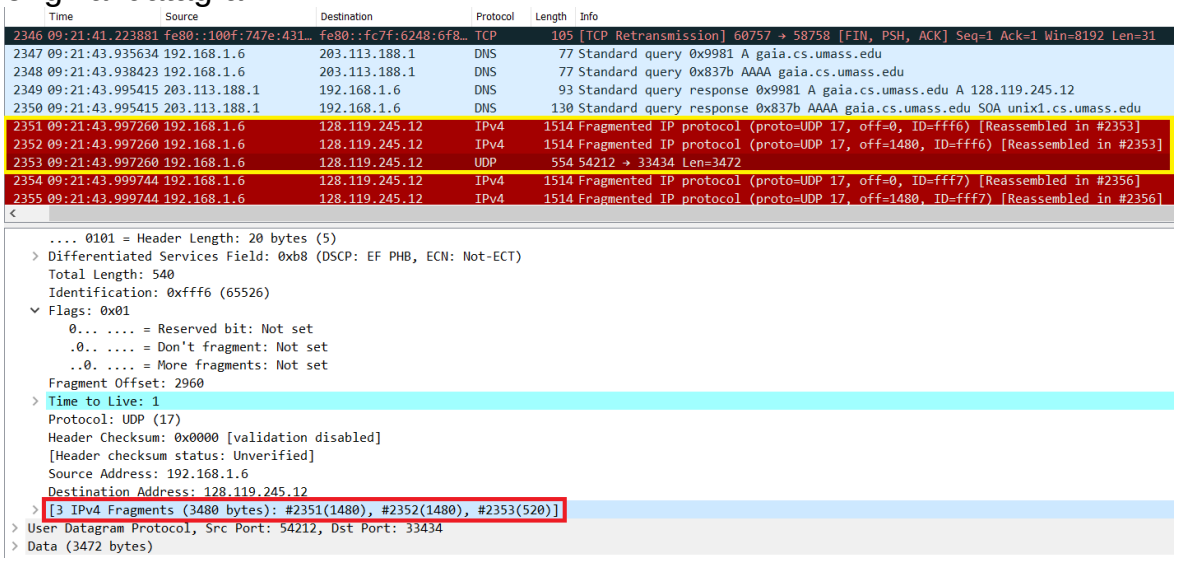
12. What information in the IP header indicates that this is not the first datagram fragment? Are the more fragments? How can you tell?
Ans:
Because the Fragment Offset = 1480, it indicates that this is the last datagram fragment.

You can see that the More Fragments is not set, so there are no more fragments in this datagram.



13. What fields change in the IP header between the first and second fragment?
Ans: The IP header fields that changed between the fragments are: total length, flags, fragment offset. You can see two screenshots above to see the differences.

14. How many fragments were created from the original datagram?
Ans:
The first ICMP Echo Request message has 3 fragments cretaed from the original datagram.



15. What fields change in the IP header among the fragments?
Ans:
Between the first and the second fragment, the Fragment Offset changes.

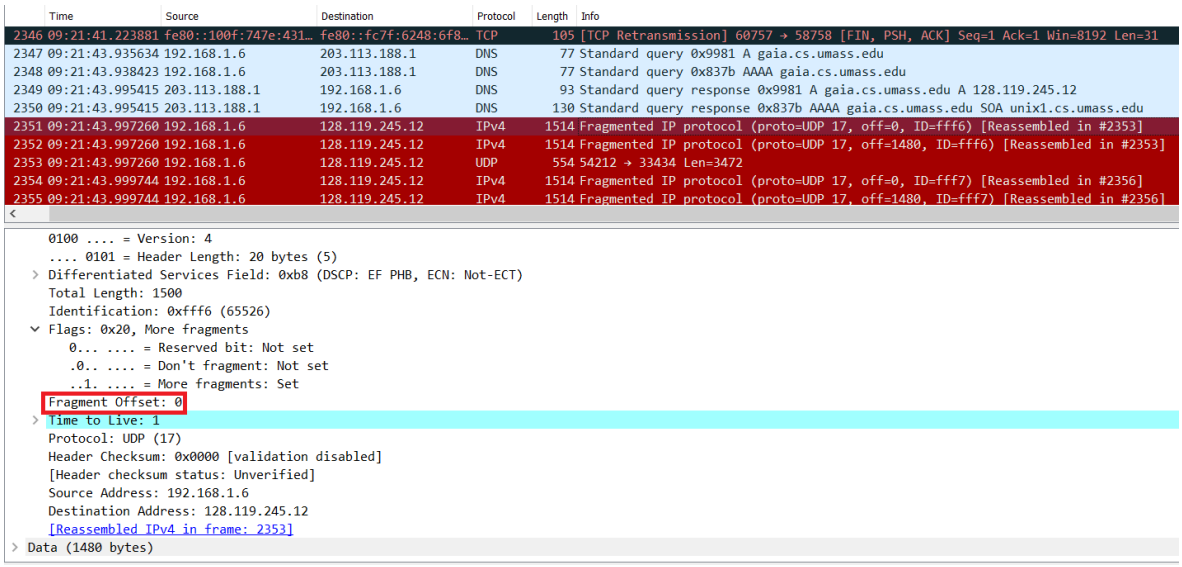


Figure 1: First fragment

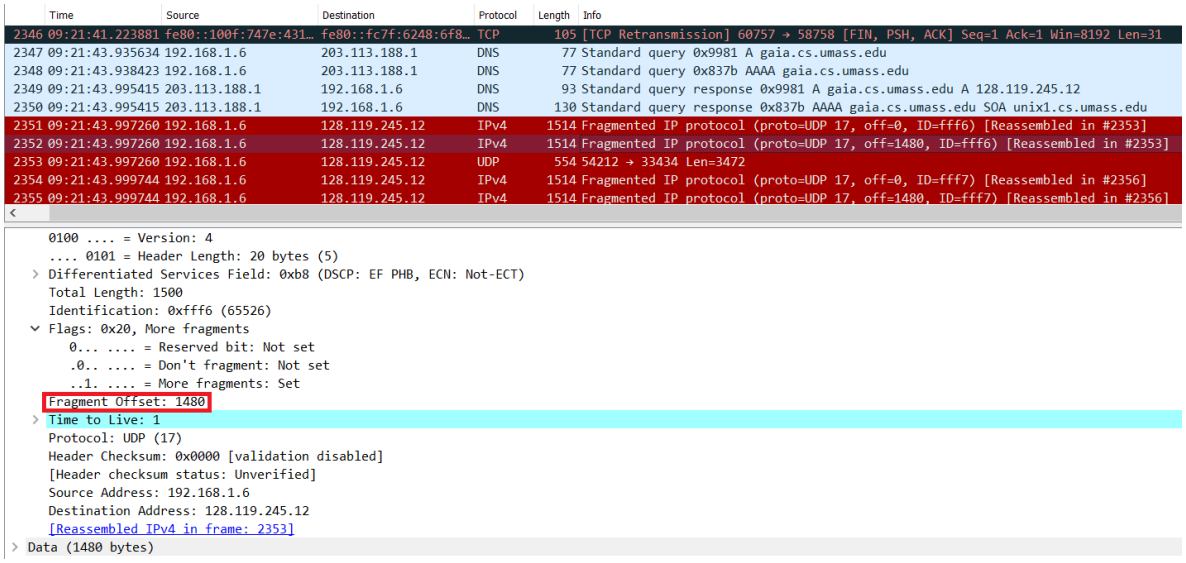
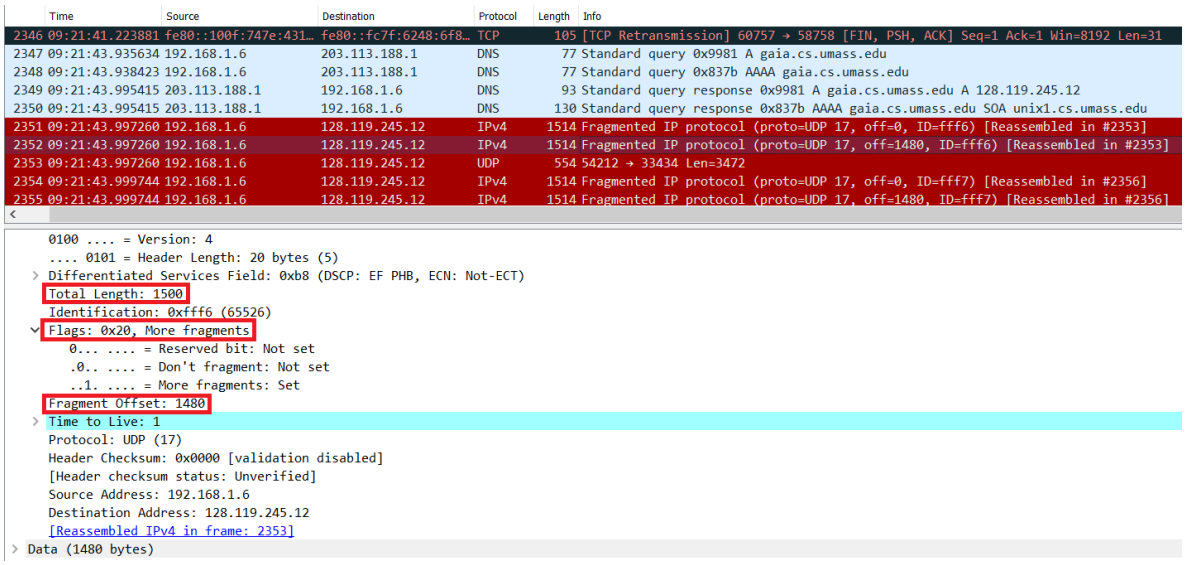


Figure 2: Second fragment

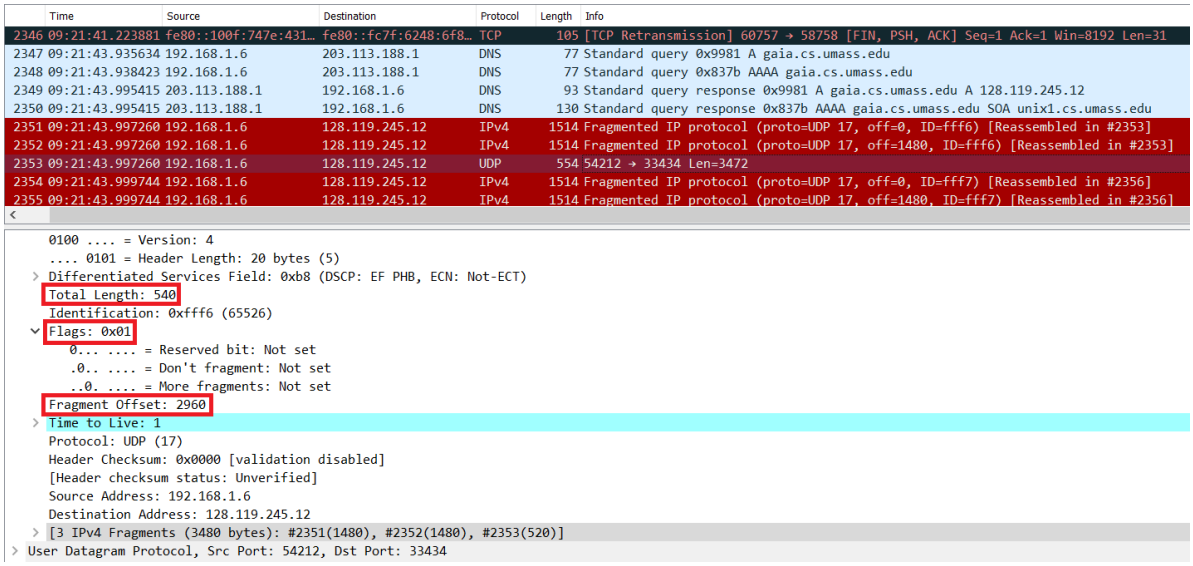
Between the second and the third fragment, the Total Length, the Flags and the Fragment Offset change.



No.	Time	Source	Destination	Protocol	Length	Info
2346	09:21:41.223881	fe80::100f:747e:431…	fe80::fc7f:6248:6f8…	TCP	105	[TCP Retransmission] 60757 → 58758 [FIN, PSH, ACK] Seq=1 Ack=1 Win=8192 Len=31
2347	09:21:43.935634	192.168.1.6	203.113.188.1	DNS	77	Standard query 0x9981 A gaia.cs.umass.edu
2348	09:21:43.938423	192.168.1.6	203.113.188.1	DNS	77	Standard query 0x837b AAAA gaia.cs.umass.edu
2349	09:21:43.995415	203.113.188.1	192.168.1.6	DNS	93	Standard query response 0x9981 A gaia.cs.umass.edu A 128.119.245.12
2350	09:21:43.995415	203.113.188.1	192.168.1.6	DNS	130	Standard query response 0x837b AAAA gaia.cs.umass.edu SOA unix1.cs.umass.edu
2351	09:21:43.997260	192.168.1.6	128.119.245.12	IPv4	1514	Fragmented IP protocol (proto=UDP 17, off=0, ID=fff6) [Reassembled in #2353]
2352	09:21:43.997260	192.168.1.6	128.119.245.12	IPv4	1514	Fragmented IP protocol (proto=UDP 17, off=1480, ID=fff6) [Reassembled in #2353]
2353	09:21:43.997260	192.168.1.6	128.119.245.12	UDP	554	54212 → 33434 Len=3472
2354	09:21:43.999744	192.168.1.6	128.119.245.12	IPv4	1514	Fragmented IP protocol (proto=UDP 17, off=0, ID=fff7) [Reassembled in #2356]
2355	09:21:43.999744	192.168.1.6	128.119.245.12	IPv4	1514	Fragmented IP protocol (proto=UDP 17, off=1480, ID=fff7) [Reassembled in #2356]

```
    0100 .... = Version: 4
    .... 0101 = Header Length: 20 bytes (5)
  > Differentiated Services Field: 0xb8 (DSCP: EF PHB, ECN: Not-ECT)
    Total Length: 1500
    Identification: 0xfff6 (65526)
  v Flags: 0x20, More fragments
      0... .... = Reserved bit: Not set
      .0.. .... = Don't fragment: Not set
      ..1. .... = More fragments: Set
    Fragment Offset: 1480
  > Time to Live: 1
    Protocol: UDP (17)
    Header Checksum: 0x0000 [validation disabled]
    [Header checksum status: Unverified]
    Source Address: 192.168.1.6
    Destination Address: 128.119.245.12
    [Reassembled IPv4 in frame: 2353]
> Data (1480 bytes)
```

Figure 3: Second fragment



No.	Time	Source	Destination	Protocol	Length	Info
2346	09:21:41.223881	fe80::100f:747e:431…	fe80::fc7f:6248:6f8…	TCP	105	[TCP Retransmission] 60757 → 58758 [FIN, PSH, ACK] Seq=1 Ack=1 Win=8192 Len=31
2347	09:21:43.935634	192.168.1.6	203.113.188.1	DNS	77	Standard query 0x9981 A gaia.cs.umass.edu
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2349	09:21:43.995415	203.113.188.1	192.168.1.6	DNS	93	Standard query response 0x9981 A gaia.cs.umass.edu A 128.119.245.12
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2351	09:21:43.997260	192.168.1.6	128.119.245.12	IPv4	1514	Fragmented IP protocol (proto=UDP 17, off=0, ID=fff6) [Reassembled in #2353]
2352	09:21:43.997260	192.168.1.6	128.119.245.12	IPv4	1514	Fragmented IP protocol (proto=UDP 17, off=1480, ID=fff6) [Reassembled in #2353]
2353	09:21:43.997260	192.168.1.6	128.119.245.12	UDP	554	54212 → 33434 Len=3472
2354	09:21:43.999744	192.168.1.6	128.119.245.12	IPv4	1514	Fragmented IP protocol (proto=UDP 17, off=0, ID=fff7) [Reassembled in #2356]
2355	09:21:43.999744	192.168.1.6	128.119.245.12	IPv4	1514	Fragmented IP protocol (proto=UDP 17, off=1480, ID=fff7) [Reassembled in #2356]

```
    0100 .... = Version: 4
    .... 0101 = Header Length: 20 bytes (5)
  > Differentiated Services Field: 0xb8 (DSCP: EF PHB, ECN: Not-ECT)
    Total Length: 540
    Identification: 0xfff6 (65526)
  v Flags: 0x01
      0... .... = Reserved bit: Not set
      .0.. .... = Don't fragment: Not set
      ..0. .... = More fragments: Not set
    Fragment Offset: 2960
  > Time to Live: 1
    Protocol: UDP (17)
    Header Checksum: 0x0000 [validation disabled]
    [Header checksum status: Unverified]
    Source Address: 192.168.1.6
    Destination Address: 128.119.245.12
  > [3 IPv4 Fragments (3480 bytes): #2351(1480), #2352(1480), #2353(520)]
> User Datagram Protocol, Src Port: 54212, Dst Port: 33434
```

Figure 4: Third fragment