CSE 3300 - Homework 4

Prof. Bing Wang

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Problem 1

1. 223.1.17.0/26
2. 223.1.17.64/26
3. 223.1.17.128/25

Problem 2

Dijkstra's Algorithm (Working)

Step	N' (visited)	D,p(y)	D,p(w)	D,p(v)	D,p(z)	D,p(t)	D,p(u)	D,p(s)
0	x	6,x	1,x	3,x	∞	∞	∞	∞
1	xw	6,x		2,w	∞	∞	4,w	∞
2	xwv	3,v			∞	11,v	3,v	∞
3	xwvy				17,y	7,y		∞
4	xwvyu				17,y	5,u		7,u
5	xwvyut				7,t			6,t
6	xwvyuts							
7	xwvyutsz							

Shortest Paths From Node x

Node	Shortest Path	Length
x	x	0
y	xwvy	3
w	xw	1
v	xwv	2
z	xwvutz	7
t	xwvut	5
u	xwvu	3
s	xwvuts	6

Problem 3

Node A Table

T = 1

	A	B	C
A	0	5	1
B	∞	∞	∞
C	∞	∞	∞

T = 2

	A	B	C
A	0	5	1
B	5	0	7
C	1	7	0

T = 3

	A	B	C
A	0	5	1
B	5	0	6
C	1	6	0

Node B Table

T = 1

	A	B	C
A	∞	∞	∞
B	5	0	7
C	∞	∞	∞

T = 2

	A	B	C
A	0	5	1
B	5	0	6
C	1	7	0

T = 3

	A	B	C

	A	B	C
A	0	5	1
B	5	0	6
C	1	6	0

Node C Table

T = 1

	A	B	C
A	∞	∞	∞
B	∞	∞	∞
C	1	7	0

T = 2

	A	B	C
A	0	5	1
B	5	0	7
C	1	6	0

T = 3

	A	B	C
A	0	5	1
B	5	0	6
C	1	6	0

Convergent Table (T=3)

	A	B	C
A	0	5	1
B	5	0	6
C	1	6	0

Problem 4

a) Maximum Throughput (Single Node)

- TDMA: $\frac{C}{N}$
- CSMA: C
- Slotted Aloha: C
- Token Passing: C (Assuming zero transmission time of token).

b) Aggregate Throughput (All Nodes)

- TDMA: C is achievable when all nodes are transmitting in all slots.
- CSMA: C is not achievable when there is a non-zero propagation delay between nodes. Maximum throughput is $\frac{1}{1+5P/d_{trans}} \cdot C$. Due to collisions.
- Slotted Aloha: Cannot acheive throughput of ***C***, maximum efficiency limited to $Np(1-p)^{N-1}$ of C due to collisions.
- Token Passing: C is achievable.

Problem 5

a) Network adapters have been added as red bars on each interface in the image below.

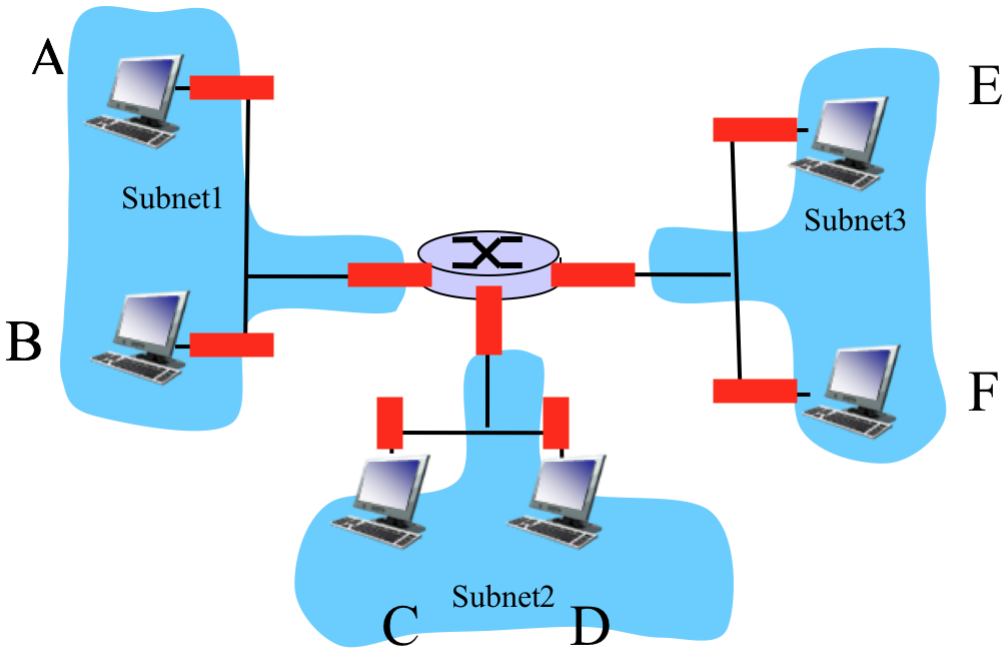


Fig. 3: Three LANs connected by a router.

b) In the image below, the network interfaces have been assigned IP addresses. Note: the adresses specified for subnet 3 are invalid, as each block of an IP address is made of 8 bits, which means a maximum value of 255 ($2^8 - 1$), less than the specified 333.

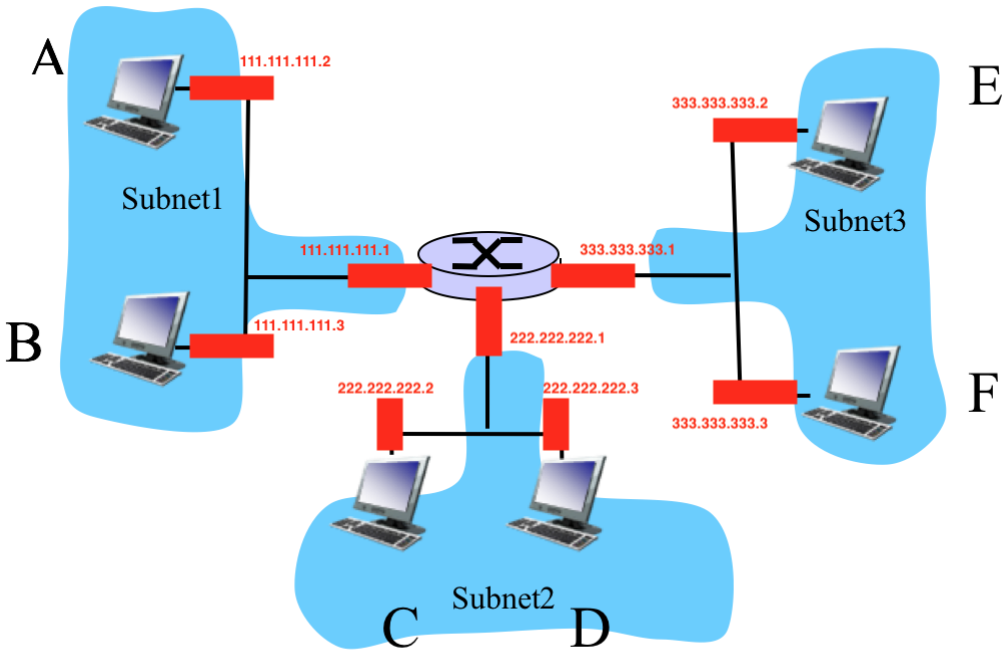


Fig. 3: Three LANs connected by a router.

c) In the image below, each network adapter has been assigned a unique MAC address.

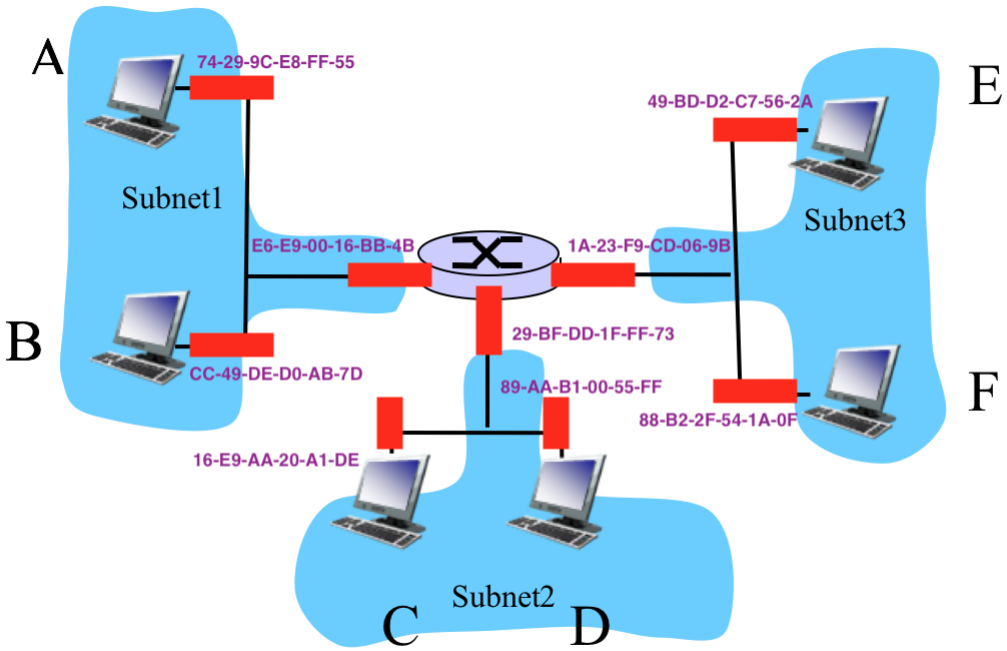


Fig. 3: Three LANs connected by a router.

d) If the ARP tables are up to date then the process for sending an IP datagram from A to F is as follows:

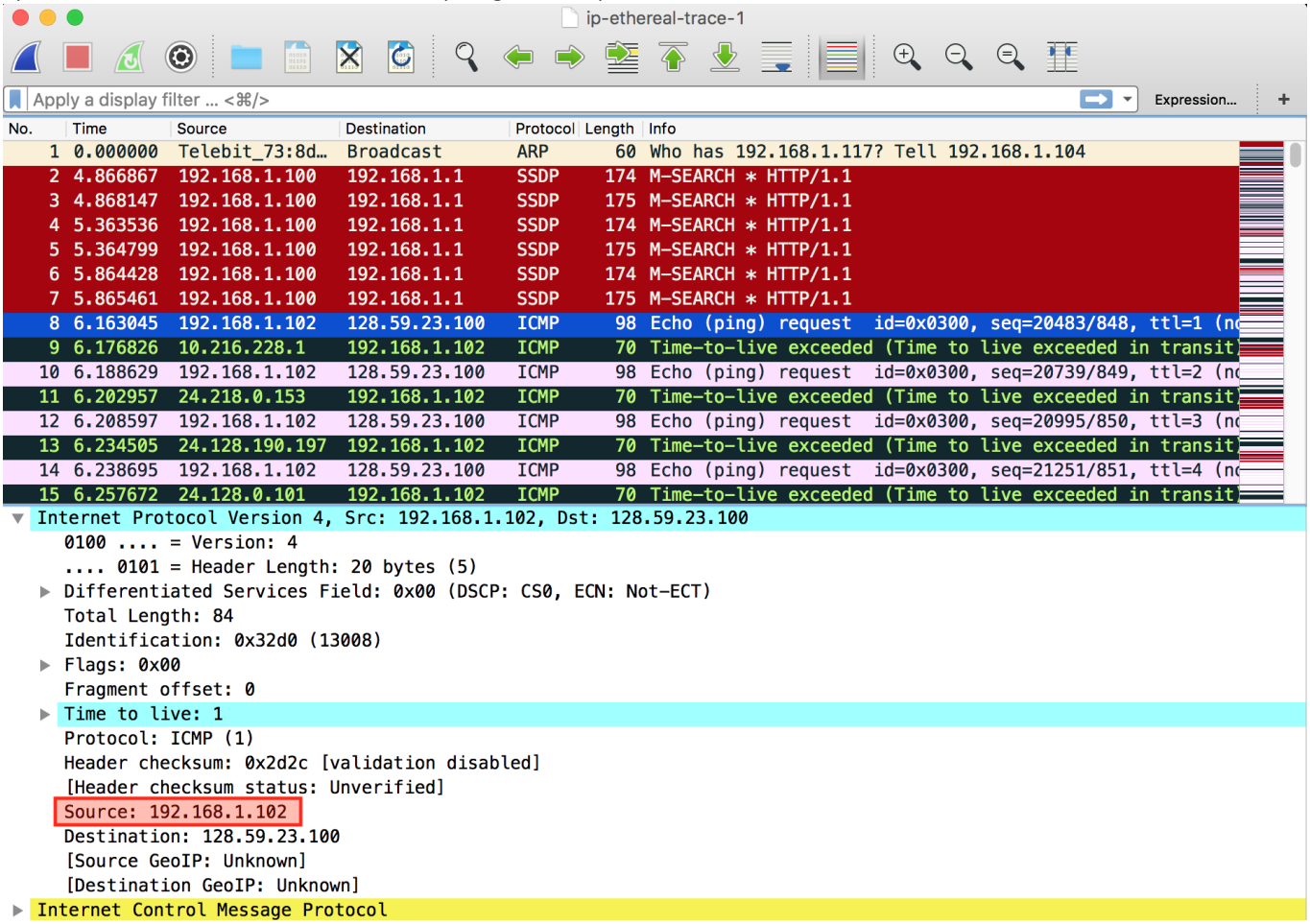
- A creates an IP datagram with IP source A, destination F.
- A creates a link-layer frame with the MAC address of the central router, containing the A-F IP datagram.
- The frame is sent from A to the central router, where the datagram is removed and passed up to the IP layer.
- The central router then takes the IP datagram and includes it as the payload in a new link-layer frame with F's MAC address as the destination (and forwards it to host F).
- When the frame reaches host F, the link-layer frame is stripped off and the datagram is passed to the IP layer.

e) If the ARP tables in the sending host (A) are empty, it will need to conduct additional steps in order to route the IP datagram to host F:

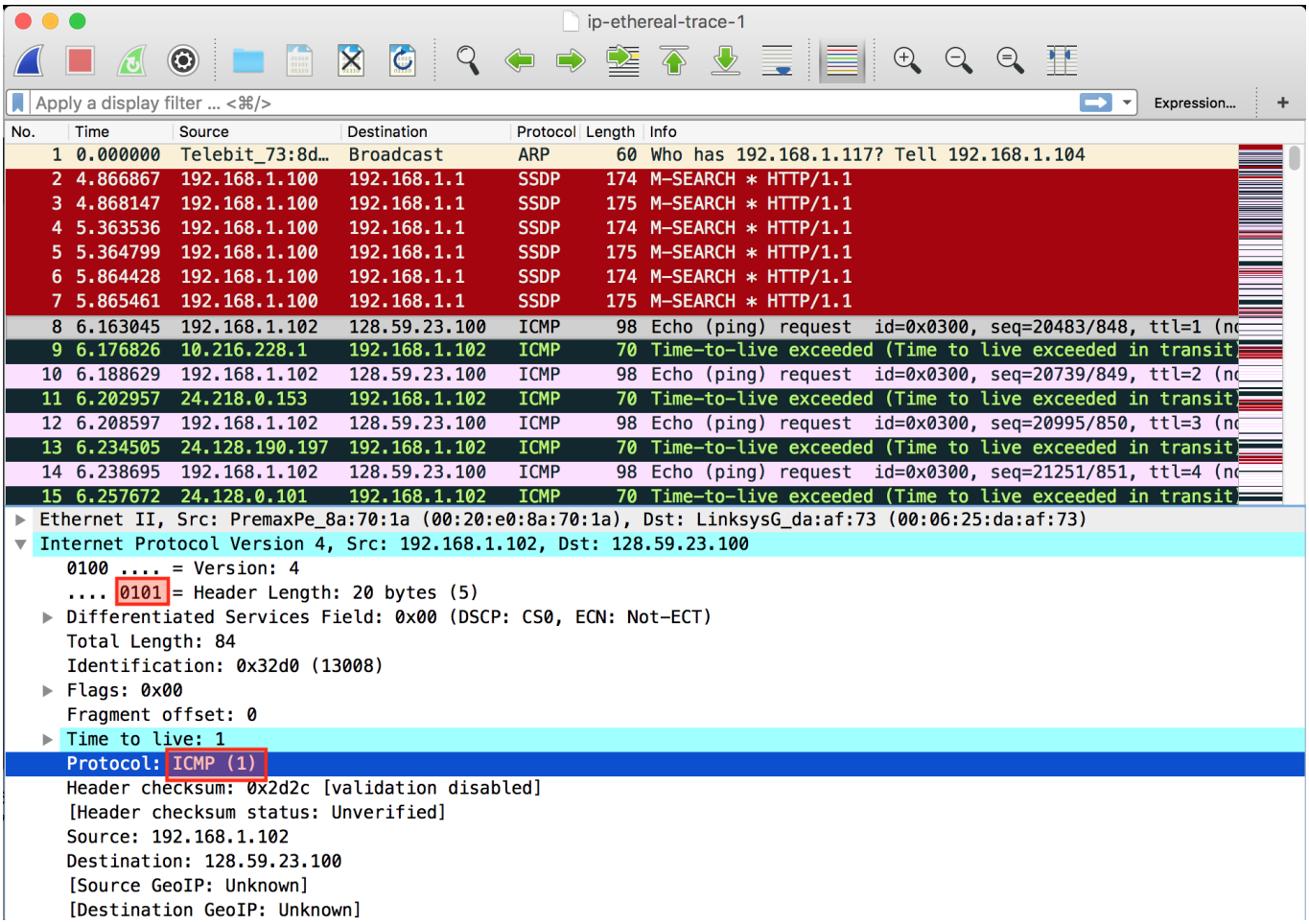
- A broadcasts an ARP query containing B's IP address to all nodes in the LAN.
- It will receive a response from the central router (which has a cached copy of the IP-MAC mapping for host F - if DHCP is being used F gets its IP assigned from the central router) with the MAC for F.
- Then the process will in d (above) will start and continue as described.

Problem 6 - Wireshark IP Lab

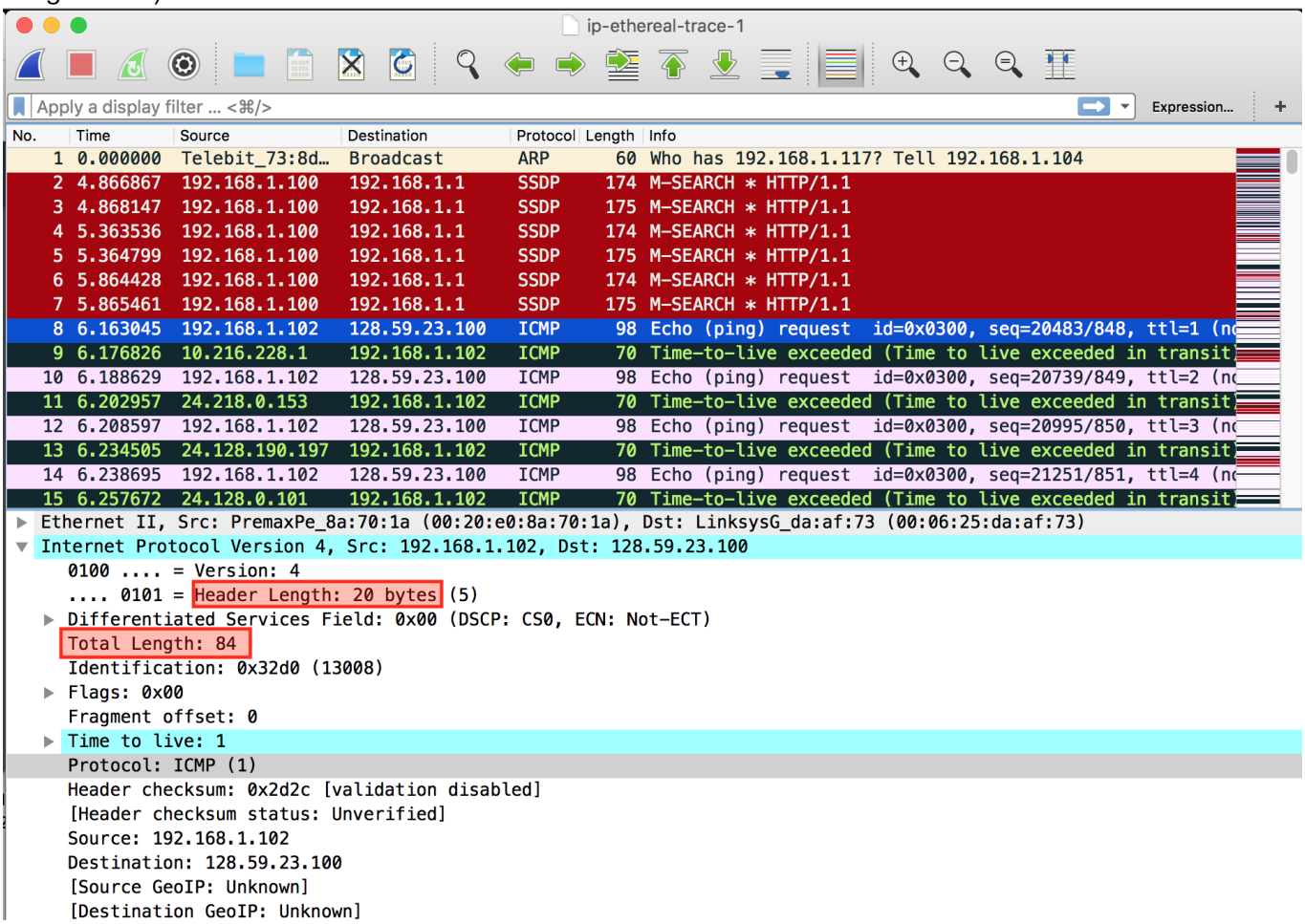
1) The source IP was 192.168.1.102 (image below).



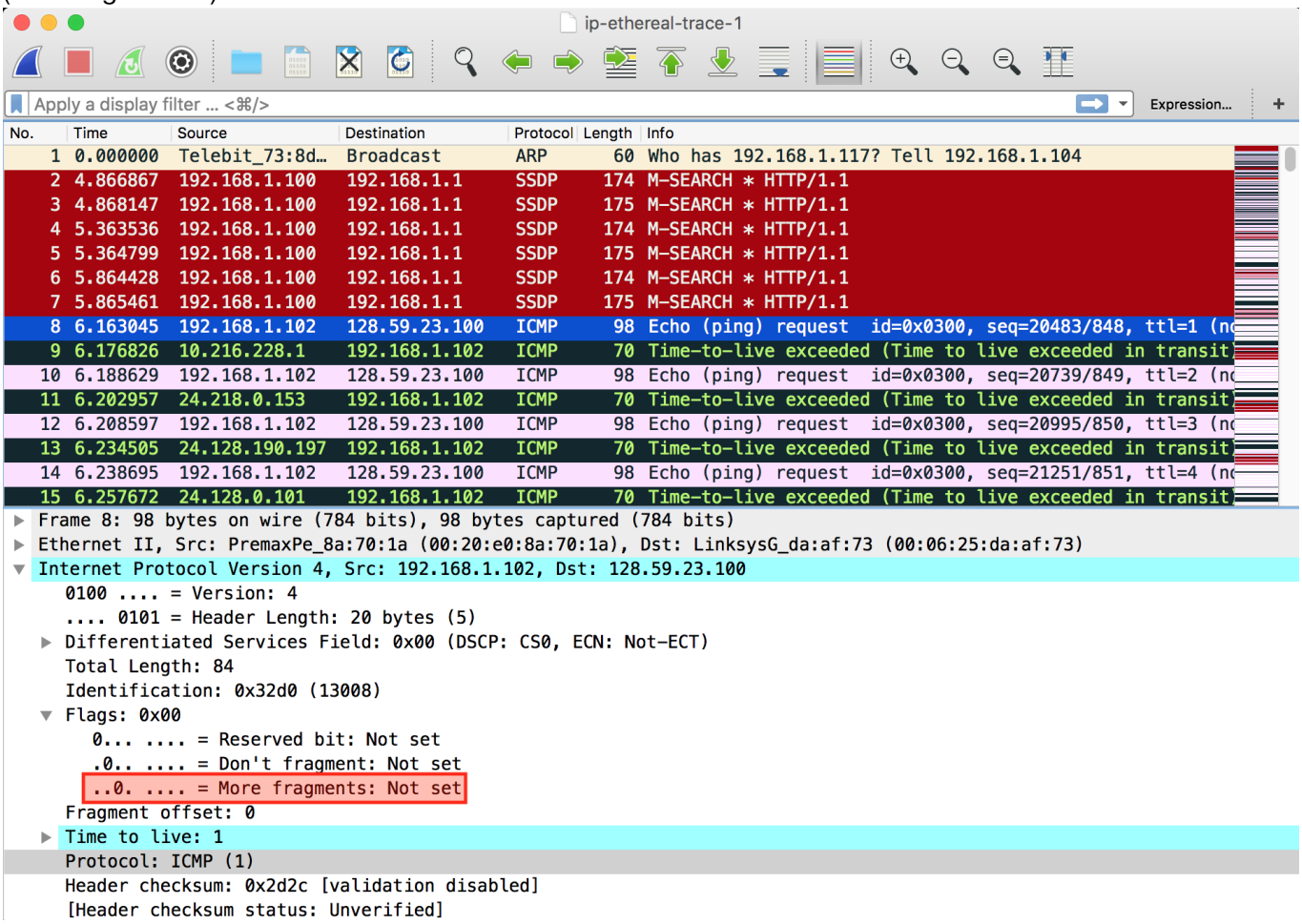
2) The value in the upper layer protocol field is 0x01 (the code for ICMP - image below).



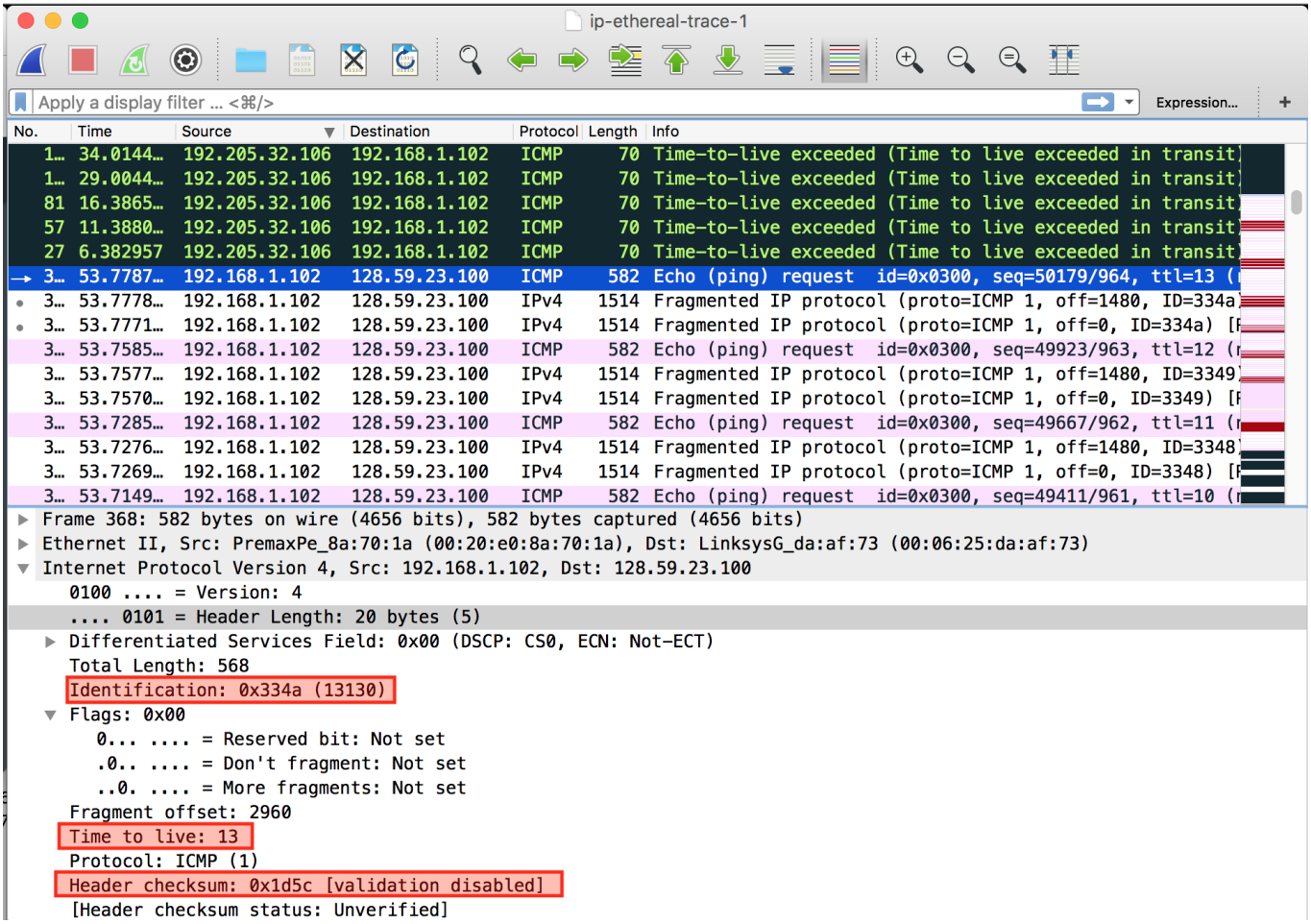
3) The header length was 20 bytes, the payload is the total length minus the header (84-20), 64 bytes (see image below).



4) The IP datagram has not been fragmented, this is evidenced by the "More fragments" bit not being set (see image below).



5) Between subsequent packets, the Identification, Header Checksum and Time To Live (TTL) always change.

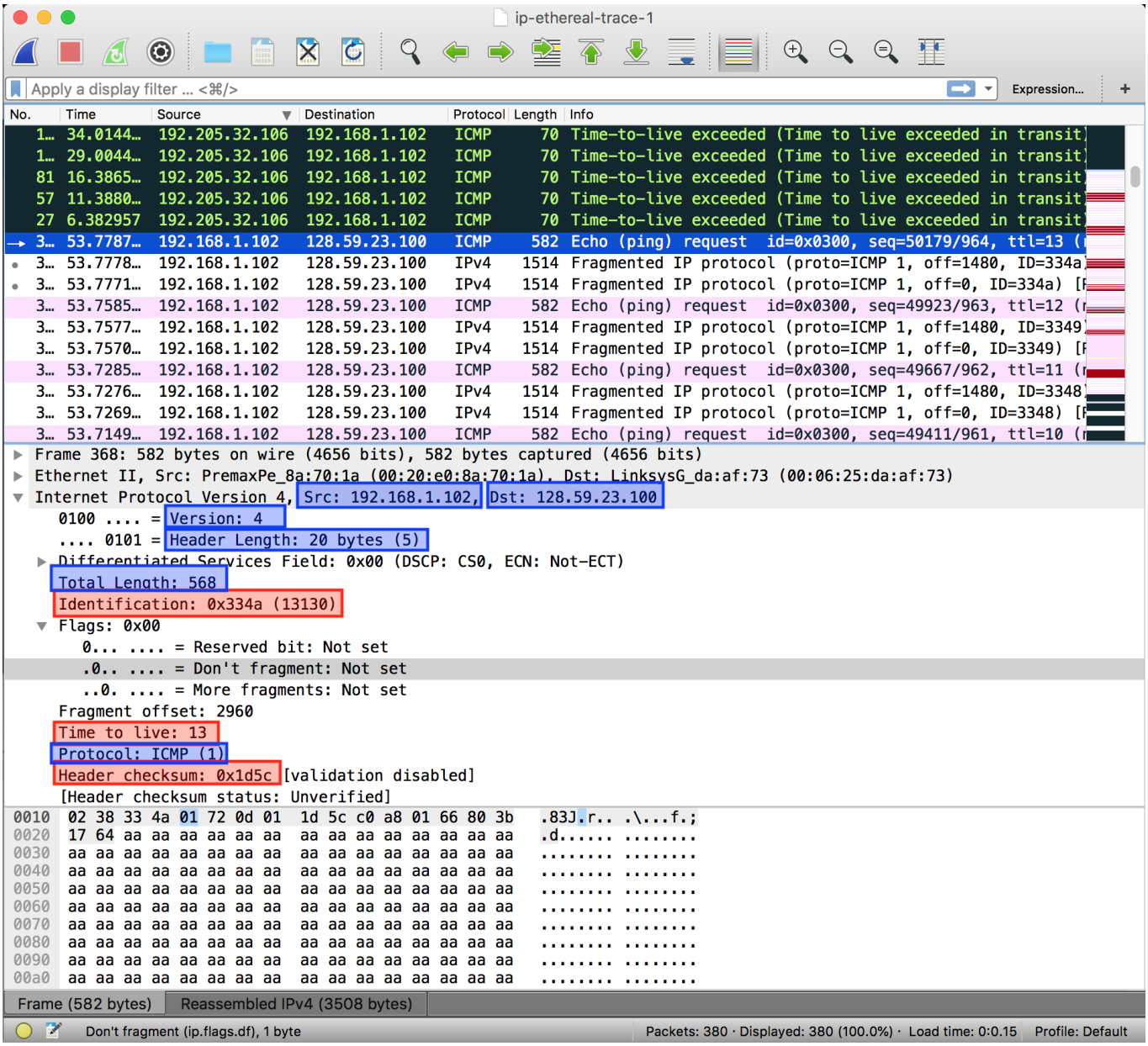


6) The following fields all (must) stay contstant (blue) between all datagrams:

- IP Version: the IP is always version 4.
- Header Length: the header itself does not change.
- Destination IP: the destination is always the same (though not all packets get to it - by design).
- Source IP: the source never changes, every packet is sent from the same requesting machine.
- Upper Layer Protocol (ICMP): every datagram is an ICMP request.

The fields that must change between datagrams (red) are:

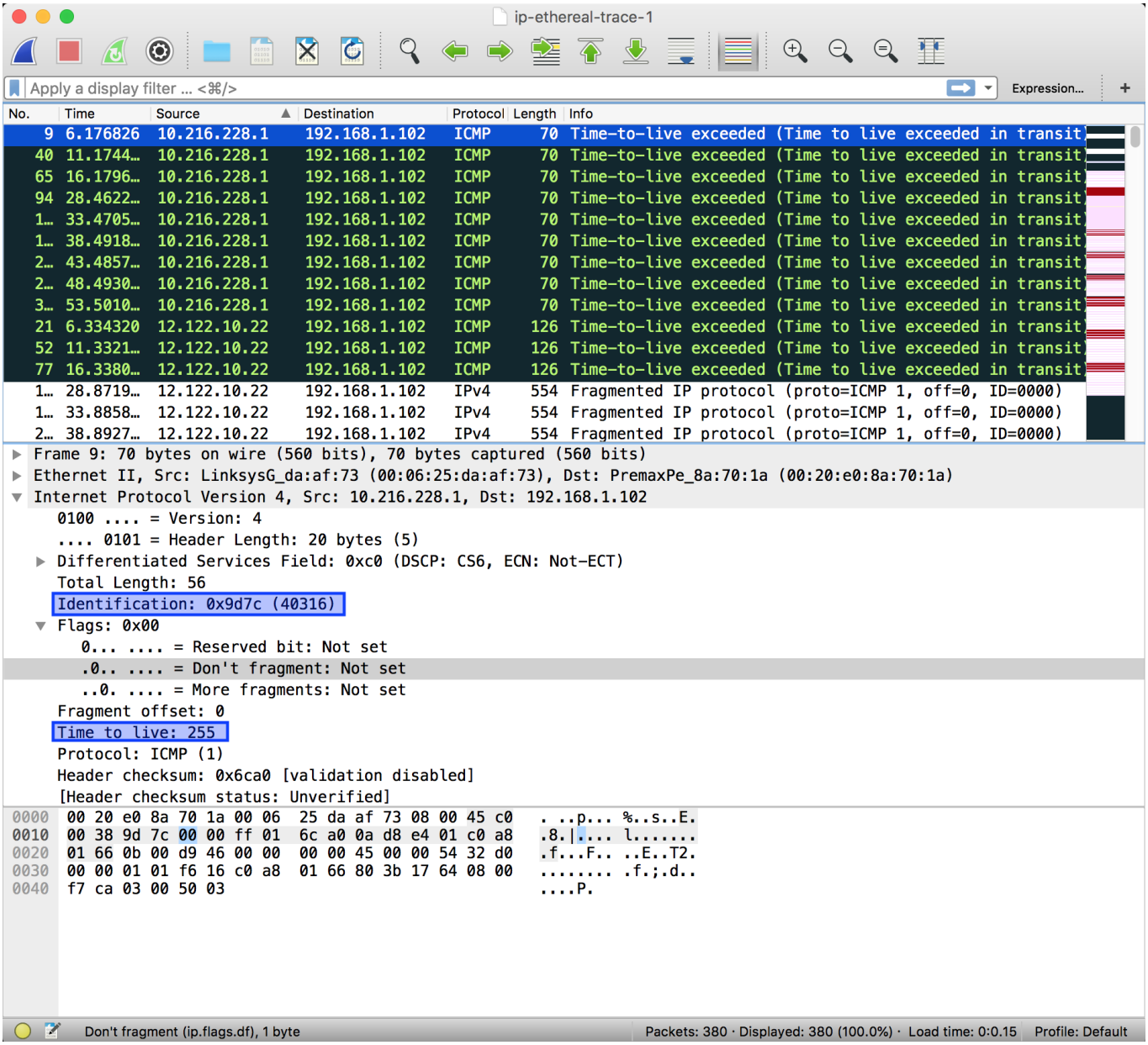
- ID
- Header Checksum
- TTL



7) With each ICMP echo request, the IP datagram Identification field increments by one in hexadecimal (two examples are included below).

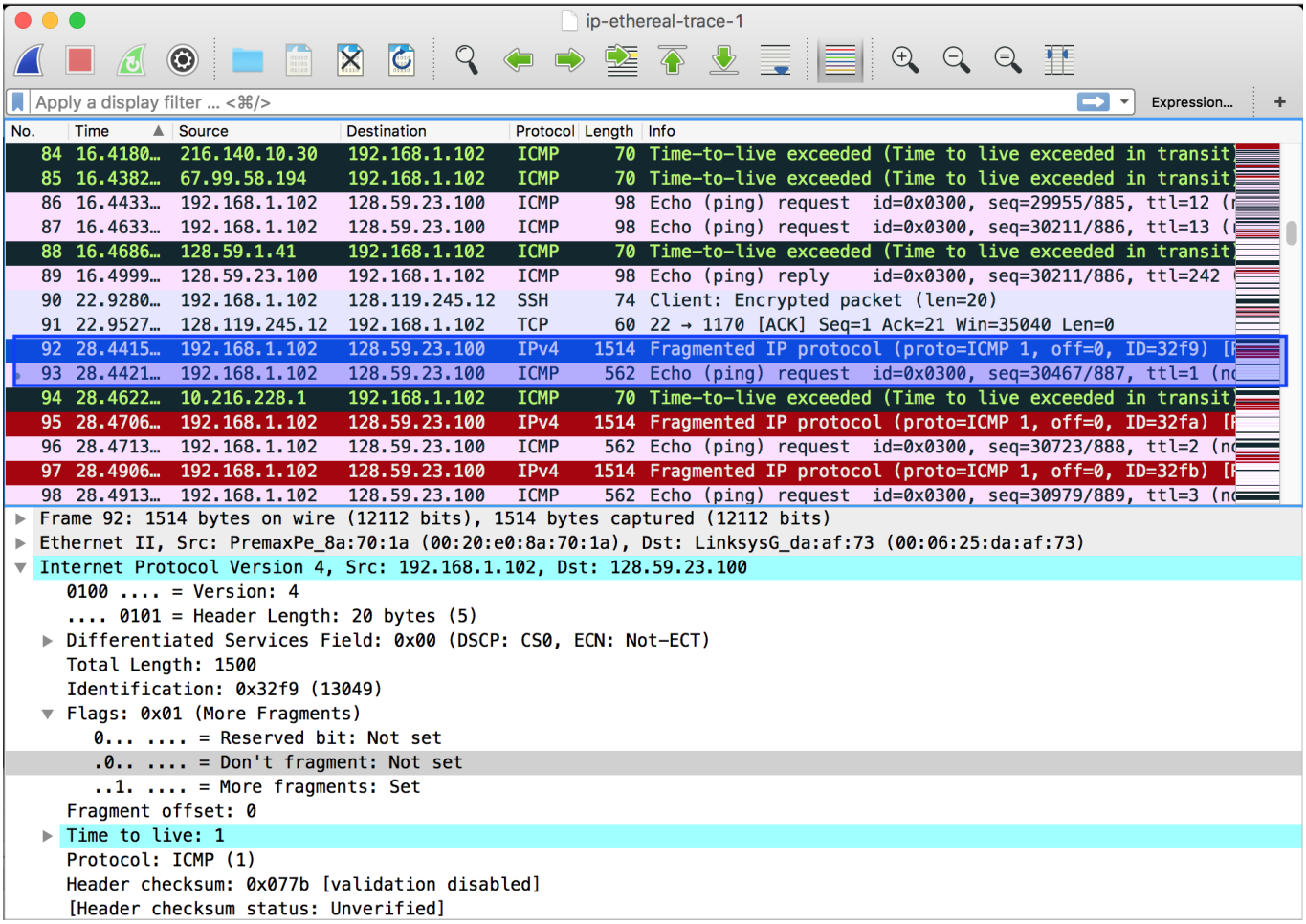
```
Identification: 0x3349 (13129)

Identification: 0x334a (13130)
```

8) The value in the ID field is always different (by nature, e.g. 0x9d7c = 40316) and the TTL value is always 255 (see image below).

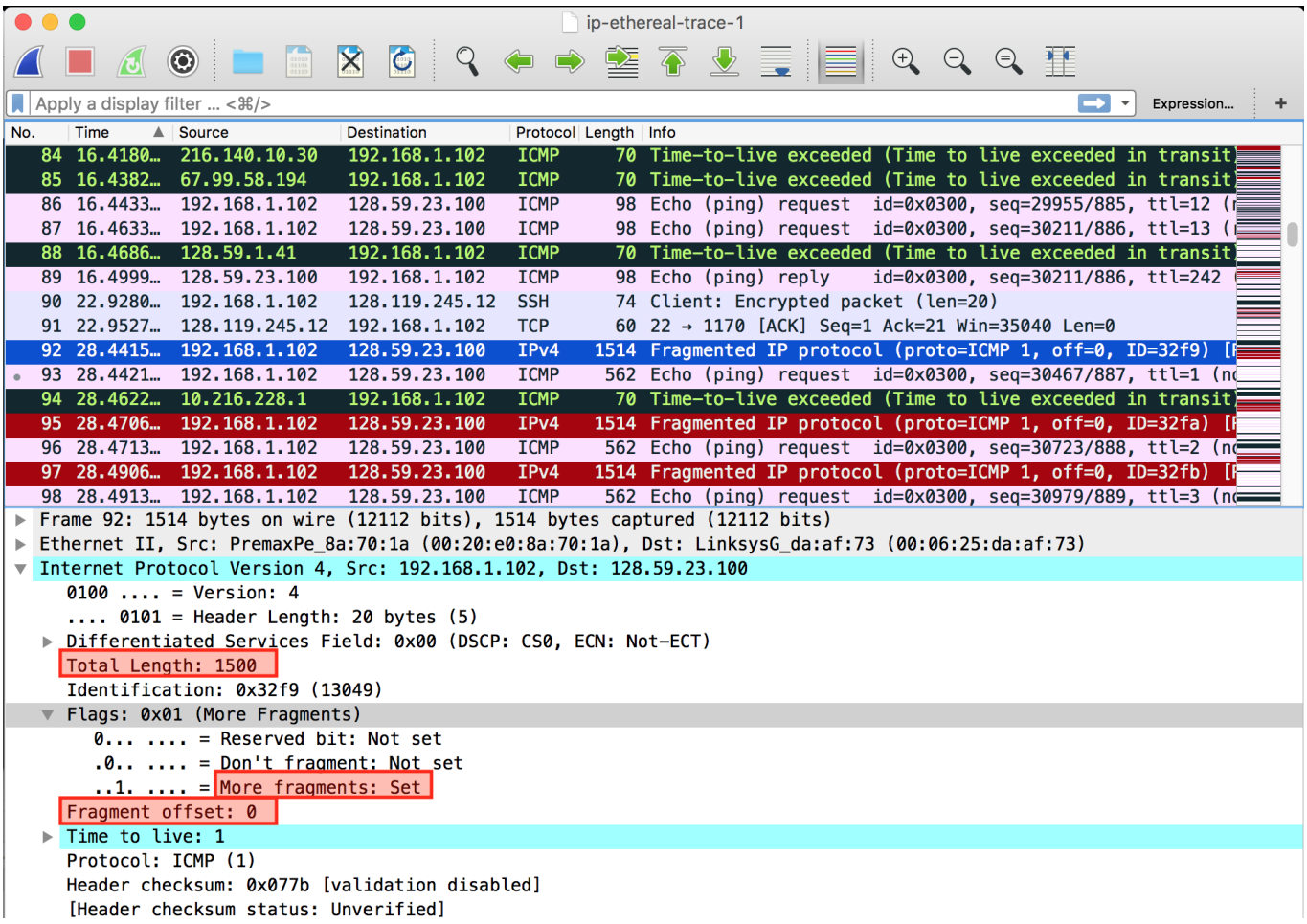


9) The TTL always stays the same for the nearest hop router, because the number of hops to it is always the same. The identification value is always different because it uniquely identifies the response (the same ID for two datagrams indicates that they are both fragments of the same message).

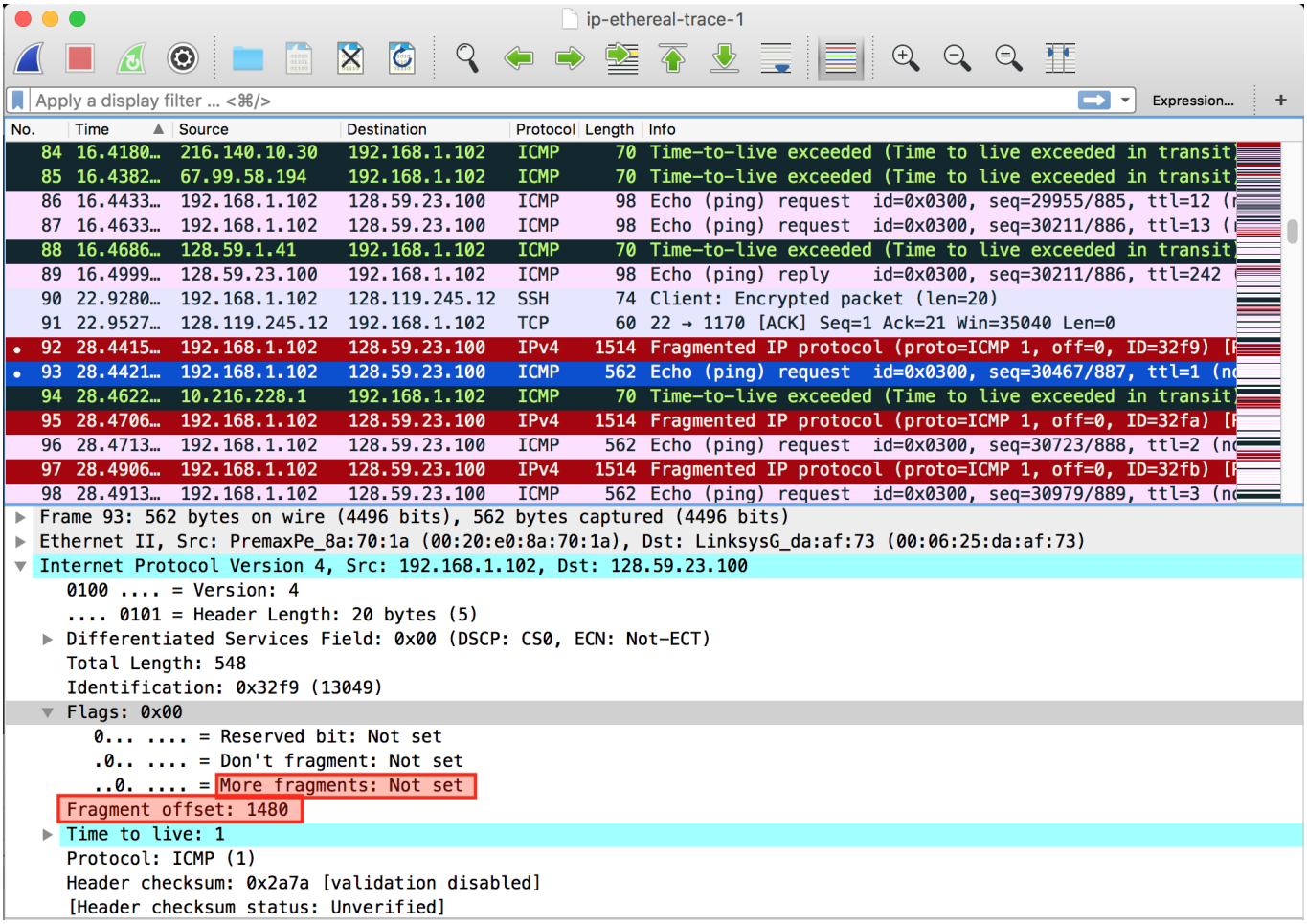
10) Yes, the message has been fragmented across two IP datagrams (see image below).



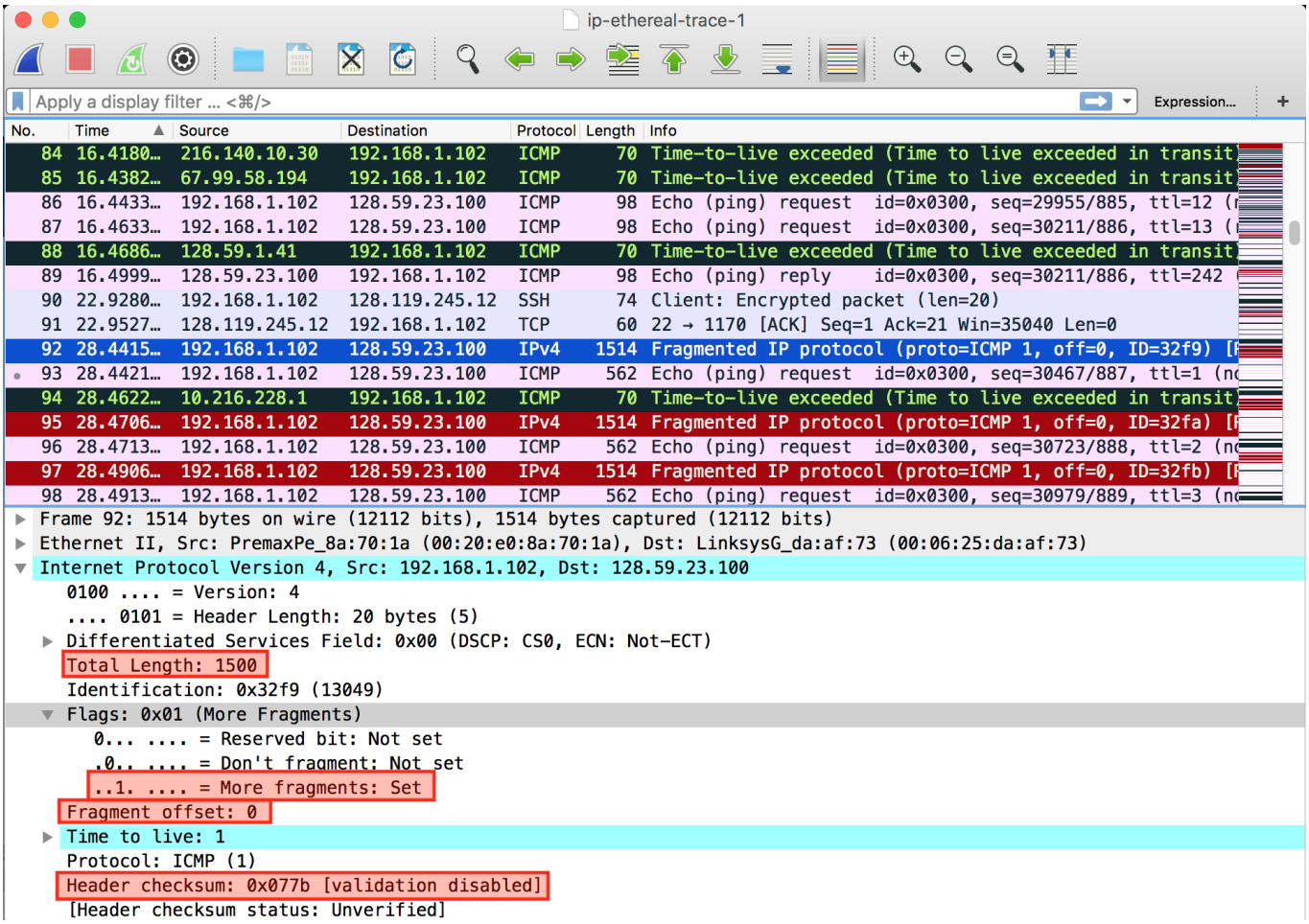
11) The fact that the 'More Fragments' bit has been set signifies that it has been fragmented. The fact that this is the first fragment is signified by the fact that the fragment offset is 0. This IP datagram is 1500 bytes in length (see image below).

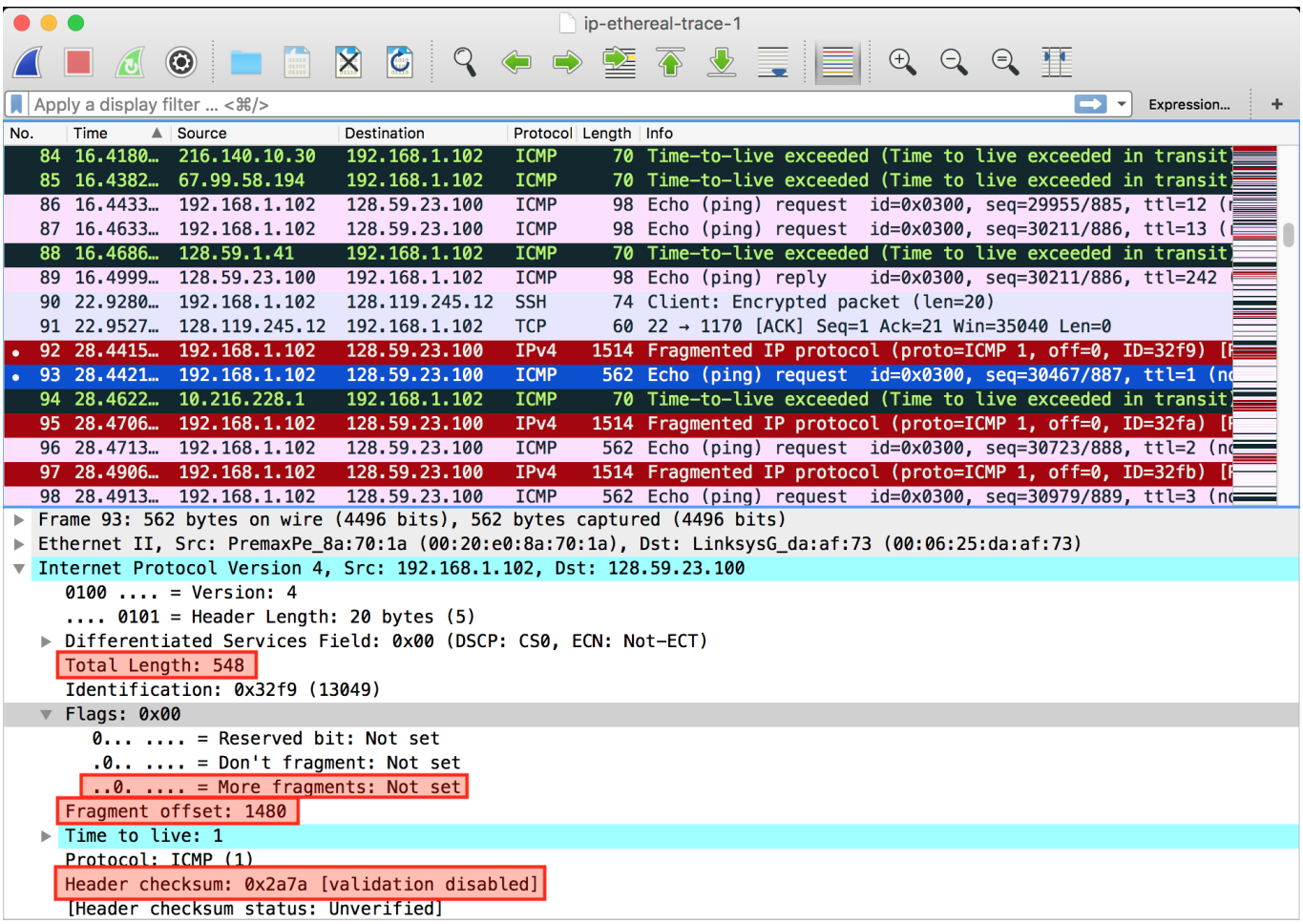


12) The fact there is a non-zero (1480) Fragment Offset indicates that this is not the first datagram fragment. There are no more fragments because the 'More Fragments' bit is not set (see image below).

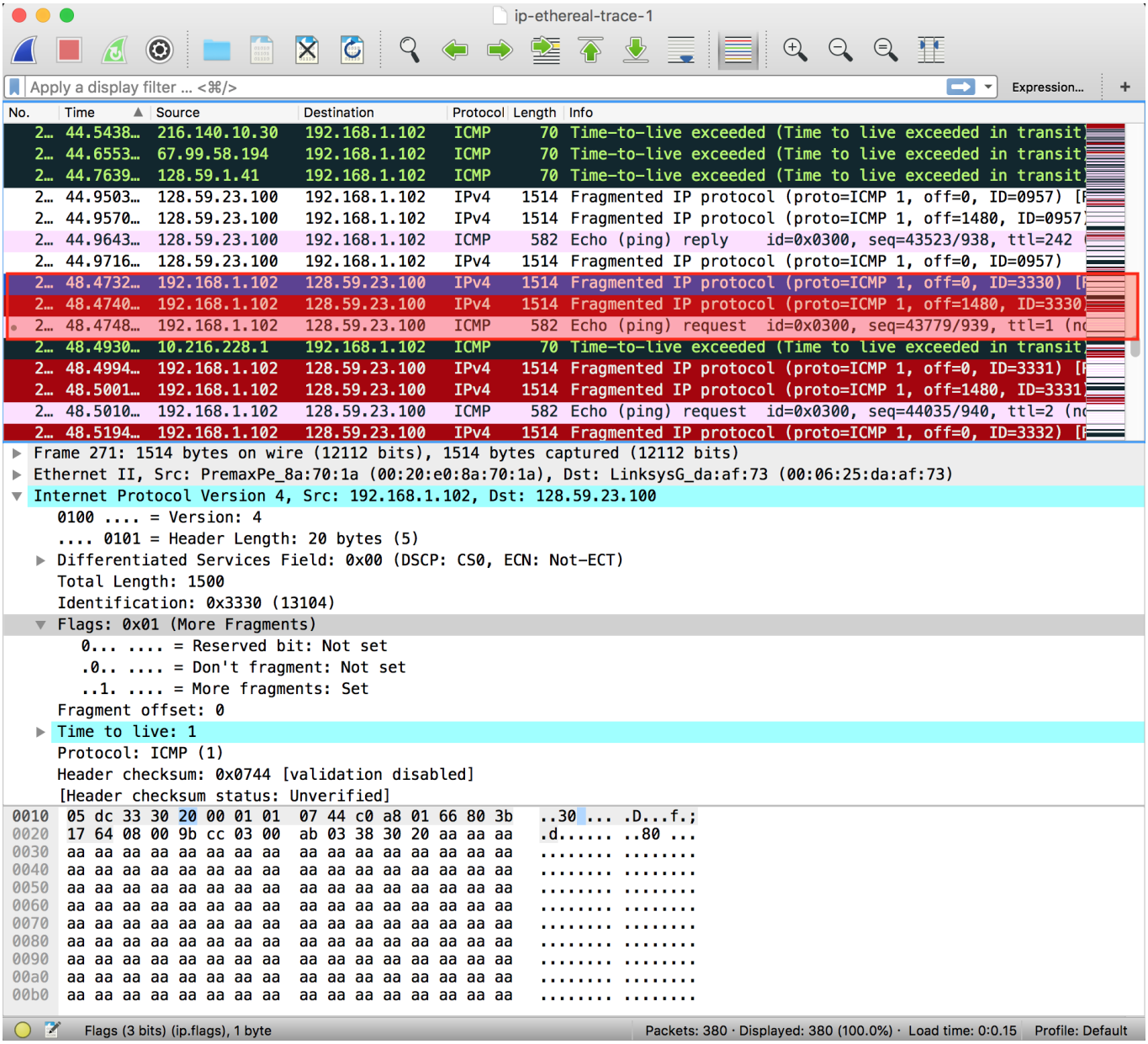


13) The length, the more fragments bit, the fragment offset and the header checksum change between the first and second fragments (see images below).

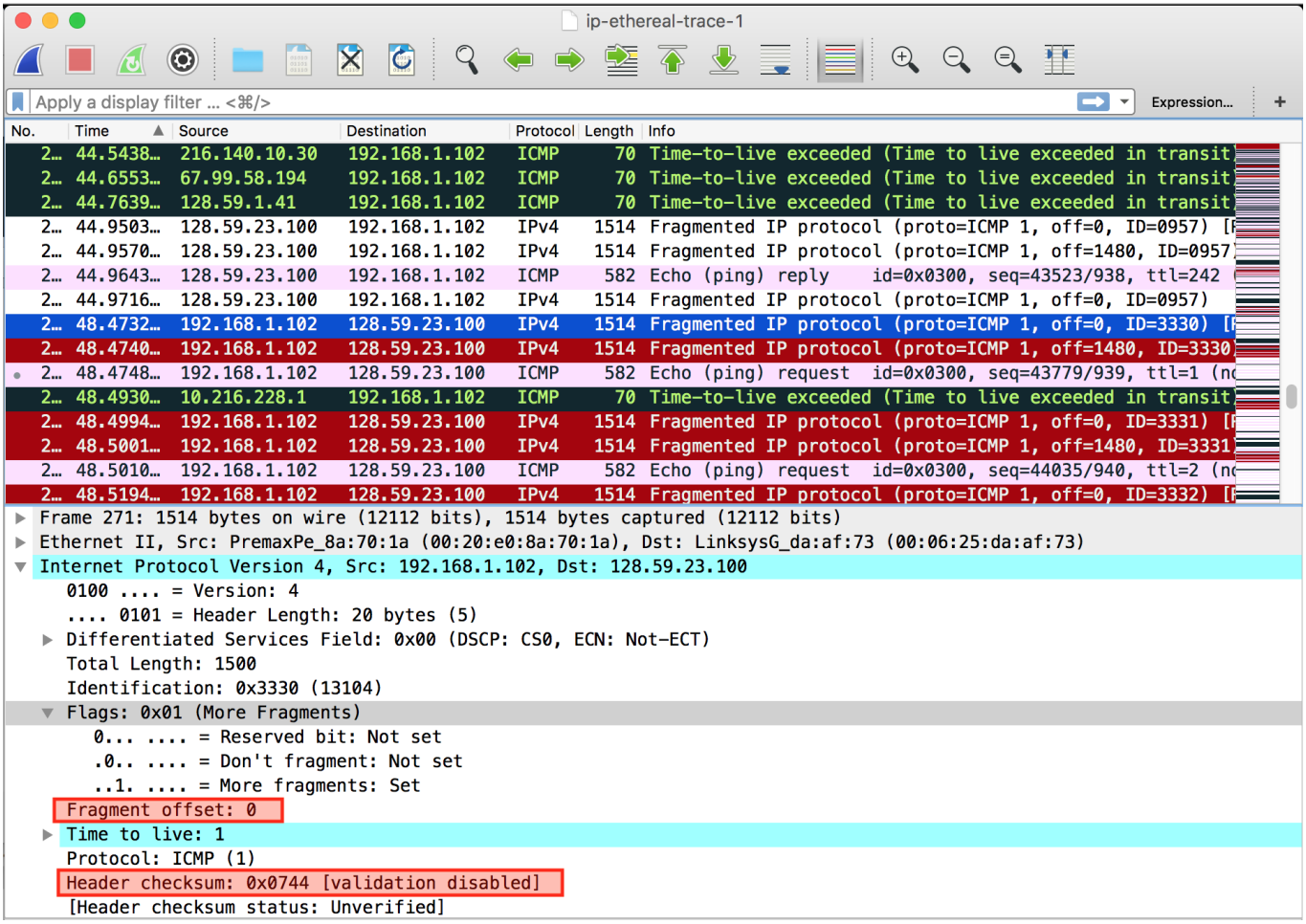


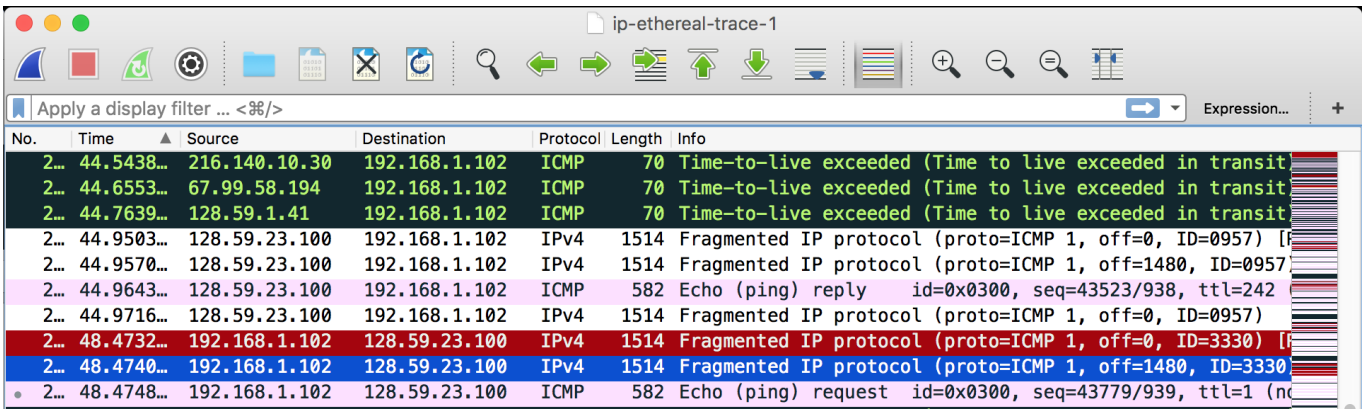


14) For a packet size of 3500, there are three fragments made from the original datagram (see image below).



15) The the fragment offset and the header checksum change between the first and second fragments (see images below). The length, more fragments bit, the fragment offset bit change between the second and third fragments.


ip-ethereal-trace-1
Apply a display filter ... <⌘/>
Expression...
No. Time Source Destination Protocol Length Info
2... 44.5438... 216.140.10.30 192.168.1.102 ICMP 70 Time-to-live exceeded (Time to live exceeded in transit
2... 44.6553... 67.99.58.194 192.168.1.102 ICMP 70 Time-to-live exceeded (Time to live exceeded in transit
2... 44.7639... 128.59.1.41 192.168.1.102 ICMP 70 Time-to-live exceeded (Time to live exceeded in transit
2... 44.9503... 128.59.23.100 192.168.1.102 IPv4 1514 Fragmented IP protocol (proto=ICMP 1, off=0, ID=0957)
2... 44.9570... 128.59.23.100 192.168.1.102 IPv4 1514 Fragmented IP protocol (proto=ICMP 1, off=1480, ID=0957
2... 44.9643... 128.59.23.100 192.168.1.102 ICMP 582 Echo (ping) reply id=0x0300, seq=43523/938, ttl=242
2... 44.9716... 128.59.23.100 192.168.1.102 IPv4 1514 Fragmented IP protocol (proto=ICMP 1, off=0, ID=0957)
2... 48.4732... 192.168.1.102 128.59.23.100 IPv4 1514 Fragmented IP protocol (proto=ICMP 1, off=0, ID=3330)
2... 48.4740... 192.168.1.102 128.59.23.100 IPv4 1514 Fragmented IP protocol (proto=ICMP 1, off=1480, ID=3330
2... 48.4748... 192.168.1.102 128.59.23.100 ICMP 582 Echo (ping) request id=0x0300, seq=43779/939, ttl=1 (n
2... 48.4930... 10.216.228.1 192.168.1.102 ICMP 70 Time-to-live exceeded (Time to live exceeded in transit
2... 48.4994... 192.168.1.102 128.59.23.100 IPv4 1514 Fragmented IP protocol (proto=ICMP 1, off=0, ID=3331)
2... 48.5001... 192.168.1.102 128.59.23.100 IPv4 1514 Fragmented IP protocol (proto=ICMP 1, off=1480, ID=3331
2... 48.5010... 192.168.1.102 128.59.23.100 ICMP 582 Echo (ping) request id=0x0300, seq=44035/940, ttl=2 (n
2... 48.5194... 192.168.1.102 128.59.23.100 IPv4 1514 Fragmented IP protocol (proto=ICMP 1, off=0, ID=3332)
Frame 271: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits)
Ethernet II, Src: PremaxPe_8a:70:1a (00:20:e0:8a:70:1a), Dst: LinksysG_da:af:73 (00:06:25:da:af:73)
Internet Protocol Version 4, Src: 192.168.1.102, Dst: 128.59.23.100
0100 .... = Version: 4
.... 0101 = Header Length: 20 bytes (5)
Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
Total Length: 1500
Identification: 0x3330 (13104)
Flags: 0x01 (More Fragments)
0... .... = Reserved bit: Not set
.0.. .... = Don't fragment: Not set
..1. .... = More fragments: Set
Fragment offset: 0
Time to live: 1
Protocol: ICMP (1)
Header checksum: 0x0744 [validation disabled]
[Header checksum status: Unverified]


ip-ethereal-trace-1
Apply a display filter ... <⌘/>
Expression...
No. Time Source Destination Protocol Length Info
2... 44.5438... 216.140.10.30 192.168.1.102 ICMP 70 Time-to-live exceeded (Time to live exceeded in transit
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2... 44.9503... 128.59.23.100 192.168.1.102 IPv4 1514 Fragmented IP protocol (proto=ICMP 1, off=0, ID=0957)
2... 44.9570... 128.59.23.100 192.168.1.102 IPv4 1514 Fragmented IP protocol (proto=ICMP 1, off=1480, ID=0957
2... 44.9643... 128.59.23.100 192.168.1.102 ICMP 582 Echo (ping) reply id=0x0300, seq=43523/938, ttl=242
2... 44.9716... 128.59.23.100 192.168.1.102 IPv4 1514 Fragmented IP protocol (proto=ICMP 1, off=0, ID=0957)
2... 48.4732... 192.168.1.102 128.59.23.100 IPv4 1514 Fragmented IP protocol (proto=ICMP 1, off=0, ID=3330)
2... 48.4740... 192.168.1.102 128.59.23.100 IPv4 1514 Fragmented IP protocol (proto=ICMP 1, off=1480, ID=3330
2... 48.4748... 192.168.1.102 128.59.23.100 ICMP 582 Echo (ping) request id=0x0300, seq=43779/939, ttl=1 (n

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