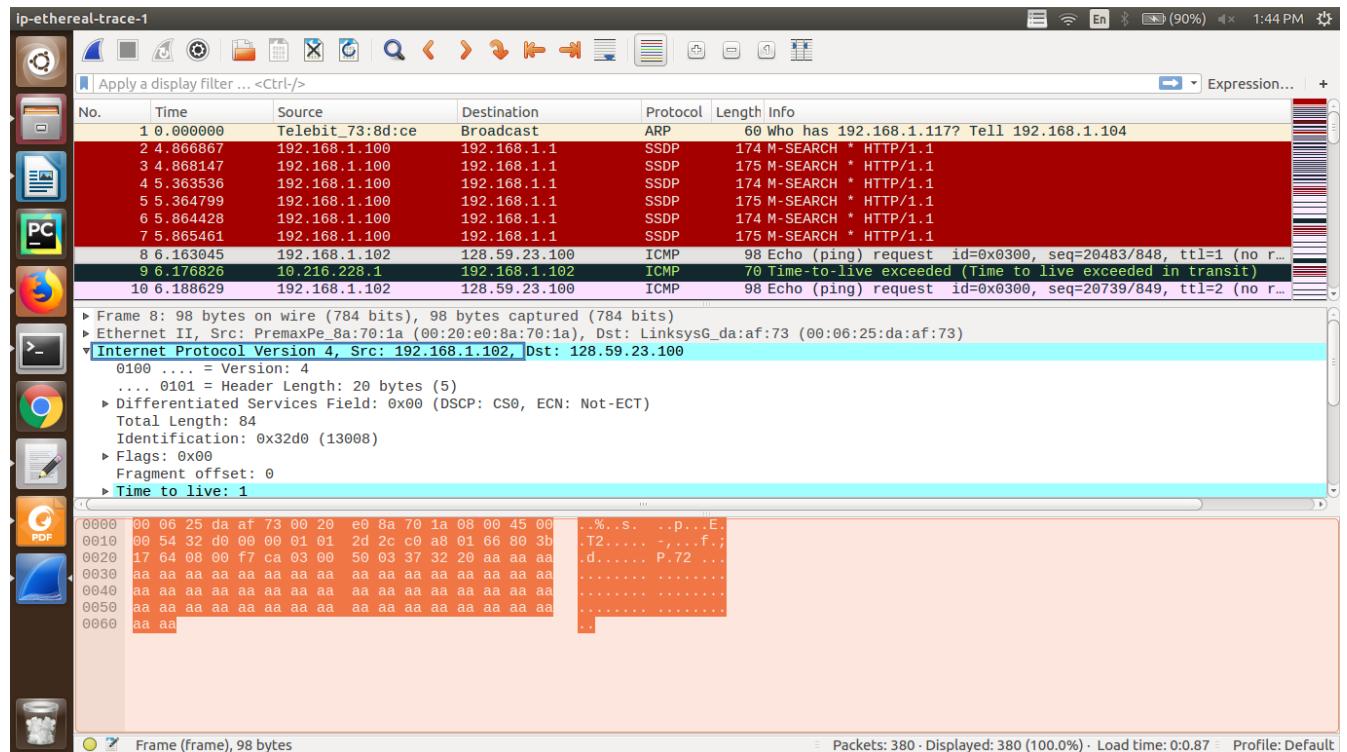
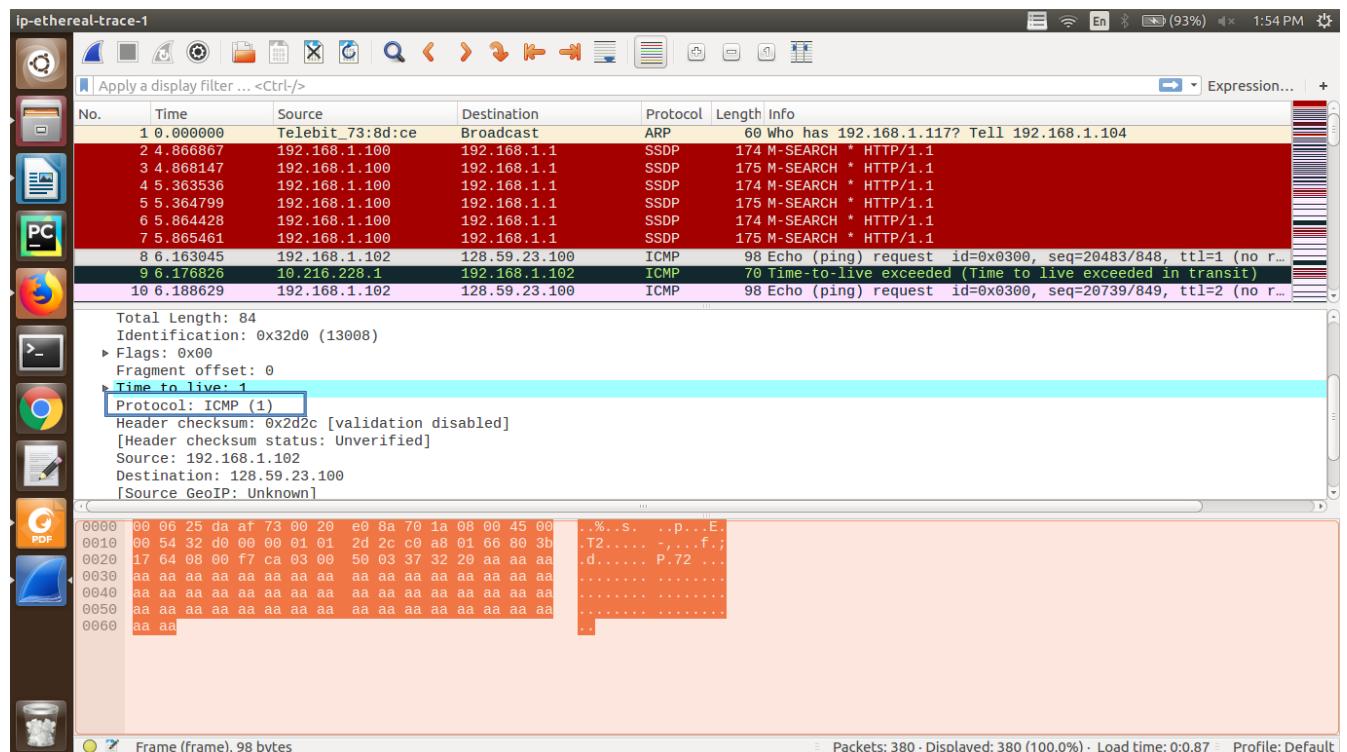


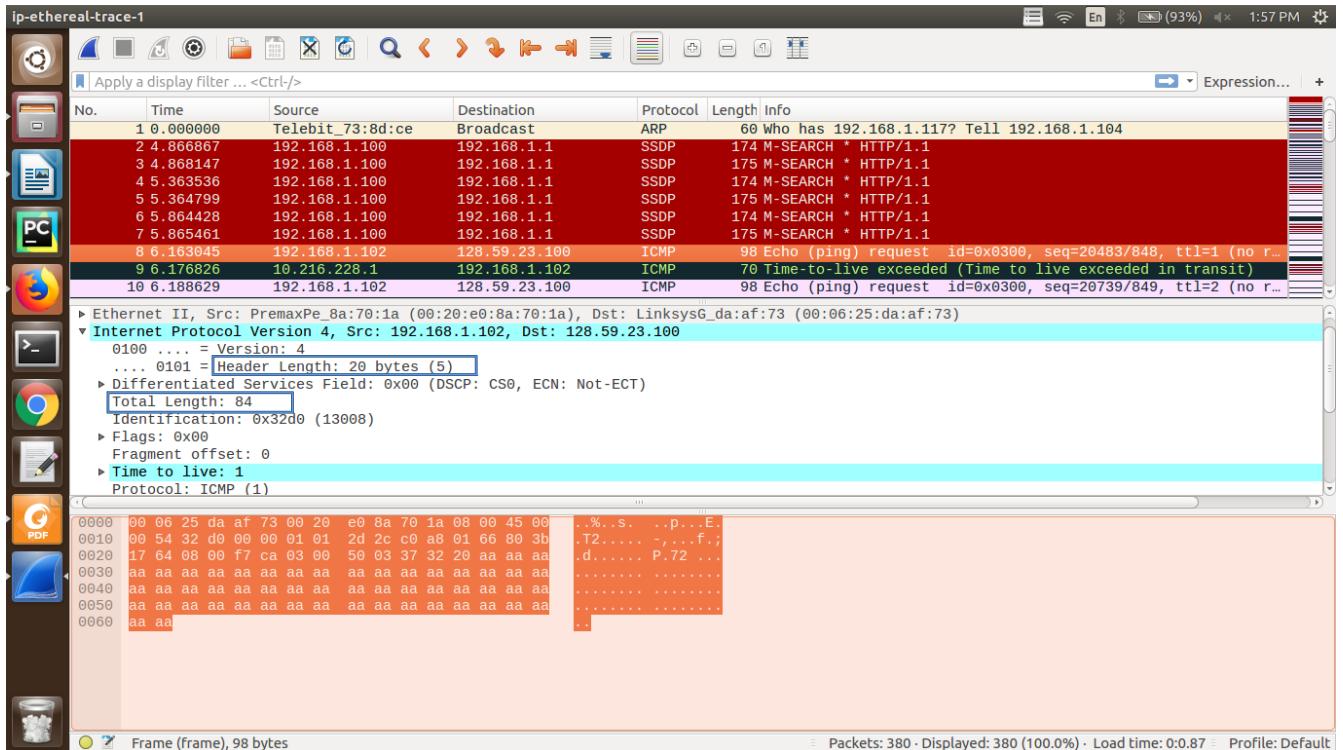
Q1 – IP address for my computer is :- 192.168.1.102



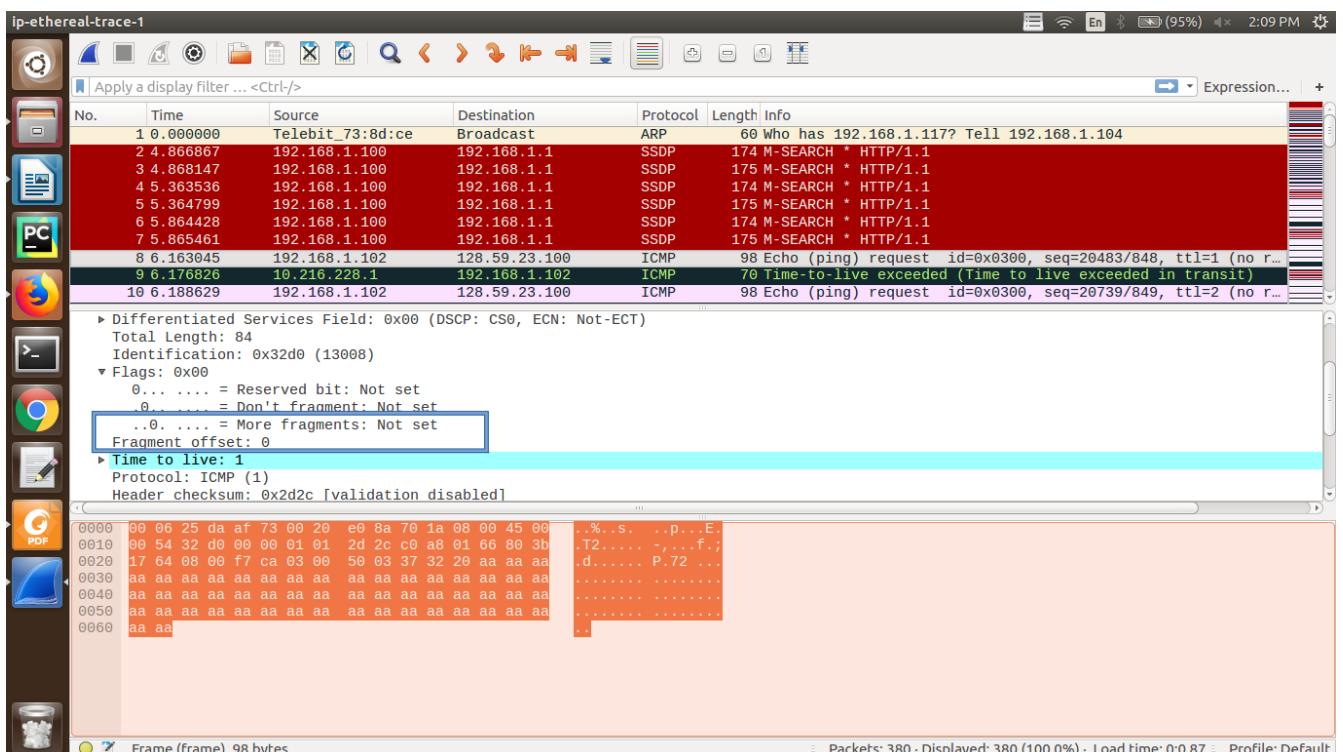
Q2- The value of the upper layer protocol field in the IP Packet header is “1” i.e. ICMP



Q3- The length of header is 20 bytes and the length of payload is 64 bytes. As it can be seen from below attached screen shot that the total length is 84 bytes and header length is 20 bytes. Hence payload is 64 bytes.



Q4- The IP datagram is not fragmented which can be verified from the More fragments flag being set to zero and the fragment offset being clear and set to zero.



Q5 – The fields which keep on changing from one datagram to another are:

- a) Identification
- b) Time to Live
- c) Header Checksum

ip-ethereal-trace-1

icmp

No.	Time	Source	Destination	Protocol	Length	Info
212	39.227649	128.59.1.41	192.168.1.102	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
266	44.763963	128.59.1.41	192.168.1.102	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
320	49.770176	128.59.1.41	192.168.1.102	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
377	54.774816	128.59.1.41	192.168.1.102	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
35	6.490987	128.59.23.100	192.168.1.102	ICMP	98	Echo (ping) reply id=0x0300, seq=23555/860, ttl=242 (re...
63	11.480063	128.59.23.100	192.168.1.102	ICMP	98	Echo (ping) reply id=0x0300, seq=26883/873, ttl=242 (re...
89	16.499919	128.59.23.100	192.168.1.102	ICMP	98	Echo (ping) reply id=0x0300, seq=30211/886, ttl=242 (re...
131	29.299545	128.59.23.100	192.168.1.102	ICMP	562	Echo (ping) reply id=0x0300, seq=33539/899, ttl=242 (re...
172	34.305470	128.59.23.100	192.168.1.102	ICMP	562	Echo (ping) reply id=0x0300, seq=36867/912, ttl=242 (re...
214	39.322566	128.59.23.100	192.168.1.102	TCMP	562	Echo (ping) reply id=0x0300, seq=40195/925, ttl=242 (re...

0100 = Version: 4
.... 0101 = Header Length: 20 bytes (5)
▶ Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
Total Length: 84
Identification: 0x0951 (2385)
▶ Flags: 0x02 (Don't Fragment)
Fragment offset: 0
Time to live: 242
Protocol: ICMP (1)
Header checksum: 0x25aa [validation disabled]

Frame (frame), 98 bytes

Packets: 380 · Displayed: 221 (58.2%) · Load time: 0:0.5 · Profile: Default

ip-ethereal-trace-1

icmp

No.	Time	Source	Destination	Protocol	Length	Info
212	39.227649	128.59.1.41	192.168.1.102	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
266	44.763963	128.59.1.41	192.168.1.102	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
320	49.770176	128.59.1.41	192.168.1.102	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
377	54.774816	128.59.1.41	192.168.1.102	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
35	6.490987	128.59.23.100	192.168.1.102	ICMP	98	Echo (ping) reply id=0x0300, seq=23555/860, ttl=242 (re...
63	11.480063	128.59.23.100	192.168.1.102	ICMP	98	Echo (ping) reply id=0x0300, seq=26883/873, ttl=242 (re...
89	16.499919	128.59.23.100	192.168.1.102	ICMP	98	Echo (ping) reply id=0x0300, seq=30211/886, ttl=242 (re...
131	29.299545	128.59.23.100	192.168.1.102	ICMP	562	Echo (ping) reply id=0x0300, seq=33539/899, ttl=242 (re...
172	34.305470	128.59.23.100	192.168.1.102	ICMP	562	Echo (ping) reply id=0x0300, seq=36867/912, ttl=242 (re...
214	39.322566	128.59.23.100	192.168.1.102	TCMP	562	Echo (ping) reply id=0x0300, seq=40195/925, ttl=242 (re...

0100 = Version: 4
.... 0101 = Header Length: 20 bytes (5)
▶ Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
Total Length: 84
Identification: 0x0952 (2386)
▶ Flags: 0x02 (Don't Fragment)
Fragment offset: 0
Time to live: 242
Protocol: ICMP (1)
Header checksum: 0x25a9 [validation disabled]

Frame (frame), 98 bytes

Packets: 380 · Displayed: 221 (58.2%) · Load time: 0:0.5 · Profile: Default

Q6- i) Fields that stay constant are as follows

- a) **Header Length** – (Header length for all the IPv4 packets remain the same)
- b) **Version** – Version will always be ipv4 as we are using that for all packets
- c) **Source IP** – (Sender IP doesn't change)
- d) **Destination IP** – (Destination IP of gaia.cs.umass.edu doesn't change)
- e) **Upper Layer protocol** – (we are using the same protocol every time).
- f) **Differentiated services** – as all the packets are using ICMP they use the same type of service class.

ii) Fields that must stay constant are as follows

- a) **Header Length** – (Header length for all the IPv4 packets remain the same)
- b) **Version** – Version will always be ipv4 as we are using that for all packets
- c) **Source IP** – (Sender IP doesn't change)
- d) **Destination IP** – (Destination IP of gaia.cs.umass.edu doesn't change)
- e) **Upper Layer protocol** – (we are using the same protocol every time).
- f) **Differentiated services** – as all the packets are using ICMP they use the same type of service class.

iii) Fields that must changes are as follows

- a) **Identification:** Each IP packet has a different id (unique id is required to identify each IP datagram).
- b) **Time to Live:** (Traceroute increases time to live subsequently for each packet sent)
- c) **Header checksum:** As header is changing the checksum for each header also changes with it.

Q7- The Identification field of each IP datagram is changing and is incrementing sequentially for each subsequent datagram being sent.

ip-ethereal-trace-1

icmp

No.	Time	Source	Destination	Protocol	Length	Info
212	39.227649	128.59.1.41	192.168.1.102	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
266	44.763963	128.59.1.41	192.168.1.102	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
320	49.770176	128.59.1.41	192.168.1.102	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
377	54.774816	128.59.1.41	192.168.1.102	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
← 35	6.490987	128.59.23.100	192.168.1.102	ICMP	98	Echo (ping) reply id=0x0300, seq=23555/860, ttl=242 (re...
63	11.480063	128.59.23.100	192.168.1.102	ICMP	98	Echo (ping) reply id=0x0300, seq=26883/873, ttl=242 (re...
89	16.499919	128.59.23.100	192.168.1.102	ICMP	98	Echo (ping) reply id=0x0300, seq=30211/886, ttl=242 (re...
131	29.299545	128.59.23.100	192.168.1.102	ICMP	562	Echo (ping) reply id=0x0300, seq=33539/899, ttl=242 (re...
172	34.305470	128.59.23.100	192.168.1.102	ICMP	562	Echo (ping) reply id=0x0300, seq=36867/912, ttl=242 (re...
214	39.322566	128.59.23.100	192.168.1.102	TCP	562	Echo (ping) reply id=0x0300, seq=40195/925, ttl=242 (re...

Frame 35: 98 bytes on wire (784 bits), 98 bytes captured (784 bits)
 ▶ Ethernet II, Src: LinksysG_da:af:73 (00:06:25:da:af:73), Dst: PremaxPe_8a:70:1a (00:20:e0:8a:70:1a)
 ▶ Internet Protocol Version 4, Src: 128.59.23.100, Dst: 192.168.1.102
 0100 = Version: 4
 0101 = Header Length: 20 bytes (5)
 ▶ Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
 Total Length: 84
 Identification: 0x0951 (2385)
 ▶ Flags: 0x02 (Don't Fragment)
 Fragment offset: 0

0000	00 20 e0 8a 70 1a 00 06 25 da af 73 08 00 45 00	. . . p . . % . s . E .
0010	00 54 09 51 40 00 f2 01 25 aa 80 3b 17 64 c0 a8	. T . Q 0 . . % . ; . d .
0020	01 66 00 00 f3 ca 03 00 5c 03 37 32 20 aa aa aa	. f \ . 72 . .
0030	aa
0040	aa
0050	aa
0060	aa aa

Frame (frame), 98 bytes

Packets: 380 · Displayed: 221 (58.2%) · Load time: 0:0.5 · Profile: Default

ip-ethereal-trace-1

icmp

No.	Time	Source	Destination	Protocol	Length	Info
212	39.2227649	128.59.1.41	192.168.1.102	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
266	44.763963	128.59.1.41	192.168.1.102	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
320	49.770176	128.59.1.41	192.168.1.102	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
377	54.774816	128.59.1.41	192.168.1.102	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
35	6.490987	128.59.23.100	192.168.1.102	ICMP	98	Echo (ping) reply id=0x0300, seq=23555/860, ttl=242 (re...
63	11.480063	128.59.23.100	192.168.1.102	ICMP	98	Echo (ping) reply id=0x0300, seq=26883/873, ttl=242 (re...
89	16.499919	128.59.23.100	192.168.1.102	ICMP	98	Echo (ping) reply id=0x0300, seq=30211/886, ttl=242 (re...
131	29.299545	128.59.23.100	192.168.1.102	ICMP	562	Echo (ping) reply id=0x0300, seq=33539/899, ttl=242 (re...
172	34.305470	128.59.23.100	192.168.1.102	ICMP	562	Echo (ping) reply id=0x0300, seq=36867/912, ttl=242 (re...
214	39.322566	128.59.23.100	192.168.1.102	TCP	562	Echo (ping) reply id=0x0300, seq=40195/925, ttl=242 (re...

Frame 63: 98 bytes on wire (784 bits), 98 bytes captured (784 bits)

Ethernet II, Src: LinksysG_da:af:73 (00:06:25:da:af:73), Dst: PremaxPe_8a:70:1a (00:20:e0:8a:70:1a)

Internet Protocol Version 4, Src: 128.59.23.100, Dst: 192.168.1.102

0100 = Version: 4
.... 0101 = Header Length: 20 bytes (5)
Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
Total Length: 84
Identification: 0x0952 (2386)
Flags: 0x02 (Don't Fragment)
Fragment offset: 0

Frame (frame), 98 bytes

Q8- Identification field – 40635

TTL: 255

ip-ethereal-trace-1

Apply a display filter ... <Ctrl-/>

No.	Time	Source	Destination	Protocol	Length	Info
135	33.470548	10.216.228.1	192.168.1.102	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
179	38.491817	10.216.228.1	192.168.1.102	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
219	43.485786	10.216.228.1	192.168.1.102	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
274	48.493073	10.216.228.1	192.168.1.102	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
330	53.501082	10.216.228.1	192.168.1.102	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
21	6.334320	12.122.10.22	192.168.1.102	ICMP	126	Time-to-live exceeded (Time to live exceeded in transit)
52	11.332109	12.122.10.22	192.168.1.102	ICMP	126	Time-to-live exceeded (Time to live exceeded in transit)
77	16.338078	12.122.10.22	192.168.1.102	ICMP	126	Time-to-live exceeded (Time to live exceeded in transit)
124	28.871954	12.122.10.22	192.168.1.102	IPv4	554	Fragmented IP protocol (proto=ICMP 1, off=0, ID=0000)
165	33.885853	12.122.10.22	192.168.1.102	IPv4	554	Fragmented IP protocol (proto=ICMP 1, off=0, ID=0000)

Frame 330: 70 bytes on wire (560 bits), 70 bytes captured (560 bits)

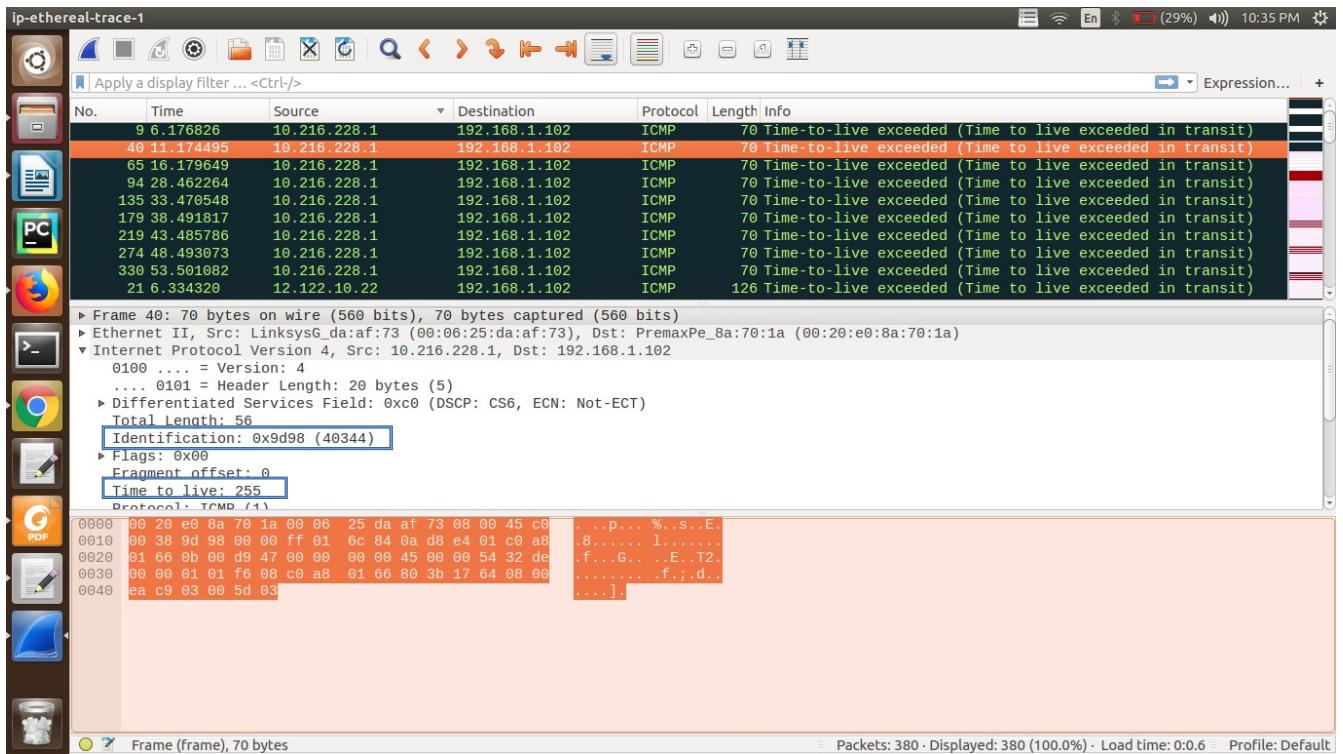
Ethernet II, Src: LinksysG_da:af:73 (00:06:25:da:af:73), Dst: PremaxPe_8a:70:1a (00:20:e0:8a:70:1a)

Internet Protocol Version 4, Src: 10.216.228.1, Dst: 192.168.1.102

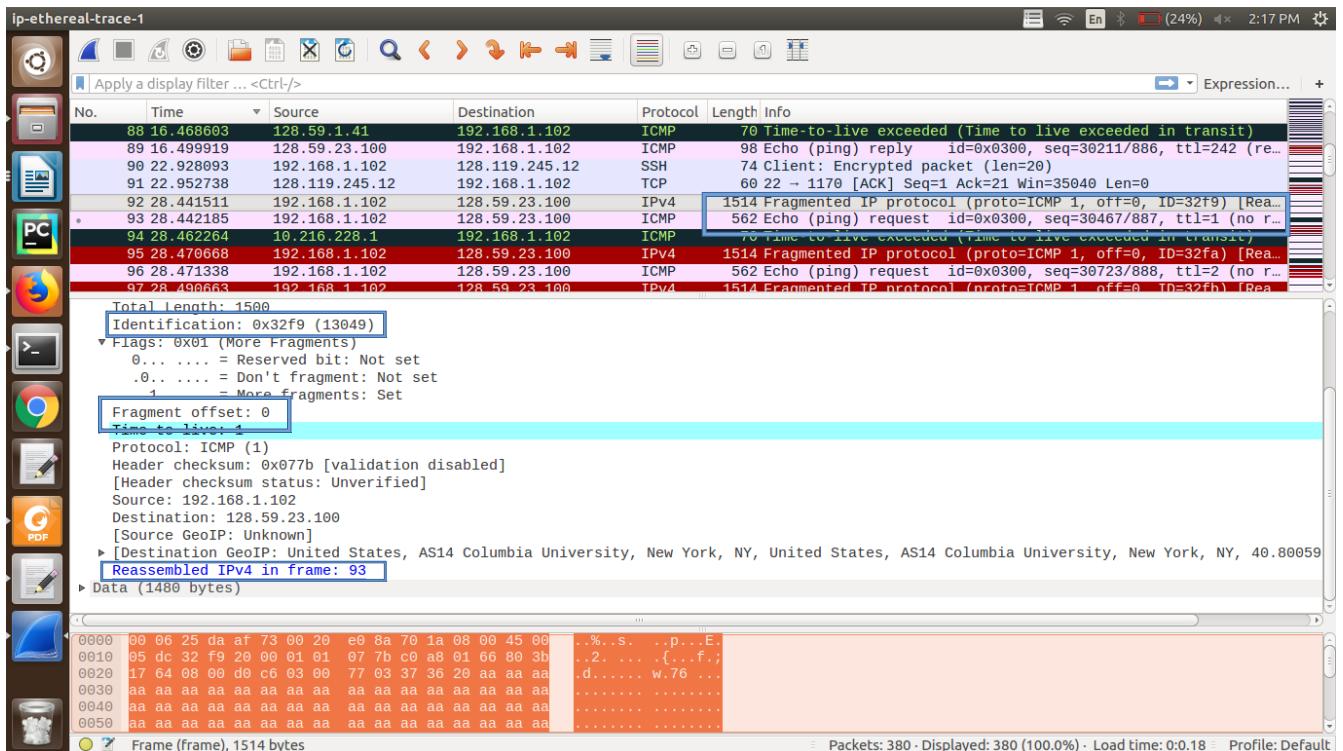
0100 = Version: 4
.... 0101 = Header Length: 20 bytes (5)
Differentiated Services Field: 0xc0 (DSCP: CS6, ECN: Not-ECT)
Identification: 0x9ebb (40635)
Flags: 0x00
Fragment offset: 0
Time to live: 255
Protocol: ICMP (1)

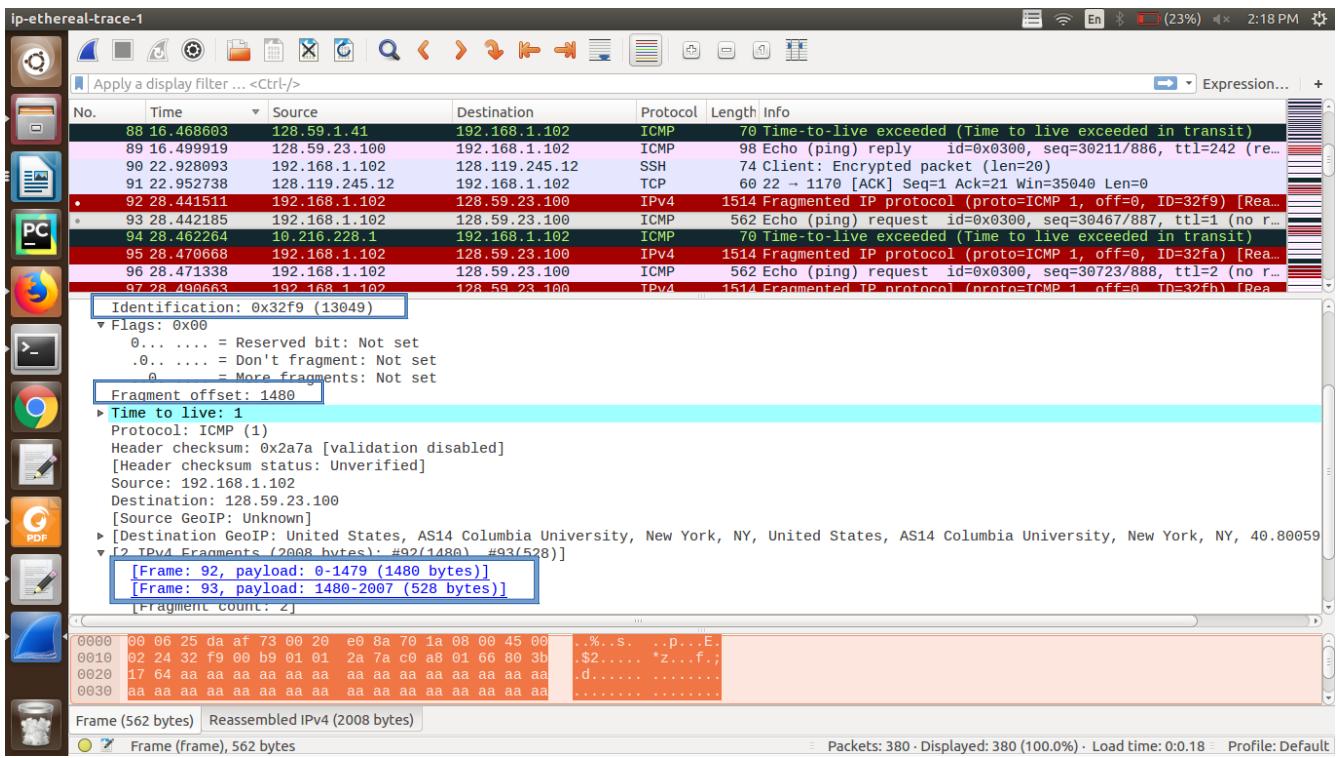
Frame (frame), 70 bytes

Q9 - Identification field value changes since each packet have unique id. The value of TTL field remains the same, because the TTL for the first hop router will always be the same.

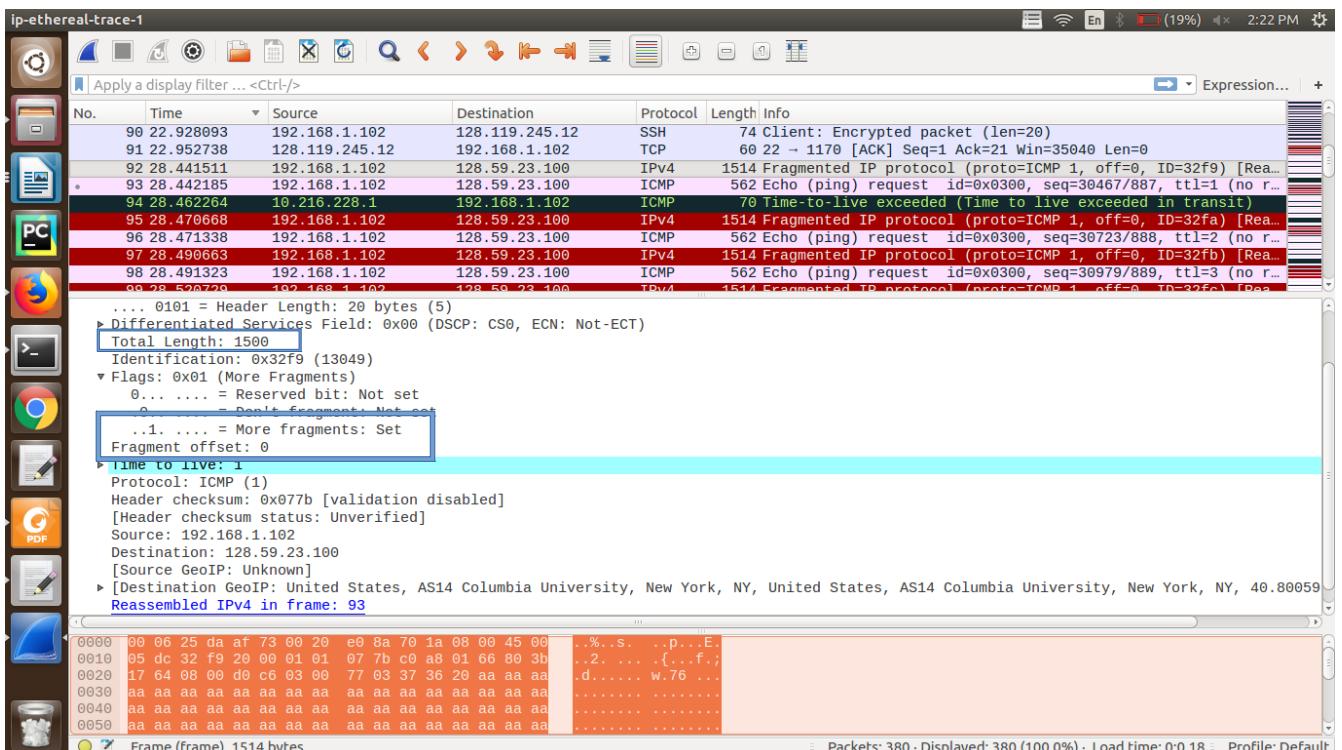


Q10- Yes, message has been fragmented across more than one IP datagram



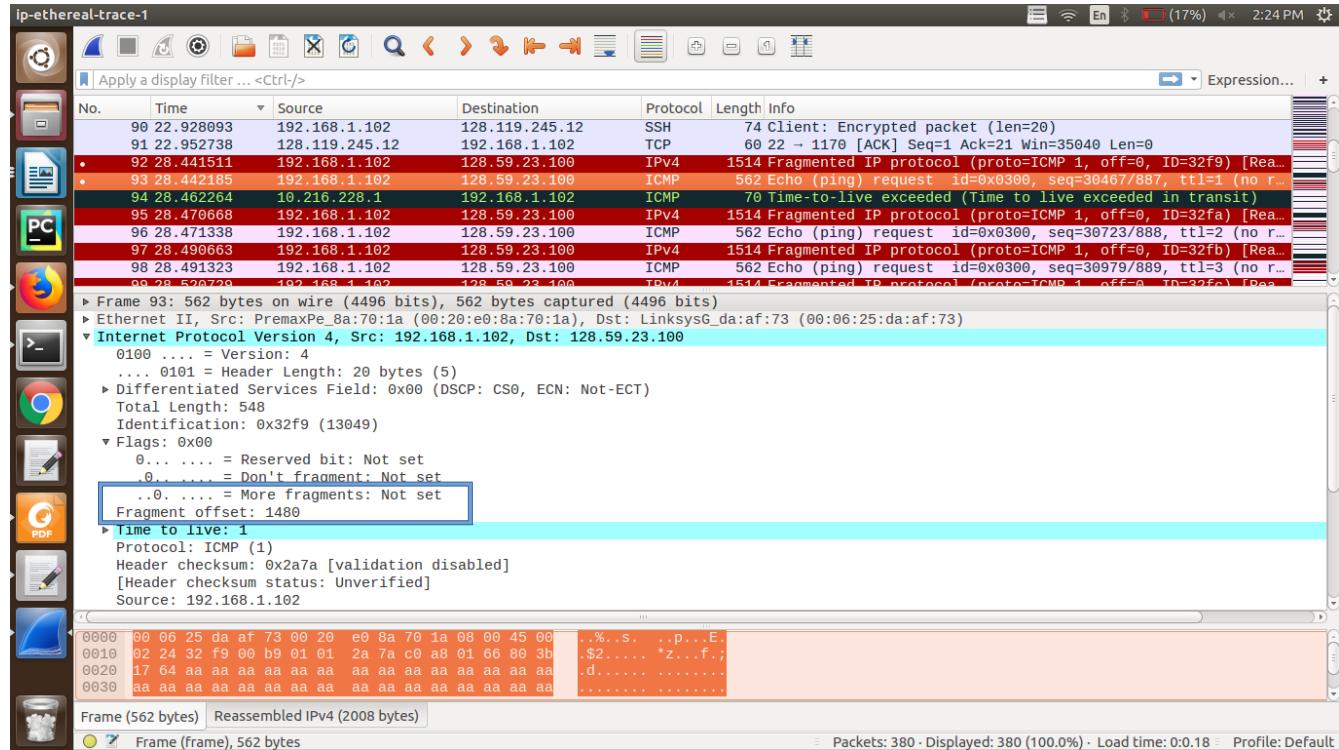


- Q11 - a) The More Fragments bit in flags section in the IP header indicates that the datagram has been fragmented.
- b) The Fragment Offset being set to zero indicates that the given fragment is the first fragment
- c) This given IP Datagram (i.e. the First Fragment of the original message) is 1500 bytes long (20 bytes header + 1480 bytes of payload).



Q12 - a) The Fragment Offset field being set to 1480 indicates that this is not the first fragment of an IP datagram.

b) No, there are no more fragments of the given IP datagram after this as the more fragments bit is clear in the flags field of the IP datagram header.



Q13 - The fields in the IP Header that change between the first and second fragment are:

- a) Fragment Offset.
- b) The Total Length field of IP header.
- c) The More Fragments bit of the Flags field.
- d) Checksum

ip-ethereal-trace-1

Apply a display filter ... <Ctrl-/>

No.	Time	Source	Destination	Protocol	Length	Info
90	22.928093	192.168.1.102	128.119.245.12	SSH	74	Client: Encrypted packet (len=20)
91	22.952738	128.119.245.12	192.168.1.102	TCP	68	22 → 1170 [ACK] Seq=1 Ack=21 Win=35040 Len=0
92	28.441511	192.168.1.102	128.59.23.100	IPv4	1514	Fragmented IP protocol (proto=ICMP 1, off=0, ID=32f9) [Reassembled]
93	28.442185	192.168.1.102	128.59.23.100	ICMP	562	Echo (ping) request id=0x0300, seq=30467/887, ttl=1 (no r...)
94	28.462264	10.216.228.1	192.168.1.102	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
95	28.470668	192.168.1.102	128.59.23.100	IPv4	1514	Fragmented IP protocol (proto=ICMP 1, off=0, ID=32fa) [Reassembled]
96	28.471338	192.168.1.102	128.59.23.100	ICMP	562	Echo (ping) request id=0x0300, seq=30723/888, ttl=2 (no r...)
97	28.490663	192.168.1.102	128.59.23.100	IPv4	1514	Fragmented IP protocol (proto=ICMP 1, off=0, ID=32fb) [Reassembled]
98	28.491323	192.168.1.102	128.59.23.100	ICMP	562	Echo (ping) request id=0x0300, seq=30979/889, ttl=3 (no r...)
99	28.520729	192.168.1.102	128.59.23.100	IPv4	1514	Fragmented IP protocol (proto=ICMP 1, off=0, ID=32fc) [Reassembled]

Frame 92: 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: 0x32f9 (13049)
 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: 0x077b [validation disabled]
 [Header checksum status: Unverified]
 Source: 192.168.1.102

Frame (frame), 1514 bytes

ip-ethereal-trace-1

Apply a display filter ... <Ctrl-/>

No.	Time	Source	Destination	Protocol	Length	Info
90	22.928093	192.168.1.102	128.119.245.12	SSH	74	Client: Encrypted packet (len=20)
91	22.952738	128.119.245.12	192.168.1.102	TCP	68	22 → 1170 [ACK] Seq=1 Ack=21 Win=35040 Len=0
92	28.441511	192.168.1.102	128.59.23.100	IPv4	1514	Fragmented IP protocol (proto=ICMP 1, off=0, ID=32f9) [Reassembled]
93	28.442185	192.168.1.102	128.59.23.100	ICMP	562	Echo (ping) request id=0x0300, seq=30467/887, ttl=1 (no r...)
94	28.462264	10.216.228.1	192.168.1.102	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
95	28.470668	192.168.1.102	128.59.23.100	IPv4	1514	Fragmented IP protocol (proto=ICMP 1, off=0, ID=32fa) [Reassembled]
96	28.471338	192.168.1.102	128.59.23.100	ICMP	562	Echo (ping) request id=0x0300, seq=30723/888, ttl=2 (no r...)
97	28.490663	192.168.1.102	128.59.23.100	IPv4	1514	Fragmented IP protocol (proto=ICMP 1, off=0, ID=32fb) [Reassembled]
98	28.491323	192.168.1.102	128.59.23.100	ICMP	562	Echo (ping) request id=0x0300, seq=30979/889, ttl=3 (no r...)
99	28.520729	192.168.1.102	128.59.23.100	IPv4	1514	Fragmented IP protocol (proto=ICMP 1, off=0, ID=32fc) [Reassembled]

Frame 93: 562 bytes on wire (4496 bits), 562 bytes captured (4496 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)

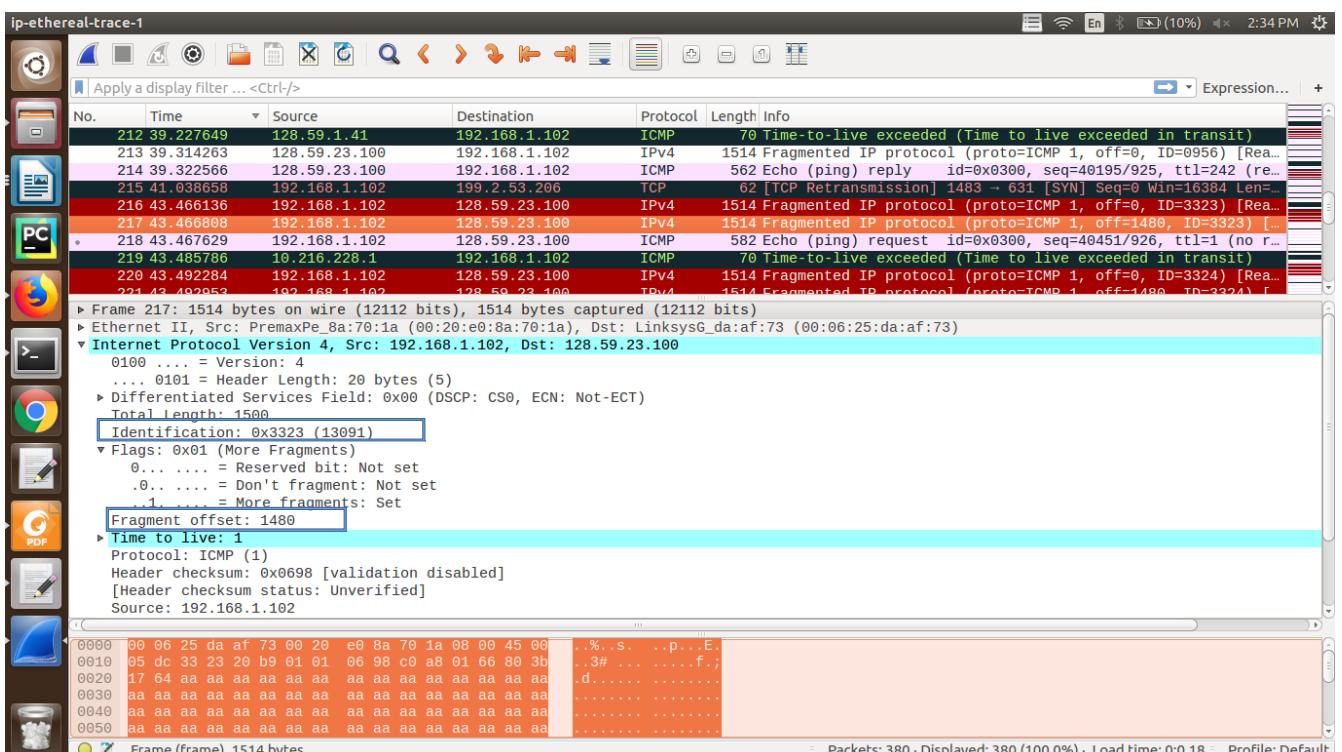
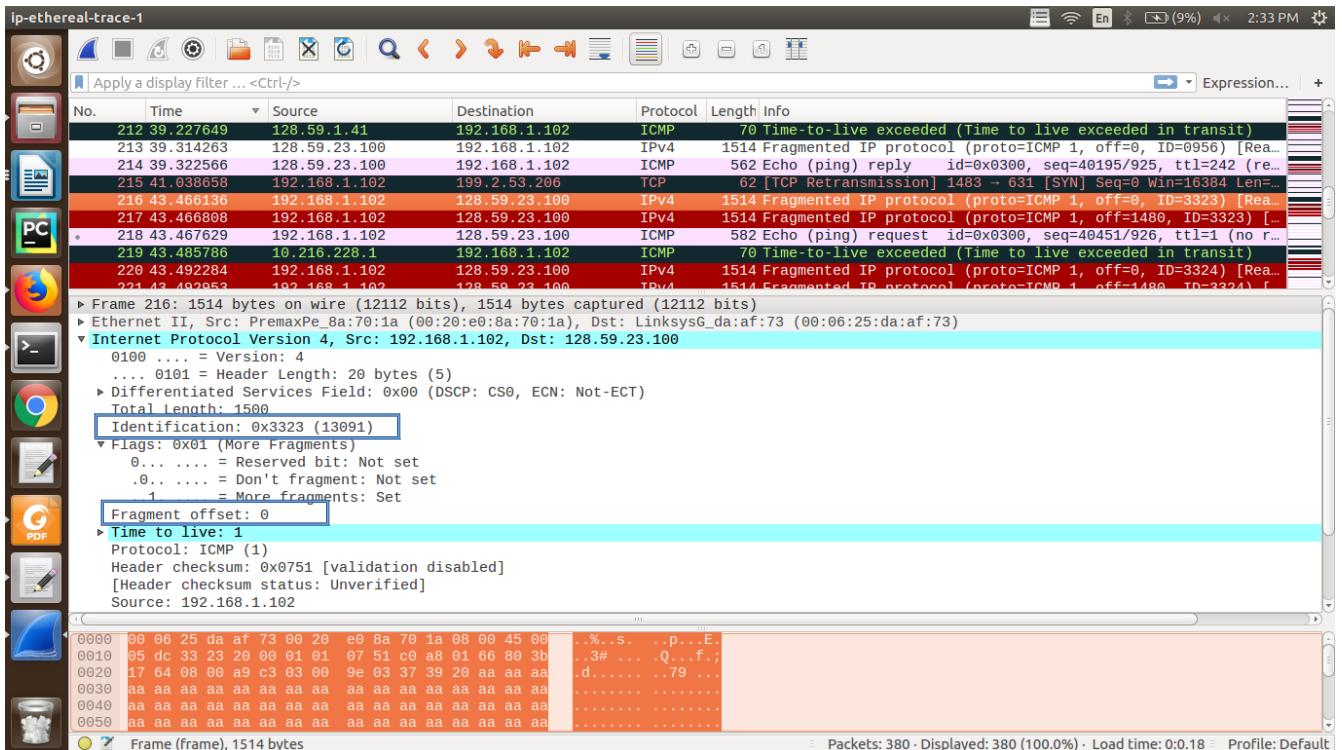
Internet Protocol Version 4, Src: 192.168.1.102, Dst: 128.59.23.100

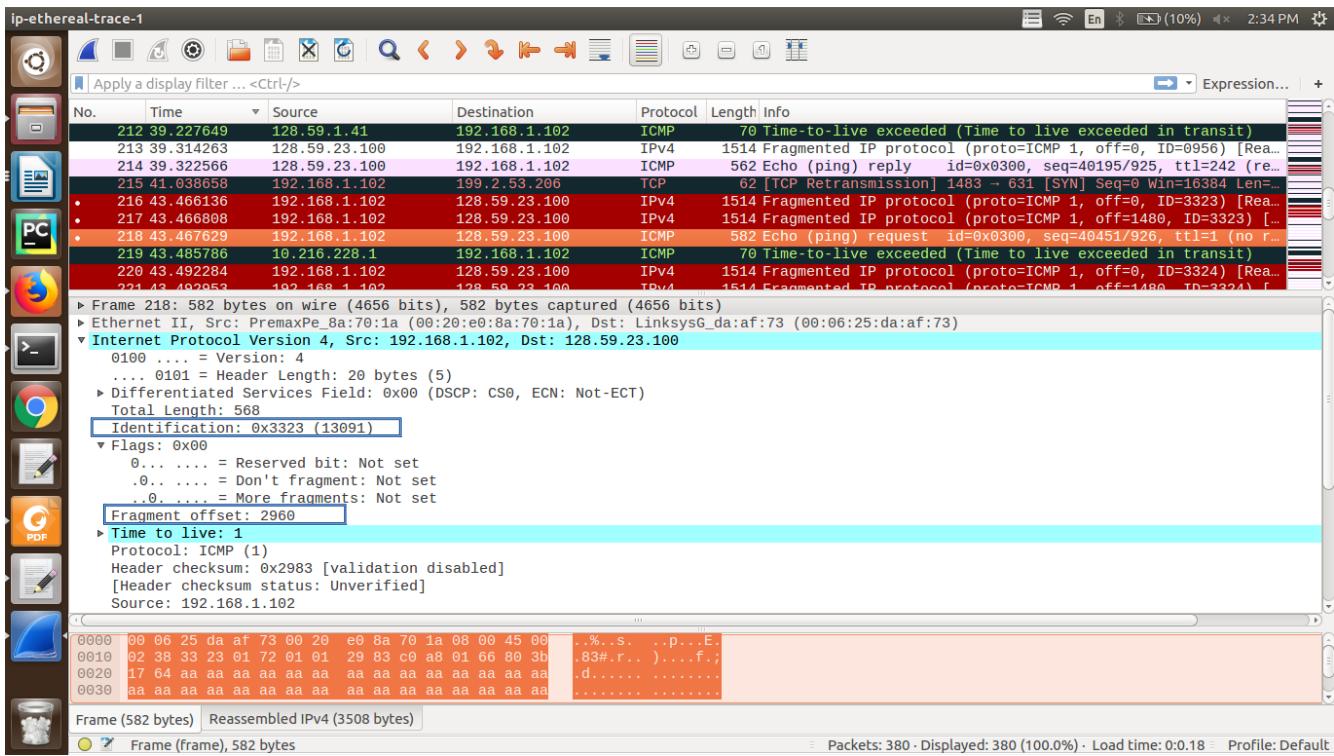
0100 = Version: 4
 ... 0101 = Header Length: 20 bytes (5)
 Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
 Total Length: 548
 Identification: 0x32f9 (13049)
 Flags: 0x00
 0.... = Reserved bit: Not set
 .0.... = Don't fragment: Not set
 ...0.... = More fragments: Not set
 Fragment offset: 1480
 Time to live: 1
 Protocol: ICMP (1)
 Header checksum: 0x2a7a [validation disabled]
 [Header checksum status: Unverified]
 Source: 192.168.1.102

Frame (562 bytes) Reassembled IPv4 (2008 bytes)

Frame (frame), 562 bytes

Q 14 - There are 3 fragments created from the original datagram after switching the packet size to 3500 bytes.





Q15 -

The fields that change between all fragments are

- a) Fragment Offset
- b) Header Checksum

The Fields that change within some datagrams are

- a) The More fragment bit is set for the first and second datagram, whereas it is clear for the third datagram
- b) The Total Length field is set to 1500 bytes for the first and second datagram, whereas for the third datagram it is 540 bytes.

