

Lab4 - IP

Jiaxi Zhang

April 13, 2025

1 A look at the captured trace

udp&&ip.dst == 128.119.245.12						
No.	Time	Source	Destination	Protocol	Length	Info
85	6.558951	10.21.143.214	128.119.245.12	UDP	70	61488 → 33435 Len=28
86	6.563033	10.21.128.2	10.21.143.214	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
87	6.564948	10.21.143.214	128.119.245.12	UDP	70	61488 → 33436 Len=28
88	6.567875	10.21.128.2	10.21.143.214	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
89	6.568115	10.21.143.214	128.119.245.12	UDP	70	61488 → 33437 Len=28
90	6.578493	10.21.128.2	10.21.143.214	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
91	6.578690	10.21.143.214	128.119.245.12	UDP	70	61488 → 33438 Len=28
92	6.573119	10.254.8.44	10.21.143.214	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
93	6.574037	10.21.143.214	128.119.245.12	UDP	70	61488 → 33439 Len=28
94	6.576987	10.254.6.44	10.21.143.214	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
97	6.584726	10.21.143.214	128.119.245.12	UDP	70	61488 → 33440 Len=28
98	6.586829	10.254.6.44	10.21.143.214	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
99	6.587047	10.21.143.214	128.119.245.12	UDP	70	61488 → 33441 Len=28
100	6.589450	10.254.8.51	10.21.143.214	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
101	6.590209	10.21.143.214	128.119.245.12	UDP	70	61488 → 33442 Len=28
102	6.592560	10.254.8.51	10.21.143.214	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
103	6.592776	10.21.143.214	128.119.245.12	UDP	70	61488 → 33443 Len=28
104	6.595144	10.254.6.51	10.21.143.214	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
107	6.600885	10.21.143.214	128.119.245.12	UDP	70	61488 → 33444 Len=28
108	6.604302	10.254.30.246	10.21.143.214	ICMP	98	Time-to-live exceeded (Time to live exceeded in transit)
109	6.605209	10.21.143.214	128.119.245.12	UDP	70	61488 → 33445 Len=28

> Frame 85: 70 bytes on wire (560 bits), 70 bytes captured (560 bits) on interface en0, id 0

> Ethernet II, Src: c6:19:77:e6:6b:1a (c6:19:77:e6:6b:1a), Dst: IETF-VRRP-VRID_32 (00:00:5e:00:00:00)

> Internet Protocol Version 4, Src: 10.21.143.214, 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: 56

> Identification: 0xf031 (61489)

> 0000 = Flags: 0x0

> ...0 0000 0000 0000 = Fragment Offset: 0

> Time to Live: 1

> Protocol: UDP (17)

> Header Checksum: 0xba14 [validation disabled]

> [Header checksum status: Unverified]

> Source Address: 10.21.143.214

> Destination Address: 128.119.245.12

> [Stream index: 10]

> User Datagram Protocol, Src Port: 61488, Dst Port: 33435

> Data (28 bytes)

0000 00 00 5e 00 01 32 c6 19 77 e6 6b 1a 08 00 45 00 ..^2..w.k...E-
0010 00 38 f0 31 00 00 01 11 ba 14 0a 15 8f d6 00 77 -8:1.....w
0020 f5 0c f0 30 82 9b 00 24 7d 6a 00 00 00 00 00 00 ...0...\$ }j.....
0030 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0040 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

No.	Time	Source	Destination	Protocol	Length	Info
85	6.558951	10.21.143.214	128.119.245.12	UDP	70	61488 → 33435

Len=28
 Frame 85: 70 bytes on wire (560 bits), 70 bytes captured (560 bits) on interface en0, id 0
 Ethernet II, Src: c6:19:77:e6:6b:1a (c6:19:77:e6:6b:1a), Dst: IETF-VRRP-VRID_32 (00:00:5e:00:01:32)
 Internet Protocol Version 4, Src: 10.21.143.214, 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: 56
 Identification: 0xf031 (61489)
 000. = Flags: 0x0
 ...0 0000 0000 0000 = Fragment Offset: 0
 Time to Live: 1
 Protocol: UDP (17)
 Header Checksum: 0xba14 [validation disabled]
 [Header checksum status: Unverified]
 Source Address: 10.21.143.214
 Destination Address: 128.119.245.12
 [Stream index: 10]
 User Datagram Protocol, Src Port: 61488, Dst Port: 33435
 Data (28 bytes)
 0000 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
 0010 00 00 00 00 00 00 00 00 00 00 00 00 00

The following questions are answered based on the above two figures.

1.1 Question 1

My IP address is 10.21.143.214

1.2 Question 2

The upper protocol is UDP, the protocol number is 17.

1.3 Question 3

IP header length is 20 bytes, the total length is 56 bytes. Thus, the payload length is $56 - 20 = 36$ bytes.

1.4 Question 4

This IP datagram is not fragmented. It can be seen from the screenshot that Fragment Offset is 0, and "Flags: 0x0" indicates that the datagram is not fragmented.

2 Sorted by source port

This is a screenshot after sorting by source port (with the arrow pointing down). It seems that since the arrow is pointing down, the time is in descending order.

No.	Time	Source	Destination	Protocol	Length	Info
677	12.133300	10.254.255.63	10.21.143.214	ICMP	590	Time-to-live exceeded (Time to live exceeded in transit)
687	14.483672	10.254.255.63	10.21.143.214	ICMP	590	Time-to-live exceeded (Time to live exceeded in transit)
599	14.381244	10.254.255.63	10.21.143.214	ICMP	590	Time-to-live exceeded (Time to live exceeded in transit)
596	14.365326	10.254.255.63	10.21.143.214	ICMP	590	Time-to-live exceeded (Time to live exceeded in transit)
152	6.711386	10.254.255.63	10.21.143.214	ICMP	98	Time-to-live exceeded (Time to live exceeded in transit)
146	6.692518	10.254.255.63	10.21.143.214	ICMP	98	Time-to-live exceeded (Time to live exceeded in transit)
888	22.231556	10.21.143.214	128.119.245.12	UDP	554	61636 → 33456 Len=3472
884	22.193182	10.21.143.214	128.119.245.12	UDP	554	61636 → 33455 Len=3472
880	22.156039	10.21.143.214	128.119.245.12	UDP	554	61636 → 33454 Len=3472
870	22.116970	10.21.143.214	128.119.245.12	UDP	554	61636 → 33453 Len=3472
866	22.071683	10.21.143.214	128.119.245.12	UDP	554	61636 → 33452 Len=3472
860	22.033951	10.21.143.214	128.119.245.12	UDP	554	61636 → 33451 Len=3472
842	21.993042	10.21.143.214	128.119.245.12	UDP	554	61636 → 33450 Len=3472
824	21.956106	10.21.143.214	128.119.245.12	UDP	554	61636 → 33449 Len=3472
820	21.919105	10.21.143.214	128.119.245.12	UDP	554	61636 → 33448 Len=3472
816	21.881084	10.21.143.214	128.119.245.12	UDP	554	61636 → 33447 Len=3472
812	21.839462	10.21.143.214	128.119.245.12	UDP	554	61636 → 33446 Len=3472
806	21.803044	10.21.143.214	128.119.245.12	UDP	554	61636 → 33445 Len=3472
800	21.766584	10.21.143.214	128.119.245.12	UDP	554	61636 → 33444 Len=3472
796	21.763832	10.21.143.214	128.119.245.12	UDP	554	61636 → 33443 Len=3472
792	21.760900	10.21.143.214	128.119.245.12	UDP	554	61636 → 33442 Len=3472
788	21.757197	10.21.143.214	128.119.245.12	UDP	554	61636 → 33441 Len=3472
784	21.754614	10.21.143.214	128.119.245.12	UDP	554	61636 → 33440 Len=3472
780	21.751855	10.21.143.214	128.119.245.12	UDP	554	61636 → 33439 Len=3472
776	21.748483	10.21.143.214	128.119.245.12	UDP	554	61636 → 33438 Len=3472
772	21.745740	10.21.143.214	128.119.245.12	UDP	554	61636 → 33437 Len=3472

Frame 888: 554 bytes on wire (4432 bits), 554 bytes captured (4432 bits) on interface en0, id 0000 00 00 5e 00 01 32 c6 19 77 e6 6b 1a 08 00 45 00 ...2...w-k...E-
Ethernet II, Src: c6:19:77:e6:6b:1a (c6:19:77:e6:6b:1a), Dst: IETF-VRRP-VRID_32 (00:00:5e:00:00:00) ...f...w
Internet Protocol Version 4, Src: 10.21.143.214, 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: 540
Identification: 0xf0da (61658)
> 000. = Flags: 0x0
...0 0001 0111 0010 = Fragment Offset: 2960
Time to Live: 8
Protocol: UDP (17)
Header Checksum: 0xaf15 [validation disabled]
[Header checksum status: Unverified]
Source Address: 10.21.143.214
Destination Address: 128.119.245.12
> [3 IPv4 Fragments (3480 bytes): #886(1480), #887(1480), #888(520)]
[Stream index: 10]
> User Datagram Protocol, Src Port: 61636, Dst Port: 33456
> Data (3472 bytes)

Frame (554 bytes) Reassembled IPv4 (3480 bytes)

2.1 Question 5

The always changing fields in the IP datagram are:

- Identification: Different datagrams have different identification numbers.
- Header Checksum: It is changed as Identification changes.

2.2 Question 6

The constant fields in the IP datagram are:

- Version: IPv4.
- Header Length: 20 bytes.
- Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)

- Source Address and Destination Address.
- Protocol: UDP.

Identification and Checksum must be changing because each datagram is different and has the unique identification number, and the checksum is calculated based on the datagram with a changing identification number. Actually, TTL is also changing for each traceout, but it is not included in the list because it is not always changing (maybe 2 or 3 datagrams have the same TTL). It might be caused by multiple datagrams packet capturing at the same time.

The Source and Destination Address must be constant, because I have made the filter with the fixed destination address while sorting with a fixed source address. The protocol is also constant, because it is always UDP on MacOS. I suppose in the same traceout the version, total length, and fragment offset are also constant (the total length has changed but it is always 540, 520, or 56 bytes, and I have made 3 traceouts at all).

2.3 Question 7

The Identification is always changing. Actually, the identification number is decreased by 1 for each datagram. I think it is because now the time is in descending order, so actually when the datagram is captured in normal order (real-time), the identification number is increased by 1 for each datagram.

3 ICMP TTLexceeded replies

No.	Time	Source	Destination	Protocol	Length	Info
121	6.625237	10.21.143.214	128.119.245.12	UDP	70	61488 → 33450 Len=28
119	6.621246	10.21.143.214	128.119.245.12	UDP	70	61488 → 33449 Len=28
117	6.617695	10.21.143.214	128.119.245.12	UDP	70	61488 → 33448 Len=28
115	6.612261	10.21.143.214	128.119.245.12	UDP	70	61488 → 33447 Len=28
112	6.609068	10.21.143.214	128.119.245.12	UDP	70	61488 → 33446 Len=28
109	6.605209	10.21.143.214	128.119.245.12	UDP	70	61488 → 33445 Len=28
107	6.600885	10.21.143.214	128.119.245.12	UDP	70	61488 → 33444 Len=28
103	6.592776	10.21.143.214	128.119.245.12	UDP	70	61488 → 33443 Len=28
101	6.590209	10.21.143.214	128.119.245.12	UDP	70	61488 → 33442 Len=28
99	6.587047	10.21.143.214	128.119.245.12	UDP	70	61488 → 33441 Len=28
97	6.584726	10.21.143.214	128.119.245.12	UDP	70	61488 → 33440 Len=28
93	6.574037	10.21.143.214	128.119.245.12	UDP	70	61488 → 33439 Len=28
91	6.570690	10.21.143.214	128.119.245.12	UDP	70	61488 → 33438 Len=28
89	6.568115	10.21.143.214	128.119.245.12	UDP	70	61488 → 33437 Len=28
87	6.564948	10.21.143.214	128.119.245.12	UDP	70	61488 → 33436 Len=28
85	6.558951	10.21.143.214	128.119.245.12	UDP	70	61488 → 33435 Len=28
773	21.748361	10.21.128.2	10.21.143.214	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
769	21.745541	10.21.128.2	10.21.143.214	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
765	21.741498	10.21.128.2	10.21.143.214	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
526	14.094984	10.21.128.2	10.21.143.214	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
523	14.092015	10.21.128.2	10.21.143.214	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
520	14.086627	10.21.128.2	10.21.143.214	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
90	6.578493	10.21.128.2	10.21.143.214	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
88	6.567875	10.21.128.2	10.21.143.214	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)
86	6.563033	10.21.128.2	10.21.143.214	ICMP	70	Time-to-live exceeded (Time to live exceeded in transit)

Source Address: 10.21.128.2
Destination Address: 10.21.143.214
[Stream Index: 11]
Internet Control Message Protocol
Type: 11 (Time-to-live exceeded)
Code: 0 (Time to live exceeded in transit)
Checksum: 0x04a5 [correct]
[Checksum Status: Good]
Unused: 00000000
Internet Protocol Version 4, Src: 10.21.143.214, Dst: 128.119.245.12
0100 = Version: 4
.... 0101 = Header Length: 20 bytes (5)
Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
0000 00.. = Differentiated Services Codepoint: Default (0)
.... ..00 = Explicit Congestion Notification: Not ECN-Capable Transport (0)
Total Length: 56
Identification: 0xf031 (61489)
> 000. = Flags: 0x0
...0 0000 0000 0000 = Fragment Offset: 0
> Time To Live: 1
Protocol: UDP (17)

0000 c6 19 77 e6 6b 1a f0 4a 02 c4 c7 82 08 00 45 c0 ...w-k...JE-
0010 00 38 35 63 00 00 fe 01 62 9f 0a 15 00 02 0a 15 ..85c.... b
0020 8f d6 00 00 04 a5 00 00 00 00 45 00 00 38 f0 31E-8-1
0030 00 00 01 11 ba 14 0a 15 8f d6 80 77 f5 0c f0 30w...0
0040 82 9b 00 24 7d 6a\$}

The packet 773 - 86 shown in the figure above is the ICMP TTLexceeded reply by the first hop router.

3.1 Question 8-9

More detailed information can be found in the attached file 8-9.pdf.

```

> Frame 86: 70 bytes on wire (560 bits), 70 bytes captured (560 bits) on interface en0, id 0
> Ethernet II, Src: Cisco_c4:c7:82 (f0:4a:02:c4:c7:82), Dst: c6:19:77:e6:6b:1a (c6:19:77:e6:6b:
v Internet Protocol Version 4, Src: 10.21.128.2, Dst: 10.21.143.214
  0100 .... = Version: 4
    .... 0101 = Header Length: 20 bytes (5)
  v Differentiated Services Field: 0xc0 (DSCP: CS6, ECN: Not-ECT)
    1100 00.. = Differentiated Services Codepoint: Class Selector 6 (48)
    .... ..00 = Explicit Congestion Notification: Not ECN-Capable Transport (0)
    Total Length: 56
    Identification: 0x3563 (13667)
  > 000. .... = Flags: 0x0
    ...0 0000 0000 0000 = Fragment Offset: 0
    Time to Live: 254
    Protocol: ICMP (1)
    Header Checksum: 0x629f [validation disabled]
    [Header checksum status: Unverified]
    Source Address: 10.21.128.2
    Destination Address: 10.21.143.214
    [Stream index: 11]
v Internet Control Message Protocol
  Type: 11 (Time-to-live exceeded)
  Code: 0 (Time to live exceeded in transit)
  Checksum: 0x04a5 [correct]
  [Checksum Status: Good]
  Unused: 00000000
v Internet Protocol Version 4, Src: 10.21.143.214, Dst: 128.119.245.12
  0100 .... = Version: 4
    .... 0101 = Header Length: 20 bytes (5)
  v Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
    0000 00.. = Differentiated Services Codepoint: Default (0)
    .... ..00 = Explicit Congestion Notification: Not ECN-Capable Transport (0)
    Total Length: 56
    Identification: 0xf031 (61489)
  > 000. .... = Flags: 0x0
    ...0 0000 0000 0000 = Fragment Offset: 0
  > Time to Live: 1
    Protocol: UDP (17)
    Header Checksum: 0xba14 [validation disabled]
    [Header checksum status: Unverified]
    Source Address: 10.21.143.214
    Destination Address: 128.119.245.12

```

In the IP protocol, the TTL field is always 254 which remains unchanged. (But in the ICMP protocol, the TTL field is always 1.) The Identification field for frame 86 (screenshot above) is 0x3563 (13667). This field is always changing.

4 Fragmentation

```
No.      Time      Source      Destination      Protocol Length Info
  518 14.082217    10.21.143.214    128.119.245.12    IPv4      1514   Fragmented IP
protocol (proto=UDP 17, off=0, ID=f06d) [Reassembled in #519]
Frame 518: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits) on interface en0, id
0
Ethernet II, Src: c6:19:77:e6:6b:1a (c6:19:77:e6:6b:1a), Dst: IETF-VRRP-VRID_32 (00:00:5e:
00:01:32)
Internet Protocol Version 4, Src: 10.21.143.214, Dst: 128.119.245.12
  0100 .... = Version: 4
  .... 0101 = Header Length: 20 bytes (5)
  Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
    0000 00.. = Differentiated Services Codepoint: Default (0)
    .... ..00 = Explicit Congestion Notification: Not ECN-Capable Transport (0)
  Total Length: 1500
  Identification: 0xf06d (61549)
  001. .... = Flags: 0x1, More fragments
  ...0 0000 0000 0000 = Fragment Offset: 0
  Time to Live: 1
  Protocol: UDP (17)
  Header Checksum: 0x9434 [validation disabled]
  [Header checksum status: Unverified]
  Source Address: 10.21.143.214
  Destination Address: 128.119.245.12
  [Reassembled IPv4 in frame: 519]
  [Stream index: 10]
Data (1480 bytes)
0000 f0 6c 82 9b 07 bc 6d fe 00 00 00 00 00 00 00 00 .l....m.....
0010 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0020 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0030 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0040 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0050 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0060 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0070 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0080 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0090 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00a0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00b0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00c0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
```

```

Ethernet II, Src: c6:19:77:e6:6b:1a (c6:19:77:e6:6b:1a), Dst: IETF-VRRP-VRID_32 (00:00:5e:
00:01:32)
Internet Protocol Version 4, Src: 10.21.143.214, Dst: 128.119.245.12
  0100 .... = Version: 4
  .... 0101 = Header Length: 20 bytes (5)
  Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
    0000 00.. = Differentiated Services Codepoint: Default (0)
    .... ..00 = Explicit Congestion Notification: Not ECN-Capable Transport (0)
  Total Length: 520
  Identification: 0xf06d (61549)
  000. .... = Flags: 0x0
  ...0 0000 1011 1001 = Fragment Offset: 1480
  Time to Live: 1
  Protocol: UDP (17)
  Header Checksum: 0xb74f [validation disabled]
  [Header checksum status: Unverified]
  Source Address: 10.21.143.214
  Destination Address: 128.119.245.12
  [2 IPv4 Fragments (1980 bytes): #518(1480), #519(500)]
  [Stream index: 10]
User Datagram Protocol, Src Port: 61548, Dst Port: 33435
Data (1972 bytes)
0000 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0010 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0020 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0030 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0040 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0050 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0060 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0070 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0080 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0090 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00a0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00b0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00c0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00d0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00e0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
00f0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0100 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0110 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....

```

The two figures above show the ICMP Echo Request message sent with a packet size of 2000 bytes. The first figure shows the first fragment, and the second figure shows the second fragment.

4.1 Question 10-13

Yes, the ICMP Echo Request message sent with a packet size of 2000 bytes has been fragmented into multiple IP datagrams.

It can be seen that the "Flags: 0x1" in the first fragment, and fragment offset is 0 which indicates that this is the first fragment (instead of a latter fragment). This datagram length is 1500 bytes with the header length of 20 bytes and the payload length of 1480 bytes.

For the second fragment, fragment offset is 1480 which indicates that this is the second fragment (instead of a first fragment). There are no more fragments after this datagram, so the "Flags: 0x0" indicates that this is

the last fragment.

The changed fields are:

- Identification: Different identification numbers for different fragments.
- Fragment Offset: 0 for the first fragment, 1480 for the second fragment.
- Flags: 0x1 for the first fragment, 0x0 for the second fragment.
- Total (and payload) Length: First fragment: 1500 bytes, second fragment: 520 bytes.
- Header Checksum: Changed as Identification changes.

4.2 Question 14-15

```
No.      Time      Source      Destination      Protocol Length Info
 762 21.735798 10.21.143.214 128.119.245.12  IPv4      1514  Fragmented IP
protocol (proto=UDP 17, off=0, ID=f0c5) [Reassembled in #764]
Frame 762: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits) on interface en0, id
0
Ethernet II, Src: c6:19:77:e6:6b:1a (c6:19:77:e6:6b:1a), Dst: IETF-VRRP-VRID_32 (00:00:5e:
00:01:32)
Internet Protocol Version 4, Src: 10.21.143.214, Dst: 128.119.245.12
 0100 .... = Version: 4
.... 0101 = Header Length: 20 bytes (5)
Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
 0000 00.. = Differentiated Services Codepoint: Default (0)
.... ..00 = Explicit Congestion Notification: Not ECN-Capable Transport (0)
Total Length: 1500
Identification: 0xf0c5 (61637)
001. .... = Flags: 0x1, More fragments
...0 0000 0000 0000 = Fragment Offset: 0
Time to Live: 1
Protocol: UDP (17)
Header Checksum: 0x93dc [validation disabled]
[Header checksum status: Unverified]
Source Address: 10.21.143.214
Destination Address: 128.119.245.12
[Reassembled IPv4 in frame: 764]
[Stream index: 10]
Data (1480 bytes)
0000 f0 c4 82 9b 0d 98 61 ee 00 00 00 00 00 00 00 00 .....a.....
0010 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0020 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0030 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0040 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
```

```

05b0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
05c0 00 00 00 00 00 00 00 00 .....
No.      Time      Source      Destination      Protocol Length Info
   763 21.735814    10.21.143.214    128.119.245.12    IPv4      1514    Fragmented IP
protocol (proto=UDP 17, off=1480, ID=f0c5) [Reassembled in #764]
Frame 763: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits) on interface en0, id
0

```

Ethernet II, Src: c6:19:77:e6:6b:1a (c6:19:77:e6:6b:1a), Dst: IETF-VRRP-VRID_32 (00:00:5e:00:01:32)

Internet Protocol Version 4, Src: 10.21.143.214, Dst: 128.119.245.12

0100 = Version: 4

.... 0101 = Header Length: 20 bytes (5)

Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)

0000 00.. = Differentiated Services Codepoint: Default (0)

.... ..00 = Explicit Congestion Notification: Not ECN-Capable Transport (0)

Total Length: 1500

Identification: 0xf0c5 (61637)

001. = Flags: 0x1, More fragments

...0 0000 1011 1001 = Fragment Offset: 1480

Time to Live: 1

Protocol: UDP (17)

Header Checksum: 0x9323 [validation disabled]

[Header checksum status: Unverified]

Source Address: 10.21.143.214

Destination Address: 128.119.245.12

[Reassembled IPv4 in frame: 764]

[Stream index: 10]

Data (1480 bytes)

```

0000 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0010 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....

```

```

05c0 00 00 00 00 00 00 00 00 .....

```

```

No.      Time      Source      Destination      Protocol Length Info
   764 21.735817    10.21.143.214    128.119.245.12    UDP        554    61636 → 33435

```

Len=3472

Frame 764: 554 bytes on wire (4432 bits), 554 bytes captured (4432 bits) on interface en0, id 0

Ethernet II, Src: c6:19:77:e6:6b:1a (c6:19:77:e6:6b:1a), Dst: IETF-VRRP-VRID_32 (00:00:5e:00:01:32)

Internet Protocol Version 4, Src: 10.21.143.214, Dst: 128.119.245.12

0100 = Version: 4

.... 0101 = Header Length: 20 bytes (5)

Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)

0000 00.. = Differentiated Services Codepoint: Default (0)

.... ..00 = Explicit Congestion Notification: Not ECN-Capable Transport (0)

Total Length: 540

Identification: 0xf0c5 (61637)

000. = Flags: 0x0

...0 0001 0111 0010 = Fragment Offset: 2960

Time to Live: 1

Protocol: UDP (17)

Header Checksum: 0xb62a [validation disabled]

[Header checksum status: Unverified]

Source Address: 10.21.143.214

Destination Address: 128.119.245.12

[3 IPv4 Fragments (3480 bytes): #762(1480), #763(1480), #764(520)]

[Stream index: 10]

User Datagram Protocol, Src Port: 61636, Dst Port: 33435

Data (3472 bytes)

```

0000 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....
0010 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 .....

```

The three figures above show the ICMP Echo Request message sent with a packet size of 3500 bytes. So the total amount of fragments is 3: The first fragment and the second fragment have "Flags: 0x1" and the third

fragment has "Flags: 0x0". Fields that are changed:

- Identification: Different identification numbers for different fragments.
- Fragment Offset: 0 for the first fragment, 1480 for the second fragment, and 2960 for the third fragment.
- Flags: 0x1 for the first and second fragments, 0x0 for the third fragment.
- Total (and payload) Length: First fragment: 1500 bytes, second fragment: 1500 bytes, third fragment: 540 bytes.
- Header Checksum: Changed as Identification changes.