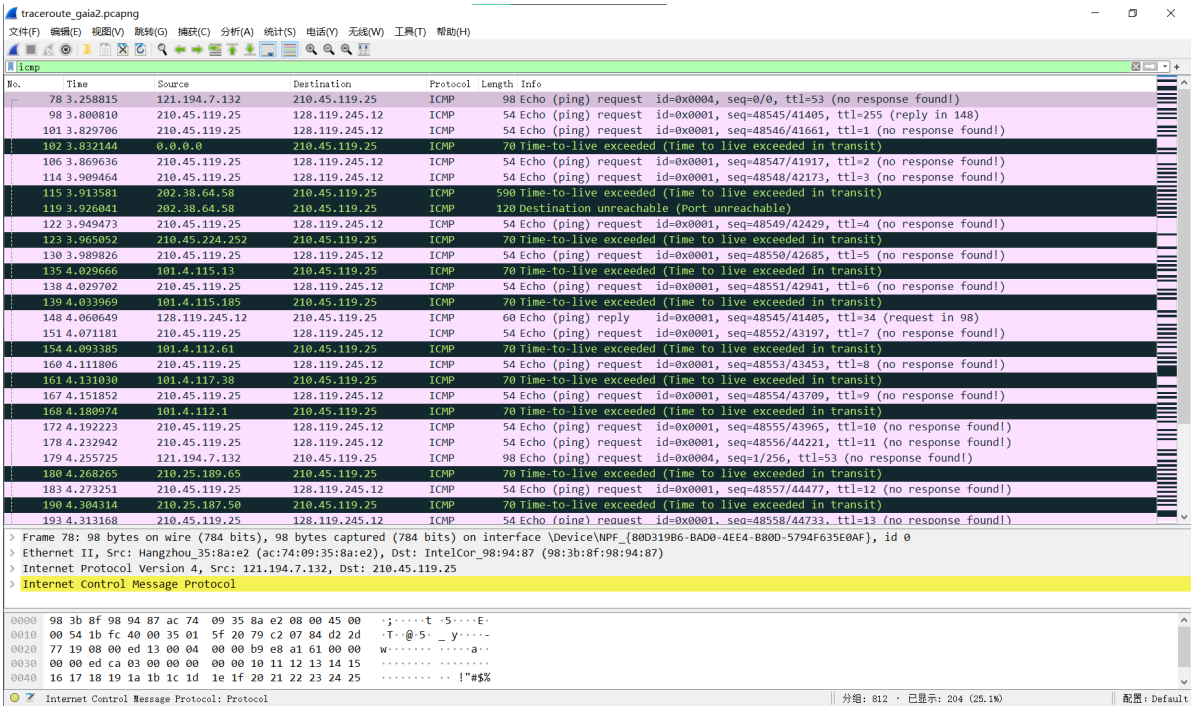
PW2 实验文档

实验名称：traceroute

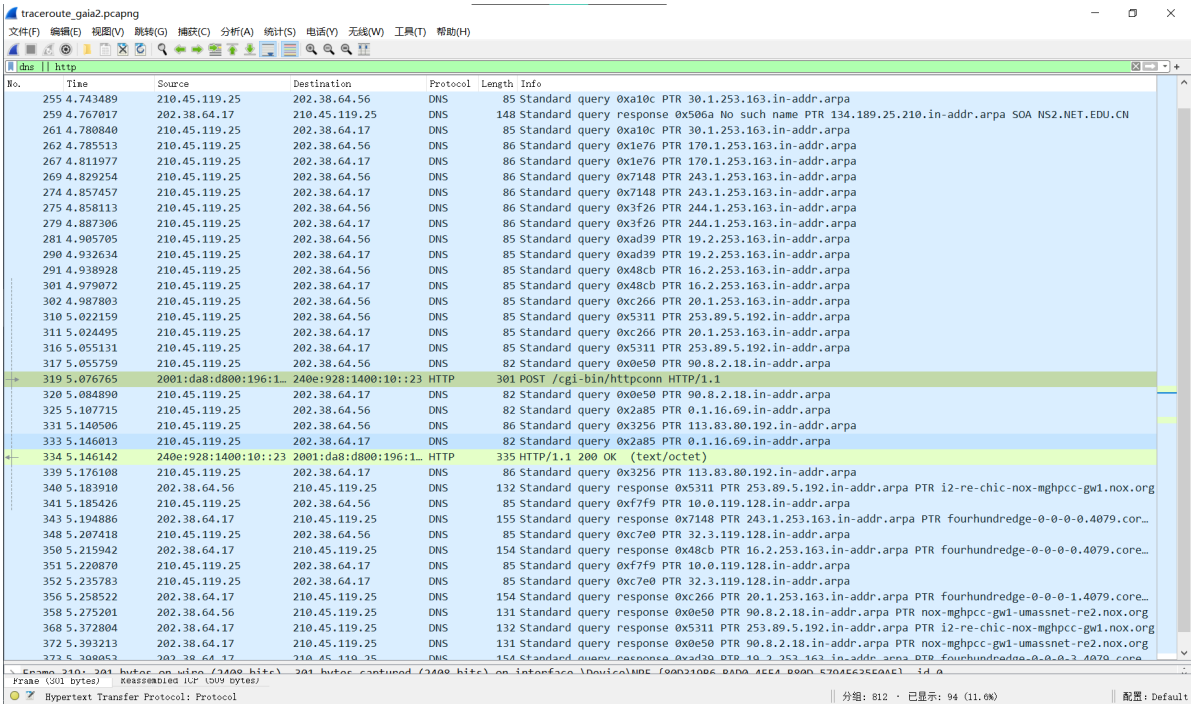
A1

1. 过滤得到所有`ICMP`包的结果：



2. 过滤得到其他应用层协议包的结果：

这里过滤了`DNS`和`HTTP`的包。



`HTTP`的包应该不是`traceroute`产生的，因为我另一次`traceroute`时抓到的`HTTP`与Windows自动更新有关；我一个同学抓的包里就没有`HTTP`包。

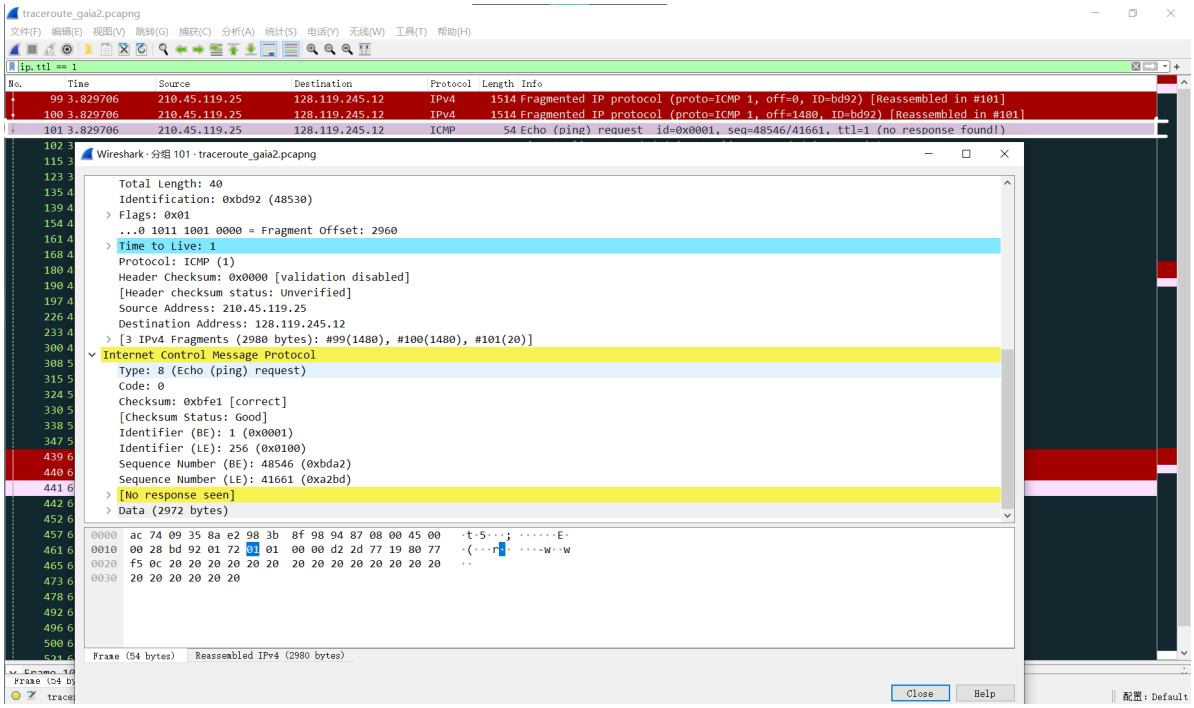
虽然上面这个截图里的`HTTP`包的链接打不开，但我合理推测，觉得和`traceroute`无关。

A2

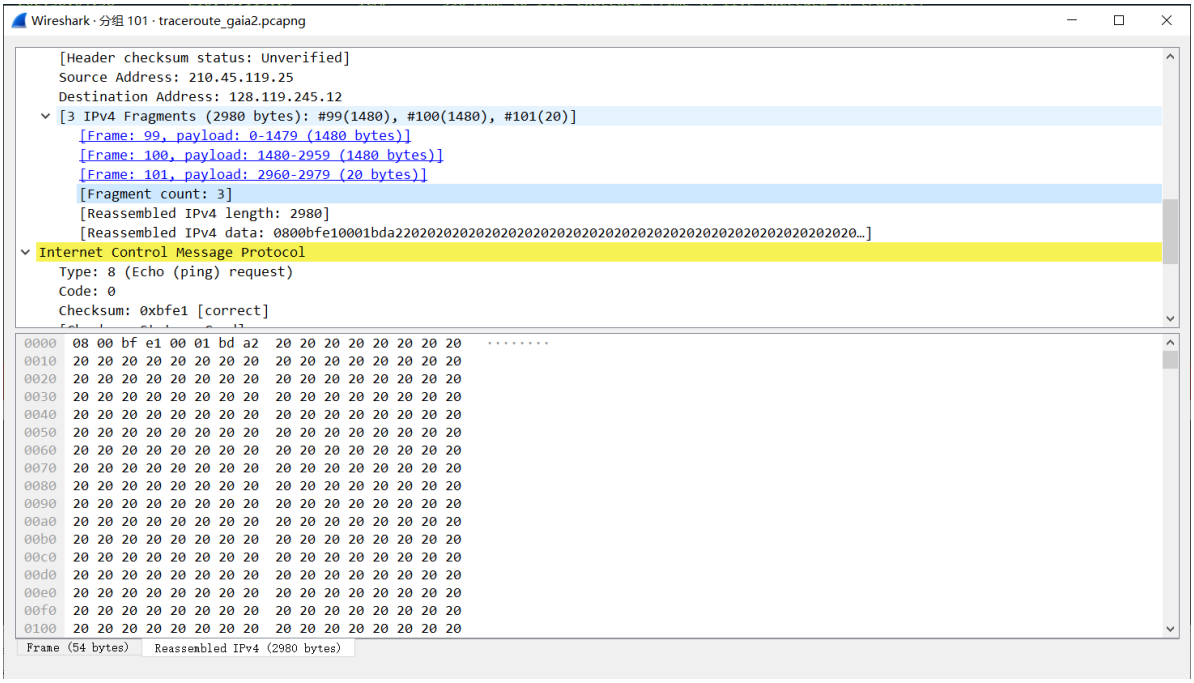
1. 从本机到`gaia.cs.umas.edu`主机，一共有36跳：

```
通过最多 48 个跃点跟踪
到 gaia.cs.umass.edu [128.119.245.12] 的路由:

  1    24 ms    34 ms    17 ms  202.141.164.254
  2     *        *        *     请求超时。
  3    22 ms    18 ms    20 ms  10.12.2.53
  4    27 ms    19 ms    16 ms  61.190.195.53
  5    13 ms    18 ms     *     61.191.109.201
  6    50 ms    61 ms    38 ms  202.102.205.77
  7    21 ms    40 ms    23 ms  202.97.100.5
  8     *        *        *     请求超时。
  9     *        *        *     请求超时。
 10   162 ms   172 ms   157 ms  202.97.51.206
 11   238 ms   158 ms   161 ms  be-221-pe04.9greatoaks.ca.ibone.comcast.net [66.208.216.33]
 12   237 ms   204 ms   204 ms  be-2204-cs02.9greatoaks.ca.ibone.comcast.net [96.110.36.181]
 13   221 ms   400 ms   202 ms  be-1212-cr12.9greatoaks.ca.ibone.comcast.net [68.86.166.146]
 14   202 ms   307 ms   203 ms  be-301-cr12.sunnyvale.ca.ibone.comcast.net [96.110.37.169]
 15   164 ms   239 ms   205 ms  be-1312-cs03.sunnyvale.ca.ibone.comcast.net [96.110.46.29]
 16   168 ms   228 ms     *     be-1311-cr11.sunnyvale.ca.ibone.comcast.net [96.110.46.26]
 17   180 ms   179 ms   193 ms  be-304-cr12.champa.co.ibone.comcast.net [96.110.39.29]
 18   206 ms   195 ms   204 ms  be-1412-cs04.champa.co.ibone.comcast.net [96.110.37.221]
 19   305 ms   295 ms   210 ms  be-1413-cr13.champa.co.ibone.comcast.net [96.110.37.238]
 20   209 ms   204 ms   203 ms  be-302-cr13.1601milehigh.co.ibone.comcast.net [96.110.36.198]
 21   297 ms   302 ms   304 ms  be-1413-cs04.1601milehigh.co.ibone.comcast.net [96.110.39.109]
 22   175 ms   245 ms     *     be-1411-cr11.1601milehigh.co.ibone.comcast.net [96.110.39.78]
 23     *        *        *     请求超时。
 24   331 ms   317 ms   221 ms  be-1111-cs01.350ecermak.il.ibone.comcast.net [96.110.35.1]
 25   296 ms   249 ms   361 ms  be-1112-cr12.350ecermak.il.ibone.comcast.net [96.110.35.18]
 26   267 ms   212 ms   289 ms  be-301-cr11.newyork.ny.ibone.comcast.net [96.110.38.66]
 27   335 ms   258 ms   218 ms  be-1111-cs01.newyork.ny.ibone.comcast.net [96.110.35.113]
 28   223 ms   223 ms   265 ms  be-32011-ar01.needham.ma.boston.comcast.net [96.110.42.2]
 29   263 ms   300 ms   220 ms  162.151.53.214
 30   300 ms   240 ms   269 ms  96.108.44.226
 31     *        *        *     请求超时。
 32   248 ms   321 ms   307 ms  core2-rt-et-8-3-0.gw.umass.edu [192.80.83.113]
 33   255 ms   276 ms   285 ms  n5-rt-1-1-et-10-0-0.gw.umass.edu [128.119.0.10]
 34   289 ms   278 ms   256 ms  cics-rt-xe-0-0-0.gw.umass.edu [128.119.3.32]
 35   343 ms   306 ms   306 ms  nscs1bbs1.cs.umass.edu [128.119.240.253]
 36   284 ms   306 ms   223 ms  gaia.cs.umass.edu [128.119.245.12]

跟踪完成。
```

2. 下图为`ICMP`第一个ttl = 1的`Echo Request`的包：



3. 分片：

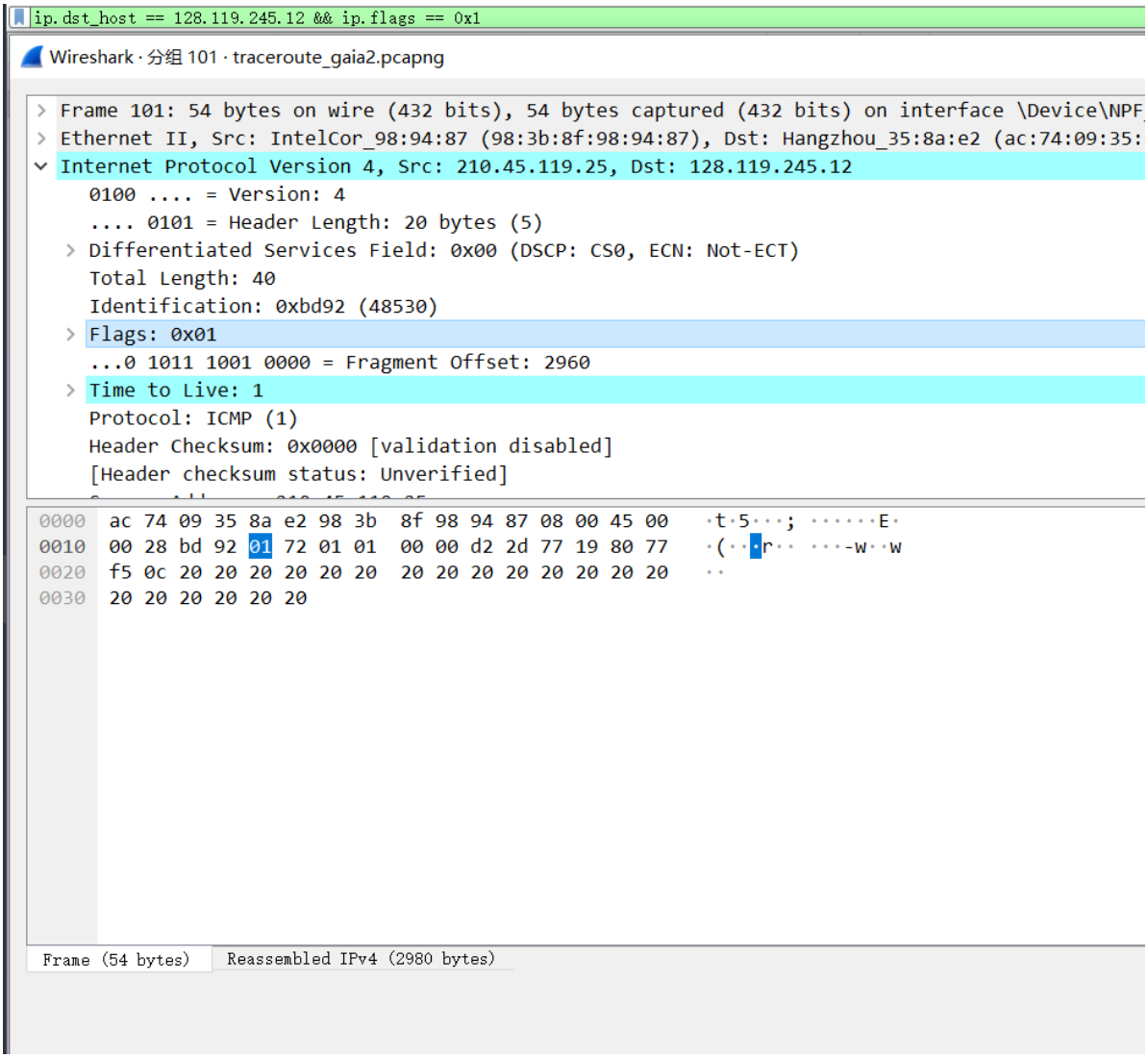


一共分了3片。（`Fragment count: 3`）

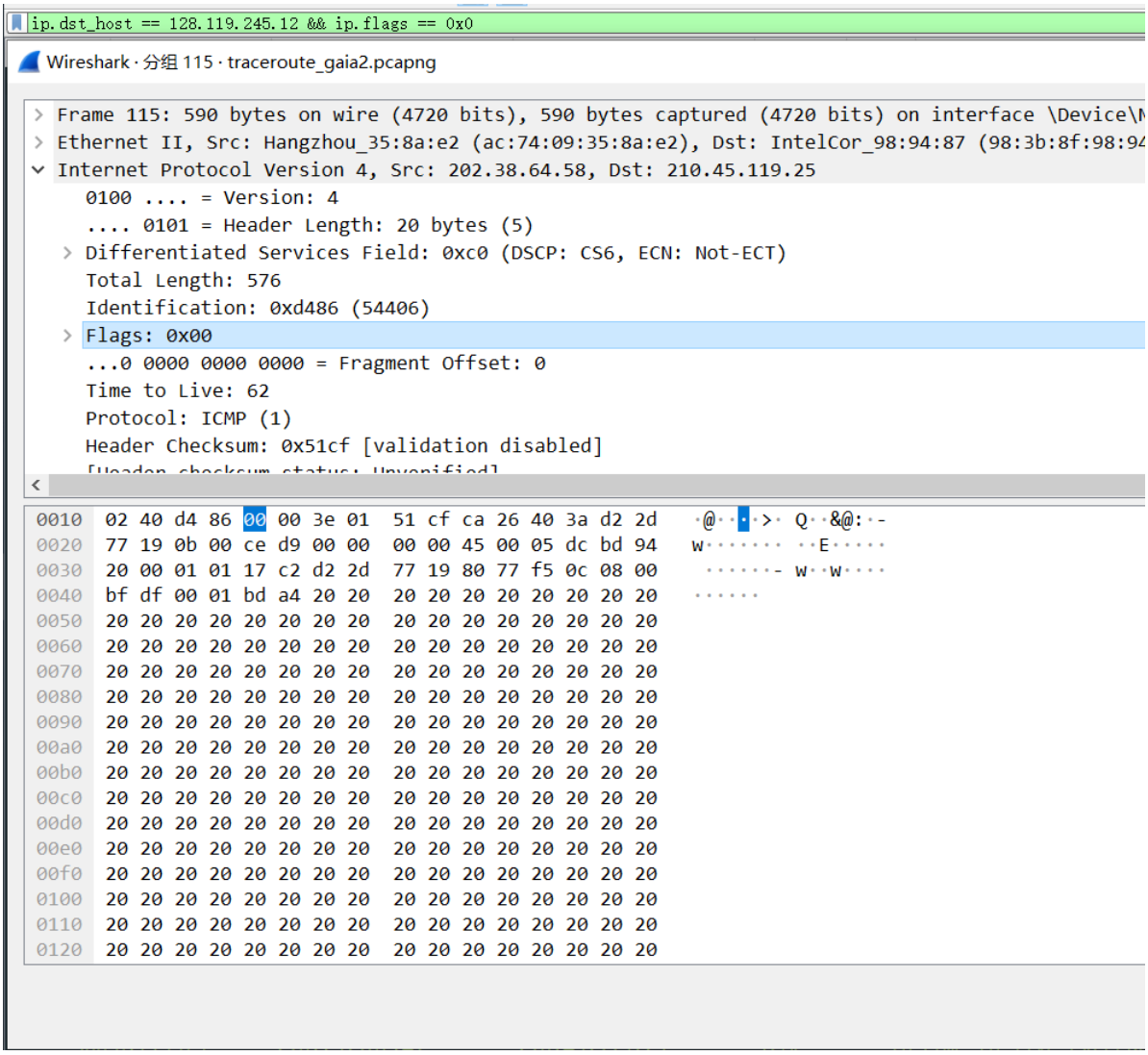
分片是因为，我们在设置里把包的大小设为3000 Bytes，并且允许包的分片；MTU最大是1500 Bytes，除去各协议的头部，小于包的长度，所以会分片。

A3

1. `fregamentation and reassembly`：IP报文被分片后，只在dst_host处重组；报文的每个分片的小报文里，携带报文长度、ID（同个大报文的片段拥有同个ID）、flag（标识是否是最后一个报文片段，若flag=0x1，则不是，若flag=0x0，则是）和offset（表示该报文片段位于大报文的哪个位置）
2. 如下图的两个fregment就分别是中间和最后一个报文片段：

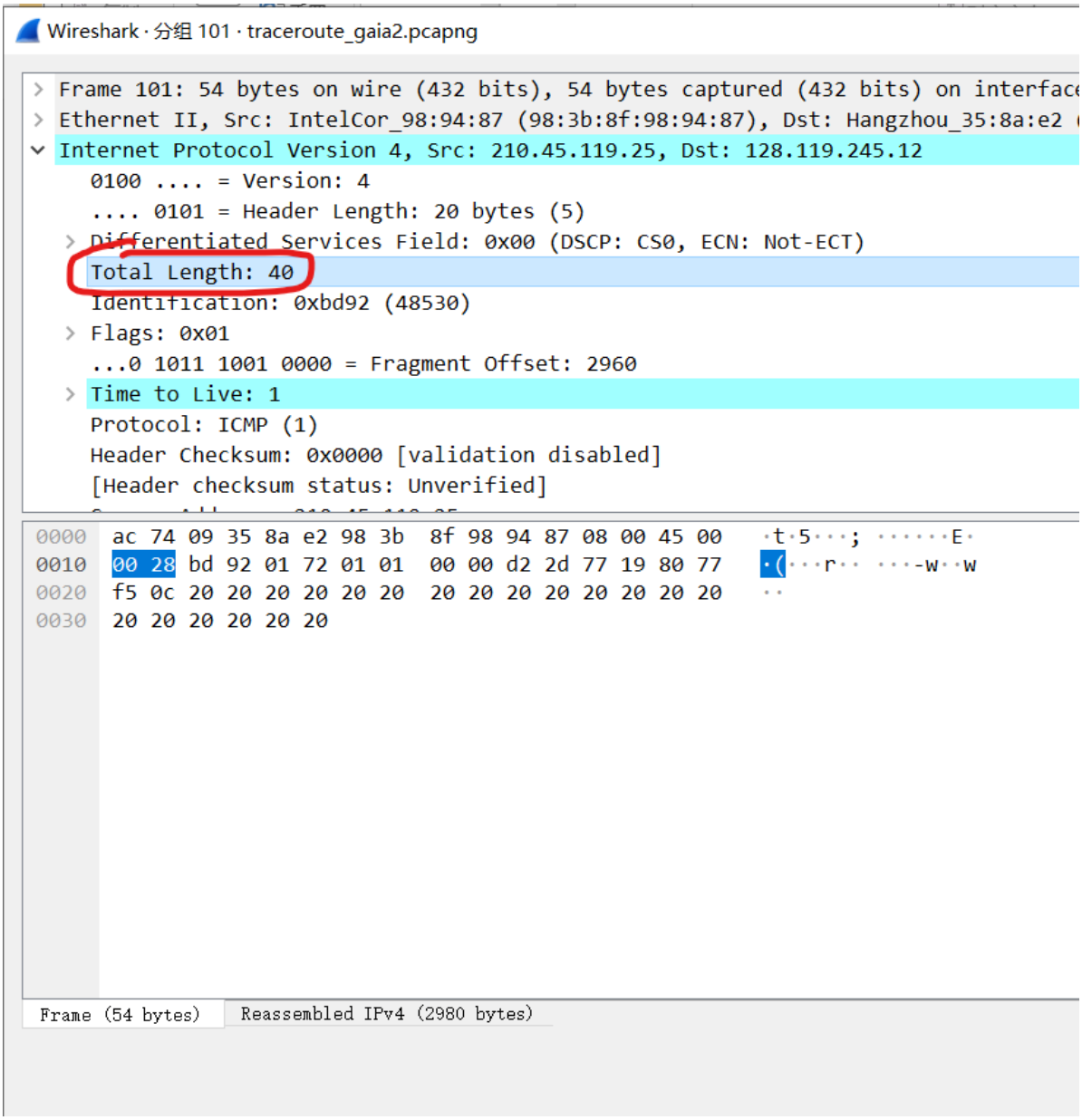


上图是报文片段的中间部分。



上图是报文片段的结尾（最后一个片段）。

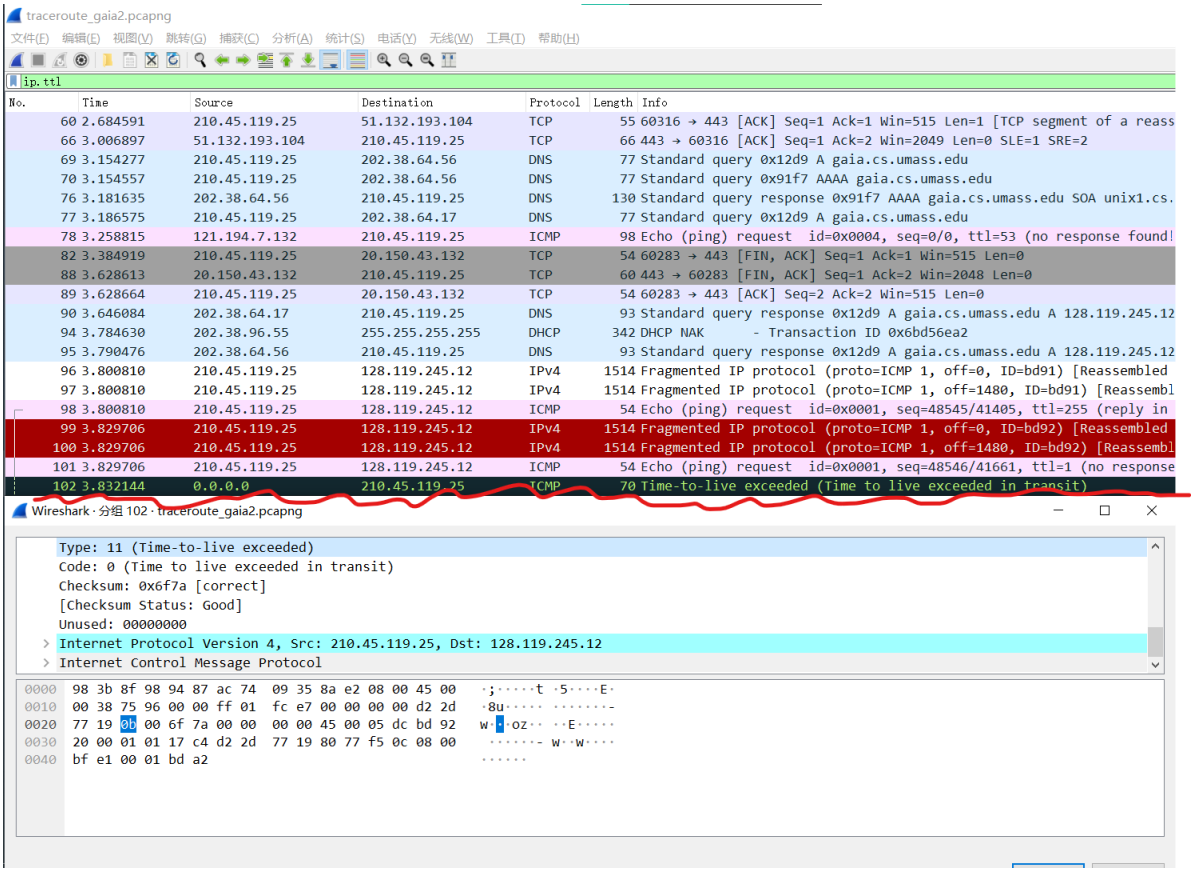
3. `Total Length` 表示这个报文片段的长度：



上图表示该报文片段的长度为40 bytes。

A4

如图，ttl-exceeded包会返回给路由器，payload里有Type: 11的字段（Time-to-live exceeded）。



A5

```
通过最多 48 个跃点跟踪
到 gaia.cs.umass.edu [128.119.245.12] 的路由:

  1    24 ms    34 ms    17 ms  202.141.164.254
  2     *        *        *     请求超时。
  3    22 ms    18 ms    20 ms  10.12.2.53
  4    27 ms    19 ms    16 ms  61.190.195.53
  5    13 ms    18 ms     *     61.191.109.201
  6    50 ms    61 ms    38 ms  202.102.205.77
  7    21 ms    40 ms    23 ms  202.97.100.5
  8     *        *        *     请求超时。
  9     *        *        *     请求超时。
 10   162 ms   172 ms   157 ms  202.97.51.206
 11   238 ms   158 ms   161 ms  be-221-pe04.9greatoaks.ca.ibone.comcast.net [66.208.216.33]
 12   237 ms   204 ms   204 ms  be-2204-cs02.9greatoaks.ca.ibone.comcast.net [96.110.36.181]
 13   221 ms   400 ms   202 ms  be-1212-cr12.9greatoaks.ca.ibone.comcast.net [68.86.166.146]
 14   202 ms   307 ms   203 ms  be-301-cr12.sunnyvale.ca.ibone.comcast.net [96.110.37.169]
 15   164 ms   239 ms   205 ms  be-1312-cs03.sunnyvale.ca.ibone.comcast.net [96.110.46.29]
 16   168 ms   228 ms     *     be-1311-cr11.sunnyvale.ca.ibone.comcast.net [96.110.46.26]
 17   180 ms   179 ms   193 ms  be-304-cr12.champa.co.ibone.comcast.net [96.110.39.29]
 18   206 ms   195 ms   204 ms  be-1412-cs04.champa.co.ibone.comcast.net [96.110.37.221]
 19   305 ms   295 ms   210 ms  be-1413-cr13.champa.co.ibone.comcast.net [96.110.37.238]
 20   209 ms   204 ms   203 ms  be-302-cr13.1601milehigh.co.ibone.comcast.net [96.110.36.198]
 21   297 ms   302 ms   304 ms  be-1413-cs04.1601milehigh.co.ibone.comcast.net [96.110.39.109]
 22   175 ms   245 ms     *     be-1411-cr11.1601milehigh.co.ibone.comcast.net [96.110.39.78]
 23     *        *        *     请求超时。
 24   331 ms   317 ms   221 ms  be-1111-cs01.350ecermak.il.ibone.comcast.net [96.110.35.1]
 25   296 ms   249 ms   361 ms  be-1112-cr12.350ecermak.il.ibone.comcast.net [96.110.35.18]
 26   267 ms   212 ms   289 ms  be-301-cr11.newyork.ny.ibone.comcast.net [96.110.38.66]
 27   335 ms   258 ms   218 ms  be-1111-cs01.newyork.ny.ibone.comcast.net [96.110.35.113]
 28   223 ms   223 ms   265 ms  be-32011-ar01.needham.ma.boston.comcast.net [96.110.42.2]
 29   263 ms   300 ms   220 ms  162.151.53.214
 30   300 ms   240 ms   269 ms  96.108.44.226
 31     *        *        *     请求超时。
 32   248 ms   321 ms   307 ms  core2-rt-et-8-3-0.gw.umass.edu [192.80.83.113]
 33   255 ms   276 ms   285 ms  n5-rt-1-1-et-10-0-0.gw.umass.edu [128.119.0.10]
 34   289 ms   278 ms   256 ms  cics-rt-xe-0-0-0.gw.umass.edu [128.119.3.32]
 35   343 ms   306 ms   306 ms  nscs1bbs1.cs.umass.edu [128.119.240.253]
 36   284 ms   306 ms   223 ms  gaia.cs.umass.edu [128.119.245.12]

跟踪完成。
```

上图为traceroute的各跳路由器，由图知，从第7到第10跳是跨过了太平洋电缆，因为RTT明显增多（增加了7倍），说明路程更远。

router addresses: 202.97.100.5~202.97.51.206

A6

第7跳的平均RTT：

$$RTT\ average_7 = (21 + 40 + 23)/3 = 28ms$$

第10跳的平均RTT：

$$RTT\ average_{10} = (162 + 172 + 157)/3 = 164ms$$

太平洋海底电缆的距离：

$$S\ pacific = [(164 - 28)/2] * 10^{-3} * 2 * 10^8 = 1.36 * 10^7 m$$