中国科学技术大学计算机学院

计算机网络实验报告

实验四

利用 Wireshark 观察 IP 报文

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一、 实验目的

1、 通过捕获观察并分析 IP 报文，理解 IP 的细节，掌握 traceroute 的使用。

二、 实验原理

Wireshark 是一个 packet 分析工具，可以抓取 packet，并分析出详细信息。Wireshark 使用 wincap 作为接口，直接与网卡进行 packet 交换，监听共享网络上传送的 packet。

IP 数据报首部的 TTL(Time to live)表示数据报的生存时间,每经过路由器转发一次,就至少减少 1,当减少到 0 的时候,会被路由器丢弃,并返回 ICMP 消息.

Traceroute 通过巧妙的设置 ttl,通过一次次的重传,与 ttl+1 来得到到目的

地址的路径上的路由器的信息.

三、 实验条件

1、 硬件条件： 联想 Y700：

i5-6300HQ 2.30GHz

16G 内存

Intel(R) Dual Band Wireless-AC 3165

2、 软件条件： Win10 Professional 1703

Wireshark2.4.2

以及 WSL(Windows Subsystem for Linux)(如下)

```
Reaper@KZ:/mnt/d/USTC/algorithm$ lsb_release -a
No LSB modules are available.
Distributor ID: Ubuntu
Description:    Ubuntu 16.04.3 LTS
Release:        16.04
Codename:       xenial
```

traceroute for Linux, 2.0.21

```
Reaper@KZ:/mnt/d/USTC/algorithm$ traceroute -V
Modern traceroute for Linux, version 2.0.21
Copyright (c) 2008  Dmitry Butskoy,   License: GPL v2 or any later
```

四、 实验过程

1、 安装 traceroute

```
Reaper@KZ:/mnt/d/USTC/algorithm$ traceroute
程序 'traceroute' 已包含在下列软件包中：
 * inetutils-traceroute
 * traceroute
请尝试：sudo apt install <选定的软件包>
Reaper@KZ:/mnt/d/USTC/algorithm$ sudo apt-get install traceroute
[sudo] Reaper 的密码：
正在读取软件包列表... 完成
正在分析软件包的依赖关系树
正在读取状态信息... 完成
下列【新】软件包将被安装：
  traceroute
升级了 0 个软件包，新安装了 1 个软件包，要卸载 0 个软件包，有 0 个软件包未被升级。
需要下载 45.5 kB 的归档。
解压缩后会消耗 177 kB 的额外空间。
获取:1 https://mirrors.ustc.edu.cn/ubuntu xenial/universe amd64 traceroute amd64 1:2.0.21-1 [45.5 kB]
已下载 45.5 kB，耗时 1秒 (40.8 kB/s)
正在选中未选择的软件包 traceroute。
(正在读取数据库 ... 系统当前共安装有 42618 个文件和目录。)
正准备解包 .../traceroute_1%3a2.0.21-1_amd64.deb  ...
正在解包 traceroute (1:2.0.21-1) ...
正在处理用于 man-db (2.7.5-1) 的触发器 ...
正在设置 traceroute (1:2.0.21-1) ...
update-alternatives: 使用 /usr/bin/traceroute.db 来在自动模式中提供 /usr/bin/traceroute (traceroute)
update-alternatives: 使用 /usr/bin/lft.db 来在自动模式中提供 /usr/bin/lft (lft)
update-alternatives: 使用 /usr/bin/traceproto.db 来在自动模式中提供 /usr/bin/traceproto (traceproto)
update-alternatives: 使用 /usr/sbin/tcptraceroute.db 来在自动模式中提供 /usr/sbin/tcptraceroute (tcptraceroute)
```

```
Reaper@KZ:/mnt/d/USTC/algorithm$ traceroute -V
Modern traceroute for Linux, version 2.0.21
Copyright (c) 2008  Dmitry Butskoy,   License: GPL v2 or any later
```

2、 利用 traceroute 发包并用 wireshark 查看.

用 wireshark 开始捕获,用 traceroute 发送 3 个 56 字节,2000 字节,3500 字节的包.

```
Reaper@KZ:/mnt/d/USTC/algorithm$ traceroute gaia.cs.umass.edu 56
traceroute to gaia.cs.umass.edu (128.119.245.12), 30 hops max, 56 byte packets
 1  * * *
 2  * * *
 3  * * *
```

```
Reaper@KZ:/mnt/d/USTC/algorithm$ traceroute gaia.cs.umass.edu 2000
traceroute to gaia.cs.umass.edu (128.119.245.12), 30 hops max, 2000 byte packets
 1  * * *
```

```
Reaper@KZ:/mnt/d/USTC/algorithm$ traceroute gaia.cs.umass.edu 3500
traceroute to gaia.cs.umass.edu (128.119.245.12), 30 hops max, 3500 byte packets
 1  * * *
 2  * * *
```

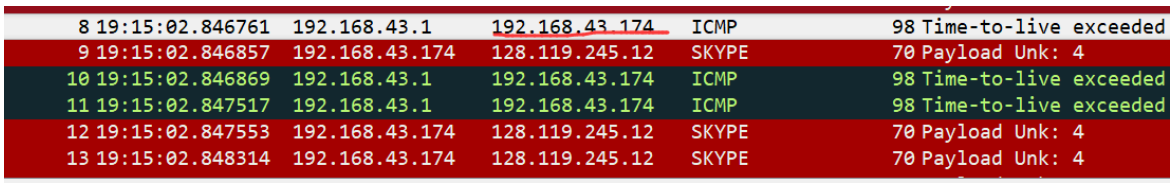
五、 结果分析

以下是 pdf 中 15 个问题对应的回答

(到第 4 题使用我自己抓的包, 之后由于我的电脑没有发 icmp 包出去, 所以用的是官网下载的包.)

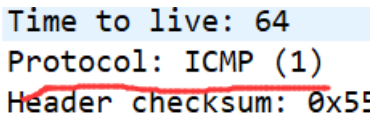
1. Select the first ICMP Echo Request message sent by your computer, and expand the Internet Protocol part of the packet in the packet details window. What is the IP address of your computer?

答：192.168.43.174



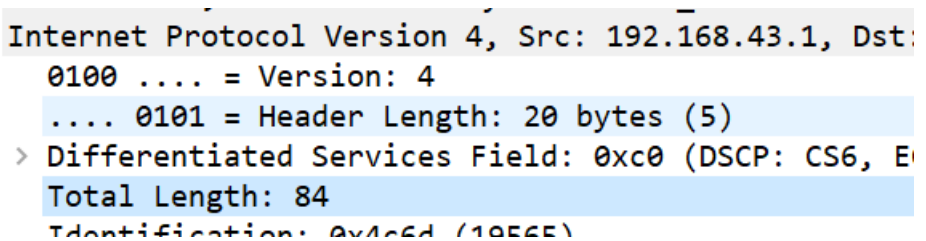
2. Within the IP packet header, what is the value in the upper layer protocol field?

答： 1(表示ICMP)



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.

答： 20 字节, 84-20=64 字节. payload 字节数就是总字节数减去 header 字节数.



4. Has this IP datagram been fragmented? Explain how you determined whether or not the datagram has been fragmented.

答： 没有被 fragmented.因为 more fragments 位没有被置为 1.如下:

```
Internet Protocol Version 4, Src: 192.168.43.174, 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: 0x7fbb (32699)
  v Flags: 0x00
      0... .... = Reserved bit: Not set
      .0.. .... = Don't fragment: Not set
      ..0. .... = More fragments: Not set
    Fragment offset: 0
```

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?

答：

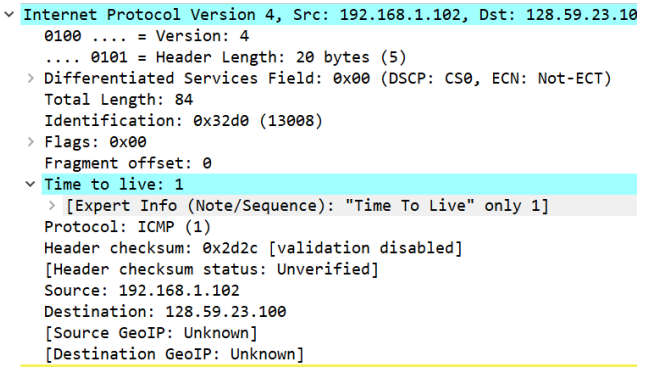
ip.addr == 192.168.43.174 && icmp

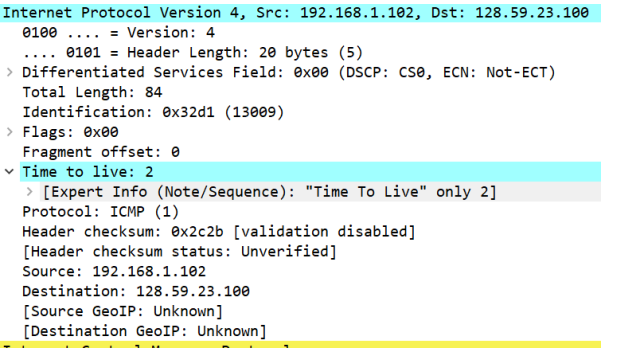
No.	Time	Source	Destination	Protocol	Length	Info
303	19:15:48.672699	192.80.83.101	192.168.43.174	ICMP	70	Time
302	19:15:48.660497	192.80.83.101	192.168.43.174	ICMP	70	Time
90	19:15:13.894417	192.80.83.101	192.168.43.174	ICMP	70	Time
87	19:15:13.891006	192.80.83.101	192.168.43.174	ICMP	70	Time
86	19:15:13.890877	192.80.83.101	192.168.43.174	ICMP	70	Time
498	19:16:35.403341	192.168.43.1	192.168.43.174	ICMP	590	Time
497	19:16:35.402442	192.168.43.1	192.168.43.174	ICMP	590	Time
493	19:16:35.402296	192.168.43.1	192.168.43.174	ICMP	590	Time
180	19:15:38.060260	192.168.43.1	192.168.43.174	ICMP	590	Time
177	19:15:38.059426	192.168.43.1	192.168.43.174	ICMP	590	Time
176	19:15:38.058588	192.168.43.1	192.168.43.174	ICMP	590	Time

↑由于我电脑没有抓到自己电脑发的 icmp,所以这部分题用官网下载好的 trace 文件.

从下面可以看出:

Header 中的 TTL,checksum,Identification 总改变





6. Which fields stay constant? Which of the fields *must* stay constant? Which fields must change? Why?

答：stay constant:

Version, header length, Differentiated Services Field, flags, fragment offset, protocol, source ip address, destination ip address.

必须不变的是

Version:因为都是 ipV4.

Protocol:都是 ICMP

Header length: 因为 protocol 不变,是 icmp,所以 header 不变

Differentiated Services:理由同上,都是 icmp 类型

source ip address,destination ip address:源,目的地址在这一过程不变

必须变的是:

TTL:因为 traceroute 会改变 ttl

Identification:IP 数据报之间要有不一样的 id

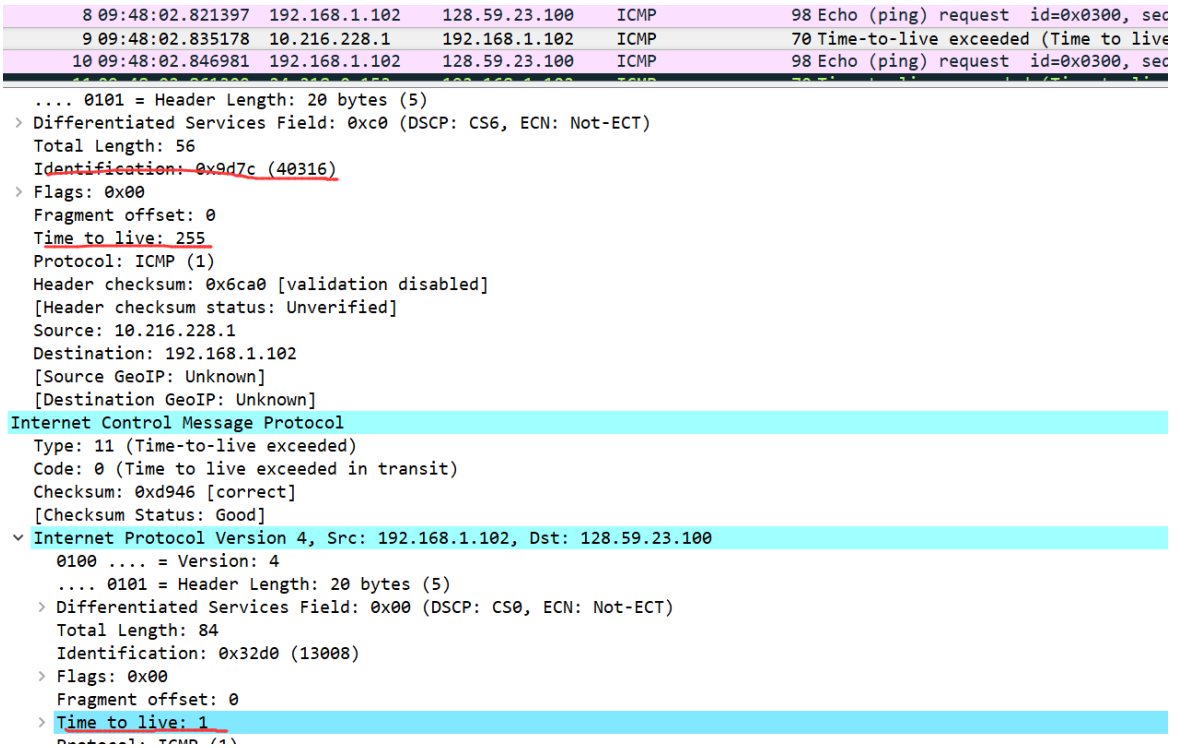
Header checksum:因为 header 每次都会不一样

7. Describe the pattern you see in the values in the Identification field of the IP datagram.

答： 每个 id 会比前一个增加 1

8. What is the value in the Identification field and the TTL field?

答：



第一跳的id为0x9d7c(40316),ttl为255

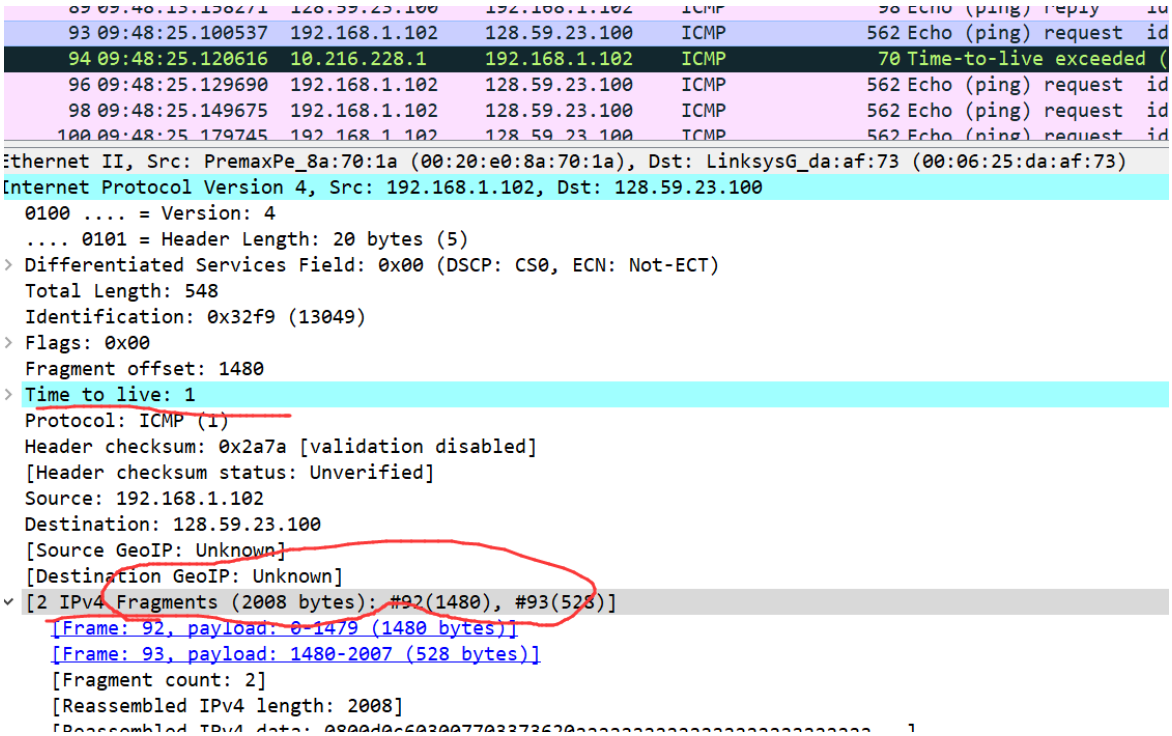
9. Do these values remain unchanged for all of the ICMP TTL-exceeded replies sent to your computer by the nearest (first hop) router? Why?

答： id变化,因为id相同表示ip包是同一个大包的fragment,这里的id需要独立.ttl不变.因为在一段时间内(排除电脑转移或者网络环境彻底

变化)，电脑的第一跳路由是不变的，其ttl的初始值已经是255了，默认不会改变.

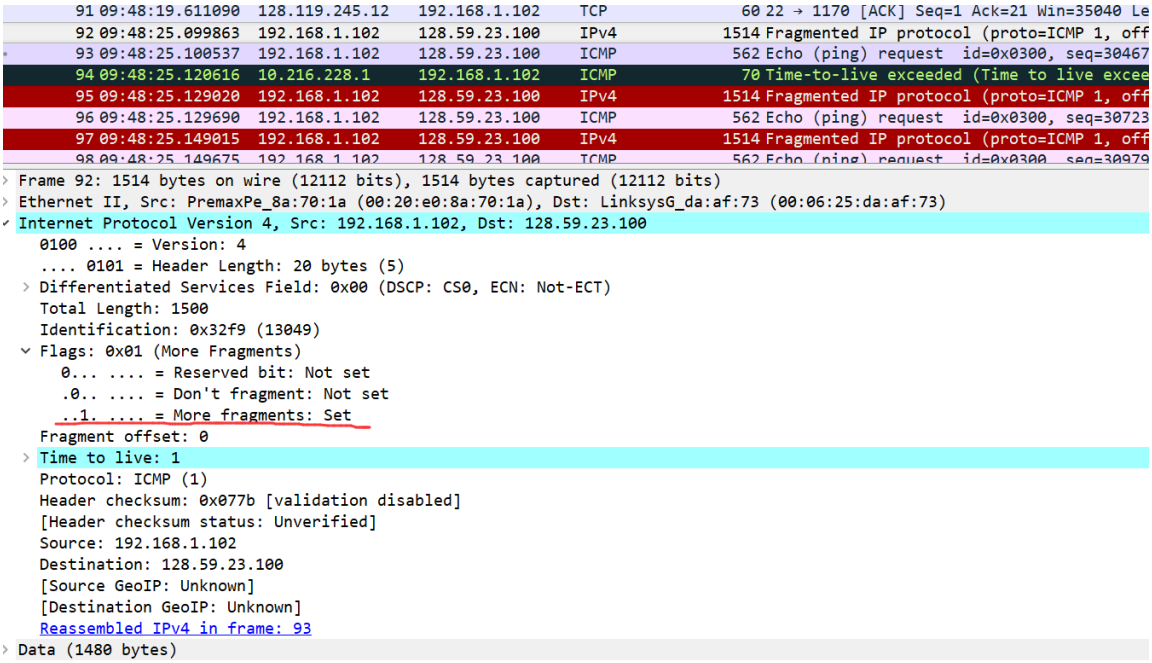
10. Find the first ICMP Echo Request message that was sent by your computer after you changed the *Packet Size* in *pingplotter* to be 2000. Has that message been fragmented across more than one IP datagram? [Note: if you find your packet has not been fragmented, you should download the zip file http://gaia.cs.umass.edu/wireshark-labs/wireshark-traces.zip and extract the *ipethereal-trace-1*packet trace. If your computer has an Ethernet interface, a packet size of 2000 *should* cause fragmentation.3]

答： 是的，被分成了2份fragments.



11. Print out the first fragment of the fragmented IP datagram. 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?

答： 有上一题的图找到No. 92 frame, 得到:



其中flags中的 More fragments位被置为1.

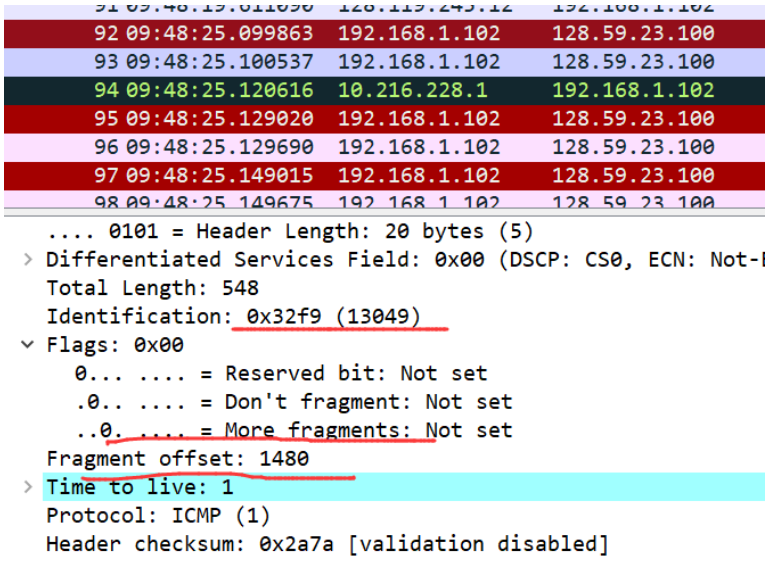
这里的fragment offset为0,

整个ip包的长度为1500字节.

12. Print out the second fragment of the fragmented IP datagram. What information in the IP header indicates that this is not the first datagram fragment? Are the more fragments? How can you tell?

答：如下图所示.与No.92 frame相同id的No.93 frame,其fragment offset为1480,非0,表示不是第一个.

不能根据more fragments位判断是不是第一个,因为最后一个fragment的more fragments位也是0.



13. What fields change in the IP header between the first and second fragment?

答：就这两个fragment来说的话,变的有:

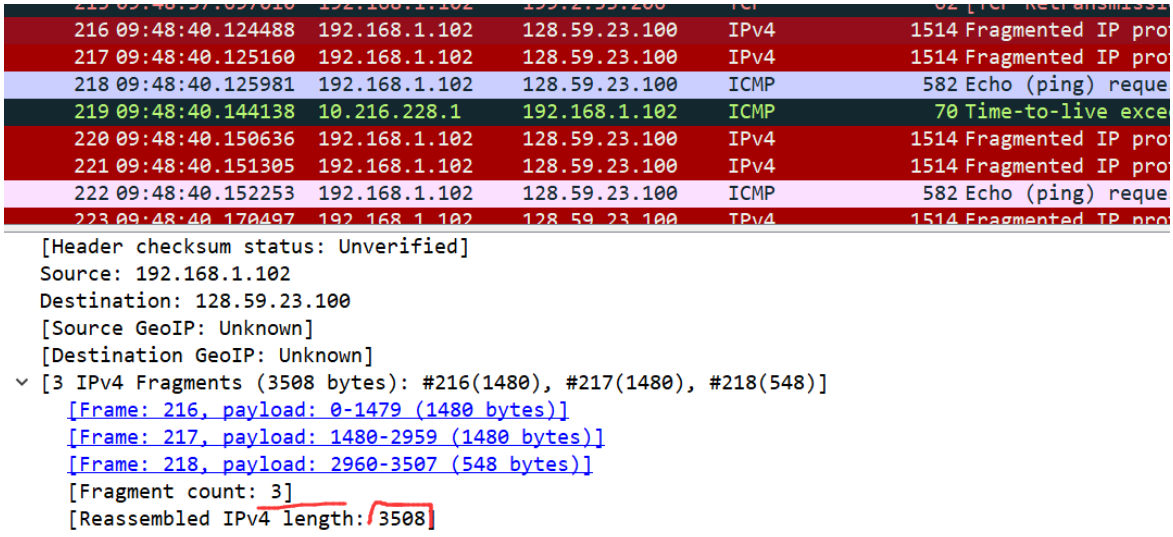
Total length, flags, fragment offset, header checksum

对于所有的第一个fragment与第二个fragment来说的话,一般肯定变的有:

Fragment offset和header checksum

14. How many fragments were created from the original datagram?

答： 3个



15. What fields change in the IP header among the fragments?

答： header checksum, fragment offset.

第一个第二个的more fragments位是1,第三个是0

第一个第二个的length是1500,第三个是568

第一个第二个的