

# 华东师范大学软件工程学院实验报告

实验课程: 计算机网络实践

年级: 2

实验成绩:

实验名称: protocol layer

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实验日期: 11.19

指导教师: 王廷

组号:

实验时间: 8:00-9:30

## 一、实验目的

学习协议和分层在数据包中是如何表示的。这些是构建网络的关键概念，在教材的§1.3 和§1.4 节中有详细说明。

## 二、实验内容与实验步骤

学习并实践网络抓包工具 Wireshark、网络文件下载工具 wget/curl 的用法，使用网络文件下载工具 wget/curl 下载网络文件，使用网络抓包工具 Wireshark 分析网络上数据包的协议层次封装结构，描述和解释实验过程中的实验步骤、实验过程、实验现象、实验结果等。掌握网络抓包工具 Wireshark、网络文件下载工具 wget/curl 的用法；掌握通过抓包工具进行数据包分析的方法。

## 三、实验环境

Wireshark curl

## 四、实验过程与分析

### Ethernet:

```

No. Time           Source             Destination          Protocol Len: Info
1 ▶ Frame 1747: Packet, 131 bytes on wire (1048 bits), 131 bytes captured (1048 bits)
   Encapsulation type: Ethernet (3)
   Arrival Time: Nov 19, 2025 10:03:15.841279000 中国标准时间
   UTC Arrival Time: Nov 19, 2025 02:03:15.841279000 UTC
   Epoch Arrival Time: 1763517795.841279000
   [Time shift for this packet: 0.000000000 seconds]
   [Time delta from previous captured frame: 23.000000 milliseconds]
   [Time since reference or first frame: 3 minutes, 44.877708000 seconds]
   [Time since reference or first frame: 1747 frames]
   Frame Number: 1747
   Frame Length: 131 bytes (1048 bits)
   Capture Length: 131 bytes (1048 bits)
   [Frame is marked: False]
   [Frame is ignored: False]
   [Protocols in frame: eth:ether:type:ip:tcp:http]
   Character encoding: ASCII (8)
   [Coloring Rule Name: HTTP]
   [Coloring Rule String: http || tcp.port == 80 || http2]
2 ▶ Ethernet II, Src: Intel_1f:81:c6 (04:ec:08:f8:81:c6), Dst: NewH3CTechno_21:78:02 (b8:d4:f7:21:78:02)
   Destination: NewH3CTechno_21:78:02 (b8:d4:f7:21:78:02)
   .... ..0. .... .... .... = LG bit: Globally unique address (factory default)
   .... ..0. .... .... .... = IG bit: Individual address (unicast)
   > Source: Intel_1f:81:c6 (04:ec:08:f8:81:c6)
   Type: IPv4 (0x0800)
   [Stream Index: 0]
3 ▶ Internet Protocol Version 4, Src: 172.25.145.1 (172.25.145.1), Dst: 182.61.200.110 (182.61.200.110)
   0100 .... = Version: 4

```

IP:

## TCP:

b8 d4 f7 21 78 02 04 ec	d8 f8 81 c6 08 00 45 00	... !x ... . . . . E
00 75 53 1a 40 00 40 06	00 00 ac 19 91 01 b6 3d	· uS @ @ . . . . =
c8 6e d1 88 00 50 68 e1	12 c0 d5 96 82 f1 50 18	· n · · Ph · . . . . P ·
00 ff bc 2e 00 00	47 45 54 20 2f 20 48 54 54 50	· · · · GE T / HTTP
2f 31 2e 31 0d 0a 48 6f	73 74 3a 20 77 77 77 2e	/1.1 · Ho st: www.
62 61 69 64 75 2e 63 6f	6d 0d 0a 55 73 65 72 2d	baidu.co m · User-
41 67 65 6e 74 3a 20 63	75 72 6c 2f 38 2e 31 36	Agent: c url/8.16
2e 30 0d 0a 41 63 63 65	70 74 3a 20 2a 2f 2a 0d	.0 · Acce pt: *//*
0a 0d 0a		· · · ·

剩下的是 HTTP

总共 131 字节

## Ethernet II 头部: 14

IP 头部：20 字节

IP 头部：20 字节

HTTP 数据 (TCP 载荷) : 77 字节

Ethernet II 头部	IP 头部	IP 头部	HTTP 数据
14	20	20	77
	IP 载荷		
	Ethernet 载荷		

## 抓一个 HTTP 响应包

Frame 1753: Packet, 387 bytes on wire (3096 bits), 387 bytes captured (3096 bits)	HTTP 387 HTTP/1.1 200 OK (text/html)
Encapsulation type: Ethernet (1)	
Arrival Time: Nov 19, 2025 10:03:15.893772000 中国标准时间	
UTC Arrival Time: Nov 19, 2025 02:03:15.893772000 UTC	
Epoch Arrival Time: 1763517795.893772000	
[Time shift for this packet: 0.000000000 seconds]	
[Time delta from previous captured frame: 0.000000000 seconds]	
[Time delta from previous displayed frame: 52.493000 milliseconds]	
[Time since reference or first frame: 3 minutes, 44.930201000 seconds]	
Frame Number: 1753	
Frame Length: 387 bytes (3096 bits)	
Capture Length: 387 bytes (3096 bits)	
[Frame is marked: False]	
[Frame is ignored: False]	
[Protocols in frame: eth:ether:ip:tcp:http:text-lines]	
Character encoding: ASCII (0)	
[Coloring Rule Name: HTTP]	
[Coloring Rule String: http    tcp.port == 80    http2]	
Ethernet II, Src: NewH3CTechno_21:78:02 (08:04:f7:21:78:02), Dst: Intel_f8:81:c6 (04:ec:d8:f8:81:c6)	
Destination: Intel_f8:81:c6 (04:ec:d8:f8:81:c6)	
.... ..0. .... .... .... = LG bit: Globally unique address (factory default)	
.... ..0. .... .... .... = IG bit: Individual address (unicast)	
Source: NewH3CTechno_21:78:02 (08:04:f7:21:78:02)	
.... ..0. .... .... .... = LG bit: Globally unique address (factory default)	

开销% = (开销 / 总大小) × 100%

开销% = (3096-2381) / 3096 = 23.09%

Hypertext Transfer Protocol	
> HTTP/1.1 200 OK\r\n	
Response Version: HTTP/1.1	
Status Code: 200	
[Status Code Description: OK]	
Response Phrase: OK	
Cache-Control: private, no-cache, no-store, proxy	
> Content-Length: 2381\r\n	
Content-Type: text/html\r\n	
Pragma: no-cache\r\n	
Server: bfe\r\n	
Set-Cookie: BDORZ=27315; max-age=86400; domain=.l	
Date: Wed, 19 Nov 2025 02:03:16 GMT\r\n	
\r\n	
<u>[Request in frame: 1747]</u>	
[Time since request: 52.493000 milliseconds]	
[Request URI: /]	
<u>[Full request URI: http://www.baidu.com/]</u>	
File Data: 2381 bytes	
> Frame 1753: Packet, 387 bytes on wire (3096 bits), 387 bytes captured (3096 bits)	
Encapsulation type: Ethernet (1)	
Arrival Time: Nov 19, 2025 10:03:15.893772000 中国标准时间	
UTC Arrival Time: Nov 19, 2025 02:03:15.893772000 UTC	
Epoch Arrival Time: 1763517795.893772000	
[Time shift for this packet: 0.000000000 seconds]	
[Time delta from previous captured frame: 0.000000000 seconds]	
[Time delta from previous displayed frame: 52.493000 milliseconds]	
[Time since reference or first frame: 3 minutes, 44.930201000 seconds]	
Frame Number: 1753	
Frame Length: 387 bytes (3096 bits)	
Capture Length: 387 bytes (3096 bits)	

一次 HTTP 下载包含：

类型	数量	大小	开销	HTTP	总开销	总
SYN-ACK	1	74	54	0	54	0
数据包	3	1500	54	1446	162	4338
HTTP 响应	1	800	54	746	54	746
FIN-ACK	1	74	54	0	54	0
总计	6	-	-	-	324	5084

整体开销百分比 = 324 / (324 + 5084) = 324 / 5408 = 6.0%

这个开销我感觉还挺合理的，可以接受。

1. 哪个 Ethernet 头部字段是解复用键？值是什么？

EtherType 字段，值为 0x0800。

2. 哪个 IP 头部字段是解复用键？值是什么？

Protocol 字段，值为 6，表示 TCP。

#### 五、实验结果总结

掌握 Wireshark 的使用方法，数据包分析方法。

#### 六、附录