

**中国科学技术大学计算机学院**

## **计算机网络实验报告**

### **实验三**

## **利用 Wireshark 观察 tcp 报文**

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## 一、 实验目的

- 1、 了解 TCP 建立连接三次握手的过程
- 2、 了解 TCP 的拥塞控制算法以及流量控制算法

## 二、 实验原理

一次完成的 TCP 通讯包括：建立连接、数据传输、关闭连接。

建立连接（三次握手）：

- 1.客户端通过向服务器端发送一个 SYN 来建立一个主动打开，作为三路握手的一部分。
- 2.服务器端应当为一个合法的 SYN 回送一个 SYN/ACK。
- 3.最后，客户端再发送一个 ACK。这样就完成了三路握手，并进入了连接建立状态。

数据传输：

- 1.发送数据端传输 PSH 数据包
- 2.接收数据端回复 ACK 数据包

关闭连接（四次分手）：

1. 一端主动关闭连接。向另一端发送 FIN 包。
2. 接收到 FIN 包的另一端回应一个 ACK 数据包。
3. 另一端发送一个 FIN 包。
4. 接收到 FIN 包的原发送方发送 ACK 对它进行确认。

### 三、 实验条件

- 1、 硬件条件：一台 PC 机
- 2、 软件条件：wireshar，chrome 浏览器，注意配置软件的环境条件

### 四、 实验过程

- 1、 下载爱丽丝梦游记并且进行上传抓包操作
- 2、 下载数据包，观察 TCP 报文结构。
- 3、 结果分析

### 五、 结果分析

**1. IP : 192.168.1.102 , TCP 发送端口 1161**

**2. IP : 128.119.245.12 , TCP 发送端口 80**

tcp-ethereal-trace-1

文件(F) 编辑(E) 视图(V) 跟踪(G) 捕获(C) 分析(A) 统计(S) 电话(Y) 无线(W) 工具(T) 帮助(H)

应用显示过滤器: <Ctrl-F>

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	192.168.1.102	128.119.245.12	TCP	62	1161 → 80 [SYN] Seq=0 Win=16384 Len=0 MSS=1460 SACK_PERM=1
2	0.023172	128.119.245.12	192.168.1.102	TCP	62	80 → 1161 [SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0 MSS=1460 SACK_PERM=1
3	0.023265	192.168.1.102	128.119.245.12	TCP	54	1161 → 80 [ACK] Seq=1 Ack=1 Win=17520 Len=0
4	0.026477	192.168.1.102	128.119.245.12	TCP	619	1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=17520 Len=565
5	0.041737	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [PSH, ACK] Seq=566 Ack=1 Win=17520 Len=1460
6	0.053937	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0
7	0.054026	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=2026 Ack=1 Win=17520 Len=1460
8	0.054690	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520 Len=1460
9	0.077294	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760 Len=0

> Internet Protocol Version 4, Src: 192.168.1.102, Dst: 128.119.245.12

Transmission Control Protocol, Src Port: 1161, Dst Port: 80, Seq: 0, Len: 0

Source Port: 1161  
Destination Port: 80  
[Stream index: 0]  
[TCP Segment Len: 0]  
Sequence Number: 0 (relative sequence number)  
Sequence Number (raw): 232129012  
[Next Sequence Number: 1 (relative sequence number)]  
Acknowledgment Number: 0  
Acknowledgment number (raw): 0  
0111 .... = Header Length: 28 bytes (7)  
> Flags: 0x002 (SYN)  
Window: 16384  
[Calculated window size: 16384]  
Checksum: 0xf6e9 [unverified]  
[Checksum Status: Unverified]  
Urgent Pointer: 0  
> Options: (8 bytes), Maximum segment size, No-Operation (NOP), No-Operation (NOP), SACK permitted  
> [Timestamps]

```

0000  00 06 25 da af 73 00 20 e0 8a 70 1a 08 00 45 00  ..%..s.  ..p...E
0010  00 30 1e 1d 40 00 80 06 a5 18 c0 a8 01 66 80 77  .0..@...  ....f..w
0020  f5 0c 04 89 00 50 0d d6 01 f4 00 00 00 00 70 02  ....P..  ....p..
0030  40 00 f6 e9 00 00 02 04 05 b4 01 01 04 02      0.....

```

### 3. 我的 IP : 114.214.228.230 , TCP 发送端口 54647

No.	Time	Source	Destination	Protocol	Length	Info
735	11.673744	114.214.228.230	128.119.245.12	TCP	1514	54647 → 80 [ACK] Seq=146047 Ack=1 Win=256 Len=1460 [TCP segment of a reassembled PDU]
736	11.673755	114.214.228.230	128.119.245.12	TCP	1514	54647 → 80 [PSH, ACK] Seq=147507 Ack=1 Win=256 Len=1460 [TCP segment of a reassembled PDU]
737	11.673766	114.214.228.230	128.119.245.12	TCP	1514	54647 → 80 [ACK] Seq=148967 Ack=1 Win=256 Len=1460 [TCP segment of a reassembled PDU]
738	11.673777	114.214.228.230	128.119.245.12	TCP	1514	54647 → 80 [ACK] Seq=150427 Ack=1 Win=256 Len=1460 [TCP segment of a reassembled PDU]
739	11.673788	114.214.228.230	128.119.245.12	HTTP	1242	POST /wirespark-labs/lab3-1-reply.htm HTTP/1.1 (text/plain)
769	11.962462	114.214.228.230	128.119.245.12	TCP	54	54647 → 80 [ACK] Seq=153075 Ack=778 Win=253 Len=0
770	11.970462	114.214.228.230	128.119.245.12	HTTP	495	GET /favicon.ico HTTP/1.1
775	12.046512	114.214.228.230	180.101.192.200	UDP	126	54204 → 27018 Len=84
791	12.265125	114.214.228.230	128.119.245.12	TCP	54	54647 → 80 [ACK] Seq=153516 Ack=1262 Win=251 Len=0

> Frame 739: 1242 bytes on wire (9936 bits), 1242 bytes captured (9936 bits) on interface \Device\NPF\_{64442337-30FA-47D5-8279-6088B04AD558}, id 0

> Ethernet II, Src: IntelCor\_a9:aa:c4 (14:4f:8a:a9:aa:c4), Dst: Hangzhou\_91:72:e2 (5c:dd:70:91:72:e2)

> Internet Protocol Version 4, Src: 114.214.228.230, Dst: 128.119.245.12

Transmission Control Protocol, Src Port: 54647, Dst Port: 80, Seq: 151887, Ack: 1, Len: 1188

Source Port: 54647  
Destination Port: 80  
[Stream index: 13]  
[TCP Segment Len: 1188]  
Sequence Number: 151887 (relative sequence number)  
Sequence Number (raw): 1177128132  
[Next Sequence Number: 153075 (relative sequence number)]  
Acknowledgment Number: 1 (relative ack number)  
Acknowledgment number (raw): 995497071  
0101 .... = Header Length: 20 bytes (5)  
> Flags: 0x018 (PSH, ACK)  
Window: 256  
[Calculated window size: 256]  
[Window size scaling factor: -1 (unknown)]

### 4. seq=0 (绝对序列 3556345267), 将 SYN 标 1 用来请求建立连接。

No.	Time	Source	Destination	Protocol	Length	Info
521	10.390198	128.119.245.12	114.214.228.230	TCP	66	80 → 54648 [SYN, ACK] Seq=0 Ack=1 Win=29200 Len=0 MSS=1460 SACK_PERM=1 WS=128
522	10.394738	114.214.228.230	128.119.245.12	TCP	66	54648 → 80 [ACK] Seq=1 Ack=1 Win=256 Len=0 SLE=0 SRE=1
532	10.590486	128.119.245.12	114.214.228.230	TCP	66	80 → 54647 [SYN, ACK] Seq=0 Ack=1 Win=29200 Len=0 MSS=1460 SACK_PERM=1 WS=128
533	10.594436	114.214.228.230	128.119.245.12	TCP	66	54647 → 80 [ACK] Seq=1 Ack=1 Win=256 Len=0 SLE=0 SRE=1
554	10.934270	114.214.228.230	128.119.245.12	TCP	807	54647 → 80 [PSH, ACK] Seq=1 Ack=1 Win=256 Len=753 [TCP segment of a reassembled PDU]
555	10.934303	114.214.228.230	128.119.245.12	TCP	1514	54647 → 80 [ACK] Seq=754 Ack=1 Win=256 Len=1460 [TCP segment of a reassembled PDU]
556	10.934317	114.214.228.230	128.119.245.12	TCP	1514	54647 → 80 [ACK] Seq=2214 Ack=1 Win=256 Len=1460 [TCP segment of a reassembled PDU]
557	10.934327	114.214.228.230	128.119.245.12	TCP	1514	54647 → 80 [ACK] Seq=3674 Ack=1 Win=256 Len=1460 [TCP segment of a reassembled PDU]
558	10.934337	114.214.228.230	128.119.245.12	TCP	1514	54647 → 80 [ACK] Seq=5134 Ack=1 Win=256 Len=1460 [TCP segment of a reassembled PDU]

Sequence Number (raw): 3556345267  
[Next Sequence Number: 1 (relative sequence number)]  
Acknowledgment Number: 1 (relative ack number)  
Acknowledgment number (raw): 3353337323  
1000 .... = Header Length: 32 bytes (8)  
▼ Flags: 0x012 (SYN, ACK)  
000. .... = Reserved: Not set  
...0 .... = Nonce: Not set  
...0 .... = Congestion Window Reduced (CWR): Not set  
...0. .... = ECN-Echo: Not set  
...0. .... = Urgent: Not set  
...1 .... = Acknowledgment: Set  
...0 .... = Push: Not set  
...0. .... = Reset: Not set  
> ...1. .... = Syn: Set  
...0 .... = Fin: Not set  
[TCP Flags: .....A..S.]  
Window: 29200

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文件(F) 编辑(E) 视图(V) 刷新(R) 捕获(C) 分析(A) 统计(S) 电话(T) 无线(W) 工具(I) 帮助(H)

tcp and ip.addr == 128.119.245.12

No.	Time	Source	Destination	Protocol	Length	Info
769	11.962462	114.214.228.230	128.119.245.12	TCP	54	54647 → 80 [ACK] Seq=1177129320 Ack=995497848 Win=253 Len=0
770	11.970462	114.214.228.230	128.119.245.12	HTTP	495	GET /favicon.ico HTTP/1.1
791	12.265125	114.214.228.230	128.119.245.12	TCP	54	54647 → 80 [ACK] Seq=1177129761 Ack=995498332 Win=251 Len=0
521	10.390198	128.119.245.12	114.214.228.230	TCP	66	80 → 54648 [SYN, ACK] Seq=3556345267 Ack=3353337323 Win=29200 Len=0 MSS=1460 SACK_PERM=1 WS=128
532	10.590486	128.119.245.12	114.214.228.230	TCP	66	80 → 54647 [SYN, ACK] Seq=995497070 Ack=1176976246 Win=29200 Len=0 MSS=1460 SACK_PERM=1 WS=128
580	11.175898	128.119.245.12	114.214.228.230	TCP	60	80 → 54647 [ACK] Seq=995497071 Ack=1176976999 Win=38720 Len=0
581	11.175898	128.119.245.12	114.214.228.230	TCP	60	80 → 54647 [ACK] Seq=995497071 Ack=1176978459 Win=33664 Len=0
582	11.175898	128.119.245.12	114.214.228.230	TCP	60	80 → 54647 [ACK] Seq=995497071 Ack=1176979919 Win=36608 Len=0
583	11.175898	128.119.245.12	114.214.228.230	TCP	60	80 → 54647 [ACK] Seq=995497071 Ack=1176982839 Win=42496 Len=0

[Stream index: 12]  
[TCP Segment Len: 0]  
Sequence Number: 3556345267  
[Next Sequence Number: 3556345268]  
Acknowledgment Number: 3353337323  
1000 .... = Header Length: 32 bytes (8)  
▼ Flags: 0x012 (SYN, ACK)  
000. .... = Reserved: Not set  
...0 .... = Nonce: Not set  
...0 .... = Congestion Window Reduced (CWR): Not set  
...0. .... = ECN-Echo: Not set  
...0. .... = Urgent: Not set  
...1 .... = Acknowledgment: Set  
...0 .... = Push: Not set  
...0. .... = Reset: Not set  
> ...1. .... = Syn: Set  
...0 .... = Fin: Not set  
[TCP Flags: .....A..S.]  
Window: 29200

5. seq=1（绝对序列 3556345268=3556345267+1），

Acknowledgment=1，服务器端、为一个合法的 SYN 回送一个 SYN/ACK。

No.	Time	Source	Destination	Protocol	Length	Info
522	10.394738	114.214.228.230	128.119.245.12	TCP	66	54648 → 80 [ACK] Seq=3353337323 Ack=3556345268 Win=256 Len=0

Transmission Control Protocol, Src Port: 54648, Dst Port: 80, Seq: 3353337323, Ack: 3556345268, Len: 0

Source Port: 54648  
Destination Port: 80  
[Stream index: 12]  
[TCP Segment Len: 0]  
Sequence Number: 3353337323  
[Next Sequence Number: 3353337323]  
Acknowledgment Number: 3556345268  
1000 .... = Header Length: 32 bytes (8)  
Flags: 0x010 (ACK)  
000. .... = Reserved: Not set  
...0 .... = Nonce: Not set  
... 0... = Congestion Window Reduced (CWR): Not set  
... .0.. = ECN-Echo: Not set  
... ..0. = Urgent: Not set  
... ...1 = Acknowledgment: Set  
... ....0.. = Push: Not set  
... ..0.. = Reset: Not set  
... ....0. = Syn: Not set

## 6. 第四号报文段包含 post 命令且，seq=1（绝对序列 232129013）

3	0.023265	192.168.1.102	128.119.245.12	TCP	54	1161 → 80 [ACK] Seq=1 Ack=1 Win=17520 Len=0
4	0.026477	192.168.1.102	128.119.245.12	TCP	619	1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=17520 Len=565
5	0.041737	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [PSH, ACK] Seq=566 Ack=1 Win=17520 Len=146
6	0.053937	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0

Flags: 0x018 (PSH, ACK)  
000. .... = Reserved: Not set  
...0 .... = Nonce: Not set  
... 0... = Congestion Window Reduced (CWR): Not set  
... .0.. = ECN-Echo: Not set  
... ..0. = Urgent: Not set  
... ...1 = Acknowledgment: Set  
... ....1... = Push: Set  
... ..0.. = Reset: Not set  
... ....0. = Syn: Not set  
... ....0 = Fin: Not set  
[TCP Flags: .....AP...]

Window: 17520

[Calculated window size: 17520]

[Window size scaling factor: -2 (no window scaling used)]

Checksum: 0x1fbd [unverified]

[Checksum Status: Unverified]

Urgent Pointer: 0

> [SEQ/ACK analysis]

> [Timestamps]

TCP payload (565 bytes)

[\[Reassembled PDU in frame: 199\]](#)

TCP segment data (565 bytes)

```

0000  00 06 25 da af 73 00 20 e0 8a 70 1a 08 00 45 00  ..%..s..p...E-
0010  02 5d 1e 21 40 00 80 06 a2 e7 c0 a8 01 66 80 77  .]!@...f.w
0020  f5 0c 04 89 00 50 0d d6 01 f5 34 a2 74 1a 50 18  ....P...4.t.P-
0030  44 70 1f bd 00 00 50 4f 53 54 20 2f 65 74 68 65  Dp... 20 ST /ethe
0040  72 65 61 6c 2d 6c 61 62 73 2f 6c 61 62 33 2d 31  real-lab s/lab3-1
0050  2d 72 65 70 6c 79 2e 68 74 6d 20 48 54 54 50 2f  -reply.h tm HTTP/
0060  31 2e 31 0d 0a 48 6f 73 74 3a 20 67 61 69 61 2e  1.1..Hos t: gaia.
0070  63 73 2e 75 6d 61 73 73 2e 65 64 75 0d 0a 55 73  cs.umass .edu..Us
0080  65 72 2d 41 67 65 6e 74 3a 20 4d 6f 7a 69 6c 6c  er-Agent : Mozill

```

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	192.168.1.102	128.119.245.12	TCP	62	1161 → 80 [SYN] Seq=232129012 Win=16384 Len=0 MSS=1460 SACK_PERM=1
2	0.023172	128.119.245.12	192.168.1.102	TCP	62	80 → 1161 [SYN, ACK] Seq=883061785 Ack=232129013 Win=5840 Len=0 MSS=1460 SACK_PERM=1
3	0.023265	192.168.1.102	128.119.245.12	TCP	54	1161 → 80 [ACK] Seq=232129013 Ack=883061786 Win=17520 Len=0
4	0.026477	192.168.1.102	128.119.245.12	TCP	619	1161 → 80 [PSH, ACK] Seq=232129013 Ack=883061786 Win=17520 Len=565 [TCP segment of a retransmission]
5	0.041737	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [PSH, ACK] Seq=232129578 Ack=883061786 Win=17520 Len=1460 [TCP segment of a retransmission]
6	0.053937	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=883061786 Ack=232129578 Win=6780 Len=0

> Frame 4: 619 bytes on wire (4952 bits), 619 bytes captured (4952 bits) on interface 0  
 > Ethernet II, Src: Actiote 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: 128.119.245.12  
 > Transmission Control Protocol, Src Port: 1161, Dst Port: 80, Seq: 232129013, Ack: 883061786, Len: 565  
 Source Port: 1161  
 Destination Port: 80  
 [Stream index: 0]  
 [TCP Segment Len: 565]  
 Sequence Number: 232129013  
 [Next Sequence Number: 232129578]  
 Acknowledgment Number: 883061786  
 0101 .... = Header Length: 20 bytes (5)  
 > Flags: 0x018 (PSH, ACK)  
 000. .... = Reserved: Not set  
 ...0 .... = Nonce: Not set  
 ....0... = Congestion Window Reduced (CWR): Not set  
 ....0... = ECN-Echo: Not set  
 ....10... = Urgent: Not set  
 ....11... = Acknowledgment: Set  
 ....1... = Push: Set  
 ....0... = Reset: Not set  
 ....0... = Syn: Not set  
 ....0... = Fin: Not set

0000 00 06 25 da af 73 00 20 e0 8a 70 1a 08 00 45 00 --%s-...p...E-  
 0010 02 5d 1e 21 40 00 80 06 a2 e7 c0 a8 01 66 80 77 -]l@...-...f:w  
 0020 f5 0c 04 89 00 50 0d d6 01 f5 34 a2 74 1a 50 18 ....P...4.t.P.  
 0030 44 70 1f bd 00 50 4f 53 54 20 2f 65 74 68 65 Dp...PO ST /ethe  
 0040 72 65 61 6c 2d 6c 61 62 73 2f 6c 61 62 33 2d 31 real-lab s/lab3-1  
 0050 2d 72 65 70 6c 79 2e 68 74 6d 20 48 54 54 50 2f -reply.htm HTTP/  
 0060 31 2e 31 0d 0a 48 6f 73 74 3a 20 67 61 69 61 2e 1.1..Hos t: gaia.  
 0070 63 73 2e 75 6d 61 73 73 2e 65 64 75 0d 0a 55 73 cs.umass .edu..Us  
 0080 65 72 2d 41 67 65 6e 74 3a 20 4d 6f 7a 69 6c 6c er-Agent : Mozill  
 0090 61 2f 35 2e 30 20 28 57 69 6e 64 6f 77 73 3b 20 a/5.0 (W indows;  
 00a0 55 3b 20 57 69 6e 64 6f 77 73 20 4e 54 20 35 2e U; Windo ws NT 5.  
 00b0 31 3b 20 65 6e 2d 55 53 3b 20 72 76 3a 31 2e 30 1; en-US ; rv:1.0  
 00c0 2e 32 29 20 47 65 63 6b 6f 2f 32 30 33 30 32 .2) Gecko o/200302  
 00d0 30 38 20 4e 65 74 73 63 61 70 65 2f 37 2e 30 32 08 Netsc ape/7.02  
 00e0 0d 0a 41 63 63 65 70 74 3a 20 74 65 78 74 2f 78 --Accept : text/x  
 00f0 64 66 2e 64 70 70 6e 69 63 61 74 69 66 66 2f 78 -l-accept: text/x

7.

前六个是 4,5,7,8,10,11

No.	Time	Source	Destination	Protocol	Length	Info
199	5.297341	192.168.1.102	128.119.245.12	HTTP	104	POST /ethereal-labs/lab3-1-reply.htm HTTP/1.1 (text/plain)
200	5.389471	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=162309 Win=62780 Len=0
201	5.447887	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=164041 Win=62780 Len=0
202	5.455830	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=164091 Win=62780 Len=0

> [122 Reassembled TCP Segments (164090 bytes): #4(565), #5(1460), #7(1460), #8(1460), #10(1460), #11(1460), #13(1147), #18(1460), #19(1460), #20(1460), #21(1460), #22(1460), #23(1460), #24(1460), #25(1460), #26(1460), #27(1460), #28(1460), #29(1460), #30(1460), #31(1460), #32(1460), #33(1460), #34(1460), #35(1460), #36(1460), #37(1460), #38(1460), #39(1460), #40(1460), #41(1460), #42(1460), #43(1460), #44(1460), #45(1460), #46(1460), #47(1460), #48(1460), #49(1460), #50(1460), #51(1460), #52(1460), #53(1460), #54(1460), #55(1460), #56(1460), #57(1460), #58(1460), #59(1460), #60(1460), #61(1460), #62(1460), #63(1460), #64(1460), #65(1460), #66(1460), #67(1460), #68(1460), #69(1460), #70(1460), #71(1460), #72(1460), #73(1460), #74(1460), #75(1460), #76(1460), #77(1460), #78(1460), #79(1460), #80(1460), #81(1460), #82(1460), #83(1460), #84(1460), #85(1460), #86(1460), #87(1460), #88(1460), #89(1460), #90(1460), #91(1460), #92(1460), #93(1460), #94(1460), #95(1460), #96(1460), #97(1460), 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4946, 232133958  
6406, 232135418。

计数	序列号	发送时间	ACK时间	RTT值	EstimatedRTT值
1	1	0.026477	0.053937	0.02746	0.02746
2	566	0.041737	0.077294	0.035557	0.028472125
3	2026	0.054026	0.124085	0.070059	0.033670484375
4	3486	0.054690	0.169118	0.114428	0.043765173828125
5	4946	0.077405	0.217299	0.139894	0.05578127709960937
6	6406	0.078157	0.267802	0.189645	0.07251424246215821

前六个报文截图：1

4	0.026477	192.168.1.102	128.119.245.12	TCP	619	1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=17520 Len=565 [TCP segment of a reassembled PDU]
5	0.041737	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [PSH, ACK] Seq=566 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
6	0.053937	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0

```

> Frame 4: 619 bytes on wire (4952 bits), 619 bytes captured (4952 bits)
> Ethernet II, Src: Actionte_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: 128.119.245.12
> Transmission Control Protocol, Src Port: 1161, Dst Port: 80, Seq: 1, Ack: 1, Len: 565
  Source Port: 1161
  Destination Port: 80
  [Stream index: 0]
  [TCP Segment Len: 565]
  Sequence Number: 1 (relative sequence number)
  Sequence Number (raw): 232129013
  [Next Sequence Number: 566 (relative sequence number)]
  Acknowledgment Number: 1 (relative ack number)
  Acknowledgment number (raw): 883061786
  0101 .... = Header Length: 20 bytes (5)
> Flags: 0x018 (PSH, ACK)
  Window: 17520
  [Calculated window size: 17520]
  [Window size scaling factor: -2 (no window scaling used)]
  Checksum: 0x1fbd [unverified]
  [Checksum Status: Unverified]
  Urgent Pointer: 0
> [SEQ/ACK analysis]
  ...

```

2

5	0.041737	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [PSH, ACK] Seq=566 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
6	0.053937	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0

```

> Frame 5: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits)
> Ethernet II, Src: Actionte_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: 128.119.245.12
> Transmission Control Protocol, Src Port: 1161, Dst Port: 80, Seq: 566, Ack: 1, Len: 1460
  Source Port: 1161
  Destination Port: 80
  [Stream index: 0]
  [TCP Segment Len: 1460]
  Sequence Number: 566 (relative sequence number)
  Sequence Number (raw): 232129578
  [Next Sequence Number: 2026 (relative sequence number)]
  Acknowledgment Number: 1 (relative ack number)
  Acknowledgment number (raw): 883061786
  0101 .... = Header Length: 20 bytes (5)
> Flags: 0x018 (PSH, ACK)
  Window: 17520
  [Calculated window size: 17520]
  [Window size scaling factor: -2 (no window scaling used)]
  Checksum: 0x3be5 [unverified]
  [Checksum Status: Unverified]
  Urgent Pointer: 0
> [SEQ/ACK analysis]
  ...

```



3

0 0.073297	192.168.1.102	128.119.245.12	TCP	60 80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760 Len=0
7 0.054026	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK] Seq=2026 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
8 0.054690	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
9 0.077294	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760 Len=0

> Frame 5: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits)

> Ethernet II, Src: Actionte\_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: 128.119.245.12

> Transmission Control Protocol, Src Port: 1161, Dst Port: 80, Seq: 566, Ack: 1, Len: 1460

Source Port: 1161

Destination Port: 80

[Stream index: 0]

[TCP Segment Len: 1460]

Sequence Number: 566 (relative sequence number)

Sequence Number (raw): 232129578

[Next Sequence Number: 2026 (relative sequence number)]

Acknowledgment Number: 1 (relative ack number)

Acknowledgment number (raw): 883061786

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

> Flags: 0x018 (PSH, ACK)

Window: 17520

[Calculated window size: 17520]

[Window size scaling factor: -2 (no window scaling used)]

Checksum: 0x3be5 [unverified]

[Checksum Status: Unverified]

Urgent Pointer: 0

4

8 0.054690	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
9 0.077294	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760 Len=0

> Frame 7: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits)

> Ethernet II, Src: Actionte\_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: 128.119.245.12

> Transmission Control Protocol, Src Port: 1161, Dst Port: 80, Seq: 2026, Ack: 1, Len: 1460

Source Port: 1161

Destination Port: 80

[Stream index: 0]

[TCP Segment Len: 1460]

Sequence Number: 2026 (relative sequence number)

Sequence Number (raw): 232131038

[Next Sequence Number: 3486 (relative sequence number)]

Acknowledgment Number: 1 (relative ack number)

Acknowledgment number (raw): 883061786

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

> Flags: 0x010 (ACK)

Window: 17520

[Calculated window size: 17520]

[Window size scaling factor: -2 (no window scaling used)]

Checksum: 0xb98e [unverified]

[Checksum Status: Unverified]

Urgent Pointer: 0

> [SEQ/ACK analysis]

> [TimeRange]

5

10 0.077405	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK] Seq=4946 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
11 0.078157	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK] Seq=6406 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
12 0.124085	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=3486 Win=11680 Len=0

> Frame 10: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits)

> Ethernet II, Src: Actionte\_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: 128.119.245.12

> Transmission Control Protocol, Src Port: 1161, Dst Port: 80, Seq: 4946, Ack: 1, Len: 1460

Source Port: 1161

Destination Port: 80

[Stream index: 0]

[TCP Segment Len: 1460]

Sequence Number: 4946 (relative sequence number)

Sequence Number (raw): 232133958

[Next Sequence Number: 6406 (relative sequence number)]

Acknowledgment Number: 1 (relative ack number)

Acknowledgment number (raw): 883061786

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

> Flags: 0x010 (ACK)

Window: 17520

[Calculated window size: 17520]

[Window size scaling factor: -2 (no window scaling used)]

Checksum: 0x908e [unverified]

[Checksum Status: Unverified]

Urgent Pointer: 0

> [SEQ/ACK analysis]

> [TimeRange]

6

11 0.078157	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK] Seq=6406 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
12 0.124085	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=3486 Win=11680 Len=0

```

> Frame 11: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits)
> Ethernet II, Src: Actionte_8a:70:1a (00:20:e0:8a:70:1a), Dst: Linksys6_da:af:73 (00:06:25:da:af:73)
> Internet Protocol Version 4, Src: 192.168.1.102, Dst: 128.119.245.12
√ Transmission Control Protocol, Src Port: 1161, Dst Port: 80, Seq: 6406, Ack: 1, Len: 1460
  Source Port: 1161
  Destination Port: 80
  [Stream index: 0]
  [TCP Segment Len: 1460]
  Sequence Number: 6406 (relative sequence number)
  Sequence Number (raw): 232135418
  [Next Sequence Number: 7866 (relative sequence number)]
  Acknowledgment Number: 1 (relative ack number)
  Acknowledgment number (raw): 883061786
  0101 .... = Header Length: 20 bytes (5)
  > Flags: 0x010 (ACK)
  Window: 17520
  [Calculated window size: 17520]
  [Window size scaling factor: -2 (no window scaling used)]
  Checksum: 0x9583 [unverified]
  [Checksum Status: Unverified]
  Urgent Pointer: 0
  > [SEQ/ACK analysis]
  > [Timestamps]

```

## 8.

前 6 个 TCP 报文的长度分别为: 565, 1460, 1460, 1460, 1460, 1460

199 5.297341	192.168.1.102	128.119.245.12	HTTP	104 POST /etherreal-labs/lab3-1-reply.htm HTTP/1.1 (text/plain)
200 5.309471	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=162309 Win=62780 Len=0
201 5.447887	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=164041 Win=62780 Len=0
202 5.455830	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=164091 Win=62780 Len=0

```

√ [122 Reassembled TCP Segments (164090 bytes): #4(565), #5(1460), #7(1460), #8(1460), #10(1460), #11(1460), #13(1147), #18(1460), #19(1460), #20(1460), #21(1460), #
  [Frame: 4, payload: 0-564 (565 bytes)]
  [Frame: 5, payload: 565-2024 (1460 bytes)]
  [Frame: 7, payload: 2025-3484 (1460 bytes)]
  [Frame: 8, payload: 3485-4944 (1460 bytes)]
  [Frame: 10, payload: 4945-6404 (1460 bytes)]
  [Frame: 11, payload: 6405-7864 (1460 bytes)]
  [Frame: 13, payload: 7865-9011 (1147 bytes)]
  [Frame: 18, payload: 9012-10471 (1460 bytes)]
  [Frame: 19, payload: 10472-11931 (1460 bytes)]
  [Frame: 20, payload: 11932-13391 (1460 bytes)]
  [Frame: 21, payload: 13392-14851 (1460 bytes)]
  [Frame: 22, payload: 14852-16311 (1460 bytes)]
  [Frame: 23, payload: 16312-17703 (800 bytes)]

```

## 9.

接收方通知给发送方的最低窗口大小为 5840 字节, 即在服务器端传回的第一个 ACK 中的窗口大小。接收方的窗口大小没有抑制发送方的传输速率, 因为窗口大小从 5840 逐步增加到 62780, 窗口大小始终大于发送方发送的分组的容量

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	192.168.1.102	128.119.245.12	TCP	62	1161 → 80 [SYN] Seq=0 Win=16384 Len=0 MSS=1460 SACK_PERM=1
2	0.023172	128.119.245.12	192.168.1.102	TCP	62	80 → 1161 [SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0 MSS=1460 SACK_PERM=1
3	0.023265	192.168.1.102	128.119.245.12	TCP	54	1161 → 80 [ACK] Seq=1 Ack=1 Win=17520 Len=0
4	0.026477	192.168.1.102	128.119.245.12	TCP	619	1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=17520 Len=565 [TCP segment of a reassembled PDU]
5	0.041737	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [PSH, ACK] Seq=566 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
6	0.053937	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0

```

> Frame 2: 62 bytes on wire (496 bits), 62 bytes captured (496 bits)
> Ethernet II, Src: Linksys6_da:af:73 (00:06:25:da:af:73), Dst: Actionte_8a:70:1a (00:20:e0:8a:70:1a)
> Internet Protocol Version 4, Src: 128.119.245.12, Dst: 192.168.1.102
√ Transmission Control Protocol, Src Port: 80, Dst Port: 1161, Seq: 0, Ack: 1, Len: 0
  Source Port: 80
  Destination Port: 1161
  [Stream index: 0]
  [TCP Segment Len: 0]
  Sequence Number: 0 (relative sequence number)
  Sequence Number (raw): 883061785
  [Next Sequence Number: 1 (relative sequence number)]
  Acknowledgment Number: 1 (relative ack number)
  Acknowledgment number (raw): 232129013
  0111 .... = Header Length: 28 bytes (7)
  > Flags: 0x012 (SYN, ACK)
  Window: 5840
  [Calculated window size: 5840]
  Checksum: 0x774d [unverified]
  [Checksum Status: Unverified]
  Urgent Pointer: 0
  > Options: (8 bytes), Maximum segment size, No-Operation (NOP), No-Operation (NOP), SACK permitted
  > [SEQ/ACK analysis]
  > [Timestamps]

```

No.	Time	Source	Destination	Protocol	Length	Info
200	5.389471	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=162309 Win=62780 Len=0
201	5.447887	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=164041 Win=62780 Len=0
202	5.455838	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=164091 Win=62780 Len=0
203	5.461175	128.119.245.12	192.168.1.102	HTTP	784	HTTP/1.1 200 OK (text/html)
204	5.510804	192.168.1.102	192.168.1.1	SSDP	174	M-SEARCH → HTTP/1.1
205	5.592892	192.168.1.102	192.168.1.1	SSDP	174	M-SEARCH → HTTP/1.1

> Frame 203: 784 bytes on wire (6272 bits), 784 bytes captured (6272 bits)

> Ethernet II, Src: Linksys6\_data:af:73 (00:06:25:da:af:73), Dst: Actionte\_8a:70:1a (00:20:e0:8a:70:1a)

> Internet Protocol Version 4, Src: 128.119.245.12, Dst: 192.168.1.102

> Transmission Control Protocol, Src Port: 80, Dst Port: 1161, Seq: 1, Ack: 164091, Len: 730

Source Port: 80

Destination Port: 1161

[Stream index: 0]

[TCP Segment Len: 730]

Sequence Number: 1 (relative sequence number)

Sequence Number (raw): 883061786

[Next Sequence Number: 731 (relative sequence number)]

Acknowledgment Number: 164091 (relative ack number)

Acknowledgment number (raw): 232293103

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

> Flags: 0x018 (PSH, ACK)

Window: 62780

[calculated window size: 62780]

Window size scaling factor: -2 (no window scaling used)

Checksum: 8a0920 [unverified]

[Checksum Status: Unverified]

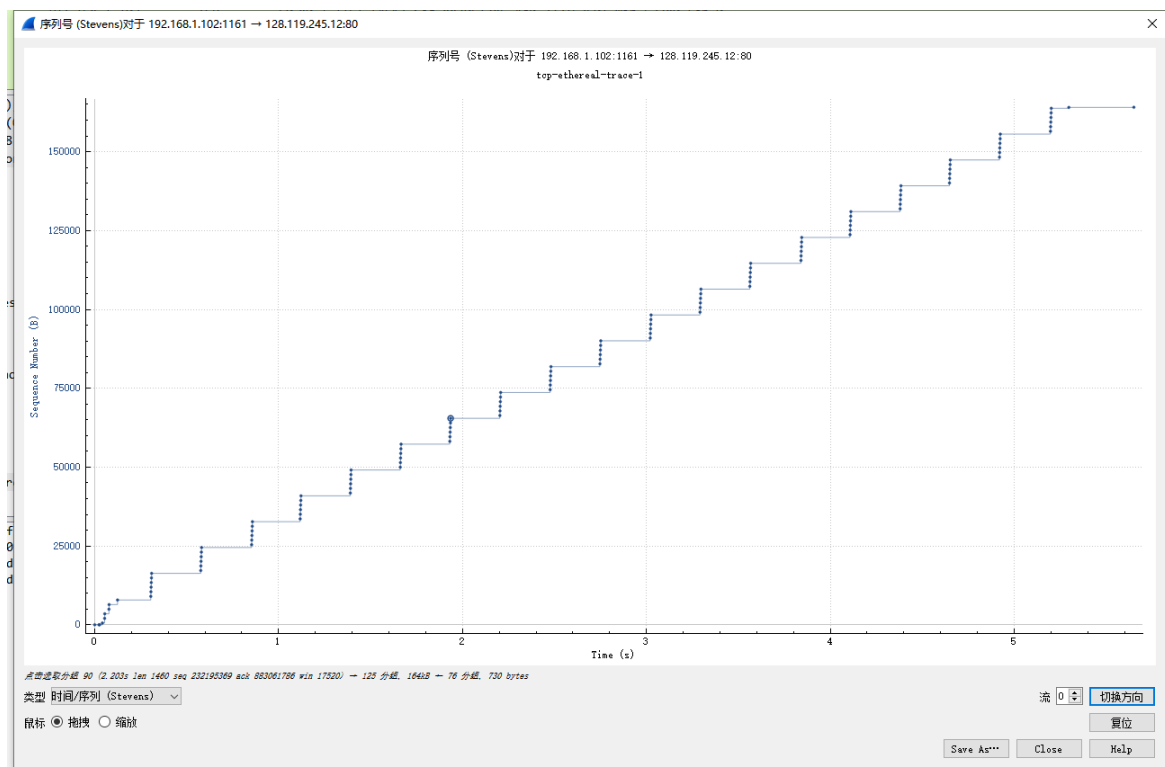
Urgent Pointer: 0

> [SEQ/ACK analysis]

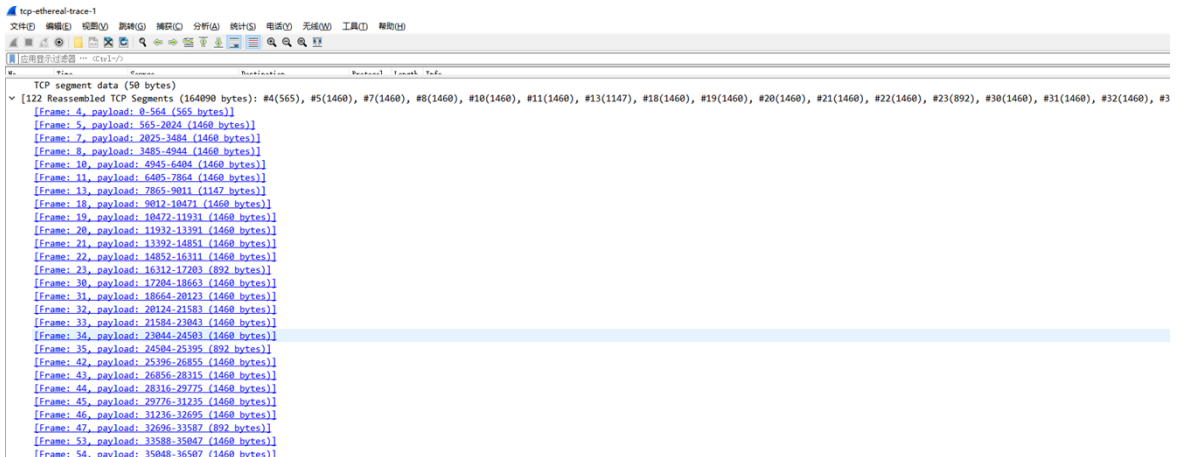
> [Timestamps]

## 10.

没有，从 TCP 报文段的序列号中可以得出以上结论。从下图中的时间—序号图可以看出，从源端发往目的端的序号逐渐递增，如果这其中有重传的报文段，则其序号中应该有小于是其临近的分组序号的分组，在图中未看到这样的分组，所以没有被重传的分组。



11，接收方在一个 ACK 确认的数据大小一般为 1460 字节。



ack1 566 566

ack2 2026 1460

ack3 3486 1460

ack4 4946 1460

ack5 6406 1460

ack6 7866 1460

ack7 9013 1147

ack8 10473 1460

ack9 11993 1460

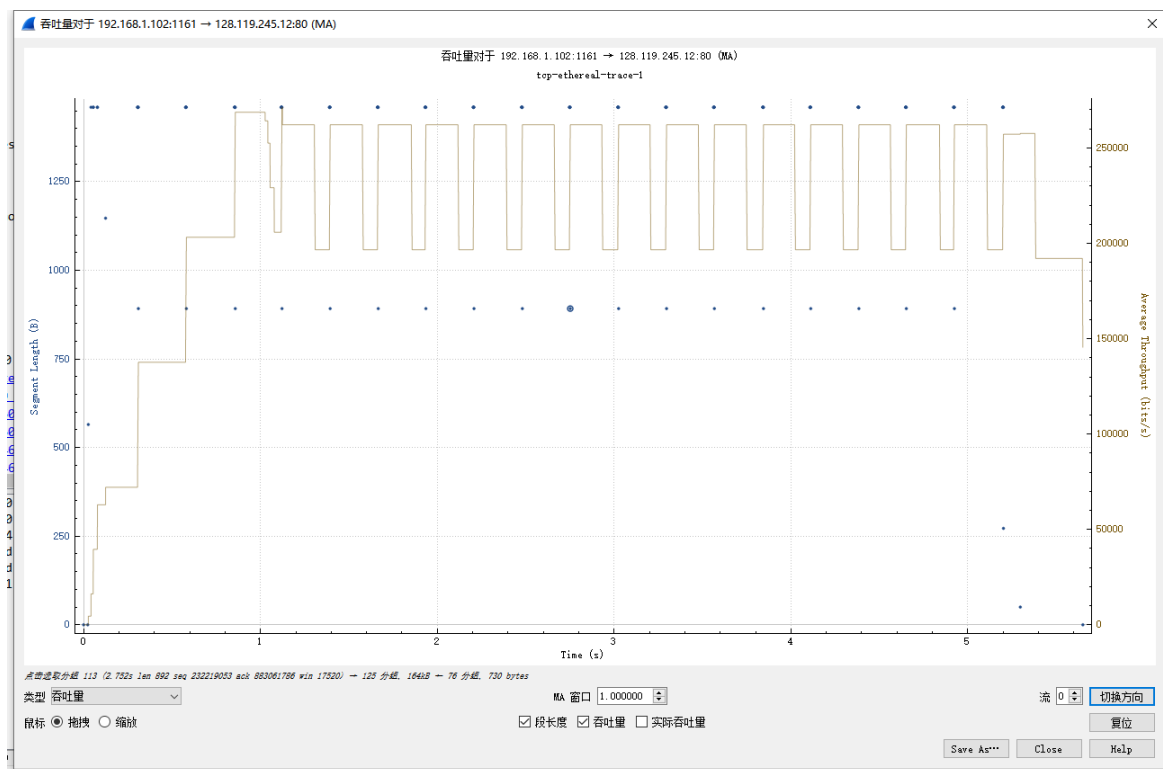
ack10 13393 1460

ack11 14853 1460

.....

报文段确认数据为 2920bytes=1460\*2 bytes, 即=2920

## 12.吞吐量折线图



197	5.202024	192.168.1.102	128.119.245.12	TCP	326 1161 -> 80 [PSH, ACK] Seq=232292781 Ack=883061786 Win=17520 Len=272 [TCP segm
198	5.297257	128.119.245.12	192.168.1.102	TCP	60 80 -> 1161 [ACK] Seq=883061786 Ack=232288401 Win=62780 Len=0
199	5.297341	192.168.1.102	128.119.245.12	HTTP	104 POST /ethereal-labs/lab3-1-reply.htm HTTP/1.1 (text/plain)
200	5.389471	128.119.245.12	192.168.1.102	TCP	60 80 -> 1161 [ACK] Seq=883061786 Ack=232291321 Win=62780 Len=0
201	5.447887	128.119.245.12	192.168.1.102	TCP	60 80 -> 1161 [ACK] Seq=883061786 Ack=232293053 Win=62780 Len=0
202	5.455830	128.119.245.12	192.168.1.102	TCP	60 80 -> 1161 [ACK] Seq=883061786 Ack=232293103 Win=62780 Len=0
203	5.461175	128.119.245.12	192.168.1.102	HTTP	784 HTTP/1.1 200 OK (text/html)

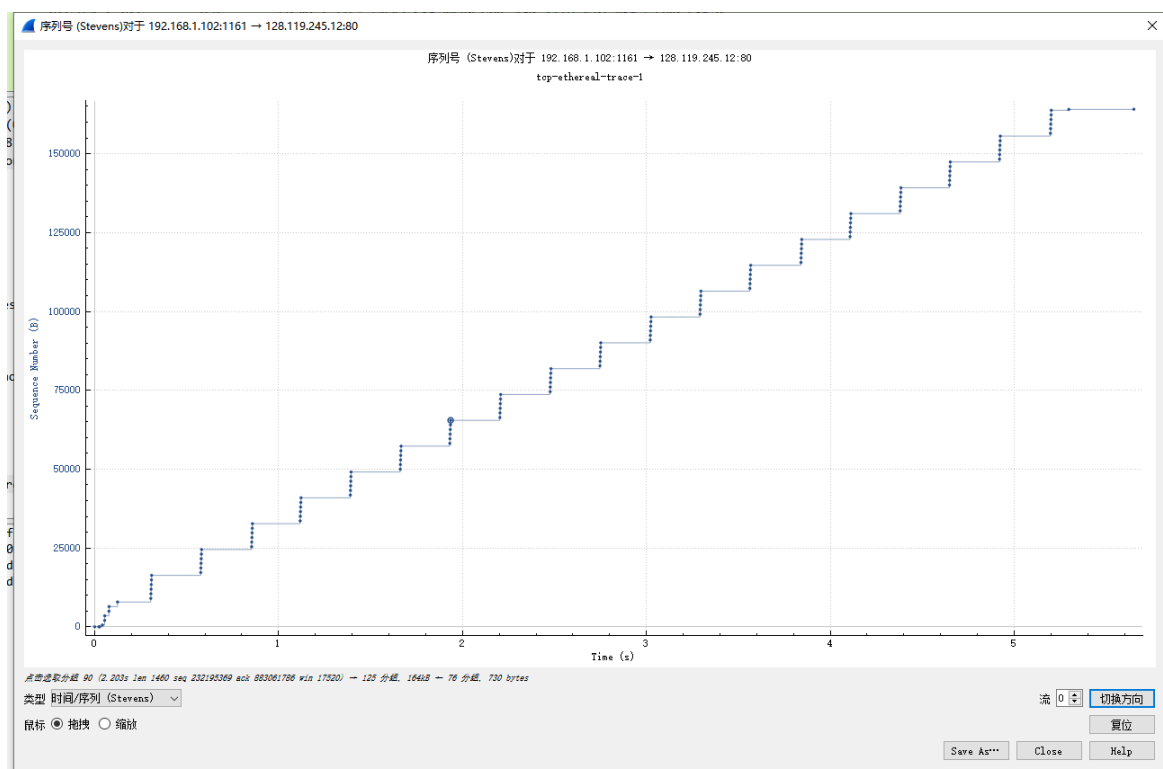
```

[Stream index: 0]
[TCP Segment Len: 50]
Sequence Number: 232293053
[Next Sequence Number: 232293103]
Acknowledgment Number: 883061786
0101 .... = Header Length: 20 bytes (5)
> Flags: 0x018 (PSH, ACK)
Window: 17520
[Calculated window size: 17520]
[Window size scaling factor: -2 (no window scaling used)]
Checksum: 0x9f0f [unverified]
[Checksum Status: Unverified]
Urgent Pointer: 0
> [SEQ/ACK analysis]
v [Timestamps]
  [Time since first frame in this TCP stream: 5.297341000 seconds]
  [Time since previous frame in this TCP stream: 0.000084000 seconds]
  TCP payload (50 bytes)
  TCP segment data (50 bytes)
> [122 Reassembled TCP Segments (164090 bytes): #4(565), #5(1460), #7(1460), #8(1460), #10(1460), #11(1460), #13(1147), #18(1460), #19(1460), #20(1460), #2

```

164090/5.297341=30975.917918 b/s

13



慢启动阶段即从 HTTP POST 报文段发出时开始，但是无法判断什么时候慢启动结束，拥塞避免阶段开始。慢启动阶段和拥塞避免阶段的鉴定取决于发送方拥塞窗口的大小。拥塞窗口的大小并不能从时间—序号图（time-sequence-graph）直接获得。然而在一个发送方中未被确认的数据量不会超过 CongWin（拥塞窗口）和 RcvWindow（接收窗口）中的最小值，即  $\text{LastByteSend} - \text{LastByteAcked} \leq \min\{\text{CongWin}, \text{RcvWindow}\}$ 。同时，在第 9 题中已知，接收方通告给发送方的窗口大小并没有遏制发送速率。因此，未被确认的数据量，是由拥塞窗口决定的，所以通过发出而未被确认的数据量，我们可以估计拥塞窗口大小的下界。通过对数据的分析，拥塞窗口的下界  $\geq 8192$ 。但是，从第 10 题（即从时间—序号图）得，没有分组丢失（不管是超时，还是三个冗余 ACK），因此无法判断什么时候慢启动结束，拥塞避免阶段开始。

76	1.665254	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80	[ACK] Seq=55813 Ack=1 Win=17520 Len=1460 [TCP segment of a re
77	1.666151	192.168.1.102	128.119.245.12	TCP	946	1161 → 80	[PSH, ACK] Seq=57273 Ack=1 Win=17520 Len=892 [TCP segment of
78	1.758227	128.119.245.12	192.168.1.102	TCP	60	80 → 1161	[ACK] Seq=1 Ack=52893 Win=62780 Len=0
79	1.860063	128.119.245.12	192.168.1.102	TCP	60	80 → 1161	[ACK] Seq=1 Ack=55813 Win=62780 Len=0
80	1.930880	128.119.245.12	192.168.1.102	TCP	60	80 → 1161	[ACK] Seq=1 Ack=58165 Win=62780 Len=0
81	1.931099	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80	[ACK] Seq=58165 Ack=1 Win=17520 Len=1460 [TCP segment of a re
82	1.931879	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80	[ACK] Seq=59625 Ack=1 Win=17520 Len=1460 [TCP segment of a re

```

[TCP Segment Len: 892]
Sequence Number: 57273      (relative sequence number)
Sequence Number (raw): 232186285
[Next Sequence Number: 58165      (relative sequence number)]
Acknowledgment Number: 1      (relative ack number)
Acknowledgment number (raw): 883061786
0101 .... = Header Length: 20 bytes (5)
> Flags: 0x018 (PSH, ACK)
Window: 17520
[Calculated window size: 17520]
[Window size scaling factor: -2 (no window scaling used)]
Checksum: 0x2ef3 [unverified]
[Checksum Status: Unverified]
Urgent Pointer: 0
v [SEQ/ACK analysis]
  [RTT: 0.023265000 seconds]
  [Bytes in flight: 8192]
  [bytes sent since last PSH flag: 8192]
> [Timestamps]
  TCP payload (892 bytes)
  [Reassembled PDU in frame: 199]
  TCP segment data (892 bytes)

```

TCP 的发送方会试探性的发送数据（即慢启动阶段），如果太多的数据使网络堵塞了，那么发送方会根据 AIMD 算法进行调整。但是在实际中，TCP 的行为主要依赖于应用程序怎么设计。在这次抓包中，在发送方还可以发送数据的时候，已经没有数据可发了。在 web 应用中，有些 web 对象比较小，在慢启动还没有结束之前，传送就结束啦，因此，传送小的 web 对象受到 TCP 慢启动阶段的影响，导致较长的延迟

## 14. 上面已经都回答了。