

TCP

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1. 192.168.43.112 128.119.245.12 TCP 66 8524 → 80 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
 - IP地址即为本机地址：192.168.43.112
 - TCP端口号为：8524
2.
 - IP地址为：128.119.245.12
 - TCP端口号为：80
3. 由于直接采用本机的实验数据包，故与第一问相同；
4.
 - 仍由上图，序列号为0；

- **Flags: 0x002 (SYN)**
 - 000. = Reserved: Not set
 - ...0 = Nonce: Not set
 - 0... = Congestion Window Reduced (CWR): Not set
 -0.. = ECN-Echo: Not set
 -0. = Urgent: Not set
 -0 = Acknowledgment: Not set
 - 0... = Push: Not set
 -0.. = Reset: Not set
 - >1. = Syn: Set
 -0 = Fin: Not set

通过标志段中的位来判断。

5. 128.119.245.12 192.168.43.112 TCP 66 80 → 8524 [SYN, ACK] Seq=0 Ack=1
 - 序列号为0；
 - ACK值为1；
 - $ACK = Seq + 1$ ；

- **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

同样通过标志段置位；

6.

34	2.037800	192.168.43.112	128.119.245.12	TCP	761 8524 → 80 [PSH, ACK] Seq=1
35	2.037935	192.168.43.112	128.119.245.12	TCP	1414 8524 → 80 [ACK] Seq=708 Ack
36	2.037935	192.168.43.112	128.119.245.12	TCP	1414 8524 → 80 [ACK] Seq=2068 Ac
37	2.037935	192.168.43.112	128.119.245.12	TCP	1414 8524 → 80 [ACK] Seq=3428 Ac
38	2.037935	192.168.43.112	128.119.245.12	TCP	1414 8524 → 80 [ACK] Seq=4788 Ac

Checksum: 0x647a [unverified]
[Checksum Status: Unverified]
Urgent Pointer: 0
> [Timestamps]
> [SEQ/ACK analysis]
TCP payload (707 bytes)
[\[Reassembled PDU in frame: 193\]](#)
TCP segment data (707 bytes)

0000	36 40 0f 46 d8 ce 34 cf f6 14 76 ed 08 00 45 00	6@·F···4· ··v···E·
0010	02 eb d5 42 40 00 80 06 00 00 c0 a8 2b 70 80 77	···B@··· ···+p·w
0020	f5 0c 21 4c 00 50 6a e7 f1 cb 81 78 b9 b4 50 18	··!L·Pj· ···x··P·
0030	02 03 64 7a 00 00 50 4f 53 54 20 2f 77 69 72 65	··dz··PO ST /wire

- 如图，序列号为1；
- 7. ○ 区段一：

34	2.037800	192.168.43.112	128.119.245.12	TCP	761 8524 → 80 [PSH, ACK] Seq=1 Ack=1 Win=131840 Len=707
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▼ Frame 34: 761 bytes on wire (6088 bits), 761 bytes captured (6088 bits) on interface \Device\NPF_{28F4B2F8-01FA-4861-94AA-BAA450D5F52E}
> Interface id: 0 (\Device\NPF_{28F4B2F8-01FA-4861-94AA-BAA450D5F52E})
Encapsulation type: Ethernet (1)
Arrival Time: Oct 18, 2022 18:25:36.023824000 中国标准时间

50	2.273741	128.119.245.12	192.168.43.112	TCP	54 80 → 8524 [ACK] Seq=1 Ack=708 Win=30720 Len=0
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▼ Frame 50: 54 bytes on wire (432 bits), 54 bytes captured (432 bits) on interface \Device\NPF_{28F4B2F8-01FA-4861-94AA-BAA450D5F52E}
> Interface id: 0 (\Device\NPF_{28F4B2F8-01FA-4861-94AA-BAA450D5F52E})
Encapsulation type: Ethernet (1)
Arrival Time: Oct 18, 2022 18:25:36.259765000 中国标准时间

[The RTT to ACK the segment was: 0.235941000 seconds]

序列号：1

发送时间：36.023824000

长度：707

到达时间：36.259765000

RTT：0.235941000

ERTT：0.235941000

- 区段二：

35	2.037935	192.168.43.112	128.119.245.12	TCP	1414 8524 → 80 [ACK] Seq=708 Ack=1 Win=131840 Len=1360
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▼ Frame 35: 1414 bytes on wire (11312 bits), 1414 bytes captured (11312 bits) on interface \Device\NPF_{28F4B2F8-01FA-4861-94AA-BAA450D5F52E}
> Interface id: 0 (\Device\NPF_{28F4B2F8-01FA-4861-94AA-BAA450D5F52E})
Encapsulation type: Ethernet (1)
Arrival Time: Oct 18, 2022 18:25:36.023959000 中国标准时间

序列号：708

发送时间：36.023959000

长度：1360

未接收到对应ACK包，无法分析。

- 区段三：

36	2.037935	192.168.43.112	128.119.245.12	TCP	1414 8524 → 80 [ACK] Seq=2068 Ack=1 Win=131840 Len=1360
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▼ Frame 36: 1414 bytes on wire (11312 bits), 1414 bytes captured (11312 bits) on interface \Device\NPF_{28F4B2F8-01FA-4861-94AA-BAA450D5F52E}
> Interface id: 0 (\Device\NPF_{28F4B2F8-01FA-4861-94AA-BAA450D5F52E})
Encapsulation type: Ethernet (1)
Arrival Time: Oct 18, 2022 18:25:36.023959000 中国标准时间

序列号：2068

发送时间：36.023959000

长度: 1360

未接收到对应ACK包, 无法分析。

○ 区段四:

37	2.037935	192.168.43.112	128.119.245.12	TCP	1414	8524 → 80 [ACK] Seq=3428 Ack=1 Win=131840 Len=1360
▼ Frame 37: 1414 bytes on wire (11312 bits), 1414 bytes captured (11312 bits) on interface \Device\NPF_{28F4B2F8-01FA-4861-94AA-BAA450D5F52E}						
> Interface id: 0 (\Device\NPF_{28F4B2F8-01FA-4861-94AA-BAA450D5F52E})						
Encapsulation type: Ethernet (1)						
Arrival Time: Oct 18, 2022 18:25:36.023959000 中国标准时间						
51	2.273741	128.119.245.12	192.168.43.112	TCP	54	80 → 8524 [ACK] Seq=1 Ack=4788 Win=38784 Len=0
▼ Frame 51: 54 bytes on wire (432 bits), 54 bytes captured (432 bits) on interface \Device\NPF_{28F4B2F8-01FA-4861-94AA-BAA450D5F52E}						
> Interface id: 0 (\Device\NPF_{28F4B2F8-01FA-4861-94AA-BAA450D5F52E})						
Encapsulation type: Ethernet (1)						
Arrival Time: Oct 18, 2022 18:25:36.259765000 中国标准时间						

[The RTT to ACK the segment was: 0.235806000 seconds]

序列号: 3428

发送时间: 36.023959000

长度: 1360

到达时间: 36.259765000

RTT: 0.235806000

ERTT: $0.875 * 0.235941000 + 0.125 * 0.235806000 = 0.235924125$

○ 区段五:

38	2.037935	192.168.43.112	128.119.245.12	TCP	1414	8524 → 80 [ACK] Seq=4788 Ack=1 Win=131840 Len=1360
▼ Frame 38: 1414 bytes on wire (11312 bits), 1414 bytes captured (11312 bits) on interface \Device\NPF_{28F4B2F8-01FA-4861-94AA-BAA450D5F52E}						
> Interface id: 0 (\Device\NPF_{28F4B2F8-01FA-4861-94AA-BAA450D5F52E})						
Encapsulation type: Ethernet (1)						
Arrival Time: Oct 18, 2022 18:25:36.023959000 中国标准时间						

序列号: 4788

发送时间: 36.023959000

长度: 1360

未接收到ACK。

○ 区段六:

39	2.037935	192.168.43.112	128.119.245.12	TCP	1414	8524 → 80 [ACK] Seq=6148 Ack=1 Win=131840 Len=1360
▼ Frame 39: 1414 bytes on wire (11312 bits), 1414 bytes captured (11312 bits) on interface \Device\NPF_{28F4B2F8-01FA-4861-94AA-BAA450D5F52E}						
> Interface id: 0 (\Device\NPF_{28F4B2F8-01FA-4861-94AA-BAA450D5F52E})						
Encapsulation type: Ethernet (1)						
Arrival Time: Oct 18, 2022 18:25:36.023959000 中国标准时间						

序列号: 6148

发送时间: 36.023959000

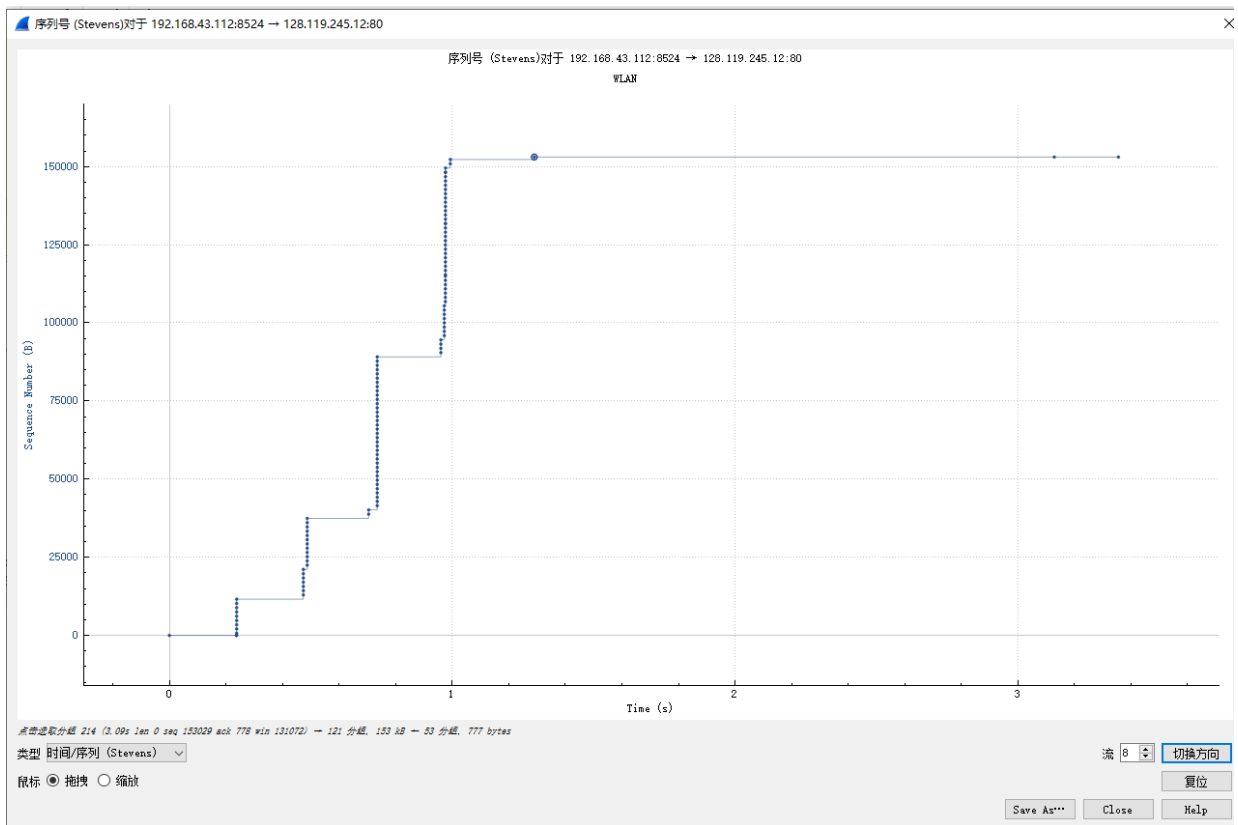
长度: 1360

未接收到ACK。

8. 如上。

9. 对于服务器, win = 229, 对于主机, win = 131840。缺少接收器缓冲空间确实会限制发送方传送TCP区段, 因为TCP采用的流量控制服务将会消除接收方缓存溢出的可能, 使得发送方的速率下降至与接收方速率相匹配。

10. 没有重传区段, 查看时间序列图呈现持续递增趋势:



11. 除了初始的707bytes外，一般确认1360bytes。有这种情况：

```
[ACK] Seq=1 Ack=8868 Win=46976 Len=0
[ACK] Seq=1 Ack=11588 Win=52480 Len=0
```

12. 平均吞吐量 = 总传输数据量 (比特) F / 总时间 T

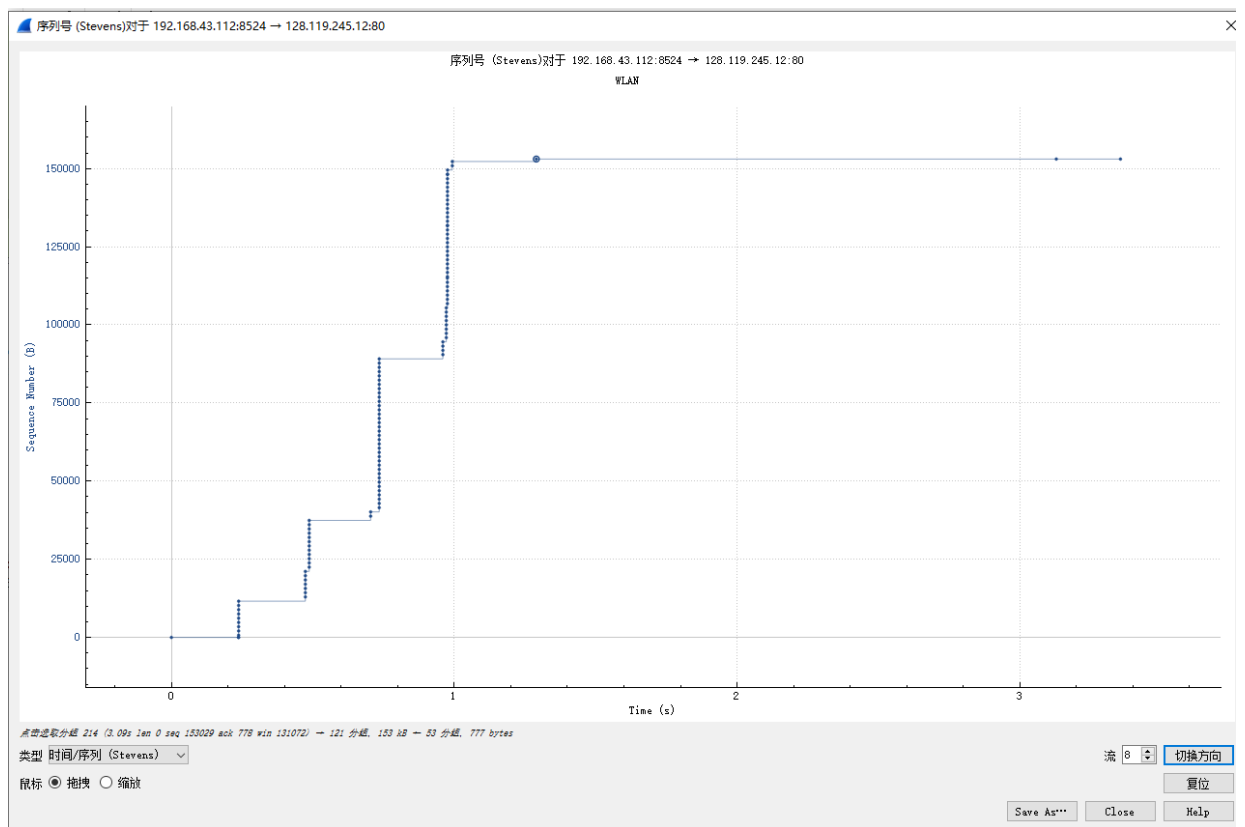
```

+-----+-----+-----+-----+-----+-----+-----+
| 193 | 2.793367 | 192.168.43.112 | 128.119.245.12 | HTTP | 839 POST /wireshark-labs/lab3-1-reply.htm HTTP/1.1 (text/plain) |
+-----+-----+-----+-----+-----+-----+-----+
> Frame 193: 839 bytes on wire (6712 bits), 839 bytes captured (6712 bits) on interface \Device\NPF_{28F4B2F8-01FA-4861-94AA-BAA450D5F52E}, id
> Ethernet II, Src: IntelCor_14:76:ed (34:cf:f6:14:76:ed), Dst: 36:40:0f:46:d8:ce (36:40:0f:46:d8:ce)
> Internet Protocol Version 4, Src: 192.168.43.112, Dst: 128.119.245.12
> Transmission Control Protocol, Src Port: 8524, Dst Port: 80, Seq: 152244, Ack: 1, Len: 785
> [116 Reassembled TCP Segments (153028 bytes): #34(707), #35(1360), #36(1360), #37(1360), #38(1360), #39(1360), #40(1360), #41(1360), #42(1360)
  
```

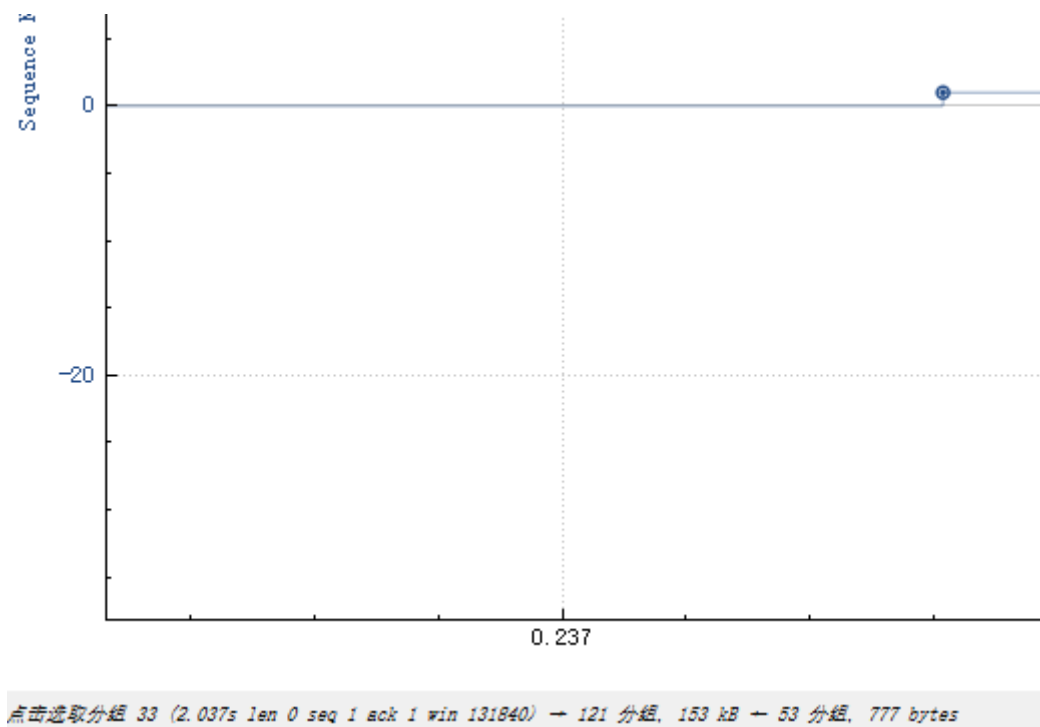
▼ [Timestamps]
 [Time since first frame in this TCP stream: 0.993182000 seconds]

平均吞吐量 = $153028 / 0.993182 = 154.078\text{kb/s}$

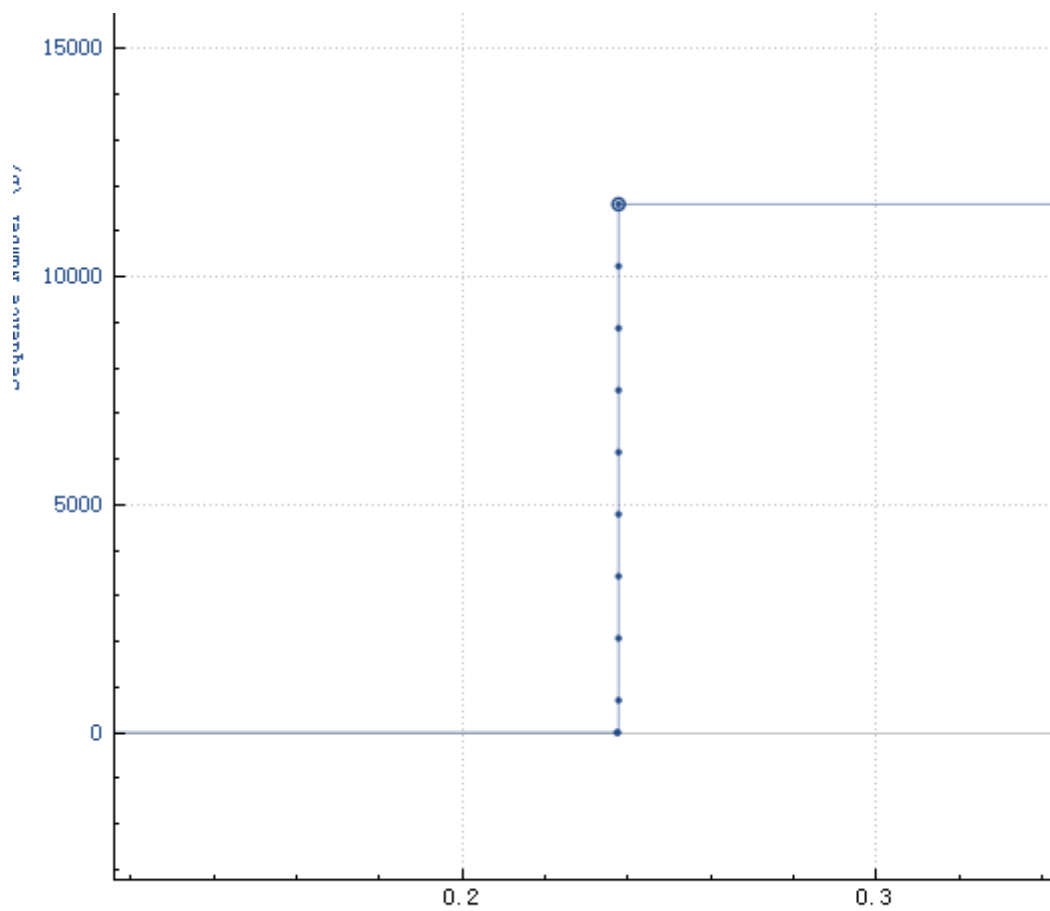
13.



慢启动开始:

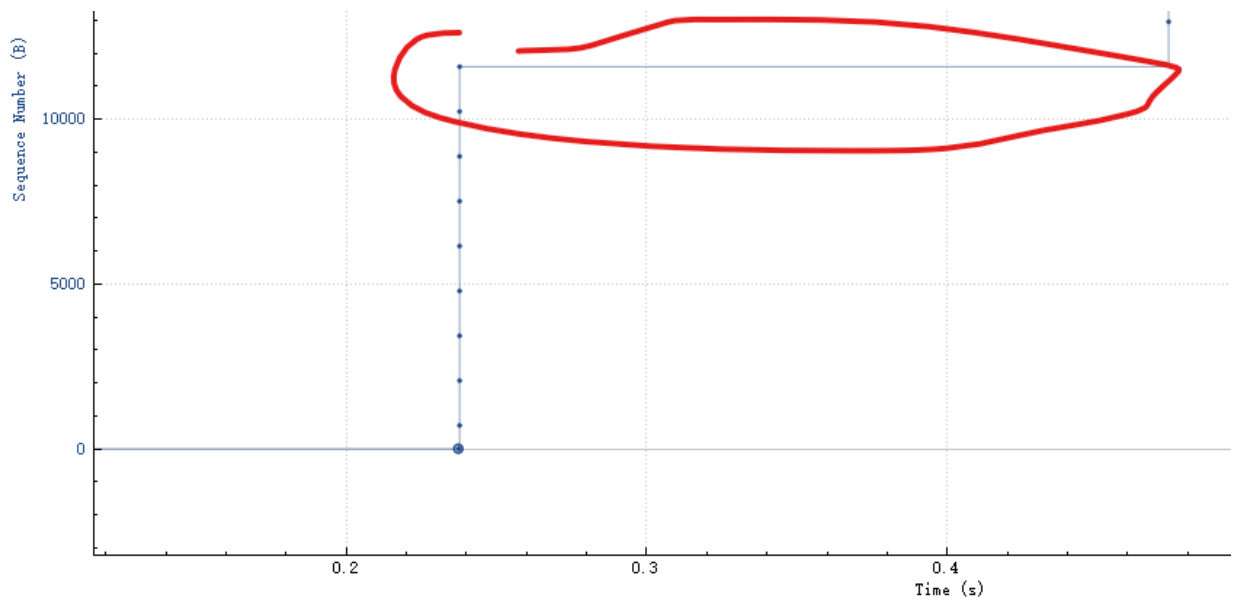


慢启动结束:



点击选取分组 43 (2.038s len 1360 seq 11588 ack 1 win 131840) → 121 分组, 153 kB → 53 分组, 777 bytes

拥塞避免:



点击选取分组 33 (2.037s len 0 seq 1 ack 1 win 131840) → 121 分组, 153 kB → 53 分组, 777 bytes

与理想化行为相比, 指数增长的速率非常大, 几乎呈现直线型增长, 而拥塞避免则相比之下也呈直线 (几乎看不到线性)。除此之外, 慢启动带来的时间延长也比理想化情况高很多, 对于一些数据量小的文件, 为了解决拥塞带来的慢启动时延可能反而会延长发送到到达的时间, 可见实际中并非时刻有所裨益。