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02/24/2017  
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Homework 04

Based on downloaded file:

The image shows a Wireshark packet capture titled 'tcp-ethereal-trace-1'. The capture is filtered on 'tcp'. The packet list shows seven packets. Packet 1 is a SYN from 192.168.1.102 to 128.119.245.12 on port 80. Packet 2 is a SYN, ACK from 128.119.245.12 to 192.168.1.102 on port 1161. Packet 3 is an ACK from 192.168.1.102 to 128.119.245.12 on port 80. Packet 4 is a PSH, ACK from 128.119.245.12 to 192.168.1.102 on port 1161. Packet 5 is a PSH, ACK from 192.168.1.102 to 128.119.245.12 on port 80. Packet 6 is an ACK from 128.119.245.12 to 192.168.1.102 on port 1161. Packet 7 is an ACK from 192.168.1.102 to 128.119.245.12 on port 80. The packet details pane shows the selected packet (Frame 1) as a SYN packet from 192.168.1.102 to 128.119.245.12 on port 80.

No.	Time	Source	Destination	Protocol	Length	Info
1	09:44:20.570381	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	09:44:20.593553	128.119.245.12	192.168.1.102	TCP	62	80 → 1161 [SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0 MSS=1460 S...
3	09:44:20.593646	192.168.1.102	128.119.245.12	TCP	54	1161 → 80 [ACK] Seq=1 Ack=1 Win=17520 Len=0
4	09:44:20.596858	128.119.245.12	192.168.1.102	TCP	619	1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=17520 Len=565
5	09:44:20.612118	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [PSH, ACK] Seq=566 Ack=1 Win=17520 Len=1460
6	09:44:20.624318	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0
7	09:44:20.624407	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=2026 Ack=1 Win=17520 Len=1460

> Frame 1: 62 bytes on wire (496 bits), 62 bytes captured (496 bits)  
> Ethernet II, Src: PremaxPe\_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: 0, Len: 0

Figure 1. Given TCP capture

1. The client computer IP address is: 192.168.1.102; My client computer port number is 1161.
2. Destination computer IP address is 128.119.245.12; Its computer port number is 80.

The image shows a Wireshark packet capture titled '\*Wi-Fi'. The capture is filtered on 'tcp'. The packet list shows seven packets. Packet 1 is a FIN, ACK from 172.16.46.211 to 128.119.245.12 on port 80. Packet 2 is an ACK from 128.119.245.12 to 172.16.46.211 on port 56056. Packet 3 is a FIN, ACK from 172.16.46.211 to 128.119.245.12 on port 80. Packet 4 is a TCP segment of a reassembled PDU. Packet 5 is a TCP segment of a reassembled PDU. Packet 6 is a TCP segment of a reassembled PDU. Packet 7 is a TCP segment of a reassembled PDU. The packet details pane shows the selected packet (Frame 1) as a FIN, ACK packet from 172.16.46.211 to 128.119.245.12 on port 80.

No.	Time	Source	Destination	Protocol	Length	Info
1	11:08:31.792398	128.119.245.12	172.16.46.211	TCP	54	80 → 56056 [FIN, ACK] Seq=1 Ack=1 Win=2326 Len=0
2	11:08:31.792493	172.16.46.211	128.119.245.12	TCP	54	56056 → 80 [ACK] Seq=1 Ack=2 Win=255 Len=0
3	11:08:32.430828	172.16.46.211	128.119.245.12	TCP	54	56056 → 80 [FIN, ACK] Seq=1 Ack=2 Win=255 Len=0
4	11:08:32.431246	172.16.46.211	128.119.245.12	TCP	703	[TCP segment of a reassembled PDU]
5	11:08:32.431403	172.16.46.211	128.119.245.12	TCP	1434	[TCP segment of a reassembled PDU]
6	11:08:32.431415	172.16.46.211	128.119.245.12	TCP	1434	[TCP segment of a reassembled PDU]
7	11:08:32.431429	172.16.46.211	128.119.245.12	TCP	1434	[TCP segment of a reassembled PDU]

> Frame 1: 54 bytes on wire (432 bits), 54 bytes captured (432 bits) on interface 0  
> Ethernet II, Src: IntelCor\_79:6a:e9 (ac:fd:ce:79:6a:e9), Dst: IETF-VRRP-VRID\_53 (00:00:5e:00:01:53)  
> Internet Protocol Version 4, Src: 172.16.46.211, Dst: 128.119.245.12  
> Transmission Control Protocol, Src Port: 56056, Dst Port: 80, Seq: 1, Ack: 2, Len: 0

Figure 2. My TCP capture

3. My client computer IP address is: 172.16.26.211; My client computer port number is 56056.

tcp-ethereal-trace-1

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tcp

No.	Time	Source	Destination	Protocol	Length	Info
1	09:44:20.570381	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	09:44:20.593553	128.119.245.12	192.168.1.102	TCP	62	80 → 1161 [SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0 MSS=1460 S...
3	09:44:20.593646	192.168.1.102	128.119.245.12	TCP	54	1161 → 80 [ACK] Seq=1 Ack=1 Win=17520 Len=0
4	09:44:20.596858	192.168.1.102	128.119.245.12	TCP	619	1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=17520 Len=565
5	09:44:20.612118	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [PSH, ACK] Seq=566 Ack=1 Win=17520 Len=1460
6	09:44:20.624318	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0
7	09:44:20.624407	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=2026 Ack=1 Win=17520 Len=1460

Acknowledgment number: 0  
Header Length: 28 bytes  
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  
[TCP Flags: .....S.]  
Window size value: 16384

Figure 3. Seq number and indication

4. The initial sequence number is 0 (Seq=0). The SYN flag is set to 1 ([SYN]) which indicates a SYN segment.

tcp-ethereal-trace-1

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No.	Time	Source	Destination	Protocol	Length	Info
2	09:44:20.593553	128.119.245.12	192.168.1.102	TCP	62	80 → 1161 [SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0 MSS=1460 S...
3	09:44:20.593646	192.168.1.102	128.119.245.12	TCP	54	1161 → 80 [ACK] Seq=1 Ack=1 Win=17520 Len=0
4	09:44:20.596858	192.168.1.102	128.119.245.12	TCP	619	[TCP segment of a reassembled PDU]
5	09:44:20.612118	192.168.1.102	128.119.245.12	TCP	1514	[TCP segment of a reassembled PDU]
6	09:44:20.624318	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0
7	09:44:20.624407	192.168.1.102	128.119.245.12	TCP	1514	[TCP segment of a reassembled PDU]
8	09:44:20.625071	192.168.1.102	128.119.245.12	TCP	1514	[TCP segment of a reassembled PDU]
9	09:44:20.647675	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760 Len=0
10	09:44:20.647786	192.168.1.102	128.119.245.12	TCP	1514	[TCP segment of a reassembled PDU]
11	09:44:20.648538	192.168.1.102	128.119.245.12	TCP	1514	[TCP segment of a reassembled PDU]
12	09:44:20.694466	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=3486 Win=11680 Len=0
13	09:44:20.694566	192.168.1.102	128.119.245.12	TCP	1201	[TCP segment of a reassembled PDU]

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

Figure 4. SYNACK pack

5. The sequence number of the SYNACK segment has the value of 0 in this trace. The value of ACK in the SYNACK is 1. The value is determined by the destination by adding 1 to the initial sequence number of SYN segment from the client computer. The SYN flag and ACK flag are set to 1. They indicate that this segment is a SYNACK segment.

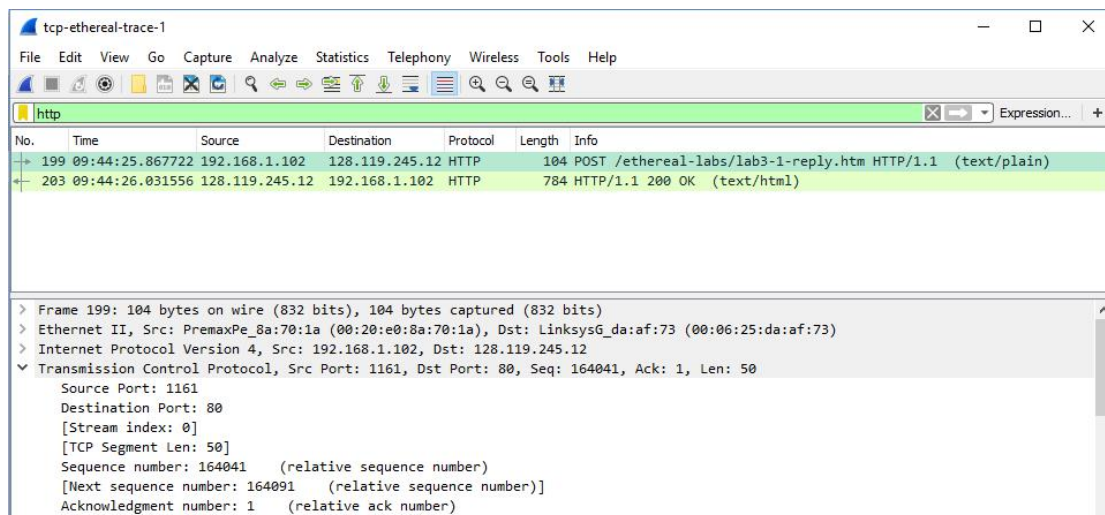


Figure 5. HTTP POST command

6. The sequence number is **164041**.

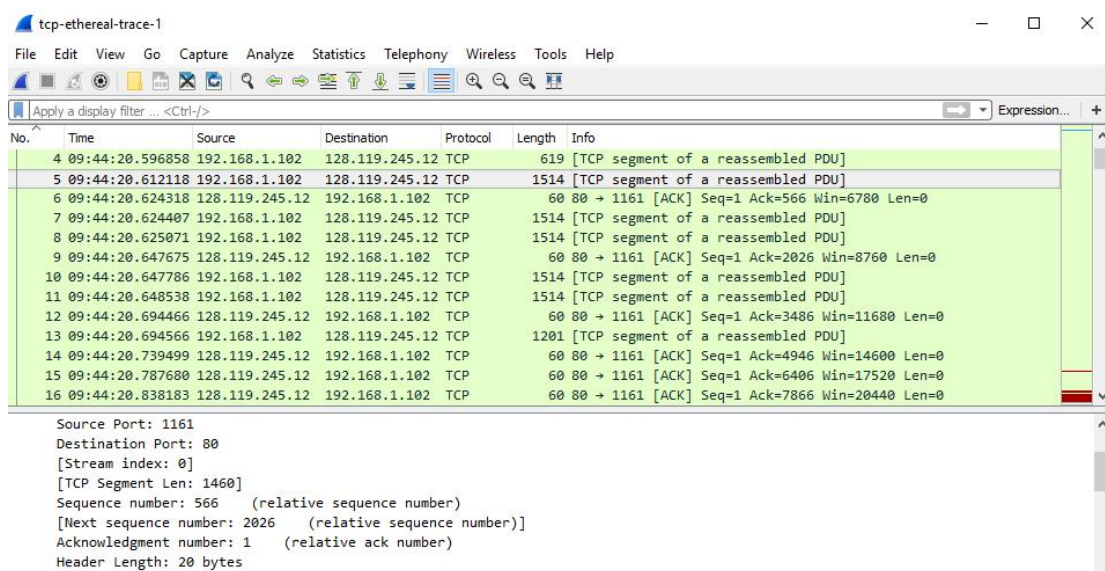


Figure 6. HTTP POST segments

7. If the HTTP POST segment is considered as the first segment, segment 1-6 are NO. 4,5,7,8,10, and 11 in this trace. The ACKs are 6,9,12,14,15, and 16. By examining each TCP segment, the sequence numbers is the following:

Sequence number: 1 (relative sequence number)  
 [Next sequence number: 566 (relative sequence number)]

Segment 1: 1  
 Segment 2: 566

Sequence number: 2026 (relative sequence number)  
 [Next sequence number: 3486 (relative sequence number)]

Segment 3: 2026  
 Segment 4: 3486

Sequence number: 4946 (relative sequence number)  
 [Next sequence number: 6406 (relative sequence number)]

Segment 5: 4946  
 Segment 6: 6406



Raw send/received time data:

4	0.026477
5	0.041737
6	0.053937
7	0.054026
8	0.054690
9	0.077294
10	0.077405
11	0.078157
12	0.124085
13	0.124185
14	0.169118
15	0.217299
16	0.267802

RTT data is obtained under: Transmission Control Protocol -> [SEQ/ACL analysis]

Segment Number	Sent Time	Received Time	Sample RTT(seconds)	Estimated RTT(seconds)
1(first)	0.026477	0.053937	0.02746	0.02746
2	0.041737	0.077294	0.035557	0.0285
3	0.054026	0.124085	0.070059	0.0337
4	0.054690	0.169118	0.11443	0.0438
5	0.077405	0.217299	0.13989	0.0558
6	0.078157	0.267802	0.18964	0.0725

Calculation for Estimated RTT:  $0.875 * \text{Estimated} + 0.125 * \text{Sample}$

#1: Segment 1 = 0.02746 secs

#2: Estimated =  $(0.875) * (\text{above from above}) + (0.125) * \text{Sample RTT} = 0.0285$

#3: Estimated =  $(0.875) * (\text{above from above}) + (0.125) * \text{Sample RTT} = 0.0337$

#4: Estimated =  $(0.875) * (\text{above from above}) + (0.125) * \text{Sample RTT} = 0.0438$

#5: Estimated =  $(0.875) * (\text{above from above}) + (0.125) * \text{Sample RTT} = 0.0558$

#6: Estimated =  $(0.875) * (\text{above from above}) + (0.125) * \text{Sample RTT} = 0.0725$

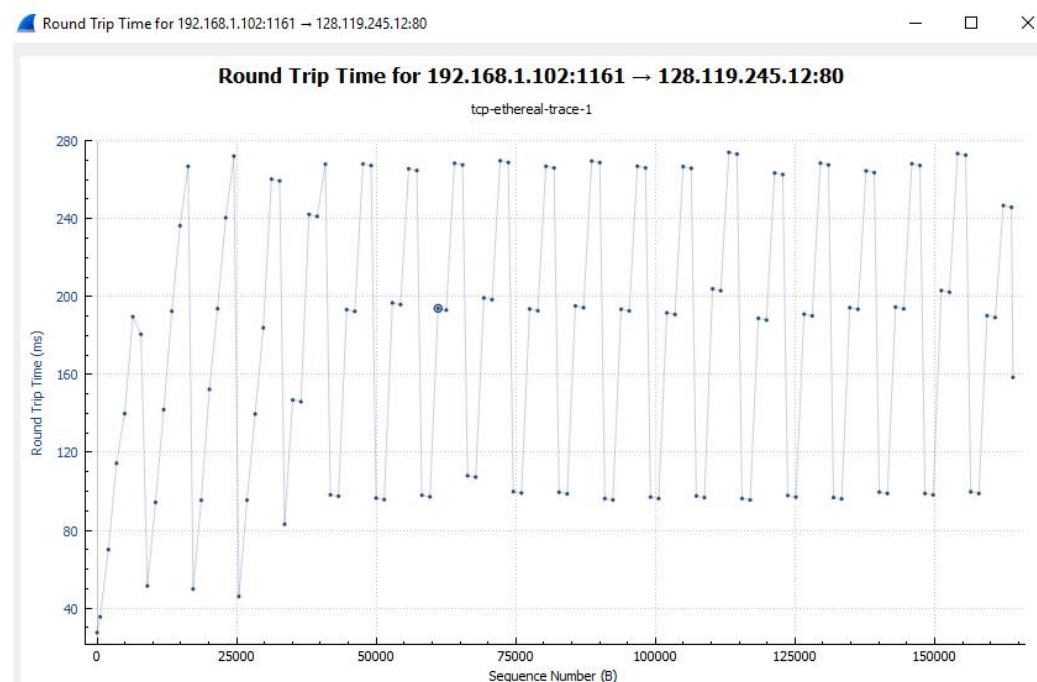


Figure 7. Round Trip Time Graph

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Transmission Control Protocol, Src Port: 1161, Dst Port: 80, Seq:
  Source Port: 1161
  Destination Port: 80
  [Stream index: 0]
  [TCP Segment Len: 565]
  Sequence number: 1 (relative sequence number)
  [Next sequence number: 566 (relative sequence number)]
  Acknowledgment number: 1 (relative ack number)
  Header Length: 20 bytes

```

Figure 8. First TCP

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Source Port: 1161
Destination Port: 80
[Stream index: 0]
[TCP Segment Len: 1460]
Sequence number: 566 (relative sequence number)
[Next sequence number: 2026 (relative sequence number)]
Acknowledgment number: 1 (relative ack number)

```

Figure 9. 2-6 TCP

8. The first TCP segment is 565 bytes, and the rest five TCP segments are 1460 bytes.

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

Figure 10. Min. buffer space

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

Figure .11. Max. buffer space

9. The minimum amount of buffer space is 5840 bytes, which is the first ACK. The maximum amount of buffer space is 62780 bytes. The send is never throttled due to lacking of receiver buffer space.

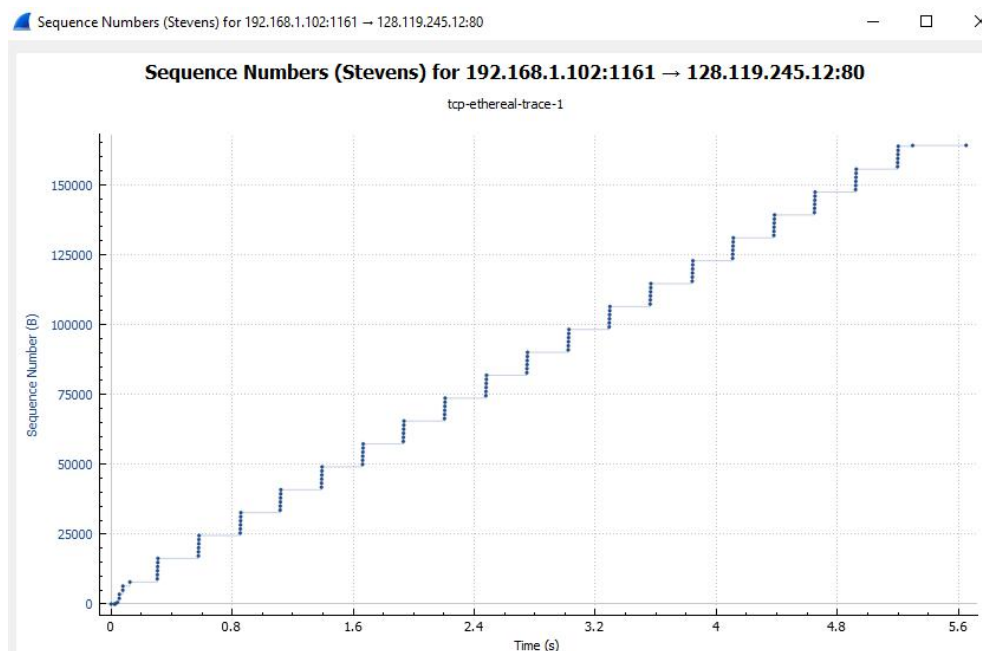


Figure 11. Time Sequence Graph

10. There are no re-transmitted segments in this file. Based on Fig. 11, all sequence is grow steadily and accordingly. If there was a re-transmission, the sequence should be smaller than previous.

No.	Time	Source	Destination	Protocol	Length	Info
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	[TCP segment of a reassembled PDU]
8	0.054690	192.168.1.102	128.119.245.12	TCP	1514	[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
10	0.077405	192.168.1.102	128.119.245.12	TCP	1514	[TCP segment of a reassembled PDU]
11	0.078157	192.168.1.102	128.119.245.12	TCP	1514	[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
13	0.124185	192.168.1.102	128.119.245.12	TCP	1201	[TCP segment of a reassembled PDU]
14	0.169118	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=4946 Win=14600 Len=0
15	0.217299	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=6406 Win=17520 Len=0
16	0.267802	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=7866 Win=20440 Len=0

Figure 12. Typical ACK data

No.	Time	Source	Destination	Protocol	Length	Info
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	[TCP segment of a reassembled PDU]
82	1.931879	192.168.1.102	128.119.245.12	TCP	1514	[TCP segment of a reassembled PDU]
83	1.932757	192.168.1.102	128.119.245.12	TCP	1514	[TCP segment of a reassembled PDU]
84	1.933636	192.168.1.102	128.119.245.12	TCP	1514	[TCP segment of a reassembled PDU]
85	1.934770	192.168.1.102	128.119.245.12	TCP	1514	[TCP segment of a reassembled PDU]
86	1.935586	192.168.1.102	128.119.245.12	TCP	946	[TCP segment of a reassembled PDU]
87	2.029069	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=61085 Win=62780 Len=0
88	2.126682	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=64005 Win=62780 Len=0
89	2.203195	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=66357 Win=62780 Len=0

Figure 13. Example of every other received segment.

Simple calculation:

ACKs	Data	Different
1	566	566
2	2026	1460
2	3486	1460

...

11. Typical ACKs data is **1460 bytes**. Through observing the files, there are cases where the receiver is ACKING every other segment. For example, in Fig. 13, **No. 80 with 2920 bytes**.

12. First: Find total data; Second: find total time; Third: use total time divide total data to find speed (throughput)

The last ACK is 164091 bytes; then, the total data is  $164091 - 1 = 164090$  bytes. The whole transmission time is the difference of the time instant of the first TCP segment (0.026477 secs) and last ACK (5.455830 SECS); then, the total time is  $5.455830 - 0.026477 = 5.4294$  secs. Then the total speed is  $164090 / 5.4294 = 30.222$  Kbytes/sec.