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CS 372-X001

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## Lab 3

### **A first look at the captured trace**

1. What is the IP address and TCP port number used by the client computer (source) that is transferring the file to `gaia.cs.umass.edu`? To answer this question, it's probably easiest to select an HTTP message and explore the details of the TCP packet used to carry this HTTP message, using the "details of the selected packet header window" (refer to Figure 2 in the "Getting Started with Wireshark" Lab if you're uncertain about the Wireshark windows).

tcp-ethereal-trace-1

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tcp

No.	Time	Source	Destination	Protocol	Length	Info
197	06:44:25.772405	192.168.1.102	128.119.245.12	TCP	326	1161 → 80 [PSH, ACK] Seq=163769 Ack=1 Win=6278
198	06:44:25.867638	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=159389 Win=6278
199	06:44:25.867722	192.168.1.102	128.119.245.12	HTTP	104	POST /ethereal-labs/lab3-1-reply.htm HTTP/1.1
200	06:44:25.959852	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=162309 Win=6278
201	06:44:26.018268	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=164041 Win=6278
202	06:44:26.026211	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=164091 Win=6278
203	06:44:26.031556	128.119.245.12	192.168.1.102	HTTP	784	HTTP/1.1 200 OK (text/html)
206	06:44:26.221522	192.168.1.102	128.119.245.12	TCP	54	1161 → 80 [ACK] Seq=164091 Ack=731 Win=16384
213	06:44:28.165938	192.168.1.102	199.2.53.206	TCP	62	1162 → 631 [SYN] Seq=0 Win=16384 Len=0 MSS=65535

> Frame 199: 104 bytes on wire (832 bits), 104 bytes captured (832 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: 164041, Ack: 1, Len: 50

Source Port: 1161

Destination Port: 80

[Stream index: 0]

[TCP Segment Len: 50]

Sequence number: 164041 (relative sequence number)

[Next sequence number: 164091 (relative sequence number)]

```

0000  00 06 25 da af 73 00 20 e0 8a 70 1a 08 00 45 00  ..%.s. .p...E.
0010  00 5a 1e 9a 40 00 80 06 a4 71 c0 a8 01 66 80 77  .Z...@... .q...f.w
0020  f5 0c 04 89 00 50 0d d8 82 bd 34 a2 74 1a 50 18  ....P... .4.t.P.
0030  44 70 9f 0f 00 00 0d 0a 2d 2d 2d 2d 2d 2d 2d 2d  Dp..... -----
0040  2d 2d 2d 2d 2d 2d 2d 2d 2d 2d 2d 2d 2d 2d 2d 2d  -----
0050  2d 2d 2d 2d 2d 32 36 35 30 30 31 39 31 36 39 31  -----265 00191691
0060  35 37 32 34 2d 2d 0d 0a 5724....

```

Frame (104 bytes) Reassembled TCP (164090 bytes)

tcp-ethereal-trace-1

Packets: 213 · Displayed: 202 (94.8%) Profile: Default

- The client IP address is 192.168.1.102 and TCP port number is 1161

2. What is the IP address of gaia.cs.umass.edu? On what port number is it sending and receiving TCP segments for this connection?

tcp-ethereal-trace-1						
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help						
tcp						
No.	Time	Source	Destination	Protocol	Length	Info
197	06:44:25.772405	192.168.1.102	128.119.245.12	TCP	326	1161 → 80 [PSH, ACK] Seq=163769 Ack=1 Win=6278
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199	06:44:25.867722	192.168.1.102	128.119.245.12	HTTP	104	POST /ethereal-labs/lab3-1-reply.htm HTTP/1.1
200	06:44:25.959852	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=162309 Win=6278
201	06:44:26.018268	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=164041 Win=6278
202	06:44:26.026211	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=164091 Win=6278
203	06:44:26.031556	128.119.245.12	192.168.1.102	HTTP	784	HTTP/1.1 200 OK (text/html)
206	06:44:26.221522	192.168.1.102	128.119.245.12	TCP	54	1161 → 80 [ACK] Seq=164091 Ack=731 Win=16384
213	06:44:28.165938	192.168.1.102	199.2.53.206	TCP	62	1162 → 631 [SYN] Seq=0 Win=16384 Len=0 MSS=65535
> Frame 203: 784 bytes on wire (6272 bits), 784 bytes captured (6272 bits) on interface 0 > Ethernet II, Src: LinksysG_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: 1, Ack: 164091, Len: 730						
Source Port: 80 Destination Port: 1161 [Stream index: 0] [TCP Segment Len: 730] Sequence number: 1 (relative sequence number) [Next sequence number: 731 (relative sequence number)] Acknowledgment number: 164091 (relative ack number)						
0000	00 20 e0 8a 70 1a 00 06	25 da af 73 08 00 45 00	. . . p . . . % . s . . E .			
0010	03 02 58 bc 40 00 37 06	b0 a7 80 77 f5 0c c0 a8	. . X . @ . 7 . . . w . . . .			
0020	01 66 00 50 04 89 34 a2	74 1a 0d d8 82 ef 50 18	. f . P . . 4 . t . . . . P .			
0030	f5 3c a9 20 00 00 48 54	54 50 2f 31 2e 31 20 32	. < . . . HT TP/1.1 2			
0040	30 30 20 4f 4b 0d 0a 44	61 74 65 3a 20 53 61 74	00 OK . . D ate: Sat			
0050	2c 20 32 31 20 41 75 67	20 32 30 30 34 20 31 33	, 21 Aug 2004 13			
0060	3a 34 34 3a 32 30 20 47	4d 54 0d 0a 53 65 72 76	:44:20 G MT . . Serv			
0070	65 72 3a 20 41 70 61 63	68 65 2f 32 2e 30 2e 34	er: Apac he/2.0.4			
0080	30 20 28 52 65 64 20 48	61 74 20 4c 69 6e 75 78	0 (Red H at Linux			
0090	29 0d 0a 4c 61 73 74 2d	4d 6f 64 69 66 69 65 64	) . . Last- Modified			
00a0	3a 20 53 61 74 2c 20 32	31 20 41 75 67 20 32 30	: Sat, 2 1 Aug 20			
00b0	30 34 20 30 31 3a 34 38	3a 31 34 20 47 4d 54 0d	04 01:48 :14 GMT .			

- The gaia.cs.umass.edu's IP address is 128.119.245.12 and port number is 80

3. What is the IP address and TCP port number used by your client computer (source) to transfer the file to gaia.cs.umass.edu?

The image shows a Wireshark packet capture window. The top pane displays a list of captured packets. The bottom pane shows the detailed view of the selected packet (No. 99).

No.	Time	Source	Destination	Protocol	Length	Info
95	16:13:55.901696	192.168.0.21	128.119.245.12	TCP	8814	63710 → 80 [ACK] Seq=133664 Ack=1 Win=262
96	16:13:55.901743	128.119.245.12	192.168.0.21	TCP	60	80 → 63710 [ACK] Seq=1 Ack=66504 Win=1623
97	16:13:55.901755	192.168.0.21	128.119.245.12	TCP	2974	63710 → 80 [ACK] Seq=142424 Ack=1 Win=262
98	16:13:55.902190	128.119.245.12	192.168.0.21	TCP	60	80 → 63710 [ACK] Seq=1 Ack=70884 Win=1716
99	16:13:55.902201	192.168.0.21	128.119.245.12	HTTP	7833	POST /wireshark-labs/lab3-1-reply.htm HTT
100	16:13:55.902264	128.119.245.12	192.168.0.21	TCP	60	80 → 63710 [ACK] Seq=1 Ack=72344 Win=1735
101	16:13:55.902425	128.119.245.12	192.168.0.21	TCP	60	80 → 63710 [ACK] Seq=1 Ack=73804 Win=1768
102	16:13:55.902640	128.119.245.12	192.168.0.21	TCP	60	80 → 63710 [ACK] Seq=1 Ack=76724 Win=1826
103	16:13:55.902795	128.119.245.12	192.168.0.21	TCP	60	80 → 63710 [ACK] Seq=1 Ack=78184 Win=1856
104	16:13:55.902960	128.119.245.12	192.168.0.21	TCP	60	80 → 63710 [ACK] Seq=1 Ack=82564 Win=1944

**Packet 99 Details:**

- Frame 99: 7833 bytes on wire (62664 bits), 7833 bytes captured (62664 bits) on interface 0
- Ethernet II, Src: AsustekC\_91:eb:e8 (04:d4:c4:91:eb:e8), Dst: Motorola\_f5:79:b1 (88:b4:a6:f5:79:b1)
- Internet Protocol Version 4, Src: 192.168.0.21, Dst: 128.119.245.12
- Transmission Control Protocol, Src Port: 63710, Dst Port: 80, Seq: 145344, Ack: 1, Len: 7779
  - Source Port: 63710
  - Destination Port: 80
  - [Stream index: 6]
  - [TCP Segment Len: 7779]
  - Sequence number: 145344 (relative sequence number)

**Packet 99 Payload (HTTP POST):**

```

0000  88 b4 a6 f5 79 b1 04 d4 c4 91 eb e8 08 00 45 00  ....y... ..E-
0010  00 00 2b 17 40 00 80 06 00 00 c0 a8 00 15 80 77  ..+..@... ..w
0020  f5 0c f8 de 00 50 50 19 76 2f d1 c2 fc 37 50 18  ....PP..v/...7P-
0030  04 02 36 48 00 00 61 6e 74 20 73 6f 6d 65 20 6d  ..6H..an t some m
0040  69 73 63 68 69 65 66 2c 20 6f 72 20 65 6c 73 65  ischief, or else
0050  20 79 6f 75 27 64 0d 0a 68 61 76 65 20 73 69 67  you'd.. have sig
0060  6e 65 64 20 79 6f 75 72 20 6e 61 6d 65 20 6c 69  ned your name li
0070  6b 65 20 61 6e 20 68 6f 6e 65 73 74 20 6d 61 6e  ke an ho nest man
0080  2e 27 0d 0a 0d 0a 20 20 54 68 65 72 65 20 77 61  .'.... There wa
0090  73 20 61 20 67 65 6e 65 72 61 6c 20 63 6c 61 70  s a gene ral clap
00a0  70 69 6e 67 20 6f 66 20 68 61 6e 64 73 20 61 74  ping of hands at
  
```

- The client IP address (my computer ethernet) is 192.168.0.21 and TCP port number is 63710

## TCP Basics

4. What is the sequence number of the TCP SYN segment that is used to initiate the TCP connection between the client computer and gaia.cs.umass.edu? What is it in the segment that identifies the segment as a SYN segment?

tcp-ethereal-trace-1

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tcp

No.	Time	Source	Destination	Protocol	Length	Info
1	06:44:20.570381	192.168.1.102	128.119.245.12	TCP	62	1161 → 80 [SYN] Seq=0 Win=16384 Len=0 MSS
2	06:44:20.593553	128.119.245.12	192.168.1.102	TCP	62	80 → 1161 [SYN, ACK] Seq=0 Ack=1 Win=5840
3	06:44:20.593646	192.168.1.102	128.119.245.12	TCP	54	1161 → 80 [ACK] Seq=1 Ack=1 Win=17520 Len
4	06:44:20.596858	192.168.1.102	128.119.245.12	TCP	619	1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=1752
5	06:44:20.612118	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [PSH, ACK] Seq=566 Ack=1 Win=17
6	06:44:20.624318	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Le
7	06:44:20.624407	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=2026 Ack=1 Win=17520
8	06:44:20.625071	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520
9	06:44:20.647675	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760 L

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)  
[Next sequence number: 0 (relative sequence number)]  
Acknowledgment number: 0  
0111 ... = Header Length: 28 bytes (7)  
Flags: 0x002 (SYN)  
Window size value: 16384

```

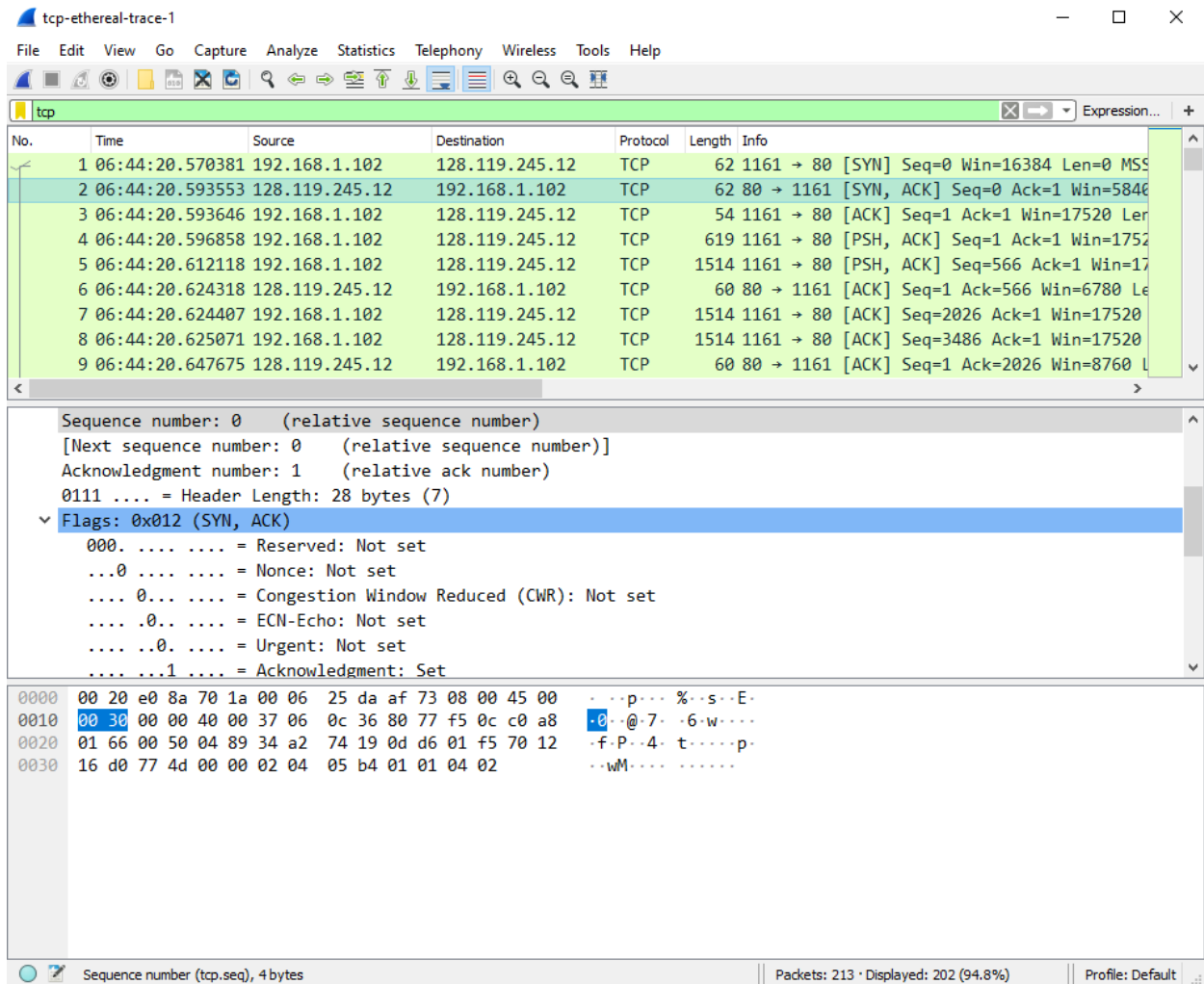
0000  00 06 25 da af 73 00 20 e0 8a 70 1a 08 00 45 00  ..%..s.. ..p...E.
0010  00 30 1e 1d 40 00 80 06 a5 18 c0 a8 01 66 80 77  ..0..@... ..f.w
0020  f5 0c 04 89 00 50 0d d6 01 f4 00 00 00 00 70 02  ....P.....p.
0030  40 00 f6 e9 00 00 02 04 05 b4 01 01 04 02      @.....

```

Sequence number (tcp.seq), 4 bytes | Packets: 213 · Displayed: 202 (94.8%) | Profile: Default

- The sequence number of TCP SYN segment is 0 because it is used for pretending the TCP connection between source client and gaia.cs.umass.edu. In addition, the flag for SYN set to 0x002 (SYN, 1) to identify the SYN segment

5. What is the sequence number of the SYNACK segment sent by gaia.cs.umass.edu to the client computer in reply to the SYN? What is the value of the Acknowledgement field in the SYNACK segment? How did gaia.cs.umass.edu determine that value? What is it in the segment that identifies the segment as a SYNACK segment?



- From the above screenshot, the sequence number of SYNACK segment sent by gaia.cs.umass.edu to the client computer in reply to the SYN is 0. The value of the acknowledgement field in the SYNACK segment is 1 because the value determined by the gaia.cs.umass.edu's server. The server adds 1 to the initial sequence number of the SYN segment from the client computer. When both SYN flag and ACK flag in the segment are set to 1, the segment will be identified as a SYNACK segment.

6. What is the sequence number of the TCP segment containing the HTTP POST command? Note that in order to find the POST command, you'll need to dig into the packet content field at the bottom of the Wireshark window, looking for a segment with a "POST" within its DATA field.

tcp-ethereal-trace-1

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tcp

No.	Time	Source	Destination	Protocol	Length	Info
1	06:44:20.570381	192.168.1.102	128.119.245.12	TCP	62	1161 → 80 [SYN] Seq=0 Win=16384 Len=0 MSS
2	06:44:20.593553	128.119.245.12	192.168.1.102	TCP	62	80 → 1161 [SYN, ACK] Seq=0 Ack=1 Win=5840
3	06:44:20.593646	192.168.1.102	128.119.245.12	TCP	54	1161 → 80 [ACK] Seq=1 Ack=1 Win=17520 Len=0
4	06:44:20.596858	192.168.1.102	128.119.245.12	TCP	619	1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=17520 Len=565
5	06:44:20.612118	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [PSH, ACK] Seq=566 Ack=1 Win=17520 Len=888
6	06:44:20.624318	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0
7	06:44:20.624407	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=2026 Ack=1 Win=17520 Len=888
8	06:44:20.625071	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520 Len=888
9	06:44:20.647675	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760 Len=0

[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)

0030 44 70 1f bd 00 00 50 4f 53 54 20 2f 65 74 68 65 Dp...P0 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..Host: 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 (Windows;  
 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 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

A data segment used in reassembly of a lower-level protocol (tcp.segment\_data), 565 bytes

Packets: 213 · Displayed: 202 (94.8%) Profile: Default

- The sequence number of the TCP segment containing the HTTP POST command is 1.

7. Consider the TCP segment containing the HTTP POST as the first segment in the TCP connection. What are the sequence numbers of the first six segments in the TCP connection (including the segment containing the HTTP POST)? At what time was each segment sent? When was the ACK for each segment received? Given the difference between when each TCP segment was sent, and when its acknowledgement was received, what is the RTT value for each of the six segments? What is the EstimatedRTT value (see Section 3.5.3, page 242 in text) after the receipt of each ACK? Assume that the value of the EstimatedRTT is equal to the measured RTT for the first segment, and then is computed using the EstimatedRTT equation on page 242 for all subsequent segments.

Note: Wireshark has a nice feature that allows you to plot the RTT for each of the TCP segments sent. Select a TCP segment in the “listing of captured packets” window that is being sent from the client to the gaia.cs.umass.edu server. Then select: Statistics->TCP Stream Graph- >Round Trip Time Graph.

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tcp

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3	06:44:20.593646	192.168.1.102	128.119.245.12	TCP	54	1161 → 80 [ACK] Seq=1 Ack=1 Win=17520 Len
4	06:44:20.596858	192.168.1.102	128.119.245.12	TCP	619	1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=1752
5	06:44:20.612118	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [PSH, ACK] Seq=566 Ack=1 Win=17
6	06:44:20.624318	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Le
7	06:44:20.624407	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=2026 Ack=1 Win=17520
8	06:44:20.625071	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520
9	06:44:20.647675	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760 L

> 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)

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

Acknowledgment number: 1 (relative ack number)

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

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....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..Host: 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 (Windows;
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 30 33 30 32	.2) Gecko /200302
00d0	30 38 20 4e 65 74 73 63 61 70 65 2f 37 2e 30 32	08 Netsc ape/7.02

Sequence number (tcp.seq), 4 bytes

Packets: 213 · Displayed: 202 (94.8%)

Profile: Default



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tcp

No.	Time	Source	Destination	Protocol	Length	Info
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2	06:44:20.593553	128.119.245.12	192.168.1.102	TCP	62	80 → 1161 [SYN, ACK] Seq=0 Ack=1 Win=5840
3	06:44:20.593646	192.168.1.102	128.119.245.12	TCP	54	1161 → 80 [ACK] Seq=1 Ack=1 Win=17520 Len=0
4	06:44:20.596858	192.168.1.102	128.119.245.12	TCP	619	1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=17520 Len=615
5	06:44:20.612118	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [PSH, ACK] Seq=566 Ack=1 Win=17520 Len=1510
6	06:44:20.624318	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0
7	06:44:20.624407	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=2026 Ack=1 Win=17520 Len=1510
8	06:44:20.625071	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520 Len=1510
9	06:44:20.647675	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760 Len=0

> 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)  
[Next sequence number: 2026 (relative sequence number)]  
Acknowledgment number: 1 (relative ack number)  
0101 .... = Header Length: 20 bytes (5)

0020	f5 0c 04 89 00 50 0d d6 04 2a 34 a2 74 1a 50 18	.....P...*4.t.P.
0030	44 70 3b e5 00 00 43 6f 6e 74 65 6e 74 2d 54 79	Dp;...Co ntent-Ty
0040	70 65 3a 20 6d 75 6c 74 69 70 61 72 74 2f 66 6f	pe: mult ipart/fo
0050	72 6d 2d 64 61 74 61 3b 20 62 6f 75 6e 64 61 72	rm-data; boundar
0060	79 3d 2d 2d 2d 2d 2d 2d 2d 2d 2d 2d 2d 2d 2d	y=-----
0070	2d 2d 2d 2d 2d 2d 2d 2d 2d 2d 2d 2d 32 36 35	-----265
0080	30 30 31 39 31 36 39 31 35 37 32 34 0d 0a 43 6f	00191691 5724..Co
0090	6e 74 65 6e 74 2d 4c 65 6e 67 74 68 3a 20 31 36	ntent-Le ngth: 16
00a0	33 34 31 31 0d 0a 0d 0a 2d 2d 2d 2d 2d 2d 2d 2d	3411....
00b0	2d 2d 2d 2d 2d 2d 2d 2d 2d 2d 2d 2d 2d 2d 2d	-----
00c0	2d 2d 2d 2d 2d 32 36 35 30 30 31 39 31 36 39 31	-----265 00191691
00d0	35 37 32 34 0d 0a 43 6f 6e 74 65 6e 74 2d 44 69	5724..Co ntent-Di

Sequence number (tcp.seq), 4 bytes

Packets: 213 · Displayed: 202 (94.8%)

Profile: Default

tcp-ethereal-trace-1

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

tcp

No.	Time	Source	Destination	Protocol	Length	Info
1	06:44:20.570381	192.168.1.102	128.119.245.12	TCP	62	1161 → 80 [SYN] Seq=0 Win=16384 Len=0 MSS
2	06:44:20.593553	128.119.245.12	192.168.1.102	TCP	62	80 → 1161 [SYN, ACK] Seq=0 Ack=1 Win=5840
3	06:44:20.593646	192.168.1.102	128.119.245.12	TCP	54	1161 → 80 [ACK] Seq=1 Ack=1 Win=17520 Len=0
4	06:44:20.596858	192.168.1.102	128.119.245.12	TCP	619	1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=17520 Len=615
5	06:44:20.612118	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [PSH, ACK] Seq=566 Ack=1 Win=17520 Len=1510
6	06:44:20.624318	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0
7	06:44:20.624407	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=2026 Ack=1 Win=17520 Len=1510
8	06:44:20.625071	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520 Len=1510
9	06:44:20.647675	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760 Len=0

> 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)  
[Next sequence number: 3486 (relative sequence number)]  
Acknowledgment number: 1 (relative ack number)  
0101 .... = Header Length: 20 bytes (5)

Offset	Hex	ASCII
0020	f5 0c 04 89 00 50 0d d6 09 de 34 a2 74 1a 50 10	.....P...4.t.P.
0030	44 70 b9 8e 00 00 0d 0a 0d 0a 57 65 20 61 72 65	Dp.... ..We are
0040	20 6e 6f 77 20 74 72 79 69 6e 67 20 74 6f 20 72	now try ing to r
0050	65 6c 65 61 73 65 20 61 6c 6c 20 6f 75 72 20 62	elease a ll our b
0060	6f 6f 6b 73 20 6f 6e 65 20 6d 6f 6e 74 68 20 69	ooks one month i
0070	6e 20 61 64 76 61 6e 63 65 0d 0a 6f 66 20 74 68	n advanc e..of th
0080	65 20 6f 66 66 69 63 69 61 6c 20 72 65 6c 65 61	e offici al relea
0090	73 65 20 64 61 74 65 73 2c 20 66 6f 72 20 74 69	se dates , for ti
00a0	6d 65 20 66 6f 72 20 62 65 74 74 65 72 20 65 64	me for b etter ed
00b0	69 74 69 6e 67 2e 20 20 57 65 0d 0a 68 61 76 65	iting. We..have
00c0	20 74 68 69 73 20 61 73 20 61 20 67 6f 61 6c 20	this as a goal
00d0	74 6f 20 61 63 63 6f 6d 70 6c 69 73 68 20 62 79	to accom plish by

Sequence number (tcp.seq), 4 bytes

Packets: 213 · Displayed: 202 (94.8%)

Profile: Default

tcp-ethereal-trace-1

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

tcp

No.	Time	Source	Destination	Protocol	Length	Info
1	06:44:20.570381	192.168.1.102	128.119.245.12	TCP	62	1161 → 80 [SYN] Seq=0 Win=16384 Len=0 MSS
2	06:44:20.593553	128.119.245.12	192.168.1.102	TCP	62	80 → 1161 [SYN, ACK] Seq=0 Ack=1 Win=5840
3	06:44:20.593646	192.168.1.102	128.119.245.12	TCP	54	1161 → 80 [ACK] Seq=1 Ack=1 Win=17520 Len
4	06:44:20.596858	192.168.1.102	128.119.245.12	TCP	619	1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=1752
5	06:44:20.612118	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [PSH, ACK] Seq=566 Ack=1 Win=17
6	06:44:20.624318	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Le
7	06:44:20.624407	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=2026 Ack=1 Win=17520
8	06:44:20.625071	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520
9	06:44:20.647675	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760 L

> 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: 3486, Ack: 1, Len: 1460

Source Port: 1161

Destination Port: 80

[Stream index: 0]

[TCP Segment Len: 1460]

Sequence number: 3486 (relative sequence number)

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

Acknowledgment number: 1 (relative ack number)

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

0020	f5 0c 04 89 00 50 0d d6 0f 92 34 a2 74 1a 50 10	.....P...4.t.P.
0030	44 70 dd 01 00 00 20 73 6f 6d 65 20 65 69 67 68	Dp.... s ome eigh
0040	74 20 74 65 78 74 0d 0a 66 69 6c 65 73 20 70 65	t text.. files pe
0050	72 20 6d 6f 6e 74 68 3a 20 20 74 68 75 73 20 75	r month: thus u
0060	70 70 69 6e 67 20 6f 75 72 20 70 72 6f 64 75 63	pping ou r produc
0070	74 69 76 69 74 79 20 66 72 6f 6d 20 24 32 20 6d	tivity f rom \$2 m
0080	69 6c 6c 69 6f 6e 2e 0d 0a 0d 0a 54 68 65 20 47	illion.. ...The G
0090	6f 61 6c 20 6f 66 20 50 72 6f 6a 65 63 74 20 47	oal of P roject G
00a0	75 74 65 6e 62 65 72 67 20 69 73 20 74 6f 20 47	utenberg is to G
00b0	69 76 65 20 41 77 61 79 20 4f 6e 65 20 54 72 69	ive Away One Tri
00c0	6c 6c 69 6f 6e 20 45 74 65 78 74 0d 0a 46 69 6c	llion Et ext..Fil
00d0	65 73 20 62 79 20 74 68 65 20 44 65 63 65 6d 62	es by th e Decemb

Sequence number (tcp.seq), 4 bytes

Packets: 213 · Displayed: 202 (94.8%)

Profile: Default

tcp-ethereal-trace-1

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

tcp

No.	Time	Source	Destination	Protocol	Length	Info
7	06:44:20.624407	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=2026 Ack=1 Win=17520
8	06:44:20.625071	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520
9	06:44:20.647675	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760
10	06:44:20.647786	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=4946 Ack=1 Win=17520
11	06:44:20.648538	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=6406 Ack=1 Win=17520
12	06:44:20.694466	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=3486 Win=11680
13	06:44:20.694566	192.168.1.102	128.119.245.12	TCP	1201	1161 → 80 [PSH, ACK] Seq=7866 Ack=1 Win=1
14	06:44:20.739499	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=4946 Win=14600
15	06:44:20.787680	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=6406 Win=17520

> 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)  
[Next sequence number: 6406 (relative sequence number)]  
Acknowledgment number: 1 (relative ack number)  
0101 .... = Header Length: 20 bytes (5)

0020 f5 0c 04 89 00 50 0d d6 15 46 34 a2 74 1a 50 10 .....P...F4.t.P.  
0030 44 70 90 8e 00 00 6f 66 20 62 6f 6f 6b 73 0d 0a Dp...of books..  
0040 61 6e 64 0d 0a 47 45 54 20 4e 45 57 20 47 55 54 and GET NEW GUT  
0050 20 66 6f 72 20 67 65 6e 65 72 61 6c 20 69 6e 66 for gen eral inf  
0060 6f 72 6d 61 74 69 6f 6e 0d 0a 61 6e 64 0d 0a 4d ormation ..and..M  
0070 47 45 54 20 47 55 54 2a 20 66 6f 72 20 6e 65 77 GET GUT\* for new  
0080 73 6c 65 74 74 65 72 73 2e 0d 0a 0d 0a 2a 2a 49 sletters .....I  
0090 6e 66 6f 72 6d 61 74 69 6f 6e 20 70 72 65 70 61 nformati on prepa  
00a0 72 65 64 20 62 79 20 74 68 65 20 50 72 6f 6a 65 red by t he Proje  
00b0 63 74 20 47 75 74 65 6e 62 65 72 67 20 6c 65 67 ct Guten berg leg  
00c0 61 6c 20 61 64 76 69 73 6f 72 2a 2a 0d 0a 28 54 al advis or\*\*..(T  
00d0 68 72 65 65 20 50 61 67 65 73 29 0d 0a 0d 0a 0d hree Pag es).....

Sequence number (tcp.seq), 4 bytes | Packets: 213 · Displayed: 202 (94.8%) | Profile: Default

tcp-ethereal-trace-1

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

tcp

No.	Time	Source	Destination	Protocol	Length	Info
7	06:44:20.624407	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=2026 Ack=1 Win=17520
8	06:44:20.625071	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520
9	06:44:20.647675	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760
10	06:44:20.647786	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=4946 Ack=1 Win=17520
11	06:44:20.648538	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=6406 Ack=1 Win=17520
12	06:44:20.694466	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=3486 Win=11680
13	06:44:20.694566	192.168.1.102	128.119.245.12	TCP	1201	1161 → 80 [PSH, ACK] Seq=7866 Ack=1 Win=1
14	06:44:20.739499	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=4946 Win=14600
15	06:44:20.787680	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=6406 Win=17520

> 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: 6406, Ack: 1, Len: 1460

Source Port: 1161  
Destination Port: 80  
[Stream index: 0]  
[TCP Segment Len: 1460]  
Sequence number: 6406 (relative sequence number)  
[Next sequence number: 7866 (relative sequence number)]  
Acknowledgment number: 1 (relative ack number)  
0101 .... = Header Length: 20 bytes (5)

0020 f5 0c 04 89 00 50 0d d6 1a fa 3a a2 74 1a 50 10 .....P...4.t.P.  
0030 44 70 95 83 00 00 20 55 6e 69 74 65 64 20 53 74 Dp.... United St  
0040 61 74 65 73 20 63 6f 70 79 72 69 67 68 74 0d 0a ates cop yright..  
0050 6f 6e 20 6f 72 20 66 6f 72 20 74 68 69 73 20 77 on or fo r this w  
0060 6f 72 6b 2c 20 73 6f 20 74 68 65 20 50 72 6f 6a ork, so the Proj  
0070 65 63 74 20 28 61 6e 64 20 79 6f 75 21 29 20 63 ect (and you!) c  
0080 61 6e 20 63 6f 70 79 20 61 6e 64 0d 0a 64 69 73 an copy and..dis  
0090 74 72 69 62 75 74 65 20 69 74 20 69 6e 20 74 68 tribute it in th  
00a0 65 20 55 6e 69 74 65 64 20 53 74 61 74 65 73 20 e United States  
00b0 77 69 74 68 6f 75 74 20 70 65 72 6d 69 73 73 69 without permissi  
00c0 6f 6e 20 61 6e 64 0d 0a 77 69 74 68 6f 75 74 20 on and.. without  
00d0 70 61 79 69 6e 67 20 63 6f 70 79 72 69 67 68 74 paying c opyright

Sequence number (tcp.seq), 4 bytes

Packets: 213 · Displayed: 202 (94.8%)

Profile: Default

- The sequence numbers of the first six segments in the TCP connection are 1, 566, 2026, 3486, 4946, and 6406. The sent times for each segment are 6:44:20.596858, 6:44:20.612118, 6:44:20.624407, 6:44:20.625071, 6:44:20.647786, and 6:44:20.648538.

tcp-ethereal-trace-1

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

tcp

No.	Time	Source	Destination	Protocol	Length	Info
1	06:44:20.570381	192.168.1.102	128.119.245.12	TCP	62	1161 → 80 [SYN] Seq=0 Win=16384 Len=0 MSS
2	06:44:20.593553	128.119.245.12	192.168.1.102	TCP	62	80 → 1161 [SYN, ACK] Seq=0 Ack=1 Win=5840
3	06:44:20.593646	192.168.1.102	128.119.245.12	TCP	54	1161 → 80 [ACK] Seq=1 Ack=1 Win=17520 Len
4	06:44:20.596858	192.168.1.102	128.119.245.12	TCP	619	1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=1752
5	06:44:20.612118	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [PSH, ACK] Seq=566 Ack=1 Win=17
6	06:44:20.624318	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Le
7	06:44:20.624407	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=2026 Ack=1 Win=17520
8	06:44:20.625071	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520
9	06:44:20.647675	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760 L

> Ethernet II, Src: LinksysG\_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: 1, Ack: 566, Len: 0

Source Port: 80

Destination Port: 1161

[Stream index: 0]

[TCP Segment Len: 0]

Sequence number: 1 (relative sequence number)

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

Acknowledgment number: 566 (relative ack number)

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

0000 00 20 e0 8a 70 1a 00 06 25 da af 73 08 00 45 00 . . . p . . . % . . s . . E .

0010 00 28 58 72 40 00 37 06 b3 cb 80 77 f5 0c c0 a8 . (Xr@.7. . . . w . . . .

0020 01 66 00 50 04 89 34 a2 74 1a 0d d6 04 2a 50 10 . f . P . . 4 . t . . . . \* P .

0030 1a 7c 9e 30 00 00 da 12 00 00 47 a5 . . . 0 . . . . . G .

tcp-ethereal-trace-1

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

tcp

No.	Time	Source	Destination	Protocol	Length	Info
1	06:44:20.570381	192.168.1.102	128.119.245.12	TCP	62	1161 → 80 [SYN] Seq=0 Win=16384 Len=0 MSS=
2	06:44:20.593553	128.119.245.12	192.168.1.102	TCP	62	80 → 1161 [SYN, ACK] Seq=0 Ack=1 Win=5840
3	06:44:20.593646	192.168.1.102	128.119.245.12	TCP	54	1161 → 80 [ACK] Seq=1 Ack=1 Win=17520 Len=
4	06:44:20.596858	192.168.1.102	128.119.245.12	TCP	619	1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=17520
5	06:44:20.612118	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [PSH, ACK] Seq=566 Ack=1 Win=17520
6	06:44:20.624318	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=
7	06:44:20.624407	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=2026 Ack=1 Win=17520
8	06:44:20.625071	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520
9	06:44:20.647675	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760 Len=

> Ethernet II, Src: LinksysG\_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: 1, Ack: 2026, Len: 0

Source Port: 80

Destination Port: 1161

[Stream index: 0]

[TCP Segment Len: 0]

Sequence number: 1 (relative sequence number)

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

Acknowledgment number: 2026 (relative ack number)

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

0000 00 20 e0 8a 70 1a 00 06 25 da af 73 08 00 45 00 . . . p . . . % . . s . . E .

0010 00 28 58 73 40 00 37 06 b3 ca 80 77 f5 0c c0 a8 . (Xs@.7. . . . w . . . .

0020 01 66 00 50 04 89 34 a2 74 1a 0d d6 09 de 50 10 . f . P . . 4 . t . . . . P .

0030 22 38 90 c0 00 00 87 9e 00 00 3a 30 "8 . . . . . : : 0

tcp-ethereal-trace-1

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

tcp

No.	Time	Source	Destination	Protocol	Length	Info
4	06:44:20.596858	192.168.1.102	128.119.245.12	TCP	619	1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=1752
5	06:44:20.612118	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [PSH, ACK] Seq=566 Ack=1 Win=17
6	06:44:20.624318	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Le
7	06:44:20.624407	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=2026 Ack=1 Win=17520
8	06:44:20.625071	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520
9	06:44:20.647675	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760 l
10	06:44:20.647786	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=4946 Ack=1 Win=17520
11	06:44:20.648538	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=6406 Ack=1 Win=17520
12	06:44:20.694466	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=3486 Win=11680

> Ethernet II, Src: LinksysG\_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: 1, Ack: 3486, Len: 0

Source Port: 80

Destination Port: 1161

[Stream index: 0]

[TCP Segment Len: 0]

Sequence number: 1 (relative sequence number)

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

Acknowledgment number: 3486 (relative ack number)

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

```

0000 00 20 e0 8a 70 1a 00 06 25 da af 73 08 00 45 00  . . . p . . % . . s . . E .
0010 00 28 58 74 40 00 37 06 b3 c9 80 77 f5 0c c0 a8  . (Xt@.7 . . . w . . . .
0020 01 66 00 50 04 89 34 a2 74 1a 0d d6 0f 92 50 10  . f . P . . 4 . t . . . . P .
0030 2d a0 7f a4 00 00 7b ec 00 00 5f 33  . . . . . { . . . _ 3

```

Sequence number (tcp.seq), 4 bytes

Packets: 213 · Displayed: 202 (94.8%)

Profile: Default



tcp-ethereal-trace-1

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tcp

No.	Time	Source	Destination	Protocol	Length	Info
7	06:44:20.624407	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=2026 Ack=1 Win=17520
8	06:44:20.625071	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520
9	06:44:20.647675	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760
10	06:44:20.647786	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=4946 Ack=1 Win=17520
11	06:44:20.648538	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=6406 Ack=1 Win=17520
12	06:44:20.694466	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=3486 Win=11680
13	06:44:20.694566	192.168.1.102	128.119.245.12	TCP	1201	1161 → 80 [PSH, ACK] Seq=7866 Ack=1 Win=1
14	06:44:20.739499	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=4946 Win=14600
15	06:44:20.787680	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=6406 Win=17520

> Ethernet II, Src: LinksysG\_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: 1, Ack: 4946, Len: 0

Source Port: 80

Destination Port: 1161

[Stream index: 0]

[TCP Segment Len: 0]

Sequence number: 1 (relative sequence number)

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

Acknowledgment number: 4946 (relative ack number)

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

```

0000 00 20 e0 8a 70 1a 00 06 25 da af 73 08 00 45 00  . . . p . . . % . . s . . E .
0010 00 28 58 75 40 00 37 06 b3 c8 80 77 f5 0c c0 a8  . (Xu@.7. . . . w . . . .
0020 01 66 00 50 04 89 34 a2 74 1a 0d d6 15 46 50 10  . f . P . . 4 . t . . . . F P .
0030 39 08 6e 88 00 00 d4 3c 00 00 d8 3a                9 . n . . . . < . . . :

```

Sequence number (tcp.seq), 4 bytes

Packets: 213 · Displayed: 202 (94.8%)

Profile: Default

tcp-ethereal-trace-1

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

tcp

No.	Time	Source	Destination	Protocol	Length	Info
7	06:44:20.624407	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=2026 Ack=1 Win=17520
8	06:44:20.625071	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520
9	06:44:20.647675	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760
10	06:44:20.647786	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=4946 Ack=1 Win=17520
11	06:44:20.648538	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=6406 Ack=1 Win=17520
12	06:44:20.694466	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=3486 Win=11680
13	06:44:20.694566	192.168.1.102	128.119.245.12	TCP	1201	1161 → 80 [PSH, ACK] Seq=7866 Ack=1 Win=1
14	06:44:20.739499	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=4946 Win=14600
15	06:44:20.787680	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=6406 Win=17520

> Ethernet II, Src: LinksysG\_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: 1, Ack: 6406, Len: 0

Source Port: 80

Destination Port: 1161

[Stream index: 0]

[TCP Segment Len: 0]

Sequence number: 1 (relative sequence number)

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

Acknowledgment number: 6406 (relative ack number)

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

```

0000 00 20 e0 8a 70 1a 00 06 25 da af 73 08 00 45 00  . . . p . . . % . . s . . E .
0010 00 28 58 76 40 00 37 06 b3 c7 80 77 f5 0c c0 a8  . (Xv@.7. . . . w . . . .
0020 01 66 00 50 04 89 34 a2 74 1a 0d d6 1a fa 50 10  . f . P . . 4 . t . . . . P .
0030 44 70 5d 6c 00 00 6a f3 00 00 b5 20              Dp]l . . j . . . .

```

Sequence number (tcp.seq), 4 bytes

Packets: 213 · Displayed: 202 (94.8%)

Profile: Default

tcp-ethereal-trace-1

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

tcp

No.	Time	Source	Destination	Protocol	Length	Info
10	06:44:20.647786	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=4946 Ack=1 Win=17520
11	06:44:20.648538	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=6406 Ack=1 Win=17520
12	06:44:20.694466	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=3486 Win=11680
13	06:44:20.694566	192.168.1.102	128.119.245.12	TCP	1201	1161 → 80 [PSH, ACK] Seq=7866 Ack=1 Win=1
14	06:44:20.739499	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=4946 Win=14600
15	06:44:20.787680	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=6406 Win=17520
16	06:44:20.838183	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=7866 Win=20440
17	06:44:20.875188	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=9013 Win=23360
18	06:44:20.875421	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=9013 Ack=1 Win=17520

> Ethernet II, Src: LinksysG\_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: 1, Ack: 7866, Len: 0

Source Port: 80

Destination Port: 1161

[Stream index: 0]

[TCP Segment Len: 0]

Sequence number: 1 (relative sequence number)

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

Acknowledgment number: 7866 (relative ack number)

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

```

0000 00 20 e0 8a 70 1a 00 06 25 da af 73 08 00 45 00  . . . p . . . % . . s . . E .
0010 00 28 58 77 40 00 37 06 b3 c6 80 77 f5 0c c0 a8  . (Xw@ . 7 . . . w . . . .
0020 01 66 00 50 04 89 34 a2 74 1a 0d d6 20 ae 50 10  . f . P . . 4 . t . . . . P .
0030 4f d8 4c 50 00 00 93 c0 00 00 63 ed 0 . l f . . . . . c .

```

Sequence number (tcp.seq), 4 bytes

Packets: 213 · Displayed: 202 (94.8%)

Profile: Default

- The received times of each segment for ACK are 6:44:20.624318, 6:44:20.647675, 6:44:20.694466, 6:44:20.739499, 6:44:20.787680, and 6:44:20.838183
- The RTT values for each of the six segments are 0.02746, 0.035557, 0.070059, 0.114428, 0.139894, and 0.189645.
- $\text{EstimatedRTT} = 0.875 * \text{EstimatedRTT} + 0.125 * \text{SampleRTT}$

EstimatedRTT after the received the ACK of segment 1:  $\text{EstimatedRTT} = \text{RTT for Segment 1} = 0.02746$

EstimatedRTT after the received the ACK of segment 2:  $\text{EstimatedRTT} = (0.875 * 0.02746) + (0.125 * 0.035557) = 0.028472125$

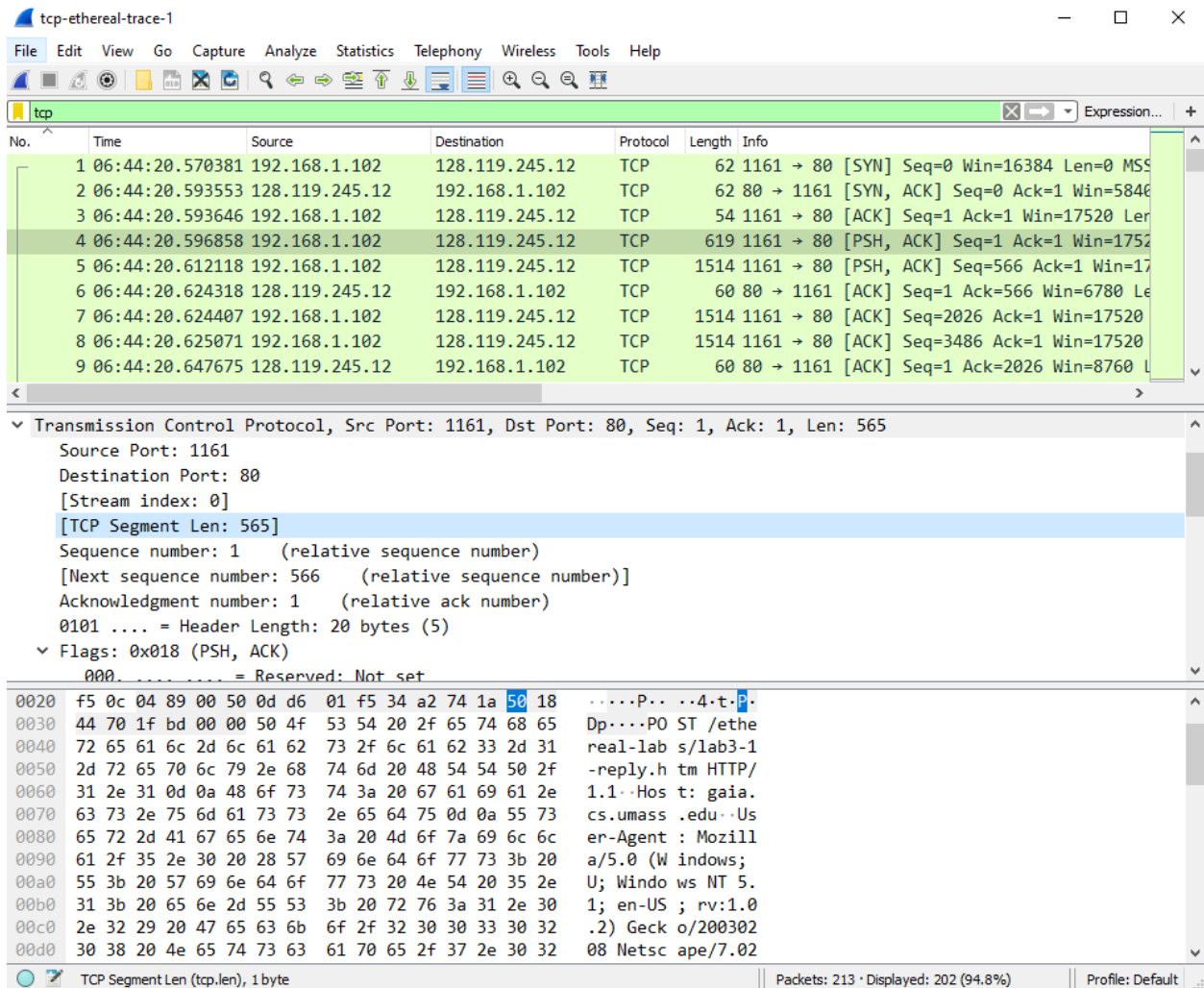
EstimatedRTT after the received the ACK of segment 3:  $\text{EstimatedRTT} = (0.875 * 0.028472125) + (0.125 * 0.070059) = 0.0367048437$

EstimatedRTT after the received the ACK of segment 4:  $\text{EstimatedRTT} = (0.875 * 0.0367048437) + (0.125 * 0.114428) = 0.04376517382$

EstimatedRTT after the received the ACK of segment 5:  $\text{EstimatedRTT} = (0.875 * 0.04376517382) + (0.125 * 0.139894) = 0.05578127709$

EstimatedRTT after the receipt of the ACK of segment 6:  $\text{EstimatedRTT} = (0.875 * 0.05578127709) + (0.125 * 0.189645) = 0.07251424246$

8. What is the length of each of the first six TCP segments?<sup>3</sup>



tcp-ethereal-trace-1

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tcp

No.	Time	Source	Destination	Protocol	Length	Info
1	06:44:20.570381	192.168.1.102	128.119.245.12	TCP	62	1161 → 80 [SYN] Seq=0 Win=16384 Len=0 MSS=
2	06:44:20.593553	128.119.245.12	192.168.1.102	TCP	62	80 → 1161 [SYN, ACK] Seq=0 Ack=1 Win=5840
3	06:44:20.593646	192.168.1.102	128.119.245.12	TCP	54	1161 → 80 [ACK] Seq=1 Ack=1 Win=17520 Len=
4	06:44:20.596858	192.168.1.102	128.119.245.12	TCP	619	1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=17520
5	06:44:20.612118	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [PSH, ACK] Seq=566 Ack=1 Win=17
6	06:44:20.624318	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Le
7	06:44:20.624407	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=2026 Ack=1 Win=17520
8	06:44:20.625071	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520
9	06:44:20.647675	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760 L

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)  
[Next sequence number: 566 (relative sequence number)]  
Acknowledgment number: 1 (relative ack number)  
0101 .... = Header Length: 20 bytes (5)  
Flags: 0x018 (PSH, ACK)  
0000 .... = Reserved: Not set

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....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..Host: 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 (Windows;  
00a0 55 3b 20 57 69 6e 64 6f 77 73 20 4e 54 20 35 2e U; Windows 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 30 33 30 32 .2) Gecko/200302  
00d0 30 38 20 4e 65 74 73 63 61 70 65 2f 37 2e 30 32 08 Netscape/7.02

TCP Segment Len (tcp.len), 1 byte

Packets: 213 · Displayed: 202 (94.8%)

Profile: Default

tcp-ethereal-trace-1

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

tcp

No.	Time	Source	Destination	Protocol	Length	Info
1	06:44:20.570381	192.168.1.102	128.119.245.12	TCP	62	1161 → 80 [SYN] Seq=0 Win=16384 Len=0 MSS
2	06:44:20.593553	128.119.245.12	192.168.1.102	TCP	62	80 → 1161 [SYN, ACK] Seq=0 Ack=1 Win=5840
3	06:44:20.593646	192.168.1.102	128.119.245.12	TCP	54	1161 → 80 [ACK] Seq=1 Ack=1 Win=17520 Len=0
4	06:44:20.596858	192.168.1.102	128.119.245.12	TCP	619	1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=17520 Len=615
5	06:44:20.612118	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [PSH, ACK] Seq=566 Ack=1 Win=17520 Len=1460
6	06:44:20.624318	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0
7	06:44:20.624407	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=2026 Ack=1 Win=17520 Len=1460
8	06:44:20.625071	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520 Len=1460
9	06:44:20.647675	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760 Len=0

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)  
[Next sequence number: 2026 (relative sequence number)]  
Acknowledgment number: 1 (relative ack number)  
0101 .... = Header Length: 20 bytes (5)  
Flags: 0x018 (PSH, ACK)  
000. .... = Reserved: Not set

Offset	Hex	ASCII
0020	f5 0c 04 89 00 50 0d d6 04 2a 34 a2 74 1a 50 18	.....P...4..t.P.
0030	44 70 3b e5 00 00 43 6f 6e 74 65 6e 74 2d 54 79	Dp;...Content-Ty
0040	70 65 3a 20 6d 75 6c 74 69 70 61 72 74 2f 66 6f	pe: multipart/fo
0050	72 6d 2d 64 61 74 61 3b 20 62 6f 75 6e 64 61 72	rm-data; boundar
0060	79 3d 2d 2d 2d 2d 2d 2d 2d 2d 2d 2d 2d 2d 2d	y=-----
0070	2d 2d 2d 2d 2d 2d 2d 2d 2d 2d 2d 2d 32 36 35	-----265
0080	30 30 31 39 31 36 39 31 35 37 32 34 0d 0a 43 6f	00191691 5724..Co
0090	6e 74 65 6e 74 2d 4c 65 6e 67 74 68 3a 20 31 36	ntent-Le ngth: 16
00a0	33 34 31 31 0d 0a 0d 0a 2d 2d 2d 2d 2d 2d 2d 2d	3411....
00b0	2d 2d 2d 2d 2d 2d 2d 2d 2d 2d 2d 2d 2d 2d 2d	-----
00c0	2d 2d 2d 2d 2d 32 36 35 30 30 31 39 31 36 39 31	-----265 00191691
00d0	35 37 32 34 0d 0a 43 6f 6e 74 65 6e 74 2d 44 69	5724..Co ntent-Di

TCP Segment Len (tcp.len), 1 byte

Packets: 213 · Displayed: 202 (94.8%)

Profile: Default

- The length of first of the six segment (HTTP POST) is only 565 byte and the rest of segments are 1460 bytes

9. What is the minimum amount of available buffer space advertised at the receiver for the entire trace? Does the lack of receiver buffer space ever throttle the sender?

tcp-ethereal-trace-1

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

tcp

No.	Time	Source	Destination	Protocol	Length	Info
1	06:44:20.570381	192.168.1.102	128.119.245.12	TCP	62	1161 → 80 [SYN] Seq=0 Win=16384 Len=0 MSS=
2	06:44:20.593553	128.119.245.12	192.168.1.102	TCP	62	80 → 1161 [SYN, ACK] Seq=0 Ack=1 Win=5840
3	06:44:20.593646	192.168.1.102	128.119.245.12	TCP	54	1161 → 80 [ACK] Seq=1 Ack=1 Win=17520 Len=
4	06:44:20.596858	192.168.1.102	128.119.245.12	TCP	619	1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=1752
5	06:44:20.612118	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [PSH, ACK] Seq=566 Ack=1 Win=17
6	06:44:20.624318	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=
7	06:44:20.624407	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=2026 Ack=1 Win=17520
8	06:44:20.625071	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520
9	06:44:20.647675	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760 Len=

.... ..0 = Fin: Not set  
[TCP Flags: .....A..S.]  
Window size value: 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]

```

0000  00 20 e0 8a 70 1a 00 06 25 da af 73 08 00 45 00  . . . p . . % . s . . E .
0010  00 30 00 00 40 00 37 06 0c 36 80 77 f5 0c c0 a8  . 0 . . @ . 7 . . 6 . w . . .
0020  01 66 00 50 04 89 34 a2 74 19 0d d6 01 f5 70 12  . f . P . . 4 . t . . . . p .
0030  16 d0 77 4d 00 00 02 04 05 b4 01 01 04 02      . . w . . . . . . . .

```

The window size value from the TCP header (tcp.window\_size\_value), 2 bytes

Packets: 213 · Displayed: 202 (94.8%)

Profile: Default

tcp-ethereal-trace-1

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

tcp

No.	Time	Source	Destination	Protocol	Length	Info
46	06:44:21.427183	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=31237 Ack=1 Win=17520
47	06:44:21.428064	192.168.1.102	128.119.245.12	TCP	946	1161 → 80 [PSH, ACK] Seq=32697 Ack=1 Win=17520
48	06:44:21.469804	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=26857 Win=55480
49	06:44:21.519926	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=28317 Win=58400
50	06:44:21.565096	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=29777 Win=61320
51	06:44:21.610201	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=31237 Win=62780
52	06:44:21.687478	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=33589 Win=62780
53	06:44:21.687714	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=33589 Ack=1 Win=17520
54	06:44:21.688514	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=35049 Ack=1 Win=17520

.... 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  
 .... .... ...0 = Fin: Not set  
 [TCP Flags: .....A....]  
 Window size value: 62780  
 [Calculated window size: 62780]

0000 00 20 e0 8a 70 1a 00 06 25 da af 73 08 00 45 00 . . . p . . . % . . s . . E .  
 0010 00 28 58 89 40 00 37 06 b3 b4 80 77 f5 0c c0 a8 . (X . @ . 7 . . . . w . . . .  
 0020 01 66 00 50 04 89 34 a2 74 1a 0d d6 85 29 50 10 . f . P . . . 4 . t . . . . ) P .  
 0030 f5 3c 42 70 00 00 a4 13 00 00 00 4c . < 8 p . . . . . L

The window size value from the TCP header (tcp.window\_size\_value), 2 bytes

Packets: 213 · Displayed: 202 (94.8%)

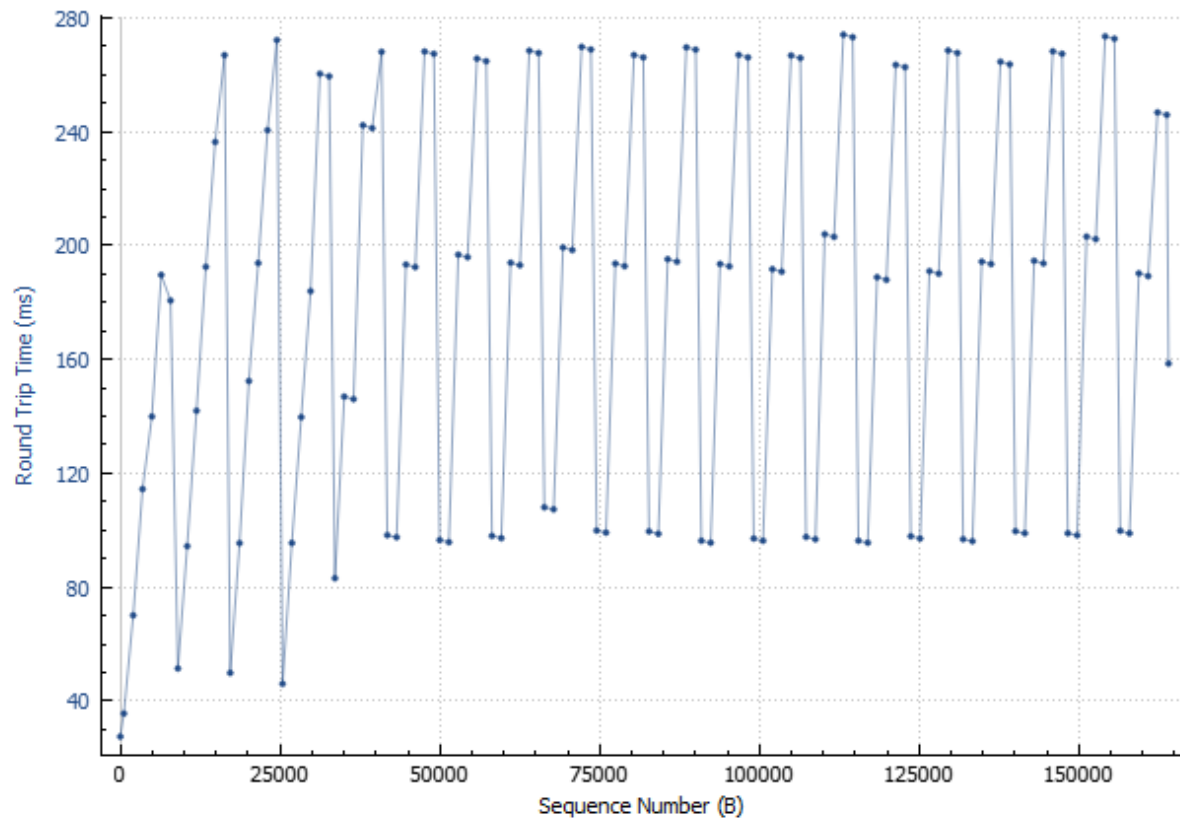
Profile: Default

- The minimum amount of available buffer space advertised at the received for the entire trace is 5840 bytes as first acknowledgement from the server. The receiver window size gradually increased until the buffer size 62780 bytes. Therefore, the sender can't be throttled because of the lack of receiver buffer space.

10. Are there any retransmitted segments in the trace file? What did you check for (in the trace) in order to answer this question?

**Round Trip Time for 192.168.1.102:1161 → 128.119.245.12:80**

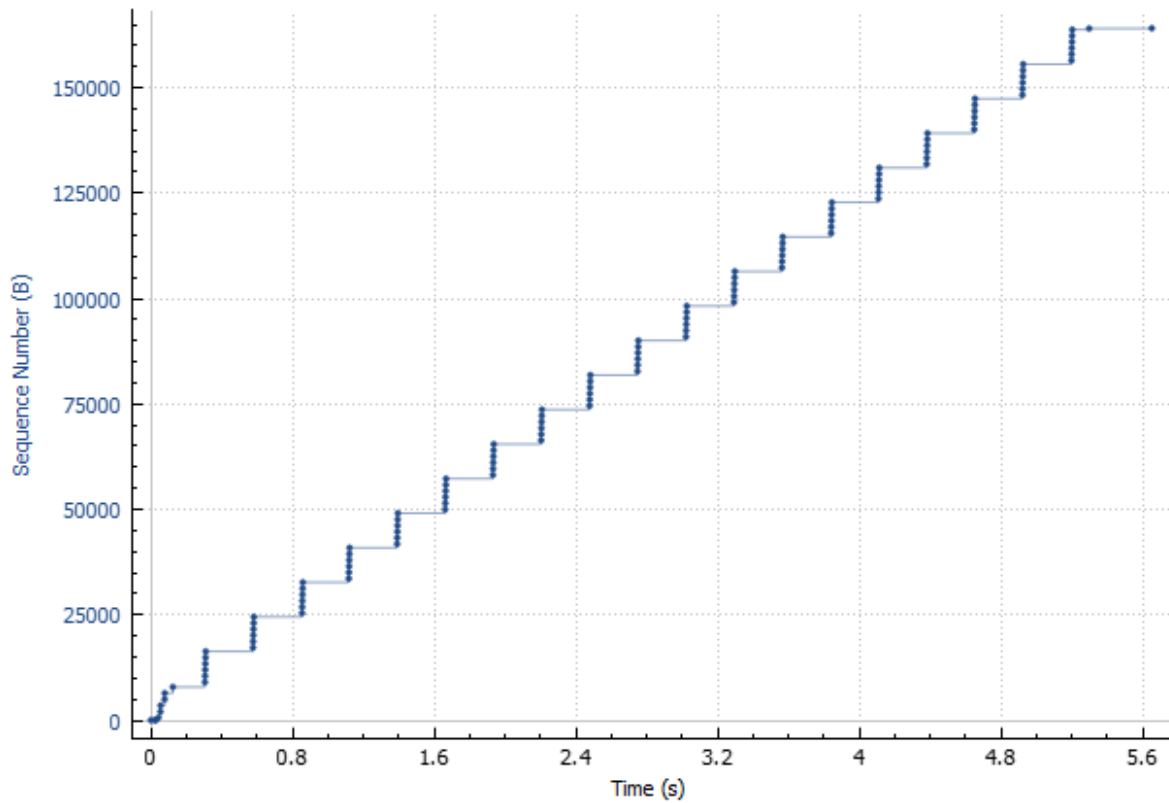
tcp-ethereal-trace-1

*Hover over the graph for details. → 125 pkts, 164 kB ← 76 pkts, 730 bytes*Type Round Trip Time ▾Stream 0 ▾ Switch DirectionMouse ☒ drags ☐ zooms☒ RTT By Sequence NumberResetSave As...CloseHelp



**Sequence Numbers (Stevens) for 192.168.1.102:1161 → 128.119.245.12:80**

tcp-ethereal-trace-1

*Hover over the graph for details. → 125 pkts, 164 kB ← 76 pkts, 730 bytes*Type **Time / Sequence (Stevens)** ▾Stream **0** ▾

Switch Direction

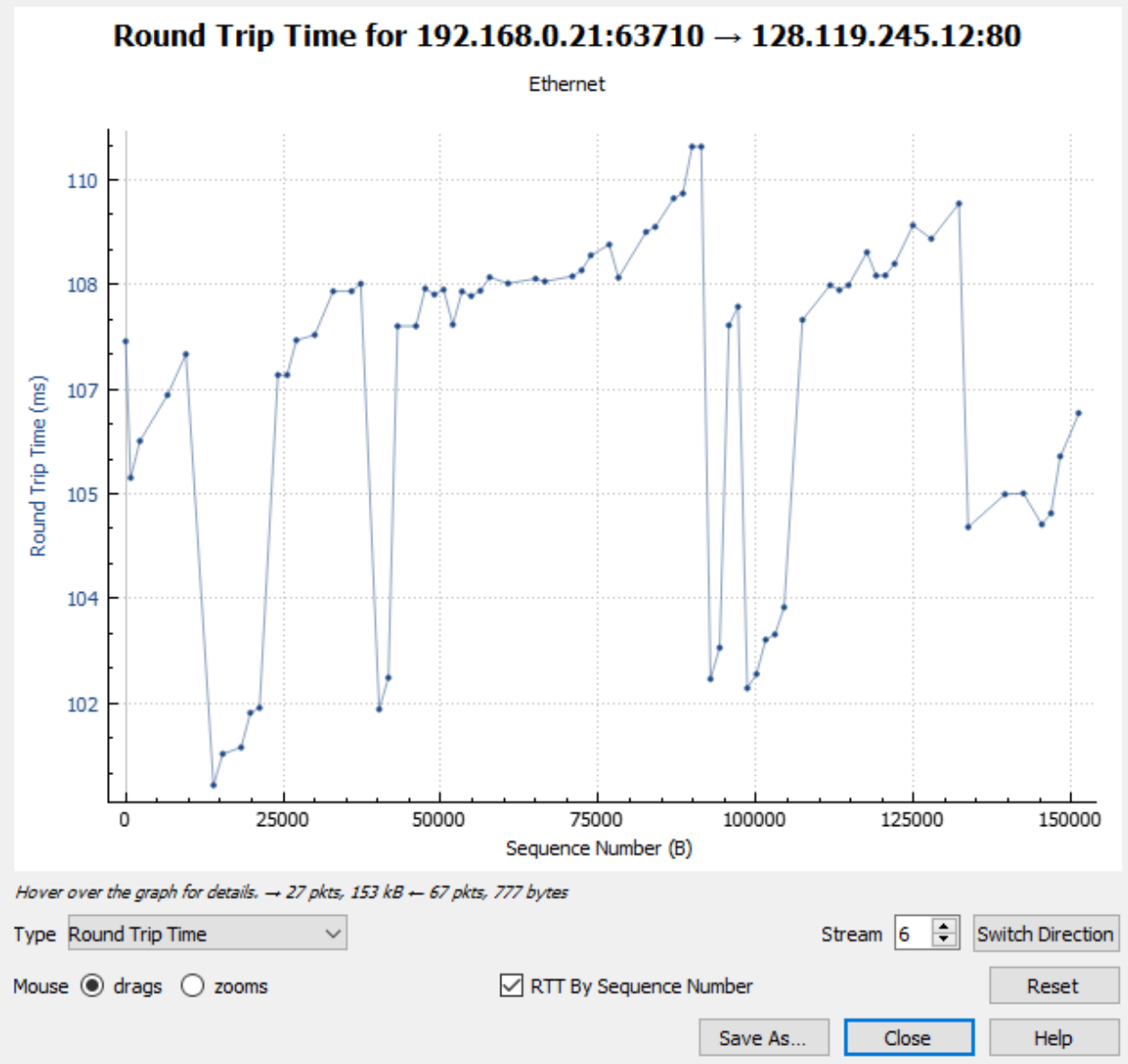
Mouse ☒ drags ☐ zooms

Reset

Save As...

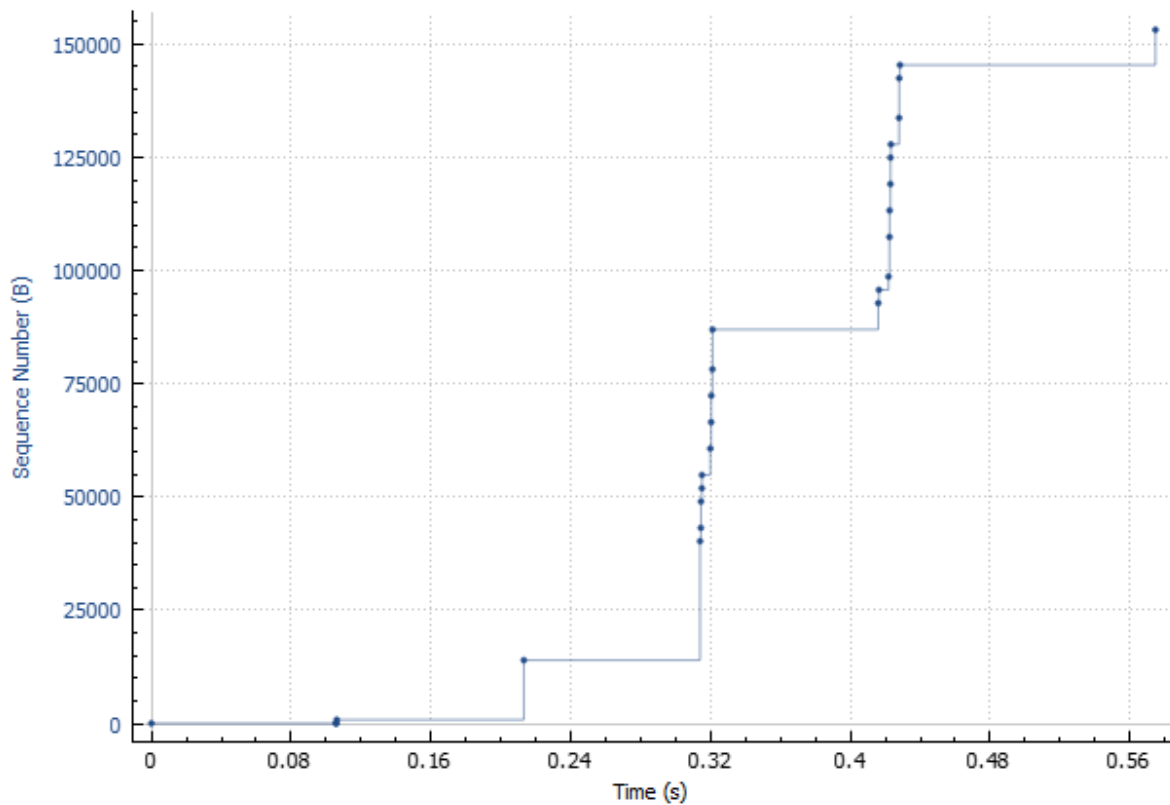
Close

Help



**Sequence Numbers (Stevens) for 192.168.0.21:63710 → 128.119.245.12:80**

Ethernet

*Hover over the graph for details. → 27 pkts, 153 kB ← 67 pkts, 777 bytes*Type Time / Sequence (Stevens) ▾Stream 6 ▾Switch DirectionMouse ☒ drags ☐ zoomsResetSave As...CloseHelp

The screenshot shows a Wireshark capture of a TCP connection. The packet list at the top shows several packets, with packet 162 highlighted in red, indicating it is a retransmission of packet 159. The packet details pane shows the structure of the selected packet: Ethernet II, Internet Protocol Version 4, and Transmission Control Protocol. The TCP segment has a sequence number of 1 (relative sequence number). The packet bytes pane shows the raw data of the packet, which is the start of an HTML document.

- There is no retransmitted segment in the trace file (tcp-ethereal-trace-1), but my computer ethernet's trace file has one retransmitted segment. I checked the packet list information for retransmitted segment.

11. How much data does the receiver typically acknowledge in an ACK? Can you identify cases where the receiver is ACKing every other received segment (see Table 3.2 on page 250 in the text).

	ACK sequence number	ACKed data
ACK 1	566	566
ACK 2	2026	1460
ACK 3	3486	1460
ACK 4	4946	1460
ACK 5	6406	1460
ACK 6	7866	1460
ACK 7	9013	1147
ACK 8	10473	1460
ACK 9	11933	1460

- Typically, the data increased by 1460 each time except for the ACK 7. Therefore, it indicates that the receiver is ACKing 1460 bytes each time.

12. What is the throughput (bytes transferred per unit time) for the TCP connection? Explain how you calculated this value.

tcp-ethereal-trace-1

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

tcp

No.	Time	Source	Destination	Protocol	Length	Info
1	06:44:20.570381	192.168.1.102	128.119.245.12	TCP	62	1161 → 80 [SYN] Seq=0 Win=16384 Len=0 MSS=1460
2	06:44:20.593553	128.119.245.12	192.168.1.102	TCP	62	80 → 1161 [SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0
3	06:44:20.593646	192.168.1.102	128.119.245.12	TCP	54	1161 → 80 [ACK] Seq=1 Ack=1 Win=17520 Len=0
4	06:44:20.596858	192.168.1.102	128.119.245.12	TCP	619	1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=17520 Len=565
5	06:44:20.612118	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [PSH, ACK] Seq=566 Ack=1 Win=17520 Len=1460
6	06:44:20.624318	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0
7	06:44:20.624407	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=2026 Ack=1 Win=17520 Len=1460
8	06:44:20.625071	192.168.1.102	128.119.245.12	TCP	1514	1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520 Len=1460
9	06:44:20.647675	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760 Len=0

[Checksum Status: Unverified]  
Urgent pointer: 0

✓ [SEQ/ACK analysis]  
[iRTT: 0.023265000 seconds]  
[Bytes in flight: 565]  
[Bytes sent since last PSH flag: 565]

✓ [Timestamps]  
[Time since first frame in this TCP stream: 0.026477000 seconds]  
[Time since previous frame in this TCP stream: 0.003212000 seconds]  
TCP payload (565 bytes)  
[Reassembled PDU in frame: 199]

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...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..Host: 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 (Windows;  
00a0 55 3b 20 57 69 6e 64 6f 77 73 20 4e 54 20 35 2e U; Windows 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 30 33 30 32 .2) Gecko/200302  
00d0 30 38 20 4e 65 74 73 63 61 70 65 2f 37 2e 30 32 08 Netscape/7.02

Time relative to first frame in this TCP stream (tcp.time\_relative) | Packets: 213 · Displayed: 202 (94.8%) | Profile: Default

tcp-ethereal-trace-1

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

tcp

No.	Time	Source	Destination	Protocol	Length	Info
197	06:44:25.772405	192.168.1.102	128.119.245.12	TCP	326	1161 → 80 [PSH, ACK] Seq=163769 Ack=1 Win=6278
198	06:44:25.867638	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=159389 Win=6278
199	06:44:25.867722	192.168.1.102	128.119.245.12	HTTP	104	POST /ethereal-labs/lab3-1-reply.htm HTTP/1.1
200	06:44:25.959852	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=162309 Win=6278
201	06:44:26.018268	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=164041 Win=6278
202	06:44:26.026211	128.119.245.12	192.168.1.102	TCP	60	80 → 1161 [ACK] Seq=1 Ack=164091 Win=6278
203	06:44:26.031556	128.119.245.12	192.168.1.102	HTTP	784	HTTP/1.1 200 OK (text/html)
206	06:44:26.221522	192.168.1.102	128.119.245.12	TCP	54	1161 → 80 [ACK] Seq=164091 Ack=731 Win=16384
213	06:44:28.165938	192.168.1.102	199.2.53.206	TCP	62	1162 → 631 [SYN] Seq=0 Win=16384 Len=0 MSS=65535

Checksum: 0x44a8 [unverified]  
[Checksum Status: Unverified]  
Urgent pointer: 0  
✓ [SEQ/ACK analysis]  
    [This is an ACK to the segment in frame: 199]  
    [The RTT to ACK the segment was: 0.158489000 seconds]  
    [iRTT: 0.023265000 seconds]  
✓ [Timestamps]  
    [Time since first frame in this TCP stream: 5.455830000 seconds]  
    [Time since previous frame in this TCP stream: 0.007943000 seconds]

0000 00 20 e0 8a 70 1a 00 06 25 da af 73 08 00 45 00 . . . p . . . % . . s . . E .  
0010 00 28 58 bb 40 00 37 06 b3 82 80 77 f5 0c c0 a8 . ( X . @ . 7 . . . . w . . . .  
0020 01 66 00 50 04 89 34 a2 74 1a 0d d8 82 ef 50 10 . f . P . . 4 . t . . . . . P .  
0030 f5 3c 44 a8 00 00 e5 e7 00 00 07 fb . < D . . . . . . . . .

Time relative to first frame in this TCP stream (tcp.time\_relative) | Packets: 213 · Displayed: 202 (94.8%) | Profile: Default

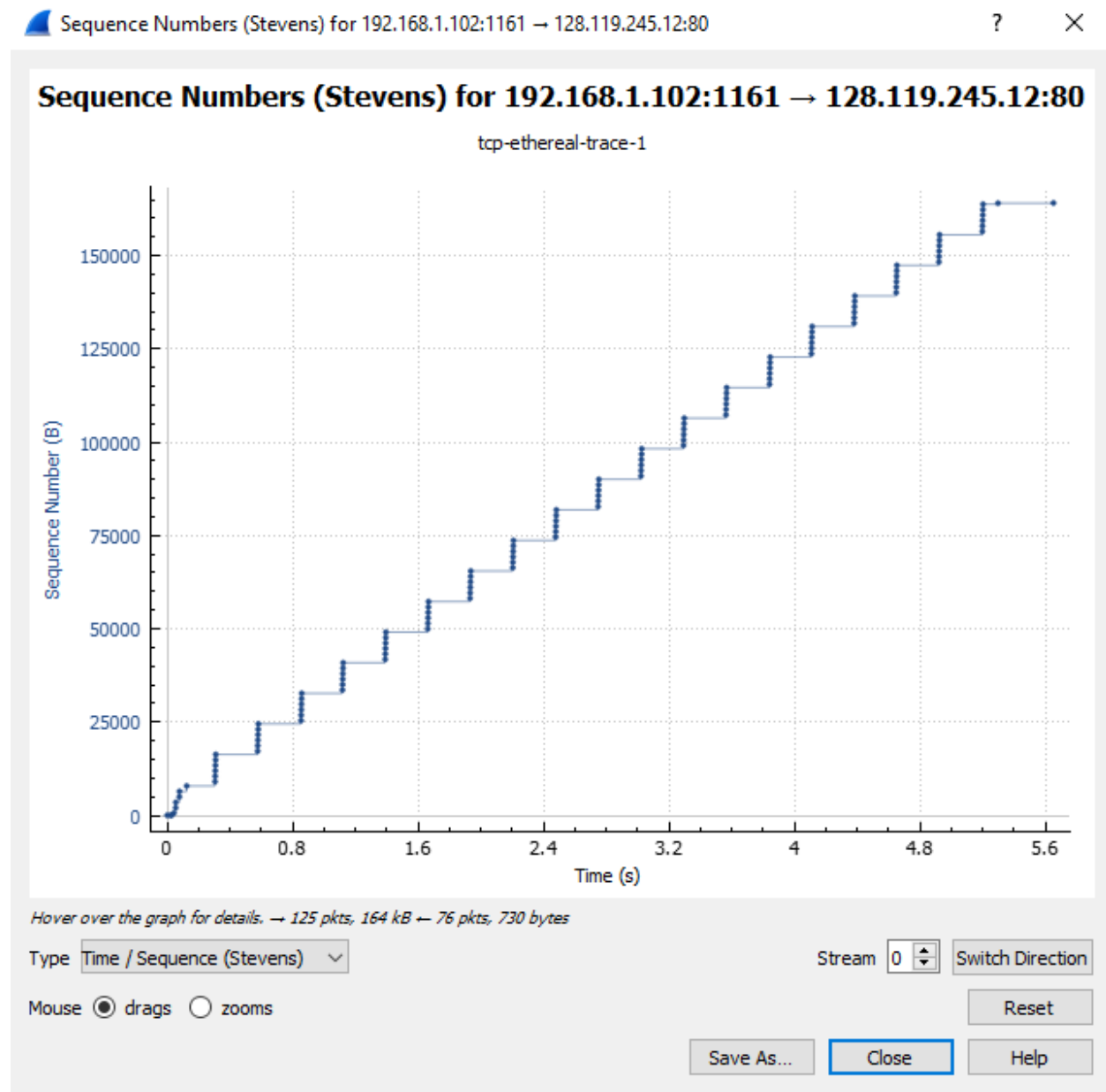
- To compute the throughput for the TCP connection, I need to calculate the amount of data transmitted and then divide it by time incurred. At this trace (tcp-ethereal-trace-1), the amount of data transmitted can be calculated by deducting the sequence number of first TCP segment (No.4) to the ACK sequence number of the last TCP segment (No.202) =>  $164091 - 1 = 164090$  bytes. The incurred time can be calculated by deducting the time instant of the first TCP segment (0.026477) to the time instant of the last TCP segment (5.45583). Therefore, the incurred time for transmission is  $5.45583 - 0.026477 = 5.429353$

Then,  $164090 / 5.429353 = \text{about } 30222.754 \text{ Byte/sec}$

## TCP congestion control in action

13. Use the Time-Sequence-Graph(Stevens) plotting tool to view the sequence number versus time plot of segments being sent from the client to the gaia.cs.umass.edu server. Can you identify where TCP's slowstart phase begins and ends, and where congestion avoidance takes over?

Comment on ways in which the measured data differs from the idealized behavior of TCP that we've studied in the text.

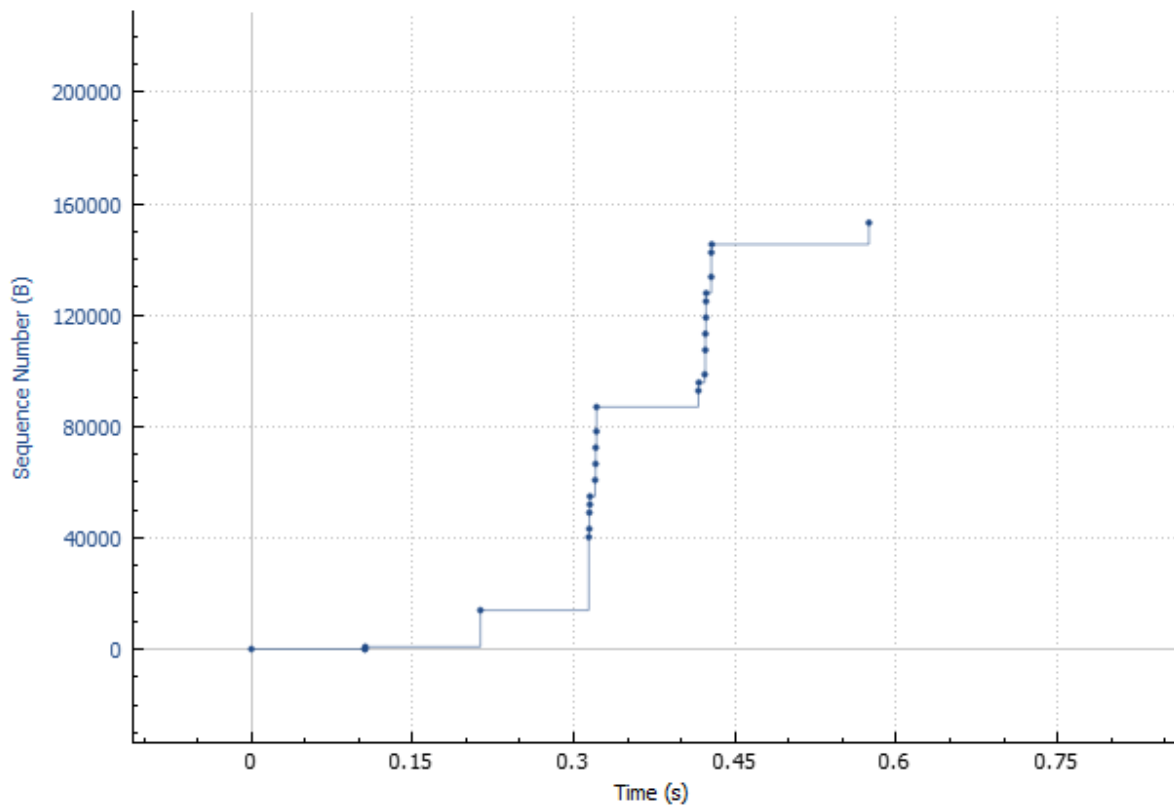


- From the plot, I can see the first 0.2 seconds have slow-start. After 0.2 seconds, the TCP is being stable and congestion avoidance state. The measured data is differed by using a fraction of the window size instead of the idealized 1/3 to a half.

14. Answer Question 13 for the trace that you captured when you transferred a file from your own computer to gaia.cs.umass.edu

**Sequence Numbers (Stevens) for 192.168.0.21:63710 → 128.119.245.12:80**

Ethernet



Hover over the graph for details. → 27 pkts, 153 kB ← 67 pkts, 777 bytes

Type Time / Sequence (Stevens) ▾

Stream 6 ▾

Switch Direction

Mouse ☒ drags ☐ zooms

Reset

Save As...

Close

Help

- From the plot by my computer ethernet, I can see the first 0.2 seconds have slow-start. After 0.2 seconds, the TCP is being stable and congestion avoidance state. In contrast to the tcp-ethereal-trace-1 trace file, my computer trace shows that the measured data is differed by using bigger fraction than tcp-ethereal-trace-1 file's fraction and close to idealized window size.