

Computer Network Lab Assignment
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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?

IP address: 192.168.1.102

TCP port number: 1161

2.

What is the IP address and port number used by gaia.cs.umass.edu to receive the file?

IP address: 128.119.245.12

TCP port number: 80

The image shows a Wireshark packet capture of an HTTP transaction. The packet list at the top shows several TCP segments and one HTTP POST request (No. 199). The selected packet (No. 199) is expanded to show the following details:

- Frame 199: 104 bytes on wire (832 bits), 104 bytes captured (832 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: 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)]
 - Acknowledgment number: 1 (relative ack number)

The packet bytes pane at the bottom shows the raw data in hexadecimal and ASCII. The ASCII column shows the text "POST /ethereal-labs/lab3-1-reply.htm HTTP/1.1" followed by a space and the word "OK".

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?

IP address: 10.42.0.254

TCP port number: 37626

The image shows a Wireshark packet capture window titled '*wlp6s0'. The top toolbar includes standard network analysis tools. Below the toolbar is a display filter bar showing 'Apply a display filter ... <Ctrl>/>'. The main packet list table shows several packets, with packet 532 highlighted in red. The details pane for packet 532 is expanded, showing the following information:

- Frame 532: 1045 bytes on wire (8360 bits), 1045 bytes captured (8360 bits) on interface 0
- Ethernet II, Src: IntelCor_bd:a8:12 (e4:f8:9c:bd:a8:12), Dst: IntelCor_cb:e1:cf (d0:7e:35:cb:e1:cf)
- Internet Protocol Version 4, Src: 10.42.0.254, Dst: 128.119.245.12
- Transmission Control Protocol, Src Port: 37626, Dst Port: 80, Seq: 148404, Ack: 1, Len: 979
- Source Port: 37626
- Destination Port: 80
- [Stream index: 4]
- [TCP Segment Len: 979]
- Sequence number: 148404 (relative sequence number)
- [Next sequence number: 149383 (relative sequence number)]
- Acknowledgment number: 1 (relative ack number)

The packet bytes pane shows the raw data of the frame, with a hex dump on the left and a corresponding ASCII representation on the right. The ASCII representation shows the beginning of an HTTP POST request:

```
POST /wiresark-labs/lab3-1-reply.htm HTTP/1.1
Host: 128.119.245.12
User-Agent: Mozilla/5.0 (Macintosh; Intel Mac OS X 10_7_0; rv:1.9.2.1) Gecko/20100101 Firefox/3.6.10
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8
Accept-Language: en-us
Accept-Encoding: gzip, deflate
Connection: close
Content-Type: text/plain
Content-Length: 979
```

The status bar at the bottom indicates 'Frame (1045 bytes) Reassembled TCP (149382 bytes)', 'Packets: 544 · Displayed: 544 (100.0%)', and 'Profile: Default'.

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?

ANS:

Seq number of the TCP SYN segment is used to initiate the TCP connection between the client computer and gaia.cs.umass.edu. The value is 0. SYN flag is set to 1 => SYN segment.

The image shows a Wireshark packet capture of a network session. The packet list pane at the top shows several packets, with packet 17 highlighted in red. The packet details pane below shows the structure of packet 17, which is a TCP SYN segment. The 'Transmission Control Protocol' section is expanded, showing the source port as 37622, destination port as 80, and sequence number as 0. The 'Flags' field is set to '0x002 (SYN)'. The packet bytes pane at the bottom shows the raw data of the packet, with the first few bytes highlighted in red.

No.	Time	Source	Destination	Protocol	Length	Info
14	4.041558060	10.42.0.254	128.119.245.12	TCP	1434	37608 → 80 [ACK] Seq=11604 Ack=1 Win=229 Len=1368 TSval=267401496...
15	4.168564717	10.42.0.254	10.42.0.1	DNS	77	Standard query 0xd0e8 A gaia.cs.umass.edu
16	4.171785279	10.42.0.1	10.42.0.254	DNS	93	Standard query response 0xd0e8 A gaia.cs.umass.edu A 128.119.245.12
17	4.172184510	10.42.0.254	128.119.245.12	TCP	74	37622 → 80 [SYN] Seq=0 Win=29200 Len=0 MSS=1460 SACK_PERM=1 TSval=...
18	4.214270767	128.119.245.12	10.42.0.254	TCP	66	80 → 37608 [ACK] Seq=1 Ack=660 Win=237 Len=0 TSval=3519879196 TSe...
19	4.214318273	10.42.0.254	128.119.245.12	TCP	1434	37608 → 80 [ACK] Seq=12972 Ack=1 Win=229 Len=1368 TSval=267401500...
20	4.214335669	10.42.0.254	128.119.245.12	TCP	1434	37608 → 80 [ACK] Seq=14340 Ack=1 Win=229 Len=1368 TSval=267401500...
21	4.228312263	128.119.245.12	10.42.0.254	TCP	66	80 → 37608 [ACK] Seq=1 Ack=2028 Win=260 Len=0 TSval=3519879210 TS...
22	4.228366241	10.42.0.254	128.119.245.12	TCP	1434	37608 → 80 [ACK] Seq=15708 Ack=1 Win=229 Len=1368 TSval=267401501...
23	4.228387291	10.42.0.254	128.119.245.12	TCP	1434	37608 → 80 [ACK] Seq=17076 Ack=1 Win=229 Len=1368 TSval=267401501...

Frame 17: 74 bytes on wire (592 bits), 74 bytes captured (592 bits) on interface 0
Ethernet II, Src: IntelCor_bd:a8:12 (e4:f8:9c:bd:a8:12), Dst: IntelCor_cb:e1:cf (d0:7e:35:cb:e1:cf)
Internet Protocol Version 4, Src: 10.42.0.254, Dst: 128.119.245.12
Transmission Control Protocol, Src Port: 37622, Dst Port: 80, Seq: 0, Len: 0
Source Port: 37622
Destination Port: 80
[Stream index: 2]
[TCP Segment Len: 0]
Sequence number: 0 (relative sequence number)
Acknowledgment number: 0
1010 = Header Length: 40 bytes (10)
Flags: 0x002 (SYN)

0000 00 7e 35 cb e1 cf e4 f8 9c bd a8 12 08 00 45 00 ...5...E...
0010 00 3c 18 92 00 00 0f 06 a1 7e 0a 2a 09 fe 00 77 ...0.0.0.0...W...
0020 f5 0c 02 f6 00 50 6d b2 23 cb 00 00 00 00 a0 02 ...PM...#...
0030 72 10 56 08 00 00 02 04 05 b4 04 02 08 0a 9f 62 ...V...b...
0040 3b 15 00 00 00 00 01 03 03 07 ...

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?

ANS:

Seq number of the SYNACK segment in reply to the SYN has the value of 0.

ACKnowledgement field in the SYNACK segment is 1. ACKnowledgement field in the SYNACK segment is determined by adding 1 to the initial sequence number of SYN segment from the client computer.

The SYN flag and Acknowledgement flag in the segment are set to 1 => SYNACK segment.

The image shows a Wireshark packet capture of a network connection. The packet list at the top shows a series of packets. Packet 44 is highlighted, showing a SYNACK segment from 128.119.245.12 to 10.42.0.254. The packet details pane shows the following information:

- Frame 44: 74 bytes on wire (592 bits), 74 bytes captured (592 bits) on interface 0
- Ethernet II, Src: IntelCor_cb:e1:cf (d0:7e:35:cb:e1:cf), Dst: IntelCor_bd:a8:12 (e4:f8:9c:bd:a8:12)
 - Destination: IntelCor_bd:a8:12 (e4:f8:9c:bd:a8:12)
 - Source: IntelCor_cb:e1:cf (d0:7e:35:cb:e1:cf)
 - Type: IPv4 (0x0800)
- Internet Protocol Version 4, Src: 128.119.245.12, Dst: 10.42.0.254
 - 0100 = Version: 4
 - 0101 = Header Length: 20 bytes (5)
 - Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
 - Total Length: 60
 - Identification: 0x0000 (0)
- TCP, Seq=0, Ack=1, Win=28960, Len=0, MSS=1380, SACK_P...
 - 0000 00 3c 00 00 40 00 31 06 c9 10 00 77 f5 0c 0a 2a ...<..@.1. ...w...*
 - 0010 00 fe 00 50 92 f6 e6 c7 5c a9 6d b2 23 cc a0 12 ...P....\..m.#...
 - 0020 71 20 29 12 00 00 02 04 05 64 04 02 08 0a d1 cd q).d.....
 - 0030 18 e6 9f 62 3b 15 01 03 03 07 ...b.....

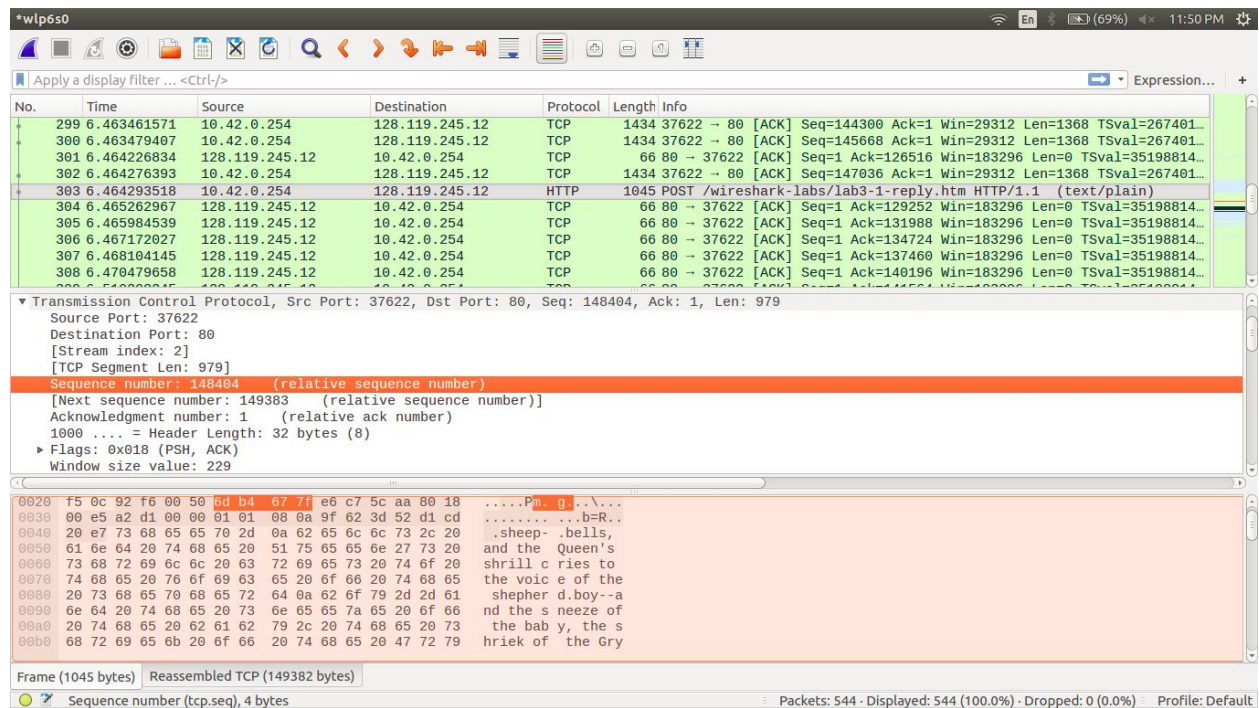
The packet bytes pane at the bottom shows the raw data of the SYNACK segment, which is a 60-byte TCP segment. The first 4 bytes are 0000, indicating the sequence number 0. The next 4 bytes are 003c, indicating the acknowledgement number 1. The rest of the packet is the TCP header and data.

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.

ANS:

In the TCP segment containing the HTTP POST command seq number of this segment has the value of 148404.



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 page 249 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 249 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.

ANS:

ACKs of seg 1,2,3,4,5,6 are :

Segment 1 sequence number: 129252

Segment 2 sequence number: 131988

Segment 3 sequence number: 134724

Segment 4 sequence number: 137460

Segment 5 sequence number: 140196

Segment 6 sequence number: 141564

*wlp6s0

Apply a display filter ... <Ctrl-/> Expression...

No.	Time	Source	Destination	Protocol	Length	Info
301	6.464226834	128.119.245.12	10.42.0.254	TCP	66	80 → 37622 [ACK] Seq=1 Ack=126516 Win=183296 Len=0 TSval=35198814...
302	6.464276393	10.42.0.254	128.119.245.12	TCP	1434	37622 → 80 [ACK] Seq=147036 Ack=1 Win=29312 Len=1368 TSval=267401...
303	6.464293518	10.42.0.254	128.119.245.12	HTTP	1045	POST /wireshark-labs/lab3-1-reply.htm HTTP/1.1 (text/plain)
304	6.465262967	128.119.245.12	10.42.0.254	TCP	66	80 → 37622 [ACK] Seq=1 Ack=129252 Win=183296 Len=0 TSval=35198814...
305	6.465984539	128.119.245.12	10.42.0.254	TCP	66	80 → 37622 [ACK] Seq=1 Ack=131988 Win=183296 Len=0 TSval=35198814...
306	6.467172027	128.119.245.12	10.42.0.254	TCP	66	80 → 37622 [ACK] Seq=1 Ack=134724 Win=183296 Len=0 TSval=35198814...
307	6.468104145	128.119.245.12	10.42.0.254	TCP	66	80 → 37622 [ACK] Seq=1 Ack=137460 Win=183296 Len=0 TSval=35198814...
308	6.470479658	128.119.245.12	10.42.0.254	TCP	66	80 → 37622 [ACK] Seq=1 Ack=140196 Win=183296 Len=0 TSval=35198814...
309	6.510208245	128.119.245.12	10.42.0.254	TCP	66	80 → 37622 [ACK] Seq=1 Ack=141564 Win=183296 Len=0 TSval=35198814...
310	7.040155186	10.42.0.254	128.119.245.12	TCP	1045	[TCP Retransmission] 37622 → 80 [PSH, ACK] Seq=148404 Ack=1 Win=2...

Transmission Control Protocol, Src Port: 37622, Dst Port: 80, Seq: 148404, Ack: 1, Len: 979

Source Port: 37622
Destination Port: 80
[Stream index: 2]
[TCP Segment Len: 979]
Sequence number: 148404 (relative sequence number)
[Next sequence number: 149383 (relative sequence number)]
Acknowledgment number: 1 (relative ack number)
1000 = Header Length: 32 bytes (8)
Flags: 0x018 (PSH, ACK)
Window size value: 229

0020 f5 0c 92 f6 00 50 6d b4 67 7f e6 c7 5c aa 80 18Pm.g...
0030 00 e5 a2 d1 00 00 01 01 08 0a 9f 62 3d 52 d1 cdb-R..
0040 20 e7 73 68 65 65 70 2d 0a 62 65 6c 73 2c 20 .sheep.bells..
0050 61 6e 64 20 74 68 65 20 51 75 65 65 6e 27 73 20 and the Queen's
0060 73 68 72 69 6c 6c 20 63 72 69 65 73 20 74 6f 20 shrill c ries to
0070 74 68 65 20 76 6f 69 63 65 20 6f 66 20 74 68 65 the voic e of the
0080 20 73 68 65 70 68 65 72 64 0a 62 6f 79 2d 2d 61 shepherd.d.boy--a
0090 6e 64 20 74 68 65 20 73 6e 65 65 7a 65 20 6f 66 nd the s neeze of
00a0 20 74 68 65 20 62 61 62 79 2c 20 74 68 65 20 73 the bab y, the s
00b0 68 72 69 65 6b 20 6f 66 20 74 68 65 20 47 72 79 hriek of the Gry

Frame (1045 bytes) Reassembled TCP (149382 bytes)

Packets: 544 · Displayed: 544 (100.0%) · Dropped: 0 (0.0%) Profile: Default

*wlp6s0

Apply a display filter ... <Ctrl-/> Expression...

No.	Time	Source	Destination	Protocol	Length	Info
2	0.000025479	IntelCor_bd:a8:12	IntelCor_cb:e1:cf	ARP	42	10.42.0.254 is at e4:f8:9c:bd:a8:12
3	2.790178458	10.42.0.254	172.217.31.14	TCP	66	53930 → 443 [ACK] Seq=1 Ack=1 Win=237 Len=0 TSval=3472919920 TSec...
4	2.799643261	172.217.31.14	10.42.0.254	TCP	66	[TCP ACKed unseen segment] 443 → 53930 [ACK] Seq=1 Ack=2 Win=170 ...
5	3.963829052	10.42.0.254	128.119.245.12	TCP	725	37608 → 80 [PSH, ACK] Seq=1 Ack=1 Win=229 Len=659 TSval=267401494...
6	3.963990488	10.42.0.254	128.119.245.12	TCP	1434	37608 → 80 [ACK] Seq=660 Ack=1 Win=229 Len=1368 TSval=2674014945 ...
7	3.964061365	10.42.0.254	128.119.245.12	TCP	1434	37608 → 80 [ACK] Seq=2028 Ack=1 Win=229 Len=1368 TSval=2674014945...
8	3.964016275	10.42.0.254	128.119.245.12	TCP	1434	37608 → 80 [ACK] Seq=3396 Ack=1 Win=229 Len=1368 TSval=2674014945...
9	3.964020605	10.42.0.254	128.119.245.12	TCP	1434	37608 → 80 [ACK] Seq=4764 Ack=1 Win=229 Len=1368 TSval=2674014945...
10	3.984431198	10.42.0.254	128.119.245.12	TCP	1434	37608 → 80 [ACK] Seq=6132 Ack=1 Win=229 Len=1368 TSval=2674014950...
11	3.984444353	10.42.0.254	128.119.245.12	TCP	1434	37608 → 80 [ACK] Seq=7500 Ack=1 Win=229 Len=1368 TSval=2674014950...

Frame 9: 1434 bytes on wire (11472 bits), 1434 bytes captured (11472 bits) on interface 0

Ethernet II, Src: IntelCor_bd:a8:12 (e4:f8:9c:bd:a8:12), Dst: IntelCor_cb:e1:cf (d0:7e:35:cb:e1:cf)

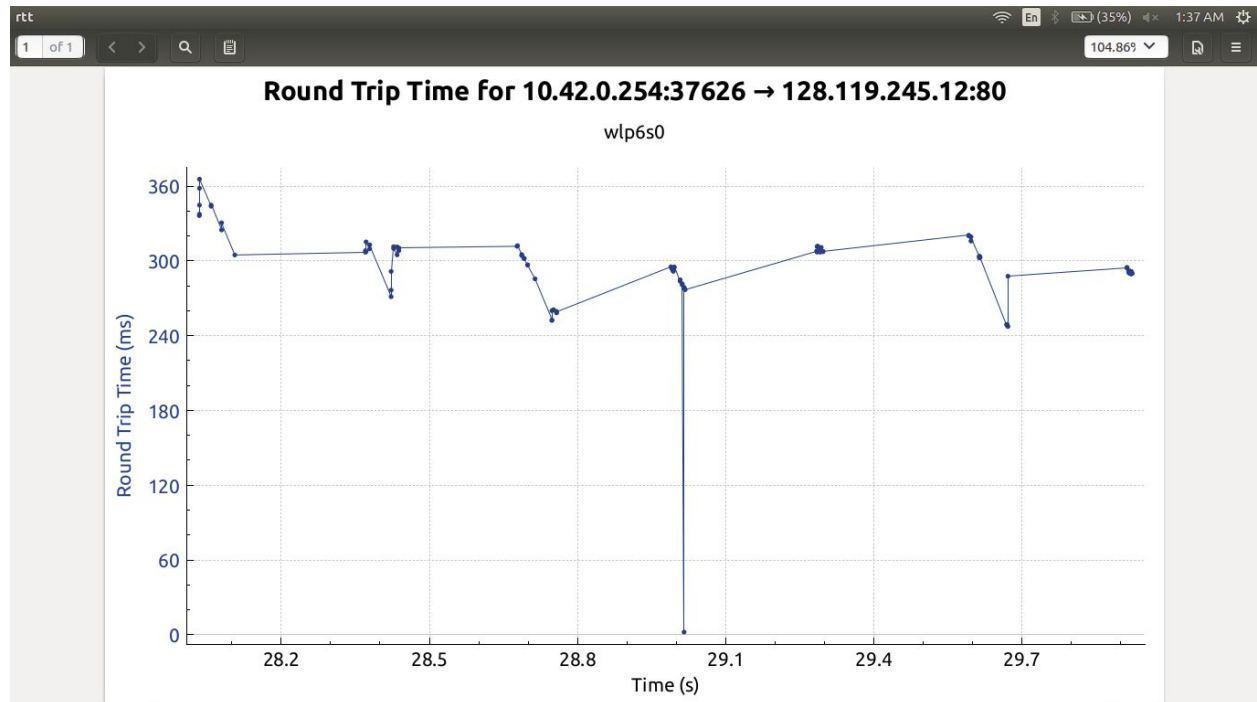
Internet Protocol Version 4, Src: 10.42.0.254, Dst: 128.119.245.12

Transmission Control Protocol, Src Port: 37608, Dst Port: 80, Seq: 4764, Ack: 1, Len: 1368

0020 f5 0c 92 e8 00 50 f9 2f 03 b8 47 af 18 6d 80 10 ...P./...G.m..
0030 00 e5 e1 6e 00 00 01 01 08 0a 9f 62 3a e1 d1 ccb;..
0040 f5 d5 77 2e 0a 50 0c 65 61 73 65 2c 20 4d 61 27 ..w..Ple ase, Ma'
0050 61 6d 2c 20 69 73 20 74 68 69 73 20 4e 65 77 20 am, is t his New
0060 5a 65 61 6c 61 6e 64 20 6f 72 20 41 75 73 74 72 Zealand or Austr
0070 61 6c 69 61 3f 27 20 28 61 6e 64 72 74 73 68 65 20 alia?' (and she
0080 74 72 69 65 64 0a 74 6f 20 63 75 72 74 73 65 79 tried.to curtsey
0090 20 61 73 20 73 68 65 20 73 70 6f 6b 65 2d 2d 66 as she spoke--f
00a0 61 6e 63 79 20 43 55 52 54 53 45 59 49 4e 47 20 ancy CUR TSEYING
00b0 61 73 20 79 6f 75 27 72 65 20 66 61 6c 6c 69 6e as you're e fallin
00c0 67 0a 74 68 72 6f 75 6f 68 20 74 68 65 20 61 69 g.throug h the ai
00d0 72 21 20 20 44 6f 20 79 6f 75 20 74 68 69 6e 6b r! Do y ou think

Transmission Control Protocol (tcp), 32 bytes

Packets: 544 · Displayed: 544 (100.0%) · Dropped: 0 (0.0%) Profile: Default



8. What is the length of each of the first six TCP segments?

Length of the first TCP segment : 725 bytes

Length of each of the other five TCP segments: 1434 bytes (MSS)

*wlp6s0

Apply a display filter ... <Ctrl-/> Expression...

No.	Time	Source	Destination	Protocol	Length	Info
2	0.000025479	IntelCor_bd:a8:12	IntelCor_cb:e1:cf	ARP	42	10.42.0.254 is at e4:f8:9c:bd:a8:12
3	2.790178458	10.42.0.254	172.217.31.14	TCP	66	53930 → 443 [ACK] Seq=1 Ack=1 Win=237 Len=0 TSval=3472919920 TSec...
4	2.799643261	172.217.31.14	10.42.0.254	TCP	66	[TCP ACKed unseen segment] 443 → 53930 [ACK] Seq=1 Ack=2 Win=170 ...
5	3.963829052	10.42.0.254	128.119.245.12	TCP	725	37608 → 80 [PSH, ACK] Seq=1 Ack=1 Win=229 Len=659 TSval=267401494...
6	3.963990488	10.42.0.254	128.119.245.12	TCP	1434	37608 → 80 [ACK] Seq=660 Ack=1 Win=229 Len=1368 TSval=2674014945 ...
7	3.964001365	10.42.0.254	128.119.245.12	TCP	1434	37608 → 80 [ACK] Seq=2028 Ack=1 Win=229 Len=1368 TSval=2674014945...
8	3.964016275	10.42.0.254	128.119.245.12	TCP	1434	37608 → 80 [ACK] Seq=3396 Ack=1 Win=229 Len=1368 TSval=2674014945...
9	3.964020605	10.42.0.254	128.119.245.12	TCP	1434	37608 → 80 [ACK] Seq=4764 Ack=1 Win=229 Len=1368 TSval=2674014945...
10	3.984431198	10.42.0.254	128.119.245.12	TCP	1434	37608 → 80 [ACK] Seq=6132 Ack=1 Win=229 Len=1368 TSval=2674014950...
11	3.984444353	10.42.0.254	128.119.245.12	TCP	1434	37608 → 80 [ACK] Seq=7500 Ack=1 Win=229 Len=1368 TSval=2674014950...

▶ Frame 9: 1434 bytes on wire (11472 bits), 1434 bytes captured (11472 bits) on interface 0
 ▶ Ethernet II, Src: IntelCor_bd:a8:12 (e4:f8:9c:bd:a8:12), Dst: IntelCor_cb:e1:cf (d0:7e:35:cb:e1:cf)
 ▶ Internet Protocol Version 4, Src: 10.42.0.254, Dst: 128.119.245.12
 ▶ Transmission Control Protocol, Src Port: 37608, Dst Port: 80, Seq: 4764, Ack: 1, Len: 1368

```

0020  f5 0c 92 e8 00 50 f9 2f 03 b8 47 af 18 6d 80 10  ...P../..G..m..
0030  80 55 e1 6e 00 00 01 01 00 0a 9f 02 3a e1 d1 0c  ..n...a...b:...
0040  f5 0c 92 e8 00 50 f9 2f 03 b8 47 af 18 6d 80 10  ...P../..G..m..
0050  61 6d 2c 20 69 73 20 74 68 69 73 20 4e 65 77 20  am, is t his New
0060  5a 65 61 6c 61 6e 64 20 6f 72 20 41 75 73 74 72  Zealand or Austr
0070  61 6c 69 61 3f 27 20 28 61 6e 64 20 73 68 65 20  alia?' ( and she
0080  74 72 69 65 64 0a 74 6f 20 63 75 72 74 73 65 79  tried.to curtsey
0090  20 61 73 20 73 68 65 20 73 70 6f 6b 65 2d 2d 66  as she spoke--f
00a0  61 6e 63 79 20 43 55 52 54 53 45 59 49 4e 47 20  ancy CUR TSEYING
00b0  61 73 20 79 6f 75 27 72 65 20 66 61 6c 6c 69 6e  as you'r e fallin
00c0  67 0a 74 68 72 6f 75 67 68 20 74 68 65 20 61 69  g.throug h the ai
00d0  72 21 20 20 44 6f 20 79 6f 75 20 74 68 69 6e 6b  r! Do y ou think

```

Transmission Control Protocol (tcp), 32 bytes Packets: 544 · Displayed: 544 (100.0%) · Dropped: 0 (0.0%) · Profile: Default

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

ANS:Max window size 29312.Min window size 229

*wlp6s0

tcp

No.	Time	Source	Destination	Protocol	Length	Info
156	5.037643672	128.119.245.12	10.42.0.254	TCP	78	[TCP Dup ACK 155#1] 80 → 37622 [ACK] Seq=1 Ack=33492 Win=99584 Le...
157	5.038153961	10.42.0.254	128.119.245.12	TCP	1434	37622 → 80 [ACK] Seq=45804 Ack=1 Win=29312 Len=1368 TSval=2674015...
158	5.038187664	10.42.0.254	128.119.245.12	TCP	1434	37622 → 80 [ACK] Seq=47172 Ack=1 Win=29312 Len=1368 TSval=2674015...
159	5.038192701	10.42.0.254	128.119.245.12	TCP	1434	37622 → 80 [ACK] Seq=48540 Ack=1 Win=29312 Len=1368 TSval=2674015...
160	5.038625826	10.42.0.254	128.119.245.12	TCP	1434	37622 → 80 [ACK] Seq=49908 Ack=1 Win=29312 Len=1368 TSval=2674015...
161	5.038639964	10.42.0.254	128.119.245.12	TCP	1434	37622 → 80 [ACK] Seq=51276 Ack=1 Win=29312 Len=1368 TSval=2674015...
162	5.042331742	10.42.0.254	128.119.245.12	TCP	1434	37622 → 80 [ACK] Seq=52644 Ack=1 Win=29312 Len=1368 TSval=2674015...
163	5.323251536	128.119.245.12	10.42.0.254	TCP	66	80 → 37622 [ACK] Seq=1 Ack=34860 Win=102400 Len=0 TSval=351988024...
164	5.323294892	10.42.0.254	128.119.245.12	TCP	1434	37622 → 80 [ACK] Seq=54012 Ack=1 Win=29312 Len=1368 TSval=2674015...
165	5.323453623	128.119.245.12	10.42.0.254	TCP	66	80 → 37622 [ACK] Seq=1 Ack=36228 Win=105344 Len=0 TSval=351988024...

Frame 164: 1434 bytes on wire (11472 bits), 1434 bytes captured (11472 bits) on interface 0
 Ethernet II, Src: IntelCor_bd:a8:12 (e4:f8:9c:bd:a8:12), Dst: IntelCor_cb:e1:cf (d0:7e:35:cb:e1:cf)
 Internet Protocol Version 4, Src: 10.42.0.254, Dst: 128.119.245.12
 Transmission Control Protocol, Src Port: 37622, Dst Port: 80, Seq: 54012, Ack: 1, Len: 1368

0020 f5 0c 92 f6 00 50 6d b2 f6 c7 e6 c7 5c aa 80 10 ...P...V...
 0030 80 e5 f6 2e 00 00 01 01 00 0a 9f 02 3c 35 d1 c0 ...S...b5...
 0040 16 35 68 6f 73 65 20 74 6f 20 73 70 65 61 6b 20 ...aise t o speak
 0050 61 67 61 69 6e 2e 0a 49 6e 20 61 20 6d 69 6e 75 again..I n a minu
 0060 74 65 20 6f 72 20 74 77 6e 20 74 68 65 20 43 61 te or tw o the Ca
 0070 74 65 72 70 69 6c 6c 61 72 20 74 6f 6f 6b 20 74 terpill a r took t
 0080 68 65 20 68 6f 6f 6b 61 68 20 6f 75 74 20 6f 66 he hooka h out of
 0090 20 69 74 73 0a 6d 6f 75 74 68 20 61 6e 64 20 79 its.mou th and y
 00a0 61 77 6e 65 64 20 6f 6e 63 65 20 6f 72 20 74 77 awned on ce or tw
 00b0 69 63 65 2c 20 61 6e 64 20 73 68 6f 6f 6b 20 69 ice, and shook i
 00c0 74 73 65 6c 66 2e 20 20 54 68 65 6e 20 69 74 20 tself. Then it
 00d0 67 6f 74 0a 64 6f 77 6e 20 6f 66 66 20 74 68 65 got.down off the

Transmission Control Protocol (tcp), 32 bytes

Packets: 544 · Displayed: 509 (93.6%) · Dropped: 0 (0.0%) · Profile: Default

*wlp6s0

tcp

No.	Time	Source	Destination	Protocol	Length	Info
3	2.790178458	10.42.0.254	172.217.31.14	TCP	66	53930 → 443 [ACK] Seq=1 Ack=1 Win=237 Len=0 TSval=3472919920 TSec...
4	2.799643261	172.217.31.14	10.42.0.254	TCP	66	[TCP ACKed unseen segment] 443 → 53930 [ACK] Seq=1 Ack=2 Win=170 ...
5	3.963829852	10.42.0.254	128.119.245.12	TCP	725	37608 → 80 [PSH, ACK] Seq=1 Ack=1 Win=229 Len=659 TSval=267401494...
6	3.963990488	10.42.0.254	128.119.245.12	TCP	1434	37608 → 80 [ACK] Seq=660 Ack=1 Win=229 Len=1368 TSval=2674014945 ...
7	3.964061365	10.42.0.254	128.119.245.12	TCP	1434	37608 → 80 [ACK] Seq=2028 Ack=1 Win=229 Len=1368 TSval=2674014945...
8	3.964016275	10.42.0.254	128.119.245.12	TCP	1434	37608 → 80 [ACK] Seq=3396 Ack=1 Win=229 Len=1368 TSval=2674014945...
9	3.964026065	10.42.0.254	128.119.245.12	TCP	1434	37608 → 80 [ACK] Seq=4764 Ack=1 Win=229 Len=1368 TSval=2674014945...
10	3.984431198	10.42.0.254	128.119.245.12	TCP	1434	37608 → 80 [ACK] Seq=6132 Ack=1 Win=229 Len=1368 TSval=2674014950...
11	3.984444353	10.42.0.254	128.119.245.12	TCP	1434	37608 → 80 [ACK] Seq=7500 Ack=1 Win=229 Len=1368 TSval=2674014950...
12	4.015798721	10.42.0.254	128.119.245.12	TCP	1434	37608 → 80 [ACK] Seq=8868 Ack=1 Win=229 Len=1368 TSval=2674014958...

Frame 5: 725 bytes on wire (5800 bits), 725 bytes captured (5800 bits) on interface 0
 Ethernet II, Src: IntelCor_bd:a8:12 (e4:f8:9c:bd:a8:12), Dst: IntelCor_cb:e1:cf (d0:7e:35:cb:e1:cf)
 Internet Protocol Version 4, Src: 10.42.0.254, Dst: 128.119.245.12
 Transmission Control Protocol, Src Port: 37608, Dst Port: 80, Seq: 1, Ack: 1, Len: 659

0020 f5 0c 92 e8 00 50 f9 2e f1 1d 47 af 18 6d 80 10 ...P...G..m..
 0030 80 e5 24 04 00 00 01 01 00 0a 9f 02 3a e1 d1 c0 ...S...b:..
 0040 f5 d9 50 4f 53 54 20 2f 77 69 72 65 73 68 61 72 POST / wireshar
 0050 6b 2d 6c 61 62 73 2f 6c 61 62 33 2d 31 2d 72 65 k-labs/l ab3-1-re
 0060 70 6c 79 2e 68 74 6d 20 48 54 54 50 2f 31 2e 31 ply.htm HTTP/1.1
 0070 0d 0a 48 6f 73 74 3a 20 67 61 69 61 2e 63 73 2e ..Host: gaia.cs.
 0080 75 6d 61 73 73 2e 65 64 75 0d 0a 43 6f 6e 6e 65 umass.ed u..Conne
 0090 63 74 69 6f 6e 3a 20 6b 65 65 70 2d 61 6c 69 76 ction: k eep-aliv
 00a0 65 0d 0a 43 6f 6e 74 65 6e 74 2d 4c 65 6e 67 74 e..Conte nt-Lengt
 00b0 68 3a 20 31 34 38 37 32 33 0d 0a 43 61 63 68 65 h: 14872 3..Cache
 00c0 2d 43 6f 6e 74 72 6f 6c 3a 20 6d 61 78 2d 61 67 -Control : max-ag
 00d0 65 3d 30 0d 0a 4f 72 69 67 69 6e 3a 20 68 74 74 e=0..Ori gin: htt

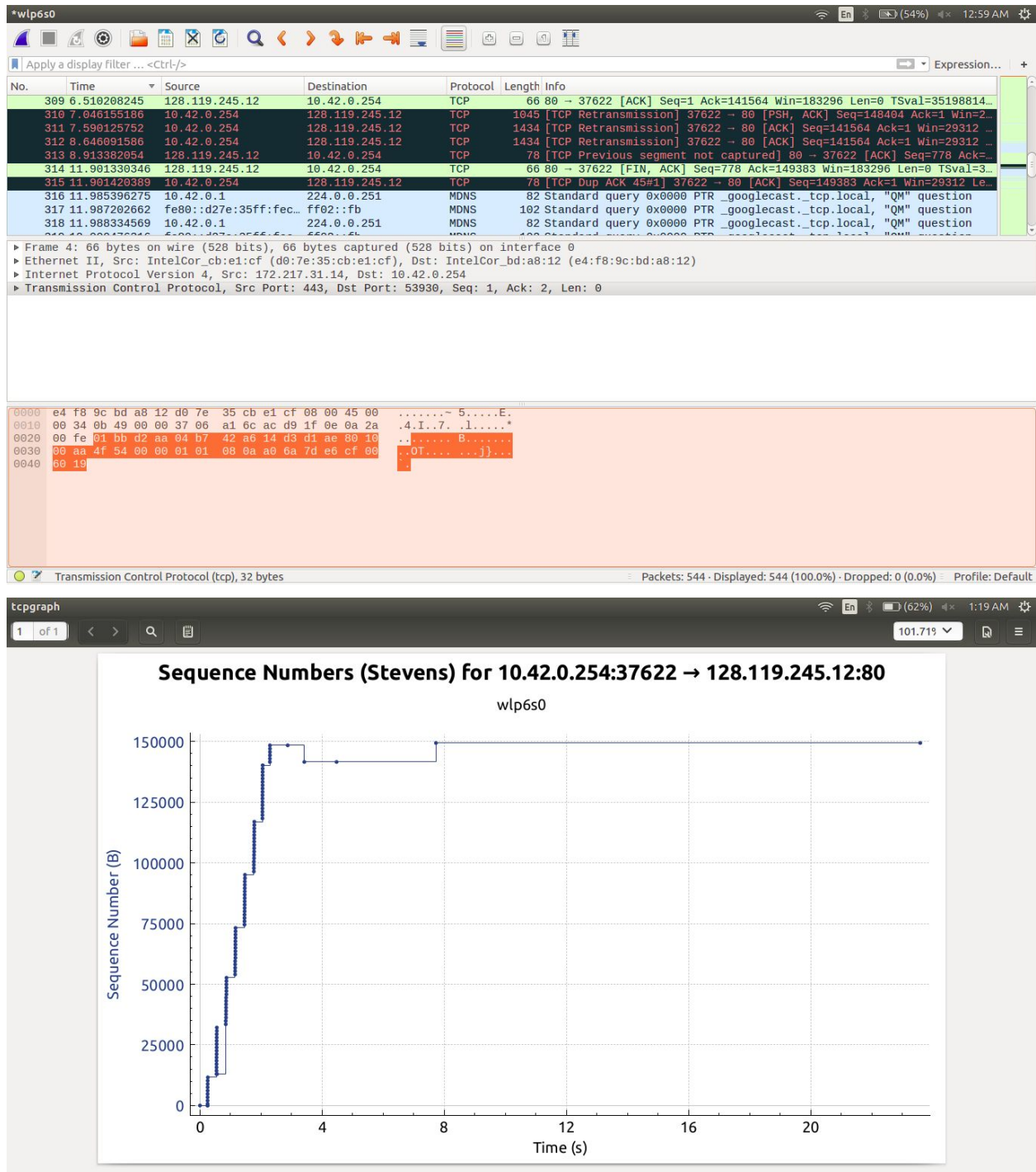
Transmission Control Protocol (tcp), 32 bytes

Packets: 544 · Displayed: 509 (93.6%) · Dropped: 0 (0.0%) · Profile: Default

Yes the lack of buffer throttled in this case.

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

There are retransmitted segments in the trace file. We can verify this by seeing the following image.

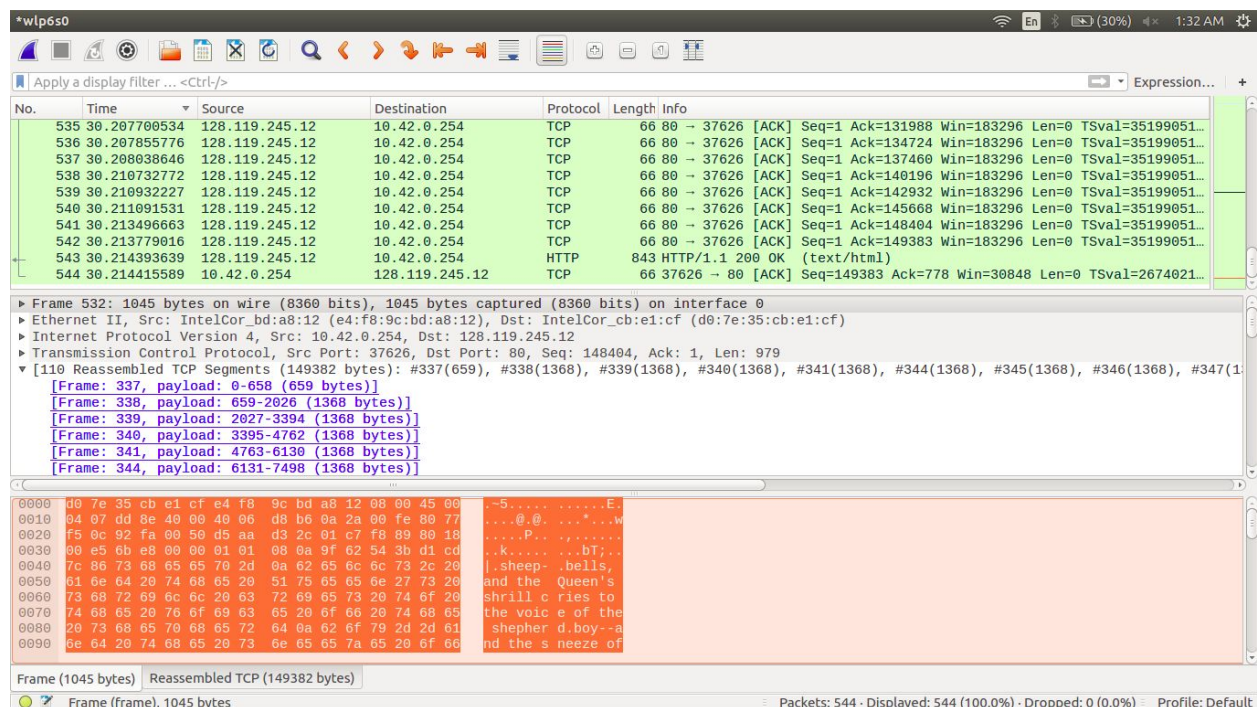


11.

How much data does the receiver typically acknowledge in an ACK? Can you identify cases where the receiver is ACKing every other received segment

ACK 1 sequence number: 129252 data : 1368


```
ACK 2 sequence number: 131988 data :2736
ACK 3 sequence number: 134724 data:2736
ACK 4 sequence number: 137460 data :2736
ACK 5 sequence number: 140196 data :2736
ACK 6 sequence number: 142932 data :2736
ACK 7 sequence number: 145668 data :2736
ACK 8 sequence number: 148404 data :2736
ACK 9 sequence number: 149383 data :979
ACK 10 sequence number: 152119 data :2736
ACK 11 sequence number: 154855 data :2736
ACK 12 sequence number: 157591 data :2736
```



12.

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

The total amount data transmitted can be computed by the difference between the sequence number of the first TCP segment (1 of No. 4 segment)

and the acknowledged sequence number of the last ACK (149383) diff =149382

The whole transmission time is the difference of the time instant of the first TCP segment (i.e., 2.790178458 for No.4 segment) and the time instant of the last ACK 30.214415589

Diff 30.214415589 - 2.790178458 = 27.424237131

$149382 / 27.424237131 = 5447.0795044$ bytes/sec = 5.31941357851293 KB/sec.

The image shows a Wireshark packet capture window. The top pane displays a list of network packets. The selected packet is a TCP ACK segment (No. 4) with the following details:

- Frame 542:** 66 bytes on wire (528 bits), 66 bytes captured (528 bits) on interface 0
- Ethernet II:** Src: IntelCor_cb:e1:cf (d0:7e:35:cb:e1:cf), Dst: IntelCor_bd:a8:12 (e4:f8:9c:bd:a8:12)
- Internet Protocol Version 4:** Src: 128.119.245.12, Dst: 10.42.0.254
- Transmission Control Protocol:** Src Port: 80, Destination Port: 37626, [Stream index: 4], [TCP Segment Len: 0], Sequence number: 1 (relative sequence number), Acknowledgment number: 149383 (relative ack number), 1000 = Header Length: 32 bytes (8), Flags: 0x010 (ACK)

The bottom pane shows the raw packet data in hexadecimal and ASCII format:

```
0000 e4 f8 9c bd a8 12 d0 7e 35 cb e1 cf 08 00 45 00 .....~ 5....E.
0010 00 34 11 9d 40 00 30 06 b8 7b 80 77 f5 0c 0a 2a ..4..@.0..{.w...*
0020 00 fe 00 50 92 fa 01 c7 f8 89 d5 aa d6 ff 80 10 ...P.....
0030 05 98 73 49 00 00 01 01 08 0a d1 cd 7d 7e 9f 62 ..SI.....}~.b
0040 54 3b T;
```

The status bar at the bottom indicates: Transmission Control Protocol (tcp), 32 bytes | Packets: 544 · Displayed: 544 (100.0%) · Dropped: 0 (0.0%) · Profile: Default

*wlp6s0

Apply a display filter ... <Ctrl-/> Expression...

No.	Time	Source	Destination	Protocol	Length	Info
535	30.207700534	128.119.245.12	10.42.0.254	TCP	66	80 → 37626 [ACK] Seq=1 Ack=131988 Win=183296 Len=0 TSval=35199051...
536	30.207855776	128.119.245.12	10.42.0.254	TCP	66	80 → 37626 [ACK] Seq=1 Ack=134724 Win=183296 Len=0 TSval=35199051...
537	30.208038646	128.119.245.12	10.42.0.254	TCP	66	80 → 37626 [ACK] Seq=1 Ack=137460 Win=183296 Len=0 TSval=35199051...
538	30.210732772	128.119.245.12	10.42.0.254	TCP	66	80 → 37626 [ACK] Seq=1 Ack=140196 Win=183296 Len=0 TSval=35199051...
539	30.210932227	128.119.245.12	10.42.0.254	TCP	66	80 → 37626 [ACK] Seq=1 Ack=142932 Win=183296 Len=0 TSval=35199051...
540	30.211091531	128.119.245.12	10.42.0.254	TCP	66	80 → 37626 [ACK] Seq=1 Ack=145668 Win=183296 Len=0 TSval=35199051...
541	30.213496663	128.119.245.12	10.42.0.254	TCP	66	80 → 37626 [ACK] Seq=1 Ack=148404 Win=183296 Len=0 TSval=35199051...
542	30.213779016	128.119.245.12	10.42.0.254	TCP	66	80 → 37626 [ACK] Seq=1 Ack=149383 Win=183296 Len=0 TSval=35199051...
543	30.214393639	128.119.245.12	10.42.0.254	HTTP	843	HTTP/1.1 200 OK (text/html)
544	30.214415589	10.42.0.254	128.119.245.12	TCP	66	37626 → 80 [ACK] Seq=149383 Ack=778 Win=30848 Len=0 TSval=2674021...

Frame 544: 66 bytes on wire (528 bits), 66 bytes captured (528 bits) on interface 0
Ethernet II, Src: IntelCor_bd:a8:12 (e4:f8:9c:bd:a8:12), Dst: IntelCor_cb:e1:cf (d0:7e:35:cb:e1:cf)
Internet Protocol Version 4, Src: 10.42.0.254, Dst: 128.119.245.12
Transmission Control Protocol, Src Port: 37626, Dst Port: 80, Seq: 149383, Ack: 778, Len: 0
Source Port: 37626
Destination Port: 80
[Stream index: 4]
[TCP Segment Len: 0]
Sequence number: 149383 (relative sequence number)
Acknowledgment number: 778 (relative ack number)
1000 = Header Length: 32 bytes (8)
Flags: 0x010 (ACK)

0000 d0 7e 35 cb e1 cf e4 f8 9c bd a8 12 08 00 45 00 ..-5....E.
0010 00 34 dd 8f 40 00 40 06 dc 08 0a 2a 00 fe 00 77 .4..@.W
0020 f5 0c 02 fa 00 50 d5 aa d0 ff 01 c7 fd 92 00 10 ...P.....
0030 08 f1 74 9e 00 00 01 01 08 0a 9f 62 54 84 d1 c0BT...
0040 7d 7c

Transmission Control Protocol (tcp), 32 bytes Packets: 544 · Displayed: 544 (100.0%) · Dropped: 0 (0.0%) Profile: Default