

## 1) Source Address: 192.168.1.102 Source Port: 1161

The screenshot shows a Wireshark packet capture of a TCP SYN packet. The packet list on the left shows a series of packets, with packet 1 (0.000000) being the SYN packet of interest. The packet details pane on the right shows the following information:

- Frame 1: 62 bytes on wire (496 bits), 62 bytes captured (496 bits)
- Ethernet II, Src: Actionte\_8a:70:1a (00:20:e0:8a:70:1a), Dst: Linksys\_08:af:73 (00:06:25:da:af:73)
- Internet Protocol Version 4, Src: 192.168.1.102, Dst: 128.119.245.12
- Transmission Control Protocol, Src Port: 1161, Dst Port: 80, Seq: 0, Len: 0
- Source Port: 1161
- Destination Port: 80
- [Stream index: 0]
- [TCP Segment Len: 0]
- Sequence number: 0 (relative sequence number)

The packet bytes pane at the bottom shows the raw data of the packet, which is a SYN packet with sequence number 0.

## 2) IP Address: 128.119.245.12 Port: 80

The screenshot shows a Wireshark packet capture of a TCP SYN packet. The packet list on the left shows a series of packets, with packet 2 (0.023172) being the SYN packet of interest. The packet details pane on the right shows the following information:

- Frame 2: 62 bytes on wire (496 bits), 62 bytes captured (496 bits)
- Ethernet II, Src: Linksys\_08:af:73 (00:06:25:da:af:73), Dst: Actionte\_8a:70:1a (00:20:e0:8a:70:1a)
- Internet Protocol Version 4, Src: 128.119.245.12, Dst: 192.168.1.102
- Transmission Control Protocol, Src Port: 80, Dst Port: 1161, Seq: 0, Ack: 1, Len: 0
- Source Port: 80
- Destination Port: 1161
- [Stream index: 0]
- [TCP Segment Len: 0]
- Sequence number: 0 (relative sequence number)

The packet bytes pane at the bottom shows the raw data of the packet, which is a SYN packet with sequence number 0.

### 3) IP Address: 10.0.0.143 Port: 60506

Wireshark packet capture showing a TCP connection from 10.0.0.143 to 10.0.0.143 on port 60506. The packet list shows a SYN segment (Seq=0, Win=0) and subsequent data segments. The packet details pane shows the source port as 60506 and the destination port as 80. The packet bytes pane shows the raw data of the SYN segment.

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	10.0.0.143	10.0.0.143	TCP	54	60506→80 [RST, ACK] Seq=1 Ack=1 Win=0 Len=0
7	0.949041	10.0.0.143	128.119.245.12	TCP	66	60506→80 [SYN] Seq=0 Win=0 Len=0 MSS=1460 SACK_PERM=1 WS=128
8	1.050750	128.119.245.12	10.0.0.143	TCP	66	80→60506 [SYN, ACK] Seq=0 Ack=1 Win=29200 Len=0 MSS=1460 SACK_PERM=1 WS=128
9	1.051166	10.0.0.143	128.119.245.12	TCP	54	60506→80 [ACK] Seq=1 Ack=1 Win=65536 Len=0
10	1.053531	10.0.0.143	128.119.245.12	TCP	698	[TCP segment of a reassembled PDU]
11	1.054011	10.0.0.143	128.119.245.12	TCP	1514	[TCP segment of a reassembled PDU]
12	1.054514	10.0.0.143	128.119.245.12	TCP	1514	[TCP segment of a reassembled PDU]
13	1.054657	10.0.0.143	128.119.245.12	TCP	1514	[TCP segment of a reassembled PDU]
14	1.054815	10.0.0.143	128.119.245.12	TCP	1514	[TCP segment of a reassembled PDU]
15	1.054868	10.0.0.143	128.119.245.12	TCP	1514	[TCP segment of a reassembled PDU]
16	1.054910	10.0.0.143	128.119.245.12	TCP	1514	[TCP segment of a reassembled PDU]
17	1.054952	10.0.0.143	128.119.245.12	TCP	1514	[TCP segment of a reassembled PDU]
18	1.055122	10.0.0.143	128.119.245.12	TCP	1514	[TCP segment of a reassembled PDU]
19	1.055165	10.0.0.143	128.119.245.12	TCP	1514	[TCP segment of a reassembled PDU]
20	1.159960	128.119.245.12	10.0.0.143	TCP	54	80→60506 [ACK] Seq=1 Ack=645 Win=30592 Len=0
21	1.160178	10.0.0.143	128.119.245.12	TCP	1514	[TCP segment of a reassembled PDU]
22	1.167024	128.119.245.12	10.0.0.143	TCP	54	80→60506 [ACK] Seq=1 Ack=2105 Win=33408 Len=0
23	1.167269	10.0.0.143	128.119.245.12	TCP	1514	[TCP segment of a reassembled PDU]
24	1.167374	10.0.0.143	128.119.245.12	TCP	1514	[TCP segment of a reassembled PDU]
25	1.168351	128.119.245.12	10.0.0.143	TCP	54	80→60506 [ACK] Seq=1 Ack=3565 Win=36352 Len=0
26	1.168599	10.0.0.143	128.119.245.12	TCP	1514	[TCP segment of a reassembled PDU]
27	1.168657	10.0.0.143	128.119.245.12	TCP	1514	[TCP segment of a reassembled PDU]
28	1.175965	128.119.245.12	10.0.0.143	TCP	54	80→60506 [ACK] Seq=1 Ack=5025 Win=39296 Len=0

Frame 7: 66 bytes on wire (528 bits), 66 bytes captured (528 bits) on interface 0  
Ethernet II, Src: NonHAlPr\_Sb:ae:c9 (08:ed:b9:5b:ae:c9), Dst: ArrisGro\_70:0f:2f (10:86:8c:70:0f:2f)  
Internet Protocol Version 4, Src: 10.0.0.143, Dst: 128.119.245.12  
Transmission Control Protocol, Src Port: 60506, Dst Port: 80, Seq: 0, Len: 0  
Source Port: 60506  
Destination Port: 80  
[Stream index: 1]  
[TCP Segment Len: 0]  
Sequence number: 0 (relative sequence number)

0000 10 86 8c 70 0f 2f 08 ed b9 5b ae c9 08 00 45 00 ...P...[...E  
0010 00 34 50 de 40 06 80 06 29 d3 0a 00 00 8f 80 77 4P@...[...  
0020 f5 0c ec 5a 00 50 6a 2e a7 a5 00 00 00 00 00 02 ...Z.P].....  
0030 20 00 d0 7e 00 00 02 04 05 b4 01 03 03 08 01 01 .....  
0040 04 02

### 4) Sequence number is 0. We know it's the SYN segment because it has the SYN flag

Wireshark packet capture showing a TCP connection from 10.0.0.143 to 10.0.0.143 on port 60506. The packet list shows a SYN segment (Seq=0, Win=0) and subsequent data segments. The packet details pane shows the source port as 60506 and the destination port as 80. The packet bytes pane shows the raw data of the SYN segment.

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	10.0.0.143	10.0.0.143	TCP	54	60506→80 [RST, ACK] Seq=1 Ack=1 Win=0 Len=0
7	0.949041	10.0.0.143	128.119.245.12	TCP	66	60506→80 [SYN] Seq=0 Win=0 Len=0 MSS=1460 SACK_PERM=1 WS=128
8	1.050750	128.119.245.12	10.0.0.143	TCP	66	80→60506 [SYN, ACK] Seq=0 Ack=1 Win=29200 Len=0 MSS=1460 SACK_PERM=1 WS=128
9	1.051166	10.0.0.143	128.119.245.12	TCP	54	60506→80 [ACK] Seq=1 Ack=1 Win=65536 Len=0
10	1.053531	10.0.0.143	128.119.245.12	TCP	698	60506→80 [PSH, ACK] Seq=1 Ack=1 Win=65536 Len=644
11	1.054011	10.0.0.143	128.119.245.12	TCP	1514	60506→80 [ACK] Seq=645 Ack=1 Win=65536 Len=1460
12	1.054514	10.0.0.143	128.119.245.12	TCP	1514	60506→80 [ACK] Seq=2105 Ack=1 Win=65536 Len=1460
13	1.054657	10.0.0.143	128.119.245.12	TCP	1514	60506→80 [ACK] Seq=3565 Ack=1 Win=65536 Len=1460
14	1.054815	10.0.0.143	128.119.245.12	TCP	1514	60506→80 [ACK] Seq=5025 Ack=1 Win=65536 Len=1460
15	1.054868	10.0.0.143	128.119.245.12	TCP	1514	60506→80 [ACK] Seq=6485 Ack=1 Win=65536 Len=1460
16	1.054910	10.0.0.143	128.119.245.12	TCP	1514	60506→80 [ACK] Seq=7945 Ack=1 Win=65536 Len=1460
17	1.054952	10.0.0.143	128.119.245.12	TCP	1514	60506→80 [ACK] Seq=9405 Ack=1 Win=65536 Len=1460
18	1.055122	10.0.0.143	128.119.245.12	TCP	1514	60506→80 [ACK] Seq=10805 Ack=1 Win=65536 Len=1460
19	1.055165	10.0.0.143	128.119.245.12	TCP	1514	60506→80 [ACK] Seq=12325 Ack=1 Win=65536 Len=1460
20	1.159960	128.119.245.12	10.0.0.143	TCP	54	80→60506 [ACK] Seq=1 Ack=645 Win=30592 Len=0
21	1.160178	10.0.0.143	128.119.245.12	TCP	1514	60506→80 [ACK] Seq=13785 Ack=1 Win=65536 Len=1460
22	1.167024	128.119.245.12	10.0.0.143	TCP	54	80→60506 [ACK] Seq=1 Ack=2105 Win=33408 Len=0
23	1.167269	10.0.0.143	128.119.245.12	TCP	1514	60506→80 [ACK] Seq=15245 Ack=1 Win=65536 Len=1460
24	1.167374	10.0.0.143	128.119.245.12	TCP	1514	60506→80 [PSH, ACK] Seq=16705 Ack=1 Win=65536 Len=1460
25	1.168351	128.119.245.12	10.0.0.143	TCP	54	80→60506 [ACK] Seq=1 Ack=3565 Win=36352 Len=0
26	1.168599	10.0.0.143	128.119.245.12	TCP	1514	60506→80 [ACK] Seq=18105 Ack=1 Win=65536 Len=1460
27	1.168657	10.0.0.143	128.119.245.12	TCP	1514	60506→80 [ACK] Seq=19625 Ack=1 Win=65536 Len=1460
28	1.175965	128.119.245.12	10.0.0.143	TCP	54	80→60506 [ACK] Seq=1 Ack=5025 Win=39296 Len=0

Frame 7: 66 bytes on wire (528 bits), 66 bytes captured (528 bits) on interface 0  
Ethernet II, Src: NonHAlPr\_Sb:ae:c9 (08:ed:b9:5b:ae:c9), Dst: ArrisGro\_70:0f:2f (10:86:8c:70:0f:2f)  
Internet Protocol Version 4, Src: 10.0.0.143, Dst: 128.119.245.12  
Transmission Control Protocol, Src Port: 60506, Dst Port: 80, Seq: 0, Len: 0  
Source Port: 60506  
Destination Port: 80  
[Stream index: 1]  
[TCP Segment Len: 0]  
Sequence number: 0 (relative sequence number)

0000 10 86 8c 70 0f 2f 08 ed b9 5b ae c9 08 00 45 00 ...P...[...E  
0010 00 34 50 de 40 06 80 06 29 d3 0a 00 00 8f 80 77 4P@...[...  
0020 f5 0c ec 5a 00 50 6a 2e a7 a5 00 00 00 00 00 02 ...Z.P].....  
0030 20 00 d0 7e 00 00 02 04 05 b4 01 03 03 08 01 01 .....  
0040 04 02

5) Sequence number is 0. ACK is 1. This is determined by what the next byte needed is (which since this is the SYN the first byte is the one that's needed.) It's identified as SYNACK by the presence of SYN and ACK flags.

The image shows a Wireshark packet capture of a TCP SYNACK. The packet list shows a packet with sequence number 0 and acknowledgment number 1. The packet details pane shows the following information:

- Frame 7: 66 bytes on wire (528 bits), 66 bytes captured (528 bits) on interface 0
- Ethernet II, Src: MonHtPr\_5b:ae:c9 (08:ed:b9:5b:ae:c9), Dst: ArrisGro\_78:0f:2f (10:80:8c:78:0f:2f)
- Internet Protocol Version 4, Src: 10.0.0.143, Dst: 128.119.245.12
- Transmission Control Protocol, Src Port: 60506, Dst Port: 80, Seq: 0, Len: 0
- Source Port: 60506
- Destination Port: 80
- [Stream index: 1]
- [TCP Segment Len: 0]
- Sequence number: 0 (relative sequence number)

The packet bytes pane shows the raw data of the packet, including the TCP header and the payload.

6) The sequence number is 1.

The image shows a Wireshark packet capture of a TCP SYNACK. The packet list shows a packet with sequence number 1 and acknowledgment number 1. The packet details pane shows the following information:

- Window size value: 256
- [Calculated window size: 65536]
- [Window size scaling factor: 256]
- Checksum: 0x8264 [unverified]
- [Checksum Status: Unverified]
- Urgent pointer: 0
- SEQ/ACK analysis
- [RTT: 0.101325000 seconds]
- [Bytes in flight: 644]

The packet bytes pane shows the raw data of the packet, including the TCP header and the payload.

7) The first six sequence numbers are 1, 645, 2105, 3565, 5025 and 6485. (Red)

They were sent at times 1.053531, 1.054011, 1.054514, 1.054657, 1.054815, and 1.054868 respectively. (Yellow)

They were acknowledged at time 1.159960, 1.167024, 1.168351, 1.175965, 1.176136, and 1.177664. (Blue)

The RTT's are .106429, .113013, .113837, .121308, .121321, and .122796 (calculated by subtracting the sent time from the ACK received time. This can be verified in the SEQ/ACK analysis section{purple})

Using an  $\alpha$  of .125, the estimated RTT following each ACK is .106429, .107252, .108075, .10972923, .1111782, and .1126304295.

The image shows a Wireshark packet capture of a TCP connection. The packet list pane displays 37 packets. The first six packets (1-6) are highlighted in red, corresponding to the sequence numbers 1, 645, 2105, 3565, 5025, and 6485. The next six packets (20-25) are highlighted in blue, corresponding to the acknowledgment times 1.159960, 1.167024, 1.168351, 1.175965, 1.176136, and 1.177664. The packet details pane shows the TCP header for packet 20, which is an acknowledgment (ACK) with sequence number 6485 and acknowledgment number 6485. The packet bytes pane shows the raw data of the packet.

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	134.170.104.154	10.0.0.143	TCP	54	80->60473 [RST, ACK] Seq=1 Ack=1 Win=0 Len=0
7	0.949941	10.0.0.143	128.119.245.12	TCP	66	60506->80 [SYN] Seq=0 Win=8192 Len=0 MSS=1460 WS=256 SACK_PERM=1
8	1.050750	128.119.245.12	10.0.0.143	TCP	66	80->60506 [SYN, ACK] Seq=0 Ack=1 Win=29200 Len=0 MSS=1460 SACK_PERM=1 WS=128
9	1.051166	10.0.0.143	128.119.245.12	TCP	54	60506->80 [ACK] Seq=1 Ack=1 Win=65536 Len=0
10	1.053531	10.0.0.143	128.119.245.12	TCP	698	60506->80 [PSH, ACK] Seq=1 Ack=1 Win=65536 Len=644
11	1.054011	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=645 Ack=1 Win=65536 Len=1460
12	1.054514	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=2105 Ack=1 Win=65536 Len=1460
13	1.054657	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=3565 Ack=1 Win=65536 Len=1460
14	1.054815	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=5025 Ack=1 Win=65536 Len=1460
15	1.054868	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=6485 Ack=1 Win=65536 Len=1460
16	1.054910	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=7945 Ack=1 Win=65536 Len=1460
17	1.054952	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=9405 Ack=1 Win=65536 Len=1460
18	1.055122	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=10805 Ack=1 Win=65536 Len=1460
19	1.055165	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=12325 Ack=1 Win=65536 Len=1460
20	1.159960	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=645 Win=30592 Len=0
21	1.160178	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=13785 Ack=1 Win=65536 Len=1460
22	1.167024	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=2105 Win=33408 Len=0
23	1.167269	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=15245 Ack=1 Win=65536 Len=1460
24	1.167374	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [PSH, ACK] Seq=16785 Ack=1 Win=65536 Len=1460
25	1.168351	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=3565 Win=36352 Len=0
26	1.168599	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=18165 Ack=1 Win=65536 Len=1460
27	1.168657	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=19625 Ack=1 Win=65536 Len=1460
28	1.175965	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=5025 Win=39296 Len=0
29	1.176136	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=6485 Win=42240 Len=0
30	1.176200	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=21805 Ack=1 Win=65536 Len=1460
31	1.176299	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=22545 Ack=1 Win=65536 Len=1460
32	1.176333	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=24005 Ack=1 Win=65536 Len=1460
33	1.176378	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=25405 Ack=1 Win=65536 Len=1460
34	1.177664	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=7945 Win=45184 Len=0
35	1.177802	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=9405 Win=48128 Len=0
36	1.177845	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=12325 Win=53888 Len=0
37	1.177892	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=13785 Win=56832 Len=0

The image shows a Wireshark packet capture of a TCP connection. The packet list pane displays 37 packets. The first six packets (1-6) are highlighted in red, corresponding to the sequence numbers 1, 645, 2105, 3565, 5025, and 6485. The next six packets (20-25) are highlighted in blue, corresponding to the acknowledgment times 1.159960, 1.167024, 1.168351, 1.175965, 1.176136, and 1.177664. The packet details pane shows the TCP header for packet 20, which is an acknowledgment (ACK) with sequence number 6485 and acknowledgment number 6485. The packet bytes pane shows the raw data of the packet.

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	134.170.104.154	10.0.0.143	TCP	54	80->60473 [RST, ACK] Seq=1 Ack=1 Win=0 Len=0
7	0.949941	10.0.0.143	128.119.245.12	TCP	66	60506->80 [SYN] Seq=0 Win=8192 Len=0 MSS=1460 WS=256 SACK_PERM=1
8	1.050750	128.119.245.12	10.0.0.143	TCP	66	80->60506 [SYN, ACK] Seq=0 Ack=1 Win=29200 Len=0 MSS=1460 SACK_PERM=1 WS=128
9	1.051166	10.0.0.143	128.119.245.12	TCP	54	60506->80 [ACK] Seq=1 Ack=1 Win=65536 Len=0
10	1.053531	10.0.0.143	128.119.245.12	TCP	698	60506->80 [PSH, ACK] Seq=1 Ack=1 Win=65536 Len=644
11	1.054011	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=645 Ack=1 Win=65536 Len=1460
12	1.054514	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=2105 Ack=1 Win=65536 Len=1460
13	1.054657	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=3565 Ack=1 Win=65536 Len=1460
14	1.054815	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=5025 Ack=1 Win=65536 Len=1460
15	1.054868	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=6485 Ack=1 Win=65536 Len=1460
16	1.054910	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=7945 Ack=1 Win=65536 Len=1460
17	1.054952	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=9405 Ack=1 Win=65536 Len=1460
18	1.055122	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=10805 Ack=1 Win=65536 Len=1460
19	1.055165	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=12325 Ack=1 Win=65536 Len=1460
20	1.159960	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=645 Win=30592 Len=0
21	1.160178	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=13785 Ack=1 Win=65536 Len=1460
22	1.167024	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=2105 Win=33408 Len=0
23	1.167269	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=15245 Ack=1 Win=65536 Len=1460
24	1.167374	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [PSH, ACK] Seq=16785 Ack=1 Win=65536 Len=1460
25	1.168351	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=3565 Win=36352 Len=0
26	1.168599	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=18165 Ack=1 Win=65536 Len=1460
27	1.168657	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=19625 Ack=1 Win=65536 Len=1460
28	1.175965	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=5025 Win=39296 Len=0
29	1.176136	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=6485 Win=42240 Len=0
30	1.176200	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=21805 Ack=1 Win=65536 Len=1460
31	1.176299	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=22545 Ack=1 Win=65536 Len=1460
32	1.176333	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=24005 Ack=1 Win=65536 Len=1460

8) The length of the first segment is 644. Segments 2 through 6 are all length 1460

No.	Time	Source	Destination	Protocol	Length	Info
7	0.949841	10.0.0.143	128.119.245.12	TCP	66	60506->80 [SYN] Seq=0 Win=8192 Len=0 MSS=1460 WS=256 SACK_PERM=1
8	1.050750	128.119.245.12	10.0.0.143	TCP	66	80->60506 [SYN, ACK] Seq=0 Ack=1 Win=29200 Len=0 MSS=1460 SACK_PERM=1 WS=128
9	1.051166	10.0.0.143	128.119.245.12	TCP	54	60506->80 [ACK] Seq=1 Ack=1 Win=65536 Len=0
10	1.053331	10.0.0.143	128.119.245.12	TCP	698	60506->80 [PSH, ACK] Seq=1 Ack=1 Win=65536 Len=644
11	1.054011	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=645 Ack=1 Win=65536 Len=1460
12	1.054514	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=2105 Ack=1 Win=65536 Len=1460
13	1.054657	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=3565 Ack=1 Win=65536 Len=1460
14	1.054815	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=5025 Ack=1 Win=65536 Len=1460
15	1.054868	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=6485 Ack=1 Win=65536 Len=1460
16	1.054910	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=7945 Ack=1 Win=65536 Len=1460
17	1.054952	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=9405 Ack=1 Win=65536 Len=1460
18	1.055122	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=10865 Ack=1 Win=65536 Len=1460
19	1.055165	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=12325 Ack=1 Win=65536 Len=1460
20	1.159960	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=645 Win=30592 Len=0
21	1.160178	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=13785 Ack=1 Win=65536 Len=1460
22	1.167024	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=2105 Win=33408 Len=0
23	1.167269	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=15245 Ack=1 Win=65536 Len=1460
24	1.167374	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [PSH, ACK] Seq=16705 Ack=1 Win=65536 Len=1460
25	1.168351	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=3565 Win=36352 Len=0
26	1.168599	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=18165 Ack=1 Win=65536 Len=1460
27	1.168657	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=19625 Ack=1 Win=65536 Len=1460
28	1.175965	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=5025 Win=39296 Len=0
29	1.176136	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=6485 Win=42240 Len=0
30	1.176200	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=21805 Ack=1 Win=65536 Len=1460
31	1.176299	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=22545 Ack=1 Win=65536 Len=1460
32	1.176333	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=24005 Ack=1 Win=65536 Len=1460
33	1.176370	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=25465 Ack=1 Win=65536 Len=1460
34	1.177664	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=7945 Win=45184 Len=0
35	1.177802	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=9405 Win=48128 Len=0
36	1.177845	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=12325 Win=53888 Len=0
37	1.177892	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=13785 Win=56832 Len=0
38	1.177961	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=26925 Ack=1 Win=65536 Len=1460

Acknowledgment number: 1 (relative ack number)  
Header Length: 20 bytes  
Flags: 0x018 (PSH, ACK)  
Window size value: 256

0030 01 68 02 64 00 00 50 4f 53 54 20 2f 77 69 72 65 .d..PO ST /w/re  
0040 73 68 61 72 6b 2d 6c 61 62 73 2f 6c 61 62 33 2d shark-la bs/lab3-  
0050 31 2d 72 65 78 6c 79 2e 68 74 6d 20 48 54 54 50 1-reply.htm HTTP  
0060 2f 31 2e 31 0d 0a 48 6f 73 74 3a 20 67 61 69 61 /1.1..Ho st: gaia  
0070 2e 63 73 2e 75 6d 61 73 73 2e 65 64 75 0d 0a 43 .cs.umas s.edu..C  
0080 0f 6e 6e 63 74 69 6f 6e 3a 20 6b 65 65 70 2d connection: keep-

9) The minimum buffer space from the receiver is 30592. After this the window keeps growing. There doesn't appear to be much throttling by the sender; it looks like the receiver is able to keep up with the sender by growing the window and sending ACK's. There are some instances though where there are gaps where no data is sent until a bunch of ACKs are received (such as the gap from 94 to 98, below).

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	134.178.104.154	10.0.0.143	TCP	54	80->60473 [RST, ACK] Seq=1 Ack=1 Win=0 Len=0
7	0.949841	10.0.0.143	128.119.245.12	TCP	66	60506->80 [SYN] Seq=0 Win=8192 Len=0 MSS=1460 WS=256 SACK_PERM=1
8	1.050750	128.119.245.12	10.0.0.143	TCP	66	80->60506 [SYN, ACK] Seq=0 Ack=1 Win=29200 Len=0 MSS=1460 SACK_PERM=1 WS=128
9	1.051166	10.0.0.143	128.119.245.12	TCP	54	60506->80 [ACK] Seq=1 Ack=1 Win=65536 Len=0
10	1.053331	10.0.0.143	128.119.245.12	TCP	698	60506->80 [PSH, ACK] Seq=1 Ack=1 Win=65536 Len=644
11	1.054011	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=645 Ack=1 Win=65536 Len=1460
12	1.054514	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=2105 Ack=1 Win=65536 Len=1460
13	1.054657	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=3565 Ack=1 Win=65536 Len=1460
14	1.054815	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=5025 Ack=1 Win=65536 Len=1460
15	1.054868	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=6485 Ack=1 Win=65536 Len=1460
16	1.054910	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=7945 Ack=1 Win=65536 Len=1460
17	1.054952	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=9405 Ack=1 Win=65536 Len=1460
18	1.055122	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=10865 Ack=1 Win=65536 Len=1460
19	1.055165	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=12325 Ack=1 Win=65536 Len=1460
20	1.159960	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=645 Win=30592 Len=0
21	1.160178	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=13785 Ack=1 Win=65536 Len=1460
22	1.167024	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=2105 Win=33408 Len=0
23	1.167269	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=15245 Ack=1 Win=65536 Len=1460
24	1.167374	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [PSH, ACK] Seq=16705 Ack=1 Win=65536 Len=1460
25	1.168351	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=3565 Win=36352 Len=0
26	1.168599	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=18165 Ack=1 Win=65536 Len=1460
27	1.168657	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=19625 Ack=1 Win=65536 Len=1460
28	1.175965	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=5025 Win=39296 Len=0
29	1.176136	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=6485 Win=42240 Len=0
30	1.176200	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=21805 Ack=1 Win=65536 Len=1460
31	1.176299	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=22545 Ack=1 Win=65536 Len=1460
32	1.176333	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=24005 Ack=1 Win=65536 Len=1460

[Calculated window size: 30592]  
[Window size scaling factor: 128]  
Checksum: 0x7e6b [unverified]  
[Checksum Status: Unverified]  
Urgent pointer: 0  
[SEQ/ACK analysis]  
[This is an ACK to the segment in frame: 10]  
[The RTT to ACK the segment was: 0.106429000 seconds]  
[RTT: 0.101325000 seconds]

0000 0d ed b9 5b ae c9 10 8e 8c 70 0f 2f 00 00 45 00 ...[... .p./..E.  
0010 00 28 65 26 40 00 2f 06 66 97 80 77 fs 0c 0a 00 ..(e@./.f..w....  
0020 00 8f 00 50 ec 5a fc 78 b2 ea 6a 2e aa 2a 50 10 ...P.Z..j..\*P.  
0030 00 ef 7e 6b 00 00 ..k..



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tcp

No.	Time	Source	Destination	Protocol	Length	Info
80	1.288821	10.0.0.143	128.119.245.12	TCP	54	80->60506 [ACK] Seq=72185 Ack=1 Win=65536 Len=1460
81	1.315620	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=31305 Win=91904 Len=0
82	1.315856	10.0.0.143	128.119.245.12	TCP	54	60506->80 [ACK] Seq=73645 Ack=1 Win=65536 Len=1460
83	1.315947	10.0.0.143	128.119.245.12	TCP	54	60506->80 [ACK] Seq=75105 Ack=1 Win=65536 Len=1460
84	1.319963	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=32765 Win=94840 Len=0
85	1.320140	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=34225 Win=97664 Len=0
86	1.320242	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=35685 Win=100608 Len=0
87	1.320308	10.0.0.143	128.119.245.12	TCP	54	60506->80 [ACK] Seq=76565 Ack=1 Win=65536 Len=1460
88	1.320854	10.0.0.143	128.119.245.12	TCP	54	60506->80 [ACK] Seq=78025 Ack=1 Win=65536 Len=1460
89	1.320784	10.0.0.143	128.119.245.12	TCP	54	60506->80 [ACK] Seq=79485 Ack=1 Win=65536 Len=1460
90	1.320875	10.0.0.143	128.119.245.12	TCP	54	60506->80 [ACK] Seq=80945 Ack=1 Win=65536 Len=1460
91	1.320914	10.0.0.143	128.119.245.12	TCP	698	60506->80 [PSH, ACK] Seq=82405 Ack=1 Win=65536 Len=644
92	1.320955	10.0.0.143	128.119.245.12	TCP	54	60506->80 [ACK] Seq=83049 Ack=1 Win=65536 Len=1460
93	1.321046	10.0.0.143	128.119.245.12	TCP	54	60506->80 [ACK] Seq=84509 Ack=1 Win=65536 Len=1460
94	1.356155	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=37145 Win=103552 Len=0
95	1.356320	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=38605 Win=106496 Len=0
96	1.356369	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=40065 Win=109440 Len=0
97	1.356398	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=41525 Win=112256 Len=0
98	1.356461	10.0.0.143	128.119.245.12	TCP	54	60506->80 [ACK] Seq=85909 Ack=1 Win=65536 Len=1460
99	1.356663	10.0.0.143	128.119.245.12	TCP	54	60506->80 [ACK] Seq=87429 Ack=1 Win=65536 Len=1460
100	1.357230	10.0.0.143	128.119.245.12	TCP	54	60506->80 [ACK] Seq=88889 Ack=1 Win=65536 Len=1460
101	1.357324	10.0.0.143	128.119.245.12	TCP	54	60506->80 [ACK] Seq=90349 Ack=1 Win=65536 Len=1460
102	1.357453	10.0.0.143	128.119.245.12	TCP	54	60506->80 [ACK] Seq=91809 Ack=1 Win=65536 Len=1460
103	1.357981	10.0.0.143	128.119.245.12	TCP	54	60506->80 [ACK] Seq=93269 Ack=1 Win=65536 Len=1460
104	1.358079	10.0.0.143	128.119.245.12	TCP	54	60506->80 [ACK] Seq=94729 Ack=1 Win=65536 Len=1460
105	1.358181	10.0.0.143	128.119.245.12	TCP	54	60506->80 [ACK] Seq=96189 Ack=1 Win=65536 Len=1460
106	1.358518	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=42985 Win=115200 Len=0

Window size value: 256  
[Calculated window size: 65536]  
[Window size scaling factor: 256]  
Checksum: 0xd4f4 [unverified]  
[Checksum Status: Unverified]  
Urgent pointer: 0  
[SEQ/ACK analysis]  
[RTT: 0.101325000 seconds]  
[Bytes in flight: 50284]

0030 01 00 d4 f4 00 00 05 6c 6c 20 75 73 20 61 20 73 .....l u s a s  
0040 74 6f 72 79 21 27 20 73 61 69 64 20 74 68 65 20 tory!' s aid the  
0050 4d 61 72 63 69 20 48 61 72 65 20 0d 0a 0d 0a 20 March He.....  
0060 20 60 59 65 73 2c 20 70 6c 65 61 73 65 20 64 6f 'Yes, p lease do  
0070 21 27 20 70 6c 65 61 64 65 64 20 41 6c 69 63 65 '! plead ed Alice  
0080 2e 0d 0a 0d 0a 20 20 60 41 6e 64 20 62 65 20 71 ..... And be q

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

Packets: 200 · Displayed: 195 (97.5%) · Dropped: 0 (0.0%) Profile: Default

10) There were no retransmitted segments, though there was an ACK that was received multiple times, suggesting that it was sent multiple times. To check for this I looked to see if there were any sequence numbers that showed up more than once. All sequence numbers were unique and were steadily increasing.

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tcp

No.	Time	Source	Destination	Protocol	Length	Info
175	1.476426	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=94729 Win=181632 Len=0
176	1.476450	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=96189 Win=183296 Len=0
177	1.476484	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=97649 Win=183296 Len=0
178	1.476507	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=99109 Win=183296 Len=0
179	1.476547	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=100569 Win=183296 Len=0
180	1.476571	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=102029 Win=183296 Len=0
181	1.477217	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=104949 Win=183296 Len=0
182	1.500987	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=107869 Win=183296 Len=0
183	1.508847	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=110789 Win=183296 Len=0
184	1.511112	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=113709 Win=183296 Len=0
185	1.512783	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=116629 Win=183296 Len=0
186	1.513406	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=122469 Win=183296 Len=0
187	1.514155	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=126849 Win=183296 Len=0
188	1.515037	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=129769 Win=183296 Len=0
189	1.520455	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=132689 Win=183296 Len=0
190	1.522981	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=135609 Win=183296 Len=0
191	1.524128	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=138529 Win=183296 Len=0
192	1.525306	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=141449 Win=183296 Len=0
193	1.529269	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=144369 Win=183296 Len=0
194	1.545051	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=147289 Win=186112 Len=0
195	1.550981	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=148749 Win=189056 Len=0
196	1.551257	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=150209 Win=192000 Len=0
197	1.563264	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=151669 Win=194944 Len=0
198	1.564795	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=152966 Win=197888 Len=0
199	1.565193	128.119.245.12	10.0.0.143	TCP	833	80->60506 [PSH, ACK] Seq=1 Ack=152966 Win=197888 Len=779
200	1.614712	10.0.0.143	128.119.245.12	TCP	54	60506->80 [ACK] Seq=152966 Ack=780 Win=64768 Len=0

[Calculated window size: 30592]  
[Window size scaling factor: 128]  
Checksum: 0x7ebd [unverified]  
[Checksum Status: Unverified]  
Urgent pointer: 0  
[SEQ/ACK analysis]  
[This is an ACK to the segment in frame: 10]  
[The RTT to ACK the segment was: 0.106429000 seconds]  
[RTT: 0.101325000 seconds]

0000 0d ed b9 5b ae c9 10 86 8c 70 0f 2f 08 00 45 00 ...[...].p./..E.  
0010 00 28 65 26 40 00 2f 06 66 97 80 77 f5 0c 0a 00 ..(e@./..f..w....  
0020 00 8f 00 50 ec 5a fc 78 b2 ea 6a 2e aa 2a 50 10 ...P..Z..X...j..\*P.  
0030 00 c1 7e 6b 00 00 ..k..

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

Packets: 200 · Displayed: 195 (97.5%) · Dropped: 0 (0.0%) Profile: Default

11) The receiver typically acknowledges between 1000 and 1500 bytes in an ACK, or one segment. There was an instance of it ACKing every other segment, but generally it ACKed one at a time.

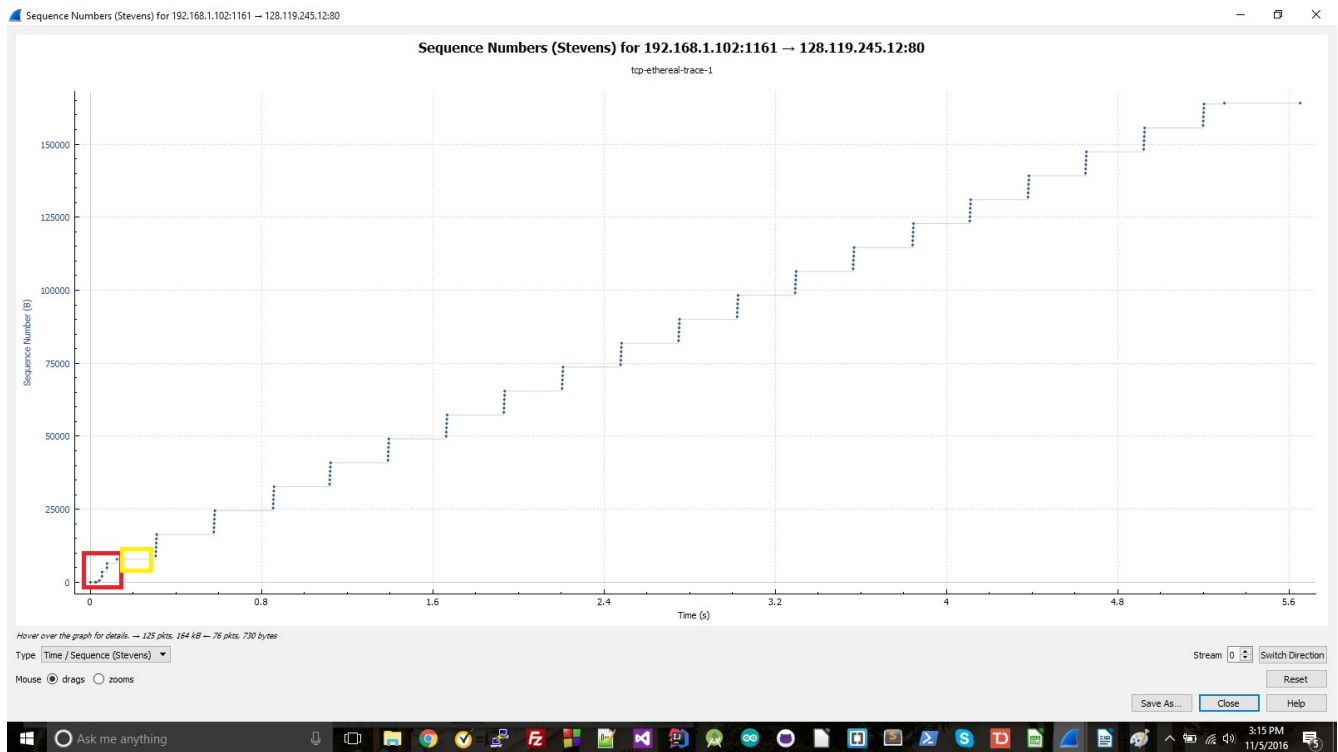
The image shows a Wireshark packet capture of a TCP connection. The packet list at the top shows segments 15 through 41, all of which are ACKed. A red box highlights a segment with Seq=9405, and a yellow box highlights an ACK with Ack=9405. The packet details pane shows the structure of the ACK, including the sequence number, acknowledgment number, and window size.

No.	Time	Source	Destination	Protocol	Length	Info
15	1.054068	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=6485 Ack=1 Win=65536 Len=1460
16	1.054910	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=7045 Ack=1 Win=65536 Len=1460
17	1.054952	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=9405 Ack=1 Win=65536 Len=1460
18	1.055122	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=10865 Ack=1 Win=65536 Len=1460
19	1.055165	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=12225 Ack=1 Win=65536 Len=1460
20	1.159960	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=9405 Win=30592 Len=0
21	1.160178	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=13785 Ack=1 Win=65536 Len=1460
22	1.167024	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=2105 Win=33408 Len=0
23	1.167269	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=15245 Ack=1 Win=65536 Len=1460
24	1.167374	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [PSH, ACK] Seq=16705 Ack=1 Win=65536 Len=1460
25	1.168351	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=3565 Win=36352 Len=0
26	1.168599	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=18165 Ack=1 Win=65536 Len=1460
27	1.168657	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=19625 Ack=1 Win=65536 Len=1460
28	1.175965	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=5025 Win=39296 Len=0
29	1.176136	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=6485 Win=42240 Len=0
30	1.176200	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=21085 Ack=1 Win=65536 Len=1460
31	1.176299	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=22545 Ack=1 Win=65536 Len=1460
32	1.176333	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=24005 Ack=1 Win=65536 Len=1460
33	1.176370	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=25465 Ack=1 Win=65536 Len=1460
34	1.177664	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=7945 Win=45184 Len=0
35	1.177802	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=9405 Win=48128 Len=0
36	1.177845	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=12225 Win=53808 Len=0
37	1.177892	128.119.245.12	10.0.0.143	TCP	54	80->60506 [ACK] Seq=1 Ack=13785 Win=56832 Len=0
38	1.177961	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=26925 Ack=1 Win=65536 Len=1460
39	1.178020	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=28385 Ack=1 Win=65536 Len=1460
40	1.178060	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=29845 Ack=1 Win=65536 Len=1460
41	1.178101	10.0.0.143	128.119.245.12	TCP	1514	60506->80 [ACK] Seq=31305 Ack=1 Win=65536 Len=1460

Destination Port: 60506  
[Stream index: 1]  
[TCP Segment Len: 0]  
Sequence number: 1 (relative sequence number)  
Acknowledgment number: 9405 (relative ack number)  
Header Length: 20 bytes  
Flags: 0x010 (ACK)  
Window size value: 376  
[calculated window size: 48128]

12) The throughput is calculated by dividing the amount of data by the amount of time it takes to send the data. Using the total length of 152966 bytes, and a total time of .560171 seconds (the time from the first packet of the post until the last), the throughput is 273070.187 bytes/second.

13) The slow-start begins on the left side in the red box, while it ends on the right side. The yellow box is where congestion control takes over and the sender waits to receive ACKs to avoid sending too many packets at once. The measured data is different from ideal TCP behavior because there are a bunch of back-to-back sequences that are being sent out, then nothing until the next batch of back-to-back signals. While this does show pipelining, in ideal TCP I think there'd be at least some signals going out between batches due to responding to every other ACK. As it stands, it seems to be waiting for an entire batch of sequences to be ACKed before sending out the next set. In addition to that, if it were following ideal TCP, the size of the pipelines would be continuing to increase until a segment was lost or there was a timeout. The number of segments being sent out at a time stays constant at six segments per bundle.



14) The beginning of the slow-start phase starts in the left side of the red box, with its ending on the right side of that same box. The yellow box shows where congestion control takes over and begins throttling back on the number of segments that are sent out at one time. The data differs from ideal TCP in that like in question 13, it seems to wait for an entire cluster of segments to be received before sending out the next cluster (though it doesn't do this as much), as opposed to sending out a segment with every other ACK.

