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Roll No	:	20P-0165
Section	:	BCS-5A

Computer Networks Lab No 9

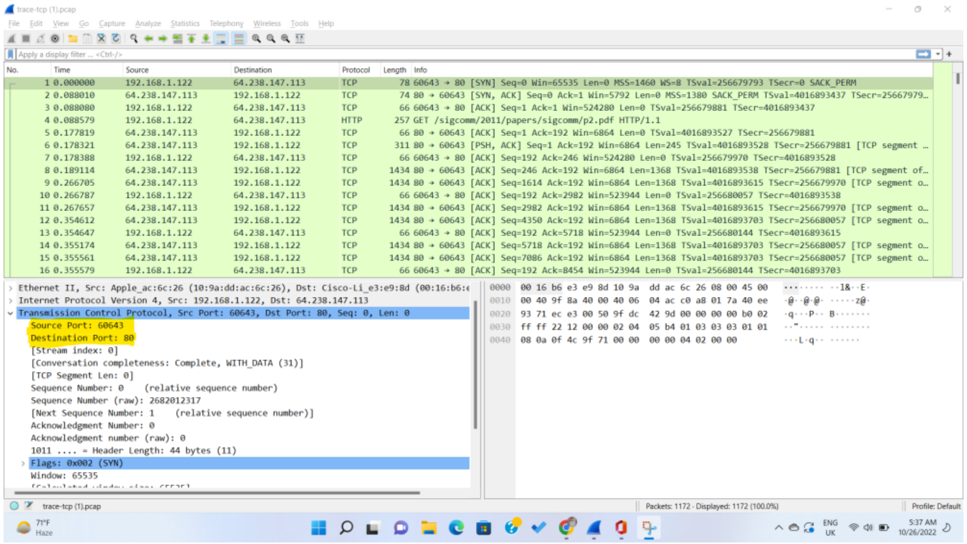
Lab Task:

Download and Open the trace file here: Inspect the three-way handshake and answer the following:

Questions:

1. What is the source and destination port numbers?

Ans: The source port is **60643** and the destination port is **80**.


trace-tcp (1).pcap
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
Apply a display filter ... <Ctrl-/>
trace-tcp (1).pcap
Packets: 1172 · Displayed: 1172 (100.0%)
Profile: Default
71°F
Haze
ENG
UK
5:37 AM
10/26/2022

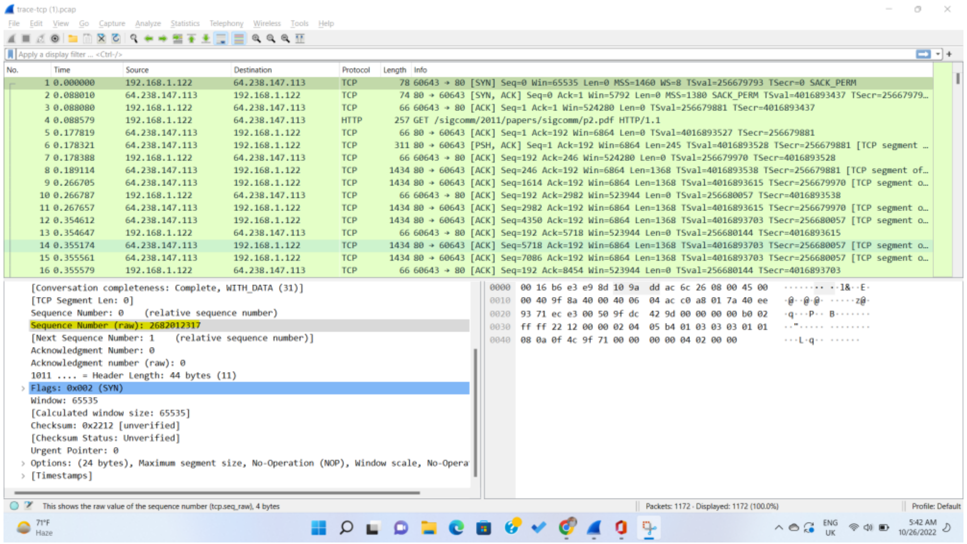
```
No.  Time      Source          Destination     Protocol Length Info
   1 0.000000  192.168.1.122   64.238.147.113  TCP        78 60643 → 80 [SYN] Seq=0 Win=65535 Len=0 MSS=1460 WS=8 TSval=256679793 TSecr=0 SACK_PERM
   2 0.088010  64.238.147.113  192.168.1.122   TCP        74 80 → 60643 [SYN, ACK] Seq=0 Ack=1 Win=5792 Len=0 MSS=1380 SACK_PERM TSval=4016893437 TSecr=25667979…
   3 0.088080  192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=1 Ack=1 Win=524280 Len=0 TSval=256679881 TSecr=4016893437
   4 0.088579  192.168.1.122   64.238.147.113  HTTP      257 GET /sigcomm/2011/papers/sigcomm/p2.pdf HTTP/1.1
   5 0.177819  64.238.147.113  192.168.1.122   TCP        66 80 → 60643 [ACK] Seq=1 Ack=192 Win=6864 Len=0 TSval=4016893527 TSecr=256679881
   6 0.178321  64.238.147.113  192.168.1.122   TCP       311 80 → 60643 [PSH, ACK] Seq=1 Ack=192 Win=6864 Len=245 TSval=4016893528 TSecr=256679881 [TCP segment …
   7 0.178388  192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=246 Win=524280 Len=0 TSval=256679970 TSecr=4016893528
   8 0.189114  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=246 Ack=192 Win=6864 Len=1368 TSval=4016893538 TSecr=256679881 [TCP segment of…
   9 0.266705  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=1614 Ack=192 Win=6864 Len=1368 TSval=4016893615 TSecr=256679970 [TCP segment o…
  10 0.266787  192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=2982 Win=523944 Len=0 TSval=256680057 TSecr=4016893538
  11 0.267657  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=2982 Ack=192 Win=6864 Len=1368 TSval=4016893615 TSecr=256679970 [TCP segment o…
  12 0.354612  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=4350 Ack=192 Win=6864 Len=1368 TSval=4016893703 TSecr=256680057 [TCP segment o…
  13 0.354647  192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=5718 Win=523944 Len=0 TSval=256680144 TSecr=4016893615
  14 0.355174  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=5718 Ack=192 Win=6864 Len=1368 TSval=4016893703 TSecr=256680057 [TCP segment o…
  15 0.355561  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=7086 Ack=192 Win=6864 Len=1368 TSval=4016893703 TSecr=256680057 [TCP segment o…
  16 0.355579  192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=8454 Win=523944 Len=0 TSval=256680144 TSecr=4016893703
```

```
> Ethernet II, Src: Apple_ac:6c:26 (10:9a:dd:ac:6c:26), Dst: Cisco-Li_e3:e9:8d (00:16:b6:e
> Internet Protocol Version 4, Src: 192.168.1.122, Dst: 64.238.147.113
v Transmission Control Protocol, Src Port: 60643, Dst Port: 80, Seq: 0, Len: 0
    Source Port: 60643
    Destination Port: 80
    [Stream index: 0]
    [Conversation completeness: Complete, WITH_DATA (31)]
    [TCP Segment Len: 0]
    Sequence Number: 0    (relative sequence number)
    Sequence Number (raw): 2682012317
    [Next Sequence Number: 1    (relative sequence number)]
    Acknowledgment Number: 0
    Acknowledgment number (raw): 0
    1011 .... = Header Length: 44 bytes (11)
  > Flags: 0x002 (SYN)
    Window: 65535
```

```
0000  00 16 b6 e3 e9 8d 10 9a  dd ac 6c 26 08 00 45 00   ········ ··l&··E·
0010  00 40 9f 8a 40 00 40 06  04 ac c0 a8 01 7a 40 ee   ·@··@·@· ·····z@·
0020  93 71 ec e3 00 50 9f dc  42 9d 00 00 00 00 b0 02   ·q···P·· B·······
0030  ff ff 22 12 00 00 02 04  05 b4 01 03 03 03 01 01   ··"····· ········
0040  08 0a 0f 4c 9f 71 00 00  00 00 04 02 00 00         ···L·q·· ······
```

2. What is the sequence number of the TCP SYN segment that is used to initiate the TCP connection? What is it in the segment that identifies the segment as a SYN segment?

Ans: The sequence number of the TCP SYN segement that is initiating the TCP connection is **2682012317.**



```
trace-tcp (1).pcap
Apply a display filter ... <Ctrl-/>

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  5 0.177819   64.238.147.113  192.168.1.122   TCP        66 80 → 60643 [ACK] Seq=1 Ack=192 Win=6864 Len=0 TSval=4016893527 TSecr=256679881
  6 0.178321   64.238.147.113  192.168.1.122   TCP       311 80 → 60643 [PSH, ACK] Seq=1 Ack=192 Win=6864 Len=245 TSval=4016893528 TSecr=256679881 [TCP segment …
  7 0.178388   192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=246 Win=524280 Len=0 TSval=256679970 TSecr=4016893528
  8 0.189114   64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=246 Ack=192 Win=6864 Len=1368 TSval=4016893538 TSecr=256679881 [TCP segment of…
  9 0.266705   64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=1614 Ack=192 Win=6864 Len=1368 TSval=4016893615 TSecr=256679970 [TCP segment o…
 10 0.266787   192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=2982 Win=523944 Len=0 TSval=256680057 TSecr=4016893538
 11 0.267657   64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=2982 Ack=192 Win=6864 Len=1368 TSval=4016893615 TSecr=256679970 [TCP segment o…
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```
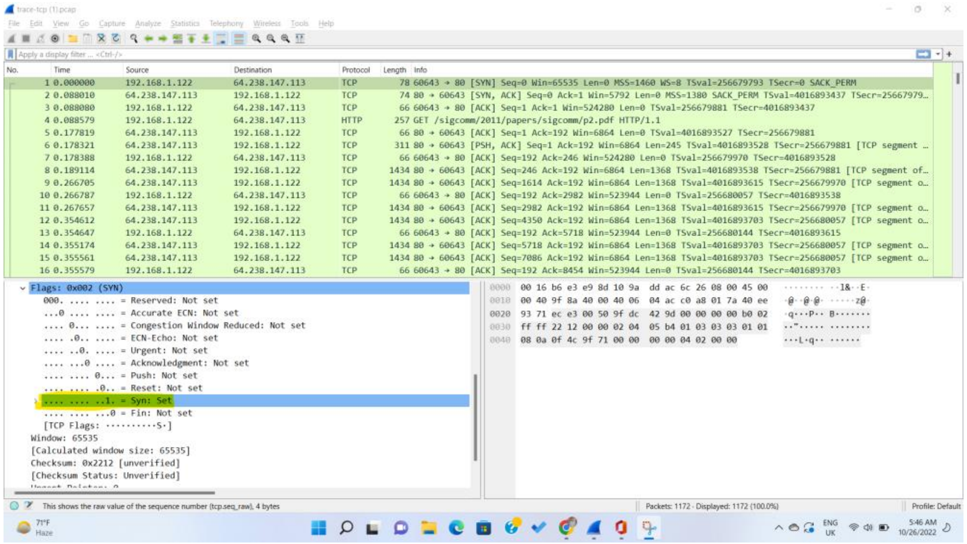

```
    [Conversation completeness: Complete, WITH_DATA (31)]
    [TCP Segment Len: 0]
    Sequence Number: 0    (relative sequence number)
    Sequence Number (raw): 2682012317
    [Next Sequence Number: 1    (relative sequence number)]
    Acknowledgment Number: 0
    Acknowledgment number (raw): 0
    1011 .... = Header Length: 44 bytes (11)
  > Flags: 0x002 (SYN)
    Window: 65535
    [Calculated window size: 65535]
    Checksum: 0x2212 [unverified]
    [Checksum Status: Unverified]
    Urgent Pointer: 0
  > Options: (24 bytes), Maximum segment size, No-Operation (NOP), Window scale, No-Opera
  > [Timestamps]
```

```
0000  00 16 b6 e3 e9 8d 10 9a  dd ac 6c 26 08 00 45 00   ·······.. ··l&··E·
0010  00 40 9f 8a 40 00 40 06  04 ac c0 a8 01 7a 40 ee   ·@··@·@· ·····z@·
0020  93 71 ec e3 00 50 9f dc  42 9d 00 00 00 00 b0 02   ·q···P·· B·······
0030  ff ff 22 12 00 00 02 04  05 b4 01 03 03 03 01 01   ··"····· ········
0040  08 0a 0f 4c 9f 71 00 00  00 00 04 02 00 00         ···L·q·· ······
```

This shows the raw value of the sequence number (tcp.seq_raw), 4 bytes | Packets: 1172 · Displayed: 1172 (100.0%) | Profile: Default

To Identify the segment that is it a SYN Segment check it SYN bit is set to 1 or not. If the SYN bit is set to 1 that means it is a SYN Segment. The segment I am inspecting is SYN because SYN bit is 1.



```
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  3 0.088080   192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=1 Ack=1 Win=524280 Len=0 TSval=256679881 TSecr=4016893437
  4 0.088579   192.168.1.122   64.238.147.113  HTTP      257 GET /sigcomm/2011/papers/sigcomm/p2.pdf HTTP/1.1
  5 0.177819   64.238.147.113  192.168.1.122   TCP        66 80 → 60643 [ACK] Seq=1 Ack=192 Win=6864 Len=0 TSval=4016893527 TSecr=256679881
  6 0.178321   64.238.147.113  192.168.1.122   TCP       311 80 → 60643 [PSH, ACK] Seq=1 Ack=192 Win=6864 Len=245 TSval=4016893528 TSecr=256679881 [TCP segment …
  7 0.178388   192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=246 Win=524280 Len=0 TSval=256679970 TSecr=4016893528
  8 0.189114   64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=246 Ack=192 Win=6864 Len=1368 TSval=4016893538 TSecr=256679881 [TCP segment of…
  9 0.266705   64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=1614 Ack=192 Win=6864 Len=1368 TSval=4016893615 TSecr=256679970 [TCP segment o…
 10 0.266787   192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=2982 Win=523944 Len=0 TSval=256680057 TSecr=4016893538
 11 0.267657   64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=2982 Ack=192 Win=6864 Len=1368 TSval=4016893615 TSecr=256679970 [TCP segment o…
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 14 0.355174   64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=5718 Ack=192 Win=6864 Len=1368 TSval=4016893703 TSecr=256680057 [TCP segment o…
 15 0.355561   64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=7086 Ack=192 Win=6864 Len=1368 TSval=4016893703 TSecr=256680057 [TCP segment o…
 16 0.355579   192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=8454 Win=523944 Len=0 TSval=256680144 TSecr=4016893703
```

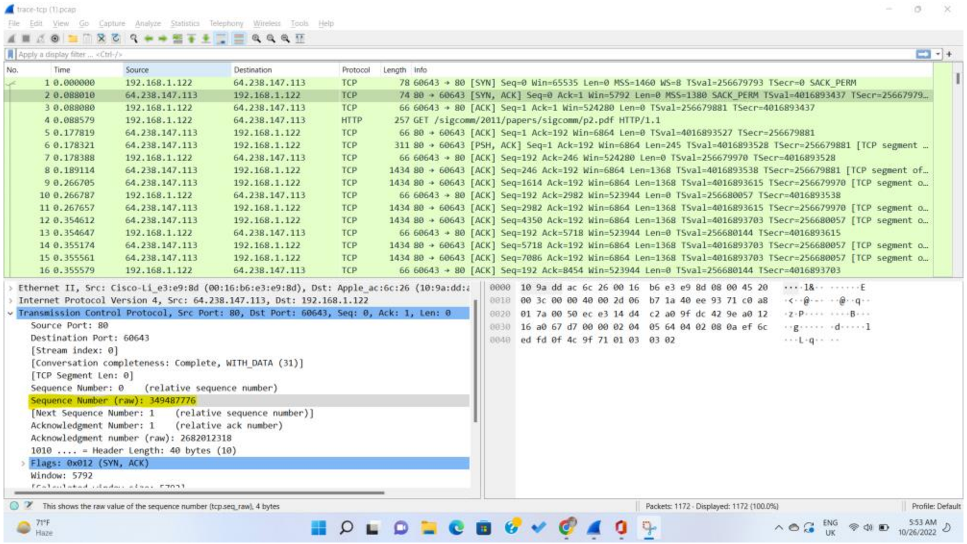
```
  v Flags: 0x002 (SYN)
      000. .... .... = Reserved: Not set
      ...0 .... .... = Accurate ECN: Not set
      .... 0... .... = Congestion Window Reduced: Not set
      .... .0.. .... = ECN-Echo: Not set
      .... ..0. .... = Urgent: Not set
      .... ...0 .... = Acknowledgment: Not set
      .... .... 0... = Push: Not set
      .... .... .0.. = Reset: Not set
      .... .... ..1. = Syn: Set
      .... .... ...0 = Fin: Not set
      [TCP Flags: ··········S·]
    Window: 65535
    [Calculated window size: 65535]
    Checksum: 0x2212 [unverified]
    [Checksum Status: Unverified]
```

```
0000  00 16 b6 e3 e9 8d 10 9a  dd ac 6c 26 08 00 45 00   ········ ··l&··E·
0010  00 40 9f 8a 40 00 40 06  04 ac c0 a8 01 7a 40 ee   ·@··@·@· ·····z@·
0020  93 71 ec e3 00 50 9f dc  42 9d 00 00 00 00 b0 02   ·q···P·· B·······
0030  ff ff 22 12 00 00 02 04  05 b4 01 03 03 03 01 01   ··"····· ········
0040  08 0a 0f 4c 9f 71 00 00  00 00 04 02 00 00         ···L·q·· ······
```

This shows the raw value of the sequence number (tcp.seq_raw), 4 bytes | Packets: 1172 · Displayed: 1172 (100.0%) | Profile: Default

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

Ans: The sequence number of the SYNACK segment sent by the server to the client in reply to the SYN is **34948776.**



```
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   2 0.088010  64.238.147.113  192.168.1.122   TCP        74 80 → 60643 [SYN, ACK] Seq=0 Ack=1 Win=5792 Len=0 MSS=1380 SACK_PERM TSval=4016893437 TSecr=25667979…
   3 0.088080  192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=1 Ack=1 Win=524280 Len=0 TSval=256679881 TSecr=4016893437
   4 0.088579  192.168.1.122   64.238.147.113  HTTP      257 GET /sigcomm/2011/papers/sigcomm/p2.pdf HTTP/1.1
   5 0.177819  64.238.147.113  192.168.1.122   TCP        66 80 → 60643 [ACK] Seq=1 Ack=192 Win=6864 Len=0 TSval=4016893527 TSecr=256679881
   6 0.178321  64.238.147.113  192.168.1.122   TCP       311 80 → 60643 [PSH, ACK] Seq=1 Ack=192 Win=6864 Len=245 TSval=4016893528 TSecr=256679881 [TCP segment …
   7 0.178388  192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=246 Win=524280 Len=0 TSval=256679970 TSecr=4016893528
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```

```
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> Internet Protocol Version 4, Src: 64.238.147.113, Dst: 192.168.1.122
v Transmission Control Protocol, Src Port: 80, Dst Port: 60643, Seq: 0, Ack: 1, Len: 0
    Source Port: 80
    Destination Port: 60643
    [Stream index: 0]
    [Conversation completeness: Complete, WITH_DATA (31)]
    [TCP Segment Len: 0]
    Sequence Number: 0    (relative sequence number)
    Sequence Number (raw): 349487776
    [Next Sequence Number: 1    (relative sequence number)]
    Acknowledgment Number: 1    (relative ack number)
    Acknowledgment number (raw): 2682012318
    1010 .... = Header Length: 40 bytes (10)
  > Flags: 0x012 (SYN, ACK)
    Window: 5792
```
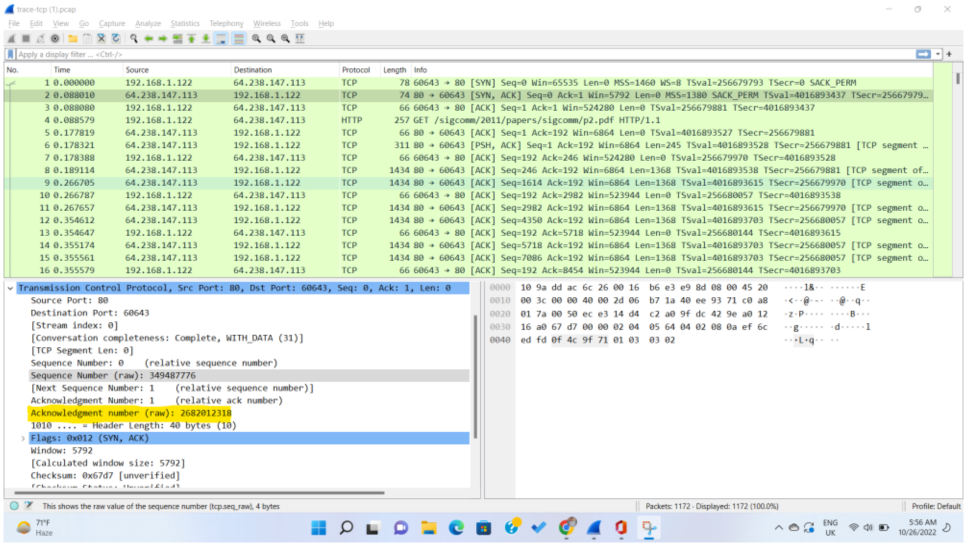

```
0000  10 9a dd ac 6c 26 00 16  b6 e3 e9 8d 08 00 45 20   ····l&·· ······E
0010  00 3c 00 00 40 00 2d 06  b7 1a 40 ee 93 71 c0 a8   ·<··@·-· ··@··q··
0020  01 7a 00 50 ec e3 14 d4  c2 a0 9f dc 42 9e a0 12   ·z·P···· ····B···
0030  16 a0 67 d7 00 00 02 04  05 64 04 02 08 0a ef 6c   ··g····· ·d·····l
0040  ed fd 0f 4c 9f 71 01 03  03 02                     ···L·q·· ··
```

This shows the raw value of the sequence number (tcp.seq_raw), 4 bytes | Packets: 1172 · Displayed: 1172 (100.0%) | Profile: Default

trace-tcp (1).pcap
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
Apply a display filter … <Ctrl-/>
71°F
Haze
ENG
UK
5:53 AM
10/26/2022

Value of the Acknowledgement field in the SYNACK segment is **2682012318.**



```
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   7 0.178388  192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=246 Win=524280 Len=0 TSval=256679970 TSecr=4016893528
   8 0.189114  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=246 Ack=192 Win=6864 Len=1368 TSval=4016893538 TSecr=256679881 [TCP segment of…
   9 0.266705  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=1614 Ack=192 Win=6864 Len=1368 TSval=4016893615 TSecr=256679970 [TCP segment o…
  10 0.266787  192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=2982 Win=523944 Len=0 TSval=256680057 TSecr=4016893538
  11 0.267657  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=2982 Ack=192 Win=6864 Len=1368 TSval=4016893615 TSecr=256679970 [TCP segment o…
  12 0.354612  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=4350 Ack=192 Win=6864 Len=1368 TSval=4016893703 TSecr=256680057 [TCP segment o…
  13 0.354647  192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=5718 Win=523944 Len=0 TSval=256680144 TSecr=4016893615
  14 0.355174  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=5718 Ack=192 Win=6864 Len=1368 TSval=4016893703 TSecr=256680057 [TCP segment o…
  15 0.355561  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=7086 Ack=192 Win=6864 Len=1368 TSval=4016893703 TSecr=256680057 [TCP segment o…
  16 0.355579  192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=8454 Win=523944 Len=0 TSval=256680144 TSecr=4016893703
```

```
v Transmission Control Protocol, Src Port: 80, Dst Port: 60643, Seq: 0, Ack: 1, Len: 0
    Source Port: 80
    Destination Port: 60643
    [Stream index: 0]
    [Conversation completeness: Complete, WITH_DATA (31)]
    [TCP Segment Len: 0]
    Sequence Number: 0    (relative sequence number)
    Sequence Number (raw): 349487776
    [Next Sequence Number: 1    (relative sequence number)]
    Acknowledgment Number: 1    (relative ack number)
    Acknowledgment number (raw): 2682012318
    1010 .... = Header Length: 40 bytes (10)
  > Flags: 0x012 (SYN, ACK)
    Window: 5792
    [Calculated window size: 5792]
    Checksum: 0x67d7 [unverified]
```

```
0000  10 9a dd ac 6c 26 00 16  b6 e3 e9 8d 08 00 45 20   ····l&·· ······E
0010  00 3c 00 00 40 00 2d 06  b7 1a 40 ee 93 71 c0 a8   ·<··@·-· ··@··q··
0020  01 7a 00 50 ec e3 14 d4  c2 a0 9f dc 42 9e a0 12   ·z·P···· ····B···
0030  16 a0 67 d7 00 00 02 04  05 64 04 02 08 0a ef 6c   ··g····· ·d·····l
0040  ed fd 0f 4c 9f 71 01 03  03 02                     ···L·q·· ··
```

This shows the raw value of the sequence number (tcp.seq_raw), 4 bytes | Packets: 1172 · Displayed: 1172 (100.0%) | Profile: Default

trace-tcp (1).pcap
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
Apply a display filter … <Ctrl-/>
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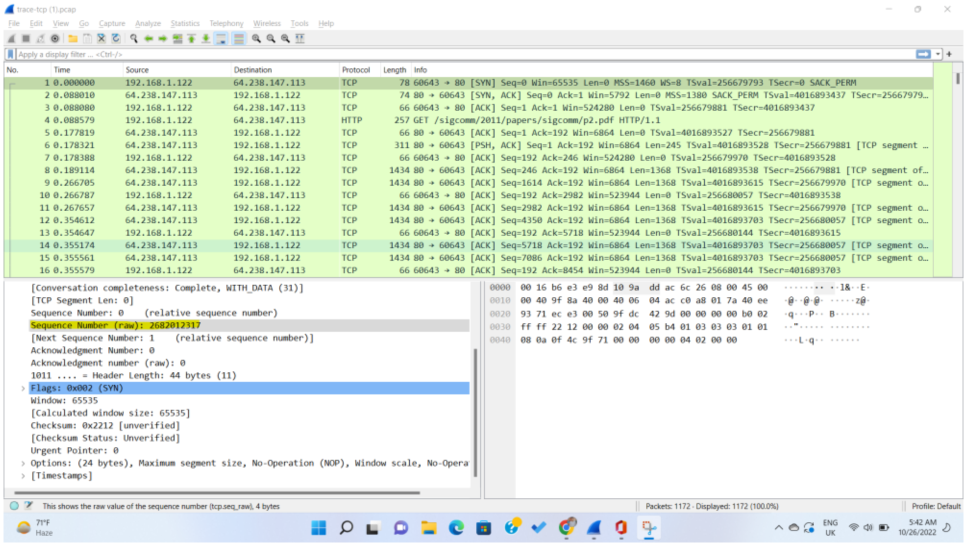
Server determines the value of Acknowledgement field by adding 1 in the previous segment sequence number.

Previous segment sequence number:



```
No.  Time       Source          Destination     Protocol Length Info
   1 0.000000   192.168.1.122   64.238.147.113  TCP        78 60643 → 80 [SYN] Seq=0 Win=65535 Len=0 MSS=1460 WS=8 TSval=256679793 TSecr=0 SACK_PERM
   2 0.088010   64.238.147.113  192.168.1.122   TCP        74 80 → 60643 [SYN, ACK] Seq=0 Ack=1 Win=5792 Len=0 MSS=1380 SACK_PERM TSval=4016893437 TSecr=25667979…
   3 0.088080   192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=1 Ack=1 Win=524280 Len=0 TSval=256679881 TSecr=4016893437
   4 0.088579   192.168.1.122   64.238.147.113  HTTP      257 GET /sigcomm/2011/papers/sigcomm/p2.pdf HTTP/1.1
   5 0.177819   64.238.147.113  192.168.1.122   TCP        66 80 → 60643 [ACK] Seq=1 Ack=192 Win=6864 Len=0 TSval=4016893527 TSecr=256679881
   6 0.178321   64.238.147.113  192.168.1.122   TCP       311 80 → 60643 [PSH, ACK] Seq=1 Ack=192 Win=6864 Len=245 TSval=4016893528 TSecr=256679881 [TCP segment …
   7 0.178388   192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=246 Win=524280 Len=0 TSval=256679970 TSecr=4016893528
   8 0.189114   64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=246 Ack=192 Win=6864 Len=1368 TSval=4016893538 TSecr=256679881 [TCP segment of…
   9 0.266705   64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=1614 Ack=192 Win=6864 Len=1368 TSval=4016893615 TSecr=256679970 [TCP segment o…
  10 0.266787   192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=2982 Win=523944 Len=0 TSval=256680057 TSecr=4016893538
  11 0.267657   64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=2982 Ack=192 Win=6864 Len=1368 TSval=4016893615 TSecr=256679970 [TCP segment o…
  12 0.354612   64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=4350 Ack=192 Win=6864 Len=1368 TSval=4016893703 TSecr=256680057 [TCP segment o…
  13 0.354647   192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=5718 Win=523944 Len=0 TSval=256680144 TSecr=4016893615
  14 0.355174   64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=5718 Ack=192 Win=6864 Len=1368 TSval=4016893703 TSecr=256680057 [TCP segment o…
  15 0.355561   64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=7086 Ack=192 Win=6864 Len=1368 TSval=4016893703 TSecr=256680057 [TCP segment o…
  16 0.355579   192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=8454 Win=523944 Len=0 TSval=256680144 TSecr=4016893703
```

```
    [Conversation completeness: Complete, WITH_DATA (31)]
    [TCP Segment Len: 0]
    Sequence Number: 0    (relative sequence number)
    Sequence Number (raw): 2682012317
    [Next Sequence Number: 1    (relative sequence number)]
    Acknowledgment Number: 0
    Acknowledgment number (raw): 0
    1011 .... = Header Length: 44 bytes (11)
  > Flags: 0x002 (SYN)
    Window: 65535
    [Calculated window size: 65535]
    Checksum: 0x2212 [unverified]
    [Checksum Status: Unverified]
    Urgent Pointer: 0
  > Options: (24 bytes), Maximum segment size, No-Operation (NOP), Window scale, No-Opera
  > [Timestamps]
```

```
0000  00 16 b6 e3 e9 8d 10 9a  dd ac 6c 26 08 00 45 00   ········ ··l&··E·
0010  00 40 9f 8a 40 00 40 06  04 ac c0 a8 01 7a 40 ee   ·@··@·@· ·····z@·
0020  93 71 ec e3 00 50 9f dc  42 9d 00 00 00 00 b0 02   ·q···P·· B·······
0030  ff ff 22 12 00 00 02 04  05 b4 01 03 03 03 01 01   ··"····· ········
0040  08 0a 0f 4c 9f 71 00 00  00 00 04 02 00 00         ···L·q·· ······
```

This shows the raw value of the sequence number (tcp.seq_raw), 4 bytes

Packets: 1172 · Displayed: 1172 (100.0%)

Profile: Default

trace-tcp (1).pcap
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
Apply a display filter ... <Ctrl-/>
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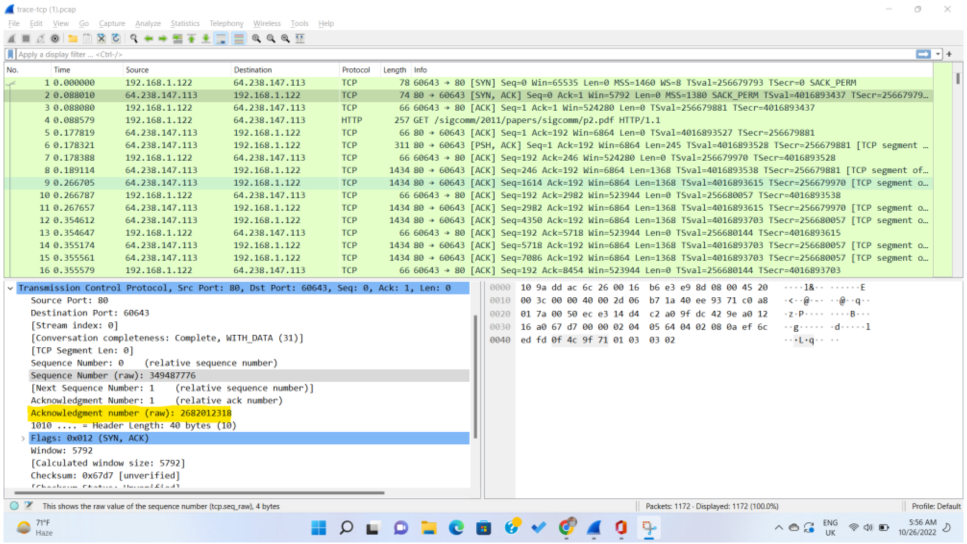
Acknowledgement number of the 2nd Segment:



```
No.  Time       Source          Destination     Protocol Length Info
   1 0.000000   192.168.1.122   64.238.147.113  TCP        78 60643 → 80 [SYN] Seq=0 Win=65535 Len=0 MSS=1460 WS=8 TSval=256679793 TSecr=0 SACK_PERM
   2 0.088010   64.238.147.113  192.168.1.122   TCP        74 80 → 60643 [SYN, ACK] Seq=0 Ack=1 Win=5792 Len=0 MSS=1380 SACK_PERM TSval=4016893437 TSecr=25667979…
   3 0.088080   192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=1 Ack=1 Win=524280 Len=0 TSval=256679881 TSecr=4016893437
   4 0.088579   192.168.1.122   64.238.147.113  HTTP      257 GET /sigcomm/2011/papers/sigcomm/p2.pdf HTTP/1.1
   5 0.177819   64.238.147.113  192.168.1.122   TCP        66 80 → 60643 [ACK] Seq=1 Ack=192 Win=6864 Len=0 TSval=4016893527 TSecr=256679881
   6 0.178321   64.238.147.113  192.168.1.122   TCP       311 80 → 60643 [PSH, ACK] Seq=1 Ack=192 Win=6864 Len=245 TSval=4016893528 TSecr=256679881 [TCP segment …
   7 0.178388   192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=246 Win=524280 Len=0 TSval=256679970 TSecr=4016893528
   8 0.189114   64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=246 Ack=192 Win=6864 Len=1368 TSval=4016893538 TSecr=256679881 [TCP segment of…
   9 0.266705   64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=1614 Ack=192 Win=6864 Len=1368 TSval=4016893615 TSecr=256679970 [TCP segment o…
  10 0.266787   192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=2982 Win=523944 Len=0 TSval=256680057 TSecr=4016893538
  11 0.267657   64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=2982 Ack=192 Win=6864 Len=1368 TSval=4016893615 TSecr=256679970 [TCP segment o…
  12 0.354612   64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=4350 Ack=192 Win=6864 Len=1368 TSval=4016893703 TSecr=256680057 [TCP segment o…
  13 0.354647   192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=5718 Win=523944 Len=0 TSval=256680144 TSecr=4016893615
  14 0.355174   64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=5718 Ack=192 Win=6864 Len=1368 TSval=4016893703 TSecr=256680057 [TCP segment o…
  15 0.355561   64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=7086 Ack=192 Win=6864 Len=1368 TSval=4016893703 TSecr=256680057 [TCP segment o…
  16 0.355579   192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=8454 Win=523944 Len=0 TSval=256680144 TSecr=4016893703
```

```
v Transmission Control Protocol, Src Port: 80, Dst Port: 60643, Seq: 0, Ack: 1, Len: 0
    Source Port: 80
    Destination Port: 60643
    [Stream index: 0]
    [Conversation completeness: Complete, WITH_DATA (31)]
    [TCP Segment Len: 0]
    Sequence Number: 0    (relative sequence number)
    Sequence Number (raw): 349487776
    [Next Sequence Number: 1    (relative sequence number)]
    Acknowledgment Number: 1    (relative ack number)
    Acknowledgment number (raw): 2682012318
    1010 .... = Header Length: 40 bytes (10)
  > Flags: 0x012 (SYN, ACK)
    Window: 5792
    [Calculated window size: 5792]
    Checksum: 0x67d7 [unverified]
```

```
0000  10 9a dd ac 6c 26 00 16  b6 e3 e9 8d 08 00 45 20   ····l&·· ······E
0010  00 3c 00 00 40 00 2d 06  b7 1a 40 ee 93 71 c0 a8   ·<··@·-· ··@··q··
0020  01 7a 00 50 ec e3 14 d4  c2 a0 9f dc 42 9e a0 12   ·z·P···· ····B···
0030  16 a0 67 d7 00 00 02 04  05 64 04 02 08 0a ef 6c   ··g····· ·d·····l
0040  ed fd 0f 4c 9f 71 01 03  03 02                     ···L·q·· ··
```

This shows the raw value of the sequence number (tcp.seq_raw), 4 bytes

Packets: 1172 · Displayed: 1172 (100.0%)

Profile: Default

trace-tcp (1).pcap
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
Apply a display filter ... <Ctrl-/>
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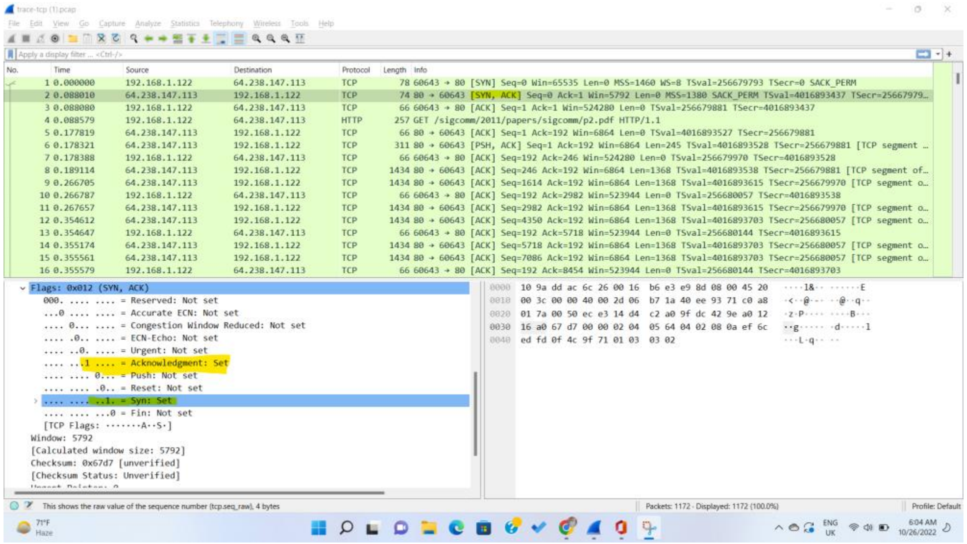
The **SYN** and **ACK** bit is set to 1. This identify the segment as **SYNACK** segment.


trace-tcp (1).pcap
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
Apply a display filter ... <Ctrl-/>
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UK
6:04 AM
10/26/2022

```
No.  Time      Source          Destination     Protocol Length Info
   1 0.000000  192.168.1.122   64.238.147.113  TCP        78 60643 → 80 [SYN] Seq=0 Win=65535 Len=0 MSS=1460 WS=8 TSval=256679793 TSecr=0 SACK_PERM
   2 0.088010  64.238.147.113  192.168.1.122   TCP        74 80 → 60643 [SYN, ACK] Seq=0 Ack=1 Win=5792 Len=0 MSS=1380 SACK_PERM TSval=4016893437 TSecr=25667979…
   3 0.088080  192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=1 Ack=1 Win=524280 Len=0 TSval=256679881 TSecr=4016893437
   4 0.088579  192.168.1.122   64.238.147.113  HTTP      257 GET /sigcomm/2011/papers/sigcomm/p2.pdf HTTP/1.1
   5 0.177819  64.238.147.113  192.168.1.122   TCP        66 80 → 60643 [ACK] Seq=1 Ack=192 Win=6864 Len=0 TSval=4016893527 TSecr=256679881
   6 0.178321  64.238.147.113  192.168.1.122   TCP       311 80 → 60643 [PSH, ACK] Seq=1 Ack=192 Win=6864 Len=245 TSval=4016893528 TSecr=256679881 [TCP segment …
   7 0.178388  192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=246 Win=524280 Len=0 TSval=256679970 TSecr=4016893528
   8 0.189114  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=246 Ack=192 Win=6864 Len=1368 TSval=4016893538 TSecr=256679881 [TCP segment of…
   9 0.266705  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=1614 Ack=192 Win=6864 Len=1368 TSval=4016893615 TSecr=256679970 [TCP segment o…
  10 0.266787  192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=2982 Win=523944 Len=0 TSval=256680057 TSecr=4016893538
  11 0.267657  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=2982 Ack=192 Win=6864 Len=1368 TSval=4016893615 TSecr=256679970 [TCP segment o…
  12 0.354612  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=4350 Ack=192 Win=6864 Len=1368 TSval=4016893703 TSecr=256680057 [TCP segment o…
  13 0.354647  192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=5718 Win=523944 Len=0 TSval=256680144 TSecr=4016893615
  14 0.355174  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=5718 Ack=192 Win=6864 Len=1368 TSval=4016893703 TSecr=256680057 [TCP segment o…
  15 0.355561  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=7086 Ack=192 Win=6864 Len=1368 TSval=4016893703 TSecr=256680057 [TCP segment o…
  16 0.355579  192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=8454 Win=523944 Len=0 TSval=256680144 TSecr=4016893703
```

```
 ⌄ Flags: 0x012 (SYN, ACK)
     000. .... .... = Reserved: Not set
     ...0 .... .... = Accurate ECN: Not set
     .... 0... .... = Congestion Window Reduced: Not set
     .... .0.. .... = ECN-Echo: Not set
     .... ..0. .... = Urgent: Not set
     .... ...1 .... = Acknowledgment: Set
     .... .... 0... = Push: Not set
     .... .... .0.. = Reset: Not set
   > .... .... ..1. = Syn: Set
     .... .... ...0 = Fin: Not set
     [TCP Flags: ·······A··S·]
   Window: 5792
   [Calculated window size: 5792]
   Checksum: 0x67d7 [unverified]
   [Checksum Status: Unverified]
```

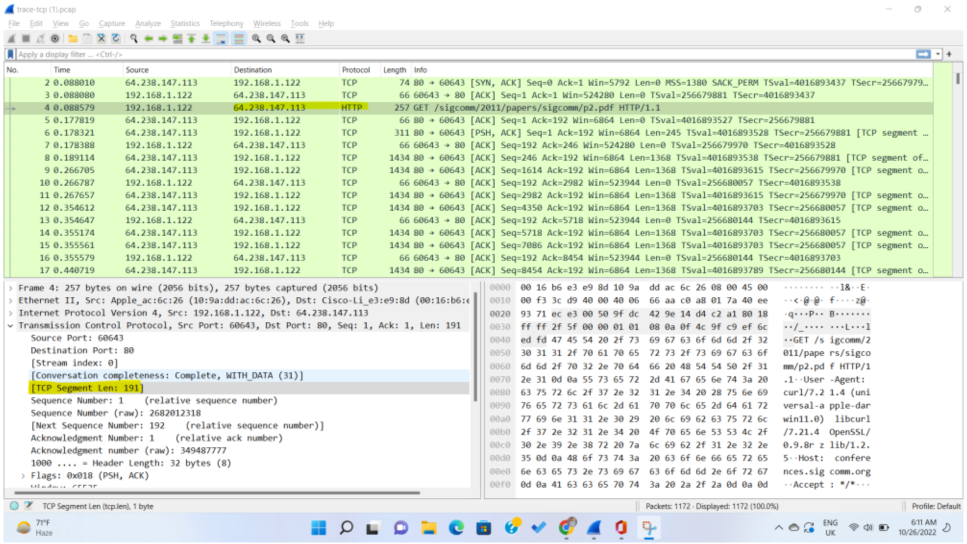
```
0000  10 9a dd ac 6c 26 00 16  b6 e3 e9 8d 08 00 45 20   ····l&·· ······E
0010  00 3c 00 00 40 00 2d 06  b7 1a 40 ee 93 71 c0 a8   ·<··@·-· ··@··q··
0020  01 7a 00 50 ec e3 14 d4  c2 a0 9f dc 42 9e a0 12   ·z·P···· ····B···
0030  16 a0 67 d7 00 00 02 04  05 64 04 02 08 0a ef 6c   ··g····· ·d·····l
0040  ed fd 0f 4c 9f 71 01 03  03 02                     ···L·q·· ··
```

This shows the raw value of the sequence number (tcp.seq_raw), 4 bytes | Packets: 1172 · Displayed: 1172 (100.0%) | Profile: Default

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

Ans: Wireshark is manually calculating it. Not returned by server.

After Handshaking first http length = 191bytes:


trace-tcp (1).pcap
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
Apply a display filter ... <Ctrl-/>
71°F
Haze
ENG
UK
6:11 AM
10/26/2022

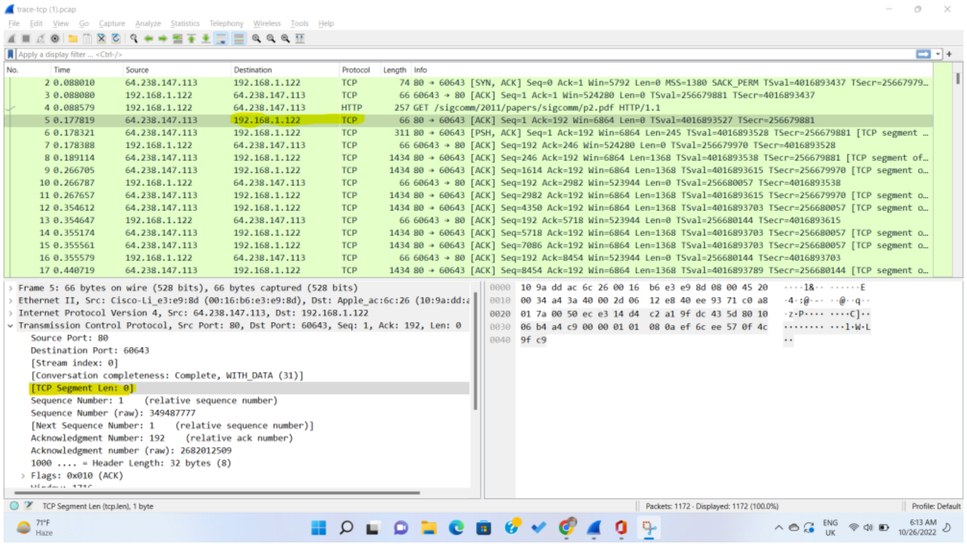
```
No.  Time      Source          Destination     Protocol Length Info
   2 0.088010  64.238.147.113  192.168.1.122   TCP        74 80 → 60643 [SYN, ACK] Seq=0 Ack=1 Win=5792 Len=0 MSS=1380 SACK_PERM TSval=4016893437 TSecr=25667979…
   3 0.088080  192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=1 Ack=1 Win=524280 Len=0 TSval=256679881 TSecr=4016893437
   4 0.088579  192.168.1.122   64.238.147.113  HTTP      257 GET /sigcomm/2011/papers/sigcomm/p2.pdf HTTP/1.1
   5 0.177819  64.238.147.113  192.168.1.122   TCP        66 80 → 60643 [ACK] Seq=1 Ack=192 Win=6864 Len=0 TSval=4016893527 TSecr=256679881
   6 0.178321  64.238.147.113  192.168.1.122   TCP       311 80 → 60643 [PSH, ACK] Seq=1 Ack=192 Win=6864 Len=245 TSval=4016893528 TSecr=256679881 [TCP segment …
   7 0.178388  192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=246 Win=524280 Len=0 TSval=256679970 TSecr=4016893528
   8 0.189114  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=246 Ack=192 Win=6864 Len=1368 TSval=4016893538 TSecr=256679881 [TCP segment of…
   9 0.266705  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=1614 Ack=192 Win=6864 Len=1368 TSval=4016893615 TSecr=256679970 [TCP segment o…
  10 0.266787  192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=2982 Win=523944 Len=0 TSval=256680057 TSecr=4016893538
  11 0.267657  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=2982 Ack=192 Win=6864 Len=1368 TSval=4016893615 TSecr=256679970 [TCP segment o…
  12 0.354612  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=4350 Ack=192 Win=6864 Len=1368 TSval=4016893703 TSecr=256680057 [TCP segment o…
  13 0.354647  192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=5718 Win=523944 Len=0 TSval=256680144 TSecr=4016893615
  14 0.355174  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=5718 Ack=192 Win=6864 Len=1368 TSval=4016893703 TSecr=256680057 [TCP segment o…
  15 0.355561  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=7086 Ack=192 Win=6864 Len=1368 TSval=4016893703 TSecr=256680057 [TCP segment o…
  16 0.355579  192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=8454 Win=523944 Len=0 TSval=256680144 TSecr=4016893703
  17 0.440719  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=8454 Ack=192 Win=6864 Len=1368 TSval=4016893789 TSecr=256680144 [TCP segment o…
```

```
> Frame 4: 257 bytes on wire (2056 bits), 257 bytes captured (2056 bits)
> Ethernet II, Src: Apple_ac:6c:26 (10:9a:dd:ac:6c:26), Dst: Cisco-Li_e3:e9:8d (00:16:b6:e
> Internet Protocol Version 4, Src: 192.168.1.122, Dst: 64.238.147.113
⌄ Transmission Control Protocol, Src Port: 60643, Dst Port: 80, Seq: 1, Ack: 1, Len: 191
    Source Port: 60643
    Destination Port: 80
    [Stream index: 0]
    [Conversation completeness: Complete, WITH_DATA (31)]
    [TCP Segment Len: 191]
    Sequence Number: 1    (relative sequence number)
    Sequence Number (raw): 2682012318
    [Next Sequence Number: 192    (relative sequence number)]
    Acknowledgment Number: 1    (relative ack number)
    Acknowledgment number (raw): 349487777
    1000 .... = Header Length: 32 bytes (8)
  > Flags: 0x018 (PSH, ACK)
```

```
0000  00 16 b6 e3 e9 8d 10 9a  dd ac 6c 26 08 00 45 00   ········ ··l&··E·
0010  00 f3 3c d9 40 00 40 06  66 aa c0 a8 01 7a 40 ee   ··<·@·@· f····z@·
0020  93 71 ec e3 00 50 9f dc  42 9e 14 d4 c2 a1 80 18   ·q···P·· B·······
0030  ff ff 2f 5f 00 00 01 01  08 0a 0f 4c 9f c9 ef 6c   ··/_···· ···L···l
0040  ed fd 47 45 54 20 2f 73  69 67 63 6f 6d 6d 2f 32   ··GET /s igcomm/2
0050  30 31 31 2f 70 61 70 65  72 73 2f 73 69 67 63 6f   011/pape rs/sigco
0060  6d 6d 2f 70 32 2e 70 64  66 20 48 54 54 50 2f 31   mm/p2.pd f HTTP/1
0070  2e 31 0d 0a 55 73 65 72  2d 41 67 65 6e 74 3a 20   .1··User -Agent: 
0080  63 75 72 6c 2f 37 2e 32  31 2e 34 20 28 75 6e 69   curl/7.2 1.4 (uni
0090  76 65 72 73 61 6c 2d 61  70 70 6c 65 2d 64 61 72   versal-a pple-dar
00a0  77 69 6e 31 31 2e 30 29  20 6c 69 62 63 75 72 6c   win11.0)  libcurl
00b0  2f 37 2e 32 31 2e 34 20  4f 70 65 6e 53 53 4c 2f   /7.21.4  OpenSSL/
00c0  30 2e 39 2e 38 72 20 7a  6c 69 62 2f 31 2e 32 2e   0.9.8r z lib/1.2.
00d0  35 0d 0a 48 6f 73 74 3a  20 63 6f 6e 66 65 72 65   5··Host:  confere
00e0  6e 63 65 73 2e 73 69 67  63 6f 6d 6d 2e 6f 72 67   nces.sig comm.org
00f0  0d 0a 41 63 63 65 70 74  3a 20 2a 2f 2a 0d 0a 0d   ··Accept : */*···
```

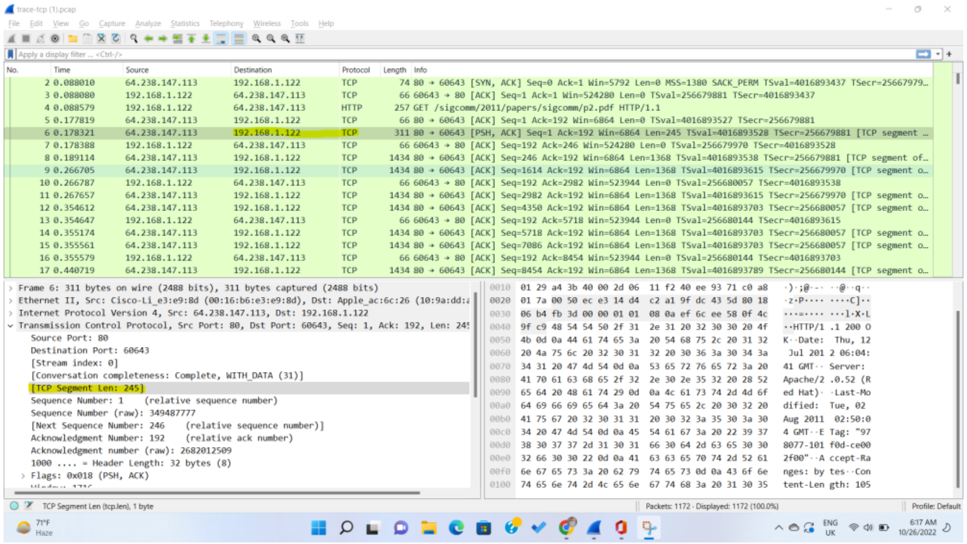
TCP Segment Len (tcp.len), 1 byte | Packets: 1172 · Displayed: 1172 (100.0%) | Profile: Default

1st TCP segment Length = 191bytes:



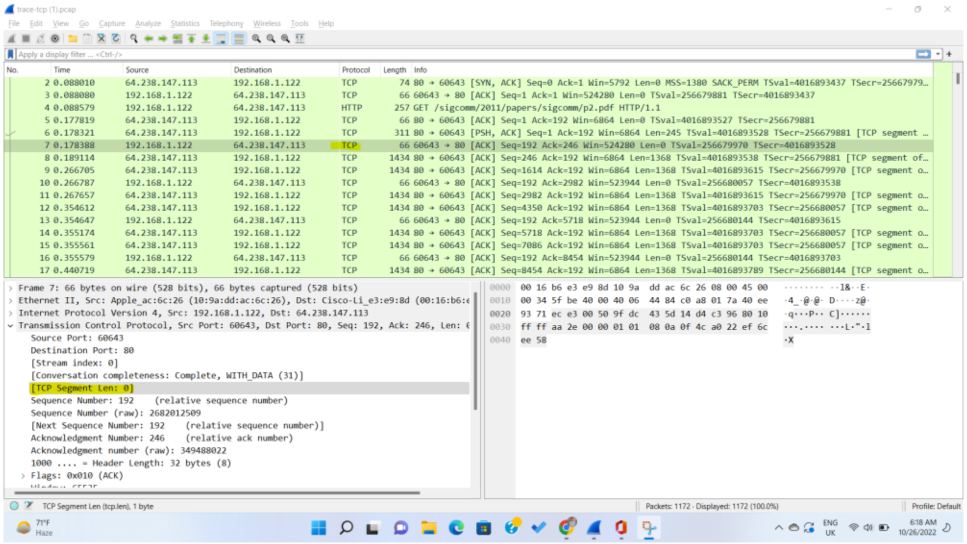
```
trace-tcp (1).pcap
Apply a display filter ... <Ctrl-/>

No.  Time      Source          Destination     Protocol Length Info
   2 0.088010  64.238.147.113  192.168.1.122   TCP        74 80 → 60643 [SYN, ACK] Seq=0 Ack=1 Win=5792 Len=0 MSS=1380 SACK_PERM TSval=4016893437 TSecr=25667979…
   3 0.088080  192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=1 Ack=1 Win=524280 Len=0 TSval=256679881 TSecr=4016893437
   4 0.088579  192.168.1.122   64.238.147.113  HTTP      257 GET /sigcomm/2011/papers/sigcomm/p2.pdf HTTP/1.1
   5 0.177819  64.238.147.113  192.168.1.122   TCP        66 80 → 60643 [ACK] Seq=1 Ack=192 Win=6864 Len=0 TSval=4016893527 TSecr=256679881
   6 0.178321  64.238.147.113  192.168.1.122   TCP       311 80 → 60643 [PSH, ACK] Seq=1 Ack=192 Win=6864 Len=245 TSval=4016893528 TSecr=256679881 [TCP segment …
   7 0.178388  192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=246 Win=524280 Len=0 TSval=256679970 TSecr=4016893528
   8 0.189114  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=246 Ack=192 Win=6864 Len=1368 TSval=4016893538 TSecr=256679881 [TCP segment of…
   9 0.266705  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=1614 Ack=192 Win=6864 Len=1368 TSval=4016893615 TSecr=256679970 [TCP segment o…
  10 0.266787  192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=2982 Win=523944 Len=0 TSval=256680057 TSecr=4016893538
  11 0.267657  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=2982 Ack=192 Win=6864 Len=1368 TSval=4016893615 TSecr=256679970 [TCP segment o…
  12 0.354612  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=4350 Ack=192 Win=6864 Len=1368 TSval=4016893703 TSecr=256680057 [TCP segment o…
  13 0.354647  192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=5718 Win=523944 Len=0 TSval=256680144 TSecr=4016893615
  14 0.355174  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=5718 Ack=192 Win=6864 Len=1368 TSval=4016893703 TSecr=256680057 [TCP segment o…
  15 0.355561  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=7086 Ack=192 Win=6864 Len=1368 TSval=4016893703 TSecr=256680057 [TCP segment o…
  16 0.355579  192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=8454 Win=523944 Len=0 TSval=256680144 TSecr=4016893703
  17 0.440719  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=8454 Ack=192 Win=6864 Len=1368 TSval=4016893789 TSecr=256680144 [TCP segment o…

> Frame 5: 66 bytes on wire (528 bits), 66 bytes captured (528 bits)
> Ethernet II, Src: Cisco-Li_e3:e9:8d (00:16:b6:e3:e9:8d), Dst: Apple_ac:6c:26 (10:9a:dd:a
> Internet Protocol Version 4, Src: 64.238.147.113, Dst: 192.168.1.122
v Transmission Control Protocol, Src Port: 80, Dst Port: 60643, Seq: 1, Ack: 192, Len: 0
    Source Port: 80
    Destination Port: 60643
    [Stream index: 0]
    [Conversation completeness: Complete, WITH_DATA (31)]
    [TCP Segment Len: 0]
    Sequence Number: 1    (relative sequence number)
    Sequence Number (raw): 349487777
    [Next Sequence Number: 1    (relative sequence number)]
    Acknowledgment Number: 192    (relative ack number)
    Acknowledgment number (raw): 2682012509
    1000 .... = Header Length: 32 bytes (8)
  > Flags: 0x010 (ACK)

0000  10 9a dd ac 6c 26 00 16  b6 e3 e9 8d 08 00 45 20   ····l&·· ······E
0010  00 34 a4 3a 40 00 2d 06  12 e8 40 ee 93 71 c0 a8   ·4·:@·-· ··@··q··
0020  01 7a 00 50 ec e3 14 d4  c2 a1 9f dc 43 5d 80 10   ·z·P···· ····C]··
0030  06 b4 a4 c9 00 00 01 01  08 0a ef 6c ee 57 0f 4c   ········ ···l·W·L
0040  9f c9                                              ··

TCP Segment Len (tcp.len), 1 byte    Packets: 1172 · Displayed: 1172 (100.0%)    Profile: Default
```

2nd Tcp Segment Length =245 bytes:



```
trace-tcp (1).pcap
Apply a display filter ... <Ctrl-/>

No.  Time      Source          Destination     Protocol Length Info
   2 0.088010  64.238.147.113  192.168.1.122   TCP        74 80 → 60643 [SYN, ACK] Seq=0 Ack=1 Win=5792 Len=0 MSS=1380 SACK_PERM TSval=4016893437 TSecr=25667979…
   3 0.088080  192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=1 Ack=1 Win=524280 Len=0 TSval=256679881 TSecr=4016893437
   4 0.088579  192.168.1.122   64.238.147.113  HTTP      257 GET /sigcomm/2011/papers/sigcomm/p2.pdf HTTP/1.1
   5 0.177819  64.238.147.113  192.168.1.122   TCP        66 80 → 60643 [ACK] Seq=1 Ack=192 Win=6864 Len=0 TSval=4016893527 TSecr=256679881
   6 0.178321  64.238.147.113  192.168.1.122   TCP       311 80 → 60643 [PSH, ACK] Seq=1 Ack=192 Win=6864 Len=245 TSval=4016893528 TSecr=256679881 [TCP segment …
   7 0.178388  192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=246 Win=524280 Len=0 TSval=256679970 TSecr=4016893528
   8 0.189114  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=246 Ack=192 Win=6864 Len=1368 TSval=4016893538 TSecr=256679881 [TCP segment of…
   9 0.266705  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=1614 Ack=192 Win=6864 Len=1368 TSval=4016893615 TSecr=256679970 [TCP segment o…
  10 0.266787  192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=2982 Win=523944 Len=0 TSval=256680057 TSecr=4016893538
  11 0.267657  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=2982 Ack=192 Win=6864 Len=1368 TSval=4016893615 TSecr=256679970 [TCP segment o…
  12 0.354612  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=4350 Ack=192 Win=6864 Len=1368 TSval=4016893703 TSecr=256680057 [TCP segment o…
  13 0.354647  192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=5718 Win=523944 Len=0 TSval=256680144 TSecr=4016893615
  14 0.355174  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=5718 Ack=192 Win=6864 Len=1368 TSval=4016893703 TSecr=256680057 [TCP segment o…
  15 0.355561  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=7086 Ack=192 Win=6864 Len=1368 TSval=4016893703 TSecr=256680057 [TCP segment o…
  16 0.355579  192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=8454 Win=523944 Len=0 TSval=256680144 TSecr=4016893703
  17 0.440719  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=8454 Ack=192 Win=6864 Len=1368 TSval=4016893789 TSecr=256680144 [TCP segment o…

> Frame 6: 311 bytes on wire (2488 bits), 311 bytes captured (2488 bits)
> Ethernet II, Src: Cisco-Li_e3:e9:8d (00:16:b6:e3:e9:8d), Dst: Apple_ac:6c:26 (10:9a:dd:a
> Internet Protocol Version 4, Src: 64.238.147.113, Dst: 192.168.1.122
v Transmission Control Protocol, Src Port: 80, Dst Port: 60643, Seq: 1, Ack: 192, Len: 245
    Source Port: 80
    Destination Port: 60643
    [Stream index: 0]
    [Conversation completeness: Complete, WITH_DATA (31)]
    [TCP Segment Len: 245]
    Sequence Number: 1    (relative sequence number)
    Sequence Number (raw): 349487777
    [Next Sequence Number: 246    (relative sequence number)]
    Acknowledgment Number: 192    (relative ack number)
    Acknowledgment number (raw): 2682012509
    1000 .... = Header Length: 32 bytes (8)
  > Flags: 0x018 (PSH, ACK)

0010  01 29 a4 3b 40 00 2d 06  11 f2 40 ee 93 71 c0 a8   ·)·;@·-· ··@··q··
0020  01 7a 00 50 ec e3 14 d4  c2 a1 9f dc 43 5d 80 18   ·z·P···· ····C]··
0030  06 b4 fb 3d 00 00 01 01  08 0a ef 6c ee 58 0f 4c   ···=···· ···l·X·L
0040  9f c9 48 54 54 50 2f 31  2e 31 20 32 30 30 20 4f   ··HTTP/1 .1 200 O
0050  4b 0d 0a 44 61 74 65 3a  20 54 68 75 2c 20 31 32   K··Date:  Thu, 12
0060  20 4a 75 6c 20 32 30 31  32 20 30 36 3a 30 34 3a    Jul 201 2 06:04:
0070  34 31 20 47 4d 54 0d 0a  53 65 72 76 65 72 3a 20   41 GMT·· Server:
0080  41 70 61 63 68 65 2f 32  2e 30 2e 35 32 20 28 52   Apache/2 .0.52 (R
0090  65 64 20 48 61 74 29 0d  0a 4c 61 73 74 2d 4d 6f   ed Hat)· ·Last-Mo
00a0  64 69 66 69 65 64 3a 20  54 75 65 2c 20 30 32 20   dified:  Tue, 02
00b0  41 75 67 20 32 30 31 31  20 30 32 3a 35 30 3a 30   Aug 2011  02:50:0
00c0  34 20 47 4d 54 0d 0a 45  54 61 67 3a 20 22 39 37   4 GMT··E Tag: "97
00d0  38 30 37 37 2d 31 30 31  66 30 64 2d 63 65 30 30   8077-101 f0d-ce00
00e0  32 66 30 30 22 0d 0a 41  63 63 65 70 74 2d 52 61   2f00"··A ccept-Ra
00f0  6e 67 65 73 3a 20 62 79  74 65 73 0d 0a 43 6f 6e   nges: by tes··Con
0100  74 65 6e 74 2d 4c 65 6e  67 74 68 3a 20 31 30 35   tent-Len gth: 105

TCP Segment Len (tcp.len), 1 byte    Packets: 1172 · Displayed: 1172 (100.0%)    Profile: Default
```

3rd TCP Segment Length = 0 bytes:



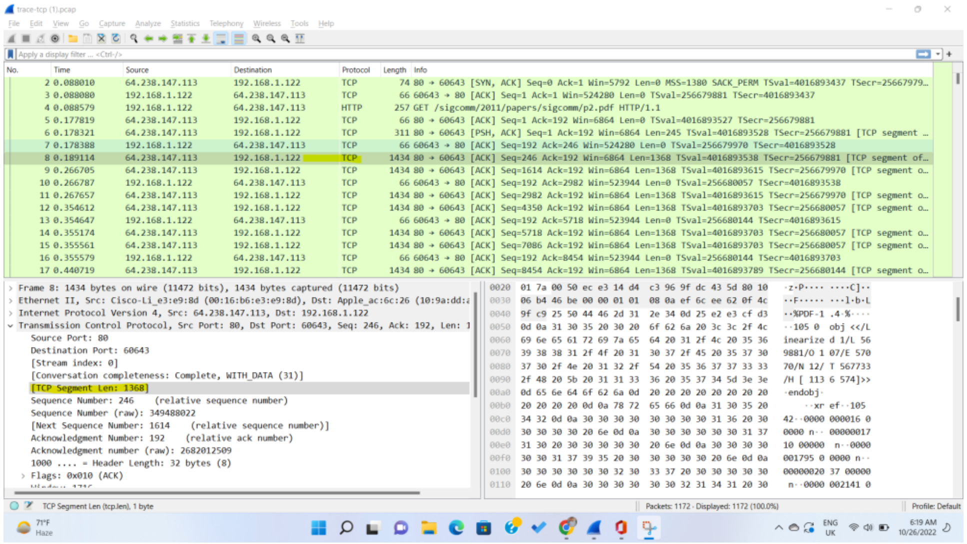
```
No.  Time       Source          Destination     Protocol Length Info
   2 0.088010   64.238.147.113  192.168.1.122   TCP        74 80 → 60643 [SYN, ACK] Seq=0 Ack=1 Win=5792 Len=0 MSS=1380 SACK_PERM TSval=4016893437 TSecr=25667979…
   3 0.088080   192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=1 Ack=1 Win=524280 Len=0 TSval=256679881 TSecr=4016893437
   4 0.088579   192.168.1.122   64.238.147.113  HTTP      257 GET /sigcomm/2011/papers/sigcomm/p2.pdf HTTP/1.1
   5 0.177819   64.238.147.113  192.168.1.122   TCP        66 80 → 60643 [ACK] Seq=1 Ack=192 Win=6864 Len=0 TSval=4016893527 TSecr=256679881
   6 0.178321   64.238.147.113  192.168.1.122   TCP       311 80 → 60643 [PSH, ACK] Seq=1 Ack=192 Win=6864 Len=245 TSval=4016893528 TSecr=256679881 [TCP segment …
   7 0.178388   192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=246 Win=524280 Len=0 TSval=256679970 TSecr=4016893528
   8 0.189114   64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=246 Ack=192 Win=6864 Len=1368 TSval=4016893538 TSecr=256679881 [TCP segment of…
   9 0.266705   64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=1614 Ack=192 Win=6864 Len=1368 TSval=4016893615 TSecr=256679970 [TCP segment o…
  10 0.266787   192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=2982 Win=523944 Len=0 TSval=256680057 TSecr=4016893538
  11 0.267657   64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=2982 Ack=192 Win=6864 Len=1368 TSval=4016893615 TSecr=256679970 [TCP segment o…
  12 0.354612   64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=4350 Ack=192 Win=6864 Len=1368 TSval=4016893703 TSecr=256680057 [TCP segment o…
  13 0.354647   192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=5718 Win=523944 Len=0 TSval=256680144 TSecr=4016893615
  14 0.355174   64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=5718 Ack=192 Win=6864 Len=1368 TSval=4016893703 TSecr=256680057 [TCP segment o…
  15 0.355561   64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=7086 Ack=192 Win=6864 Len=1368 TSval=4016893703 TSecr=256680057 [TCP segment o…
  16 0.355579   192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=8454 Win=523944 Len=0 TSval=256680144 TSecr=4016893703
  17 0.440719   64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=8454 Ack=192 Win=6864 Len=1368 TSval=4016893789 TSecr=256680144 [TCP segment o…
```

```
> Frame 7: 66 bytes on wire (528 bits), 66 bytes captured (528 bits)
> Ethernet II, Src: Apple_ac:6c:26 (10:9a:dd:ac:6c:26), Dst: Cisco-Li_e3:e9:8d (00:16:b6:e
> Internet Protocol Version 4, Src: 192.168.1.122, Dst: 64.238.147.113
v Transmission Control Protocol, Src Port: 60643, Dst Port: 80, Seq: 192, Ack: 246, Len: 0
    Source Port: 60643
    Destination Port: 80
    [Stream index: 0]
    [Conversation completeness: Complete, WITH_DATA (31)]
    [TCP Segment Len: 0]
    Sequence Number: 192    (relative sequence number)
    Sequence Number (raw): 2682012509
    [Next Sequence Number: 192    (relative sequence number)]
    Acknowledgment Number: 246    (relative ack number)
    Acknowledgment number (raw): 349488022
    1000 .... = Header Length: 32 bytes (8)
  > Flags: 0x010 (ACK)
```

```
0000  00 16 b6 e3 e9 8d 10 9a  dd ac 6c 26 08 00 45 00   ········ ··l&··E·
0010  00 34 5f be 40 00 40 06  44 84 c0 a8 01 7a 40 ee   ·4_·@·@· D····z@·
0020  93 71 ec e3 00 50 9f dc  43 5d 14 d4 c3 96 80 10   ·q···P·· C]······
0030  ff ff aa 2e 00 00 01 01  08 0a 0f 4c a0 22 ef 6c   ···.···· ···L·"·l
0040  ee 58                                              ·X
```

TCP Segment Len (tcp.len), 1 byte | Packets: 1172 · Displayed: 1172 (100.0%) | Profile: Default

4th TCP Segment Length = 1368 bytes:



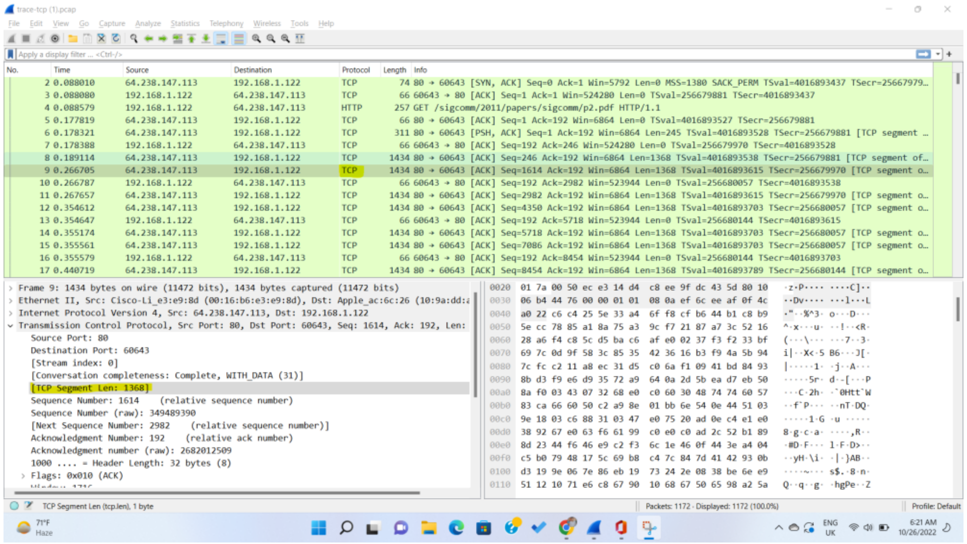
```
No.  Time       Source          Destination     Protocol Length Info
   2 0.088010   64.238.147.113  192.168.1.122   TCP        74 80 → 60643 [SYN, ACK] Seq=0 Ack=1 Win=5792 Len=0 MSS=1380 SACK_PERM TSval=4016893437 TSecr=25667979…
   3 0.088080   192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=1 Ack=1 Win=524280 Len=0 TSval=256679881 TSecr=4016893437
   4 0.088579   192.168.1.122   64.238.147.113  HTTP      257 GET /sigcomm/2011/papers/sigcomm/p2.pdf HTTP/1.1
   5 0.177819   64.238.147.113  192.168.1.122   TCP        66 80 → 60643 [ACK] Seq=1 Ack=192 Win=6864 Len=0 TSval=4016893527 TSecr=256679881
   6 0.178321   64.238.147.113  192.168.1.122   TCP       311 80 → 60643 [PSH, ACK] Seq=1 Ack=192 Win=6864 Len=245 TSval=4016893528 TSecr=256679881 [TCP segment …
   7 0.178388   192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=246 Win=524280 Len=0 TSval=256679970 TSecr=4016893528
   8 0.189114   64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=246 Ack=192 Win=6864 Len=1368 TSval=4016893538 TSecr=256679881 [TCP segment of…
   9 0.266705   64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=1614 Ack=192 Win=6864 Len=1368 TSval=4016893615 TSecr=256679970 [TCP segment o…
  10 0.266787   192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=2982 Win=523944 Len=0 TSval=256680057 TSecr=4016893538
  11 0.267657   64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=2982 Ack=192 Win=6864 Len=1368 TSval=4016893615 TSecr=256679970 [TCP segment o…
  12 0.354612   64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=4350 Ack=192 Win=6864 Len=1368 TSval=4016893703 TSecr=256680057 [TCP segment o…
  13 0.354647   192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=5718 Win=523944 Len=0 TSval=256680144 TSecr=4016893615
  14 0.355174   64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=5718 Ack=192 Win=6864 Len=1368 TSval=4016893703 TSecr=256680057 [TCP segment o…
  15 0.355561   64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=7086 Ack=192 Win=6864 Len=1368 TSval=4016893703 TSecr=256680057 [TCP segment o…
  16 0.355579   192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=8454 Win=523944 Len=0 TSval=256680144 TSecr=4016893703
  17 0.440719   64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=8454 Ack=192 Win=6864 Len=1368 TSval=4016893789 TSecr=256680144 [TCP segment o…
```

```
> Frame 8: 1434 bytes on wire (11472 bits), 1434 bytes captured (11472 bits)
> Ethernet II, Src: Cisco-Li_e3:e9:8d (00:16:b6:e3:e9:8d), Dst: Apple_ac:6c:26 (10:9a:dd:a
> Internet Protocol Version 4, Src: 64.238.147.113, Dst: 192.168.1.122
v Transmission Control Protocol, Src Port: 80, Dst Port: 60643, Seq: 246, Ack: 192, Len: 1
    Source Port: 80
    Destination Port: 60643
    [Stream index: 0]
    [Conversation completeness: Complete, WITH_DATA (31)]
    [TCP Segment Len: 1368]
    Sequence Number: 246    (relative sequence number)
    Sequence Number (raw): 349488022
    [Next Sequence Number: 1614    (relative sequence number)]
    Acknowledgment Number: 192    (relative ack number)
    Acknowledgment number (raw): 2682012509
    1000 .... = Header Length: 32 bytes (8)
  > Flags: 0x010 (ACK)
```

```
0020  01 7a 00 50 ec e3 14 d4  c3 96 9f dc 43 5d 80 10   ·z·P···· ····C]··
0030  06 b4 46 be 00 00 01 01  08 0a ef 6c ee 62 0f 4c   ··F····· ···l·b·L
0040  9f c9 25 50 44 46 2d 31  2e 34 0d 25 e2 e3 cf d3   ··%PDF-1 .4·%····
0050  0d 0a 31 30 35 20 30 20  6f 62 6a 20 3c 3c 2f 4c   ··105 0  obj <</L
0060  69 6e 65 61 72 69 7a 65  64 20 31 2f 4c 20 35 36   inearize d 1/L 56
0070  39 38 38 31 2f 4f 20 31  30 37 2f 45 20 35 37 30   9881/O 1 07/E 570
0080  37 30 2f 4e 20 31 32 2f  54 20 35 36 37 37 33 33   70/N 12/ T 567733
0090  2f 48 20 5b 20 31 31 33  36 20 35 37 34 5d 3e 3e   /H [ 113 6 574]>>
00a0  0d 65 6e 64 6f 62 6a 0d  20 20 20 20 20 20 20 20   ·endobj·
00b0  20 20 20 20 0d 0a 78 72  65 66 0d 0a 31 30 35 20       ··xr ef··105
00c0  34 32 0d 0a 30 30 30 30  30 30 30 30 31 36 20 30   42··0000 000016 0
00d0  30 30 30 30 20 6e 0d 0a  30 30 30 30 30 30 31 37   0000 n·· 00000017
00e0  31 30 20 30 30 30 30 30  20 6e 0d 0a 30 30 30 30   10 00000  n··0000
00f0  30 30 31 37 39 35 20 30  30 30 30 30 20 6e 0d 0a   001795 0 0000 n··
0100  30 30 30 30 30 30 32 30  33 37 20 30 30 30 30 30   00000020 37 00000
0110  20 6e 0d 0a 30 30 30 30  30 30 32 31 34 31 20 30    n··0000 002141 0
```

TCP Segment Len (tcp.len), 1 byte | Packets: 1172 · Displayed: 1172 (100.0%) | Profile: Default

5th TCP Segment Length = 1368 bytes:


trace-tcp (1).pcap
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
Apply a display filter ... <Ctrl-/>
71°F
Haze
ENG
UK
6:21 AM
10/26/2022

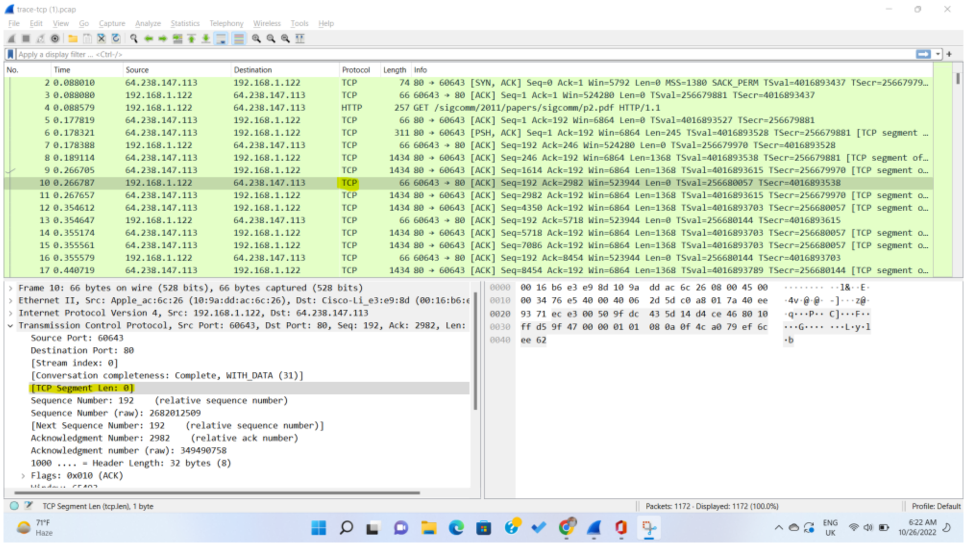
```
No.  Time       Source          Destination     Protocol Length Info
  2 0.088010   64.238.147.113  192.168.1.122   TCP        74 80 → 60643 [SYN, ACK] Seq=0 Ack=1 Win=5792 Len=0 MSS=1380 SACK_PERM TSval=4016893437 TSecr=25667979…
  3 0.088080   192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=1 Ack=1 Win=524280 Len=0 TSval=256679881 TSecr=4016893437
  4 0.088579   192.168.1.122   64.238.147.113  HTTP      257 GET /sigcomm/2011/papers/sigcomm/p2.pdf HTTP/1.1
  5 0.177819   64.238.147.113  192.168.1.122   TCP        66 80 → 60643 [ACK] Seq=1 Ack=192 Win=6864 Len=0 TSval=4016893527 TSecr=256679881
  6 0.178321   64.238.147.113  192.168.1.122   TCP       311 80 → 60643 [PSH, ACK] Seq=1 Ack=192 Win=6864 Len=245 TSval=4016893528 TSecr=256679881 [TCP segment …
  7 0.178388   192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=246 Win=524280 Len=0 TSval=256679970 TSecr=4016893528
  8 0.189114   64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=246 Ack=192 Win=6864 Len=1368 TSval=4016893538 TSecr=256679881 [TCP segment of…
  9 0.266705   64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=1614 Ack=192 Win=6864 Len=1368 TSval=4016893615 TSecr=256679970 [TCP segment o…
 10 0.266787   192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=2982 Win=523944 Len=0 TSval=256680057 TSecr=4016893538
 11 0.267657   64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=2982 Ack=192 Win=6864 Len=1368 TSval=4016893615 TSecr=256679970 [TCP segment o…
 12 0.354612   64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=4350 Ack=192 Win=6864 Len=1368 TSval=4016893703 TSecr=256680057 [TCP segment o…
 13 0.354647   192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=5718 Win=523944 Len=0 TSval=256680144 TSecr=4016893615
 14 0.355174   64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=5718 Ack=192 Win=6864 Len=1368 TSval=4016893703 TSecr=256680057 [TCP segment o…
 15 0.355561   64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=7086 Ack=192 Win=6864 Len=1368 TSval=4016893703 TSecr=256680057 [TCP segment o…
 16 0.355579   192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=8454 Win=523944 Len=0 TSval=256680144 TSecr=4016893703
 17 0.440719   64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=8454 Ack=192 Win=6864 Len=1368 TSval=4016893789 TSecr=256680144 [TCP segment o…
```

```
> Frame 9: 1434 bytes on wire (11472 bits), 1434 bytes captured (11472 bits)
> Ethernet II, Src: Cisco-Li_e3:e9:8d (00:16:b6:e3:e9:8d), Dst: Apple_ac:6c:26 (10:9a:dd:a
> Internet Protocol Version 4, Src: 64.238.147.113, Dst: 192.168.1.122
v Transmission Control Protocol, Src Port: 80, Dst Port: 60643, Seq: 1614, Ack: 192, Len:
    Source Port: 80
    Destination Port: 60643
    [Stream index: 0]
    [Conversation completeness: Complete, WITH_DATA (31)]
    [TCP Segment Len: 1368]
    Sequence Number: 1614    (relative sequence number)
    Sequence Number (raw): 349489390
    [Next Sequence Number: 2982    (relative sequence number)]
    Acknowledgment Number: 192    (relative ack number)
    Acknowledgment number (raw): 2682012509
    1000 .... = Header Length: 32 bytes (8)
  > Flags: 0x010 (ACK)
```

```
0020  01 7a 00 50 ec e3 14 d4  c8 ee 9f dc 43 5d 80 10   ·z·P···· ····C]··
0030  06 b4 44 76 00 00 01 01  08 0a ef 6c ee af 0f 4c   ··Dv···· ···l···L
0040  a0 22 c6 c4 25 5e 33 a4  6f f8 cf b6 44 b1 c8 b9   ·"··%^3· o···D···
0050  5e cc 78 85 a1 8a 75 a3  9c f7 21 87 a7 3c 52 16   ^·x···u· ··!··<R·
0060  28 a6 f4 c8 5c d5 ba c6  af e0 02 37 f3 f2 33 bf   (···\··· ···7··3·
0070  69 7c 0d 9f 58 3c 85 35  42 36 16 b3 f9 4a 5b 94   i|··X<·5 B6···J[·
0080  7c fc c2 11 a8 ec 31 d5  c0 6a f1 09 41 bd 84 93   |·····1· ·j··A···
0090  8b d3 f9 e6 d9 35 72 a9  64 0a 2d 5b ea d7 eb 50   ·····5r· d·-[···P
00a0  8a f0 03 43 07 32 68 e0  c0 60 30 48 74 74 60 57   ···C·2h· ·`0Htt`W
00b0  83 ca 66 60 50 c2 a9 8e  01 bb 6e 54 0e 44 51 03   ··f`P··· ··nT·DQ·
00c0  9e 18 03 c6 88 31 03 47  e0 75 20 ad 0e c4 e1 e0   ·····1·G ·u ·····
00d0  38 92 67 e0 63 f6 61 99  c0 e0 c0 ad 2c 52 b1 89   8·g·c·a· ····,R··
00e0  8d 23 44 f6 46 e9 c2 f3  6c 1e 46 0f 44 3e a4 04   ·#D·F··· l·F·D>··
00f0  c5 b0 79 48 17 5c 69 b8  c4 7c 84 7d 41 42 93 0b   ··yH·\i· ·|·}AB··
0100  d3 19 9e 06 7e 86 eb 19  73 24 2e 08 38 be 6e e9   ····~··· s$.·8·n·
0110  51 12 10 71 e6 c8 67 90  10 68 67 50 65 98 a2 5a   Q··q··g· ·hgPe··Z
```

TCP Segment Len (tcp.len), 1 byte   Packets: 1172 · Displayed: 1172 (100.0%)   Profile: Default

6th TCP Segment Length = 0 bytes:


trace-tcp (1).pcap
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
Apply a display filter ... <Ctrl-/>
71°F
Haze
ENG
UK
6:22 AM
10/26/2022

```
No.  Time       Source          Destination     Protocol Length Info
  2 0.088010   64.238.147.113  192.168.1.122   TCP        74 80 → 60643 [SYN, ACK] Seq=0 Ack=1 Win=5792 Len=0 MSS=1380 SACK_PERM TSval=4016893437 TSecr=25667979…
  3 0.088080   192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=1 Ack=1 Win=524280 Len=0 TSval=256679881 TSecr=4016893437
  4 0.088579   192.168.1.122   64.238.147.113  HTTP      257 GET /sigcomm/2011/papers/sigcomm/p2.pdf HTTP/1.1
  5 0.177819   64.238.147.113  192.168.1.122   TCP        66 80 → 60643 [ACK] Seq=1 Ack=192 Win=6864 Len=0 TSval=4016893527 TSecr=256679881
  6 0.178321   64.238.147.113  192.168.1.122   TCP       311 80 → 60643 [PSH, ACK] Seq=1 Ack=192 Win=6864 Len=245 TSval=4016893528 TSecr=256679881 [TCP segment …
  7 0.178388   192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=246 Win=524280 Len=0 TSval=256679970 TSecr=4016893528
  8 0.189114   64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=246 Ack=192 Win=6864 Len=1368 TSval=4016893538 TSecr=256679881 [TCP segment of…
  9 0.266705   64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=1614 Ack=192 Win=6864 Len=1368 TSval=4016893615 TSecr=256679970 [TCP segment o…
 10 0.266787   192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=2982 Win=523944 Len=0 TSval=256680057 TSecr=4016893538
 11 0.267657   64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=2982 Ack=192 Win=6864 Len=1368 TSval=4016893615 TSecr=256679970 [TCP segment o…
 12 0.354612   64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=4350 Ack=192 Win=6864 Len=1368 TSval=4016893703 TSecr=256680057 [TCP segment o…
 13 0.354647   192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=5718 Win=523944 Len=0 TSval=256680144 TSecr=4016893615
 14 0.355174   64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=5718 Ack=192 Win=6864 Len=1368 TSval=4016893703 TSecr=256680057 [TCP segment o…
 15 0.355561   64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=7086 Ack=192 Win=6864 Len=1368 TSval=4016893703 TSecr=256680057 [TCP segment o…
 16 0.355579   192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=8454 Win=523944 Len=0 TSval=256680144 TSecr=4016893703
 17 0.440719   64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=8454 Ack=192 Win=6864 Len=1368 TSval=4016893789 TSecr=256680144 [TCP segment o…
```

```
> Frame 10: 66 bytes on wire (528 bits), 66 bytes captured (528 bits)
> Ethernet II, Src: Apple_ac:6c:26 (10:9a:dd:ac:6c:26), Dst: Cisco-Li_e3:e9:8d (00:16:b6:e
> Internet Protocol Version 4, Src: 192.168.1.122, Dst: 64.238.147.113
v Transmission Control Protocol, Src Port: 60643, Dst Port: 80, Seq: 192, Ack: 2982, Len:
    Source Port: 60643
    Destination Port: 80
    [Stream index: 0]
    [Conversation completeness: Complete, WITH_DATA (31)]
    [TCP Segment Len: 0]
    Sequence Number: 192    (relative sequence number)
    Sequence Number (raw): 2682012509
    [Next Sequence Number: 192    (relative sequence number)]
    Acknowledgment Number: 2982    (relative ack number)
    Acknowledgment number (raw): 349490758
    1000 .... = Header Length: 32 bytes (8)
  > Flags: 0x010 (ACK)
```

```
0000  00 16 b6 e3 e9 8d 10 9a  dd ac 6c 26 08 00 45 00   ········ ··l&··E·
0010  00 34 76 e5 40 00 40 06  2d 5d c0 a8 01 7a 40 ee   ·4v·@·@· -]···z@·
0020  93 71 ec e3 00 50 9f dc  43 5d 14 d4 ce 46 80 10   ·q···P·· C]···F··
0030  ff d5 9f 47 00 00 01 01  08 0a 0f 4c a0 79 ef 6c   ···G···· ···L·y·l
0040  ee 62                                              ·b
```

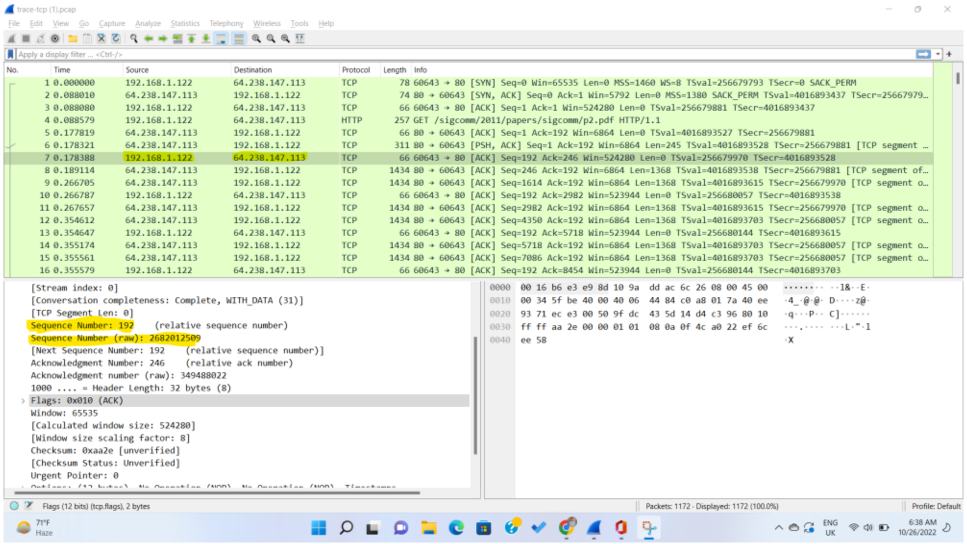
TCP Segment Len (tcp.len), 1 byte   Packets: 1172 · Displayed: 1172 (100.0%)   Profile: Default

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

Ans: Yes, there are retransmitted segments in the trace file.

How to check:

- Segment 7 has the sequence number = **192** (relative sequence number) and it has raw sequence number = **2682012509** source and destination are also same. ACK is also 1.



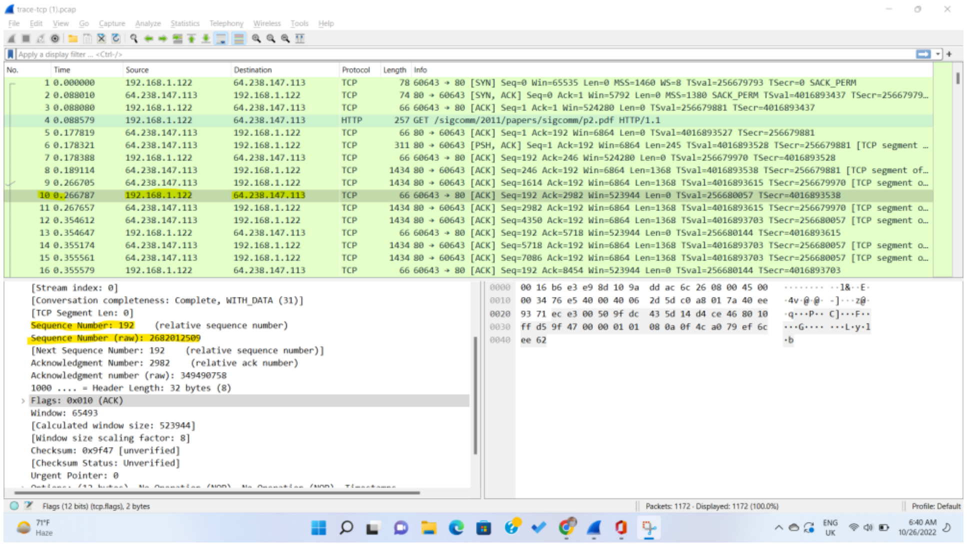
```
No.  Time      Source          Destination     Protocol Length Info
   1 0.000000  192.168.1.122   64.238.147.113  TCP        78 60643 → 80 [SYN] Seq=0 Win=65535 Len=0 MSS=1460 WS=8 TSval=256679793 TSecr=0 SACK_PERM
   2 0.088010  64.238.147.113  192.168.1.122   TCP        74 80 → 60643 [SYN, ACK] Seq=0 Ack=1 Win=5792 Len=0 MSS=1380 SACK_PERM TSval=4016893437 TSecr=25667979…
   3 0.088080  192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=1 Ack=1 Win=524280 Len=0 TSval=256679881 TSecr=4016893437
   4 0.088579  192.168.1.122   64.238.147.113  HTTP      257 GET /sigcomm/2011/papers/sigcomm/p2.pdf HTTP/1.1
   5 0.177819  64.238.147.113  192.168.1.122   TCP        66 80 → 60643 [ACK] Seq=1 Ack=192 Win=6864 Len=0 TSval=4016893527 TSecr=256679881
   6 0.178321  64.238.147.113  192.168.1.122   TCP       311 80 → 60643 [PSH, ACK] Seq=1 Ack=192 Win=6864 Len=245 TSval=4016893528 TSecr=256679881 [TCP segment …
   7 0.178388  192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=246 Win=524280 Len=0 TSval=256679970 TSecr=4016893528
   8 0.189114  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=246 Ack=192 Win=6864 Len=1368 TSval=4016893538 TSecr=256679881 [TCP segment of…
   9 0.266705  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=1614 Ack=192 Win=6864 Len=1368 TSval=4016893615 TSecr=256679970 [TCP segment o…
  10 0.266787  192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=2982 Win=523944 Len=0 TSval=256680057 TSecr=4016893538
  11 0.267657  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=2982 Ack=192 Win=6864 Len=1368 TSval=4016893615 TSecr=256679970 [TCP segment o…
  12 0.354612  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=4350 Ack=192 Win=6864 Len=1368 TSval=4016893703 TSecr=256680057 [TCP segment o…
  13 0.354647  192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=5718 Win=523944 Len=0 TSval=256680144 TSecr=4016893615
  14 0.355174  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=5718 Ack=192 Win=6864 Len=1368 TSval=4016893703 TSecr=256680057 [TCP segment o…
  15 0.355561  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=7086 Ack=192 Win=6864 Len=1368 TSval=4016893703 TSecr=256680057 [TCP segment o…
  16 0.355579  192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=8454 Win=523944 Len=0 TSval=256680144 TSecr=4016893703
```

```
[Stream index: 0]
[Conversation completeness: Complete, WITH_DATA (31)]
[TCP Segment Len: 0]
Sequence Number: 192    (relative sequence number)
Sequence Number (raw): 2682012509
[Next Sequence Number: 192    (relative sequence number)]
Acknowledgment Number: 246    (relative ack number)
Acknowledgment number (raw): 349488022
1000 .... = Header Length: 32 bytes (8)
Flags: 0x010 (ACK)
Window: 65535
[Calculated window size: 524280]
[Window size scaling factor: 8]
Checksum: 0xaa2e [unverified]
[Checksum Status: Unverified]
Urgent Pointer: 0
```

```
0000  00 16 b6 e3 e9 8d 10 9a  dd ac 6c 26 08 00 45 00   ········ ··l&··E·
0010  00 34 5f be 40 00 40 06  44 84 c0 a8 01 7a 40 ee   ·4_·@·@· D····z@·
0020  93 71 ec e3 00 50 9f dc  43 5d 14 d4 c3 96 80 10   ·q···P·· C]······
0030  ff ff aa 2e 00 00 01 01  08 0a 0f 4c a0 22 ef 6c   ···.···· ···L·"·l
0040  ee 58                                              ·X
```

Flags (12 bits) (tcp.flags), 2 bytes | Packets: 1172 · Displayed: 1172 (100.0%) | Profile: Default

- Segment 10 has the sequence number = **192** (relative sequence number) and it has raw sequence number = **2682012509** source and destination are also same. ACK is also 1.



```
No.  Time      Source          Destination     Protocol Length Info
   1 0.000000  192.168.1.122   64.238.147.113  TCP        78 60643 → 80 [SYN] Seq=0 Win=65535 Len=0 MSS=1460 WS=8 TSval=256679793 TSecr=0 SACK_PERM
   2 0.088010  64.238.147.113  192.168.1.122   TCP        74 80 → 60643 [SYN, ACK] Seq=0 Ack=1 Win=5792 Len=0 MSS=1380 SACK_PERM TSval=4016893437 TSecr=25667979…
   3 0.088080  192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=1 Ack=1 Win=524280 Len=0 TSval=256679881 TSecr=4016893437
   4 0.088579  192.168.1.122   64.238.147.113  HTTP      257 GET /sigcomm/2011/papers/sigcomm/p2.pdf HTTP/1.1
   5 0.177819  64.238.147.113  192.168.1.122   TCP        66 80 → 60643 [ACK] Seq=1 Ack=192 Win=6864 Len=0 TSval=4016893527 TSecr=256679881
   6 0.178321  64.238.147.113  192.168.1.122   TCP       311 80 → 60643 [PSH, ACK] Seq=1 Ack=192 Win=6864 Len=245 TSval=4016893528 TSecr=256679881 [TCP segment …
   7 0.178388  192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=246 Win=524280 Len=0 TSval=256679970 TSecr=4016893528
   8 0.189114  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=246 Ack=192 Win=6864 Len=1368 TSval=4016893538 TSecr=256679881 [TCP segment of…
   9 0.266705  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=1614 Ack=192 Win=6864 Len=1368 TSval=4016893615 TSecr=256679970 [TCP segment o…
  10 0.266787  192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=2982 Win=523944 Len=0 TSval=256680057 TSecr=4016893538
  11 0.267657  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=2982 Ack=192 Win=6864 Len=1368 TSval=4016893615 TSecr=256679970 [TCP segment o…
  12 0.354612  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=4350 Ack=192 Win=6864 Len=1368 TSval=4016893703 TSecr=256680057 [TCP segment o…
  13 0.354647  192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=5718 Win=523944 Len=0 TSval=256680144 TSecr=4016893615
  14 0.355174  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=5718 Ack=192 Win=6864 Len=1368 TSval=4016893703 TSecr=256680057 [TCP segment o…
  15 0.355561  64.238.147.113  192.168.1.122   TCP      1434 80 → 60643 [ACK] Seq=7086 Ack=192 Win=6864 Len=1368 TSval=4016893703 TSecr=256680057 [TCP segment o…
  16 0.355579  192.168.1.122   64.238.147.113  TCP        66 60643 → 80 [ACK] Seq=192 Ack=8454 Win=523944 Len=0 TSval=256680144 TSecr=4016893703
```

```
[Stream index: 0]
[Conversation completeness: Complete, WITH_DATA (31)]
[TCP Segment Len: 0]
Sequence Number: 192    (relative sequence number)
Sequence Number (raw): 2682012509
[Next Sequence Number: 192    (relative sequence number)]
Acknowledgment Number: 2982    (relative ack number)
Acknowledgment number (raw): 349490758
1000 .... = Header Length: 32 bytes (8)
Flags: 0x010 (ACK)
Window: 65493
[Calculated window size: 523944]
[Window size scaling factor: 8]
Checksum: 0x9f47 [unverified]
[Checksum Status: Unverified]
Urgent Pointer: 0
```

```
0000  00 16 b6 e3 e9 8d 10 9a  dd ac 6c 26 08 00 45 00   ········ ··l&··E·
0010  00 34 76 e5 40 00 40 06  2d 5d c0 a8 01 7a 40 ee   ·4v·@·@· -]···z@·
0020  93 71 ec e3 00 50 9f dc  43 5d 14 d4 ce 46 80 10   ·q···P·· C]···F··
0030  ff d5 9f 47 00 00 01 01  08 0a 0f 4c a0 79 ef 6c   ···G···· ···L·y·l
0040  ee 62                                              ·b
```

Flags (12 bits) (tcp.flags), 2 bytes | Packets: 1172 · Displayed: 1172 (100.0%) | Profile: Default

Again, the packet is retransmitted due to these reasons.

.