

5 0.041737 ① 192.168.1.102 ③ 128.119.245.12 TCP 1514 [TCP segment of a reassembled PDU]
Frame 5: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits)
Ethernet II, Src: Actionte_8a:70:1a (00:20:e0:8a:70:1a), Dst: LinksysG_da:af:73 (00:06:25:da:af:73)
Internet Protocol Version 4, Src: 192.168.1.102, Dst: 128.119.245.12
Transmission Control Protocol, Src Port: ② 1161 (1161), Dst Port: ④ 80 (80), Seq: 566, Ack: 1, Len: 1460

- ① address of client
- ② port of client
- ③ address of server
- ④ port of server

Questions 1. and 2.

```
1 0.000000 192.168.1.102 128.119.245.12 TCP 62 1161 → 80 [SYN] Seq=0
Win=16384 Len=0 MSS=1460 SACK_PERM=1
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: LinksysG_da:af:73 (00:06:25:da:af:73)
Internet Protocol Version 4, Src: 192.168.1.102, Dst: 128.119.245.12
Transmission Control Protocol, Src Port: 1161 (1161), Dst Port: 80 (80), Seq: 0, Len: 0
  Source Port: 1161
  Destination Port: 80
  [Stream index: 0]
  [TCP Segment Len: 0]
  Sequence number: 0 (relative sequence number) ①
  Acknowledgment number: 0
  Header Length: 28 bytes
  Flags: 0x002 (SYN) ②
  Window size value: 16384
  [Calculated window size: 16384]
  Checksum: 0xf6e9 [validation disabled]
  Urgent pointer: 0
  Options: (8 bytes), Maximum segment size, No-Operation (NOP), No-Operation (NOP), SACK permitted
2 0.023172 128.119.245.12 192.168.1.102 TCP 62 80 → 1161 [SYN, ACK]
Seq=0 Ack=1 Win=5840 Len=0 MSS=1460 SACK_PERM=1
Frame 2: 62 bytes on wire (496 bits), 62 bytes captured (496 bits)
Ethernet II, Src: LinksysG_da:af:73 (00:06:25:da:af:73), Dst: Actionte_8a:70:1a (00:20:e0:8a:70:1a)
Internet Protocol Version 4, Src: 128.119.245.12, Dst: 192.168.1.102
Transmission Control Protocol, Src Port: 80 (80), Dst Port: 1161 (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) ③
  Acknowledgment number: 1 (relative ack number) ④
  Header Length: 28 bytes
  Flags: 0x012 (SYN, ACK) ⑤
  Window size value: 5840
  [Calculated window size: 5840]
  Checksum: 0x774d [validation disabled]
  Urgent pointer: 0
  Options: (8 bytes), Maximum segment size, No-Operation (NOP), No-Operation (NOP), SACK permitted
  [SEQ/ACK analysis]
    [This is an ACK to the segment in frame: 1]
    [The RTT to ACK the segment was: 0.023172000 seconds]
    [iRTT: 0.023265000 seconds]
```

Question 4, - ① and ②

Question 5, - ③ and ④ and ⑤. gaia.cs.umass.edu
determined that value by looking at the number of
bytes passed in the last segment

```
4 0.026477      192.168.1.102      128.119.245.12      TCP      619      [TCP segment of a
reassembled PDU]
Frame 4: 619 bytes on wire (4952 bits), 619 bytes captured (4952 bits)
Ethernet II, Src: Actionte_8a:70:1a (00:20:e0:8a:70:1a), Dst: LinksysG_da:af:73 (00:06:25:da:af:73)
Internet Protocol Version 4, Src: 192.168.1.102, Dst: 128.119.245.12
Transmission Control Protocol, Src Port: 1161 (1161), Dst Port: 80 (80), Seq: 1, Ack: 1, Len: 565
  Source Port: 1161
  Destination Port: 80
  [Stream index: 0]
  [TCP Segment Len: 565]
  Sequence number: 1 (relative sequence number)
  [Next sequence number: 566 (relative sequence number)]
  Acknowledgment number: 1 (relative ack number)
  Header Length: 20 bytes
  Flags: 0x018 (PSH, ACK)
  Window size value: 17520
  [Calculated window size: 17520]
  [Window size scaling factor: -2 (no window scaling used)]
  Checksum: 0x1fbd [validation disabled]
  Urgent pointer: 0
  [SEQ/ACK analysis]
    [iRTT: 0.023265000 seconds]
    [Bytes in flight: 565]
  TCP segment data (565 bytes)
0000  00 06 25 da af 73 00 20 e0 8a 70 1a 08 00 45 00  ..%..s. .p...E.
0010  02 5d 1e 21 40 00 80 06 a2 e7 c0 a8 01 66 80 77  .].!@.....f.w
0020  f5 0c 04 89 00 50 0d d6 01 f5 34 a2 74 1a 50 18  ....P....4.t.P.
0030  44 70 1f bd 00 00 50 4f 53 54 20 2f 65 74 68 65  Dp....POST /ethe
0040  72 65 61 6c 2d 6c 61 62 73 2f 6c 61 62 33 2d 31  real-labs/lab3-1
0050  2d 72 65 70 6c 79 2e 68 74 6d 20 48 54 54 50 2f  -reply.htm HTTP/
0060  31 2e 31 0d 0a 48 6f 73 74 3a 20 67 61 69 61 2e  1.1..Host: gaia.
0070  63 73 2e 75 6d 61 73 73 2e 65 64 75 0d 0a 55 73  cs.umass.edu..Us
0080  65 72 2d 41 67 65 6e 74 3a 20 4d 6f 7a 69 6c 6c  er-Agent: Mozill
0090  61 2f 35 2e 30 20 28 57 69 6e 64 6f 77 73 3b 20  a/5.0 (Windows;
00a0  55 3b 20 57 69 6e 64 6f 77 73 20 4e 54 20 35 2e  U; Windows NT 5.
00b0  31 3b 20 65 6e 2d 55 53 3b 20 72 76 3a 31 2e 30  1; en-US; rv:1.0
00c0  2e 32 29 20 47 65 63 6b 6f 2f 32 30 30 33 30 32  .2) Gecko/200302
00d0  30 38 20 4e 65 74 73 63 61 70 65 2f 37 2e 30 32  08 Netscape/7.02
00e0  0d 0a 41 63 63 65 70 74 3a 20 74 65 78 74 2f 78  ..Accept: text/x
00f0  6d 6c 2c 61 70 70 6c 69 63 61 74 69 6f 6e 2f 78  ml,application/x
0100  6d 6c 2c 61 70 70 6c 69 63 61 74 69 6f 6e 2f 78  ml,application/x
0110  68 74 6d 6c 2b 78 6d 6c 2c 74 65 78 74 2f 68 74  html+xml,text/ht
0120  6d 6c 3b 71 3d 30 2e 39 2c 74 65 78 74 2f 70 6c  ml;q=0.9,text/pl
0130  61 69 6e 3b 71 3d 30 2e 38 2c 76 69 64 65 6f 2f  ain;q=0.8,video/
0140  78 2d 6d 6e 67 2c 69 6d 61 67 65 2f 70 6e 67 2c  x-mng,image/png,
0150  69 6d 61 67 65 2f 6a 70 65 67 2c 69 6d 61 67 65  image/jpeg,image
0160  2f 67 69 66 3b 71 3d 30 2e 32 2c 74 65 78 74 2f  /gif;q=0.2,text/
0170  63 73 73 2c 2a 2f 2a 3b 71 3d 30 2e 31 0d 0a 41  css,*/*;q=0.1..A
0180  63 63 65 70 74 2d 4c 61 6e 67 75 61 67 65 3a 20  ccept-Language:
0190  65 6e 2d 75 73 2c 20 65 6e 3b 71 3d 30 2e 35 30  en-us, en;q=0.50
01a0  0d 0a 41 63 63 65 70 74 2d 45 6e 63 6f 64 69 6e  ..Accept-Encodin
01b0  67 3a 20 67 7a 69 70 2c 20 64 65 66 6c 61 74 65  g: gzip, deflate
01c0  2c 20 63 6f 6d 70 72 65 73 73 3b 71 3d 30 2e 39  , compress;q=0.9
01d0  0d 0a 41 63 63 65 70 74 2d 43 68 61 72 73 65 74  ..Accept-Charset
01e0  3a 20 49 53 4f 2d 38 38 35 39 2d 31 2c 20 75 74  : ISO-8859-1, ut
01f0  66 2d 38 3b 71 3d 30 2e 36 36 2c 20 2a 3b 71 3d  f-8;q=0.66, *;q=
0200  30 2e 36 36 0d 0a 4b 65 65 70 2d 41 6c 69 76 65  0.66..Keep-Alive
0210  3a 20 33 30 30 0d 0a 43 6f 6e 6e 65 63 74 69 6f  : 300..Connectio
0220  6e 3a 20 6b 65 65 70 2d 61 6c 69 76 65 0d 0a 52  n: keep-alive..R
0230  65 66 65 72 65 72 3a 20 68 74 74 70 3a 2f 2f 67  eferer: http://g
0240  61 69 61 2e 63 73 2e 75 6d 61 73 73 2e 65 64 75  aia.cs.umass.edu
0250  2f 65 74 68 65 72 65 61 6c 2d 6c 61 62 73 2f 6c  /ethereal-labs/l
0260  61 62 33 2d 31 2e 68 74 6d 0d 0a
```

Question 6-①

RT1
4 0.026477 192.168.1.102 128.119.245.12 TCP 619 [TCP segment of a reassembled PDU]
Frame 4: 619 bytes on wire (4952 bits), 619 bytes captured (4952 bits)
Ethernet II, Src: Actionte_8a:70:1a (00:20:e0:8a:70:1a), Dst: LinksysG_da:af:73 (00:06:25:da:af:73)
Internet Protocol Version 4, Src: 192.168.1.102, Dst: 128.119.245.12
Transmission Control Protocol, Src Port: 1161 (1161), Dst Port: 80 (80), Seq: 1, Ack: 1, Len: 565 *Len*
5 0.041737 192.168.1.102 128.119.245.12 TCP 1514 [TCP segment of a reassembled PDU]
RT2
Frame 5: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits)
Ethernet II, Src: Actionte_8a:70:1a (00:20:e0:8a:70:1a), Dst: LinksysG_da:af:73 (00:06:25:da:af:73)
Internet Protocol Version 4, Src: 192.168.1.102, Dst: 128.119.245.12
Transmission Control Protocol, Src Port: 1161 (1161), Dst Port: 80 (80), Seq: 566, Ack: 1, Len: 1460 *Len*
6 0.053937 128.119.245.12 192.168.1.102 TCP 60 80 → 1161 [ACK] Seq=1
Ack=566 Win=6780 Len=0
Frame 6: 60 bytes on wire (480 bits), 60 bytes captured (480 bits)
Ethernet II, Src: LinksysG_da:af:73 (00:06:25:da:af:73), Dst: Actionte_8a:70:1a (00:20:e0:8a:70:1a)
Internet Protocol Version 4, Src: 128.119.245.12, Dst: 192.168.1.102
Transmission Control Protocol, Src Port: 80 (80), Dst Port: 1161 (1161), Seq: 1, Ack: 566, Len: 0
7 0.054026 192.168.1.102 128.119.245.12 TCP 1514 [TCP segment of a reassembled PDU]
RT3
Frame 7: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits)
Ethernet II, Src: Actionte_8a:70:1a (00:20:e0:8a:70:1a), Dst: LinksysG_da:af:73 (00:06:25:da:af:73)
Internet Protocol Version 4, Src: 192.168.1.102, Dst: 128.119.245.12
Transmission Control Protocol, Src Port: 1161 (1161), Dst Port: 80 (80), Seq: 2026, Ack: 1, Len: 1460 *Len*
8 0.054690 192.168.1.102 128.119.245.12 TCP 1514 [TCP segment of a reassembled PDU]
RT4
Frame 8: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits)
Ethernet II, Src: Actionte_8a:70:1a (00:20:e0:8a:70:1a), Dst: LinksysG_da:af:73 (00:06:25:da:af:73)
Internet Protocol Version 4, Src: 192.168.1.102, Dst: 128.119.245.12
Transmission Control Protocol, Src Port: 1161 (1161), Dst Port: 80 (80), Seq: 3486, Ack: 1, Len: 1460 *Len*
9 0.077294 128.119.245.12 192.168.1.102 TCP 60 80 → 1161 [ACK] Seq=1
Ack=2026 Win=8760 Len=0
Frame 9: 60 bytes on wire (480 bits), 60 bytes captured (480 bits)
Ethernet II, Src: LinksysG_da:af:73 (00:06:25:da:af:73), Dst: Actionte_8a:70:1a (00:20:e0:8a:70:1a)
Internet Protocol Version 4, Src: 128.119.245.12, Dst: 192.168.1.102
Transmission Control Protocol, Src Port: 80 (80), Dst Port: 1161 (1161), Seq: 1, Ack: 2026, Len: 0
10 0.077405 192.168.1.102 128.119.245.12 TCP 1514 [TCP segment of a reassembled PDU]
RT5
Frame 10: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits)
Ethernet II, Src: Actionte_8a:70:1a (00:20:e0:8a:70:1a), Dst: LinksysG_da:af:73 (00:06:25:da:af:73)
Internet Protocol Version 4, Src: 192.168.1.102, Dst: 128.119.245.12
Transmission Control Protocol, Src Port: 1161 (1161), Dst Port: 80 (80), Seq: 4946, Ack: 1, Len: 1460 *Len*
11 0.078157 192.168.1.102 128.119.245.12 TCP 1514 [TCP segment of a reassembled PDU]
RT6
Frame 11: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits)
Ethernet II, Src: Actionte_8a:70:1a (00:20:e0:8a:70:1a), Dst: LinksysG_da:af:73 (00:06:25:da:af:73)
Internet Protocol Version 4, Src: 192.168.1.102, Dst: 128.119.245.12
Transmission Control Protocol, Src Port: 1161 (1161), Dst Port: 80 (80), Seq: 6406, Ack: 1, Len: 1460 *Len*
12 0.124085 128.119.245.12 192.168.1.102 TCP 60 80 → 1161 [ACK] Seq=1
Ack=3486 Win=11680 Len=0
Frame 12: 60 bytes on wire (480 bits), 60 bytes captured (480 bits)
Ethernet II, Src: LinksysG_da:af:73 (00:06:25:da:af:73), Dst: Actionte_8a:70:1a (00:20:e0:8a:70:1a)
Internet Protocol Version 4, Src: 128.119.245.12, Dst: 192.168.1.102
Transmission Control Protocol, Src Port: 80 (80), Dst Port: 1161 (1161), Seq: 1, Ack: 3486, Len: 0
14 0.169118 128.119.245.12 192.168.1.102 TCP 60 80 → 1161 [ACK] Seq=1
Ack=4946 Win=14600 Len=0
Frame 14: 60 bytes on wire (480 bits), 60 bytes captured (480 bits)
Ethernet II, Src: LinksysG_da:af:73 (00:06:25:da:af:73), Dst: Actionte_8a:70:1a (00:20:e0:8a:70:1a)
Internet Protocol Version 4, Src: 128.119.245.12, Dst: 192.168.1.102
Transmission Control Protocol, Src Port: 80 (80), Dst Port: 1161 (1161), Seq: 1, Ack: 4946, Len: 0
15 0.217299 128.119.245.12 192.168.1.102 TCP 60 80 → 1161 [ACK] Seq=1
Ack=6406 Win=17520 Len=0
Frame 15: 60 bytes on wire (480 bits), 60 bytes captured (480 bits)
Ethernet II, Src: LinksysG_da:af:73 (00:06:25:da:af:73), Dst: Actionte_8a:70:1a (00:20:e0:8a:70:1a)
Internet Protocol Version 4, Src: 128.119.245.12, Dst: 192.168.1.102
Transmission Control Protocol, Src Port: 80 (80), Dst Port: 1161 (1161), Seq: 1, Ack: 6406, Len: 0
16 0.267802 128.119.245.12 192.168.1.102 TCP 60 80 → 1161 [ACK] Seq=1
Ack=7866 Win=20440 Len=0
Frame 16: 60 bytes on wire (480 bits), 60 bytes captured (480 bits)
Ethernet II, Src: LinksysG_da:af:73 (00:06:25:da:af:73), Dst: Actionte_8a:70:1a (00:20:e0:8a:70:1a)
Internet Protocol Version 4, Src: 128.119.245.12, Dst: 192.168.1.102
Transmission Control Protocol, Src Port: 80 (80), Dst Port: 1161 (1161), Seq: 1, Ack: 7866, Len: 0

4 → 6	RT1 =	.02746	.02317	.0237
5 → 9	RT2 =	.035557	.0237 0625	.0252
7 → 12	RT3 =	.070059	.025 47788	.0308
8 → 14	RT4 =	.114428	.0308	.0413
10 → 15	RT5 =	.139894	.0413	.0536
11 → 16	RT6 =	.189645	.0536	.0706

Question 7

Length: 565, 1460, 1460, 1460, 1460, 1460

Question 8

Question 9: minimum is 6780, this does not seem to throttle the sender.

Question 10: no retransmissions, Wireshark has a TCP analysis ~~filter~~ ^{attrib} for this:

tcp.analysis.retransmission or tcp.analysis.fast-retransmission

Question 11: somewhere around 3-4k of data, Around packet 68-71, Three ACKs are sent for 6 transmissions

Question 12:
$$\frac{\text{(1st seq num)} 164081 \text{ bits} \cdot 8 \text{ bits} - 23228}{\text{(total time)} 516511415} - \text{bits/}$$