#### LAB 5 TCP

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

#### 192.168.1.102 port 1161

```
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, Dst Port: 80, Seq: 0, Len: 0
```

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

#### 128.119.245.12 port 80

Time	Source	Destination	Protocol	Length Info
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
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

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

#### อันนี้ใช้ไฟล์ของ lab ครับ

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

```
Flags: 0x002 (SYN)
000. ... = Reserved: Not set
...0 ... = Nonce: Not set
...0 ... = Congestion Window Reduced (CWR): Not set
...0 ... = ECN-Echo: Not set
...0 ... = Urgent: Not set
...0 ... = Acknowledgment: Not set
...0 ... = Push: Not set
...0 ... = Reset: Not set
...0 ... = Fin: Not set
...0 ... = Fin: Not set
```

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

gaia.cs.umass.edu determine that value? What is it in the segment that identifies the segment as a SYNACK segment?

```
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]
                            (relative sequence number)
     Sequence number: 0
     Sequence number (raw): 883061785
     [Next sequence number: 1
                                   (relative sequence number)]
     Acknowledgment number: 1
                                   (relative ack number)
     Acknowledgment number (raw): 232129013
     0111 .... = Header Length: 28 bytes (7)
    Flags: 0x012 (SYN, ACK)
   0111 .... = Header Length: 28 bytes (/) Flags: 0x012 (SYN, ACK)
      000. .... = Reserved: Not set
      ...0 .... = Nonce: Not set
      .... 0... = Congestion Window Reduced (CWR): Not set
      .... .0.. ... = ECN-Echo: Not set
      .... ..0. .... = Urgent: Not set
      .... ...1 .... = Acknowledgment: Set
      .... 0... = Push: Not set
       ... .... .0.. = Reset: Not set
      .... .... ..1. = Syn: Set
            .... ...0 = Fin: Not set
      [TCP Flags: .....A..S.]
```

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

```
[TCP Segment Len: 565]
    Sequence number: 1
                          (relative sequence number)
    Sequence number (raw): 232129013
     [Next sequence number: 566
                                  (relative sequence number)]
    Acknowledgment number: 1
                                (relative ack number)
    Acknowledgment number (raw): 883061786
   0101 = Header Length: 20 hvtes (5)
   [Reassembled PDU in frame: 199]
  TCP segment data (565 bytes)
  44 70 1f bd 00 00 50 4f
                              53 54 20 2f 65 74 68 65
                                                          Dp····PO ST /ethe
    72 65 61 6c 2d 6c 61 62
                              73 2f 6c 61 62 33 2d 31
                                                          real-lab s/lab3-1
40
50
    2d 72 65 70 6c 79 2e 68
                              74 6d 20 48 54 54 50 2f
                                                           reply.h tm HTTP
```

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

the measured RTT for the first segment, and then is computed using the EstimatedRTT equation on page 242 for all subsequent segments. Note: Wireshark has a nice feature that allows you to plot the RTT for each of the TCP segments sent. Select a TCP segment in the "listing of captured packets" window that is being sent from the client to the gaia.cs.umass.edu server. Then select: Statistics->TCP Stream Graph->Round Trip Time Graph.

### เซคเมนต์ที่ 1-6 คือ 4, 5, 7, 8, 10, 11

3 0.023203	172.100.1.102	120.117.247.12	ICF	74 TIOT 4 OF [WCV] 964-T WCV-T MIH-T1/950 FCH-0
4 0.026477	192.168.1.102	128.119.245.12	TCP	619 1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=17520 Len=565 [TCP segment of a reassembled PDU]
5 0.041737	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [PSH, ACK] Seq=566 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
6 0.053937	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0
7 0.054026	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK] Seq=2026 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
8 0.054690	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
9 0.077294	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760 Len=0
10 0.077405	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK] Seq=4946 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
11 0.078157	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK] Seq=6406 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]

### ack ของมันคือ 6, 9, 12, 14, 15, 16 ตามลำดับกับค้านบน

5 0.041/3/	192.168.1.102	128.119.245.12	ICP	1514 1161 → 80  PSH, ACK  Seq=566 Ack=1 Win=1/520 Len=1460   CP segment of a reassembled PDU
6 0.053937	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0
7 0.054026	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK] Seq=2026 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
8 0.054690	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
9 0.077294	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seg=1 Ack=2026 Win=8760 Len=0
10 0.077405	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK] Seq=4946 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
11 0.078157	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK] Seq=6406 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
12 0.124085	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seg=1 Ack=3486 Win=11680 Len=0
13 0.124185	192.168.1.102	128.119.245.12	TCP	1201 1161 → 80 [PSH, ACK] Seq=7866 Ack=1 Win=17520 Len=1147 [TCP segment of a reassembled PDU]
14 0.169118	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=4946 Win=14600 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
16 0.267802	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=7866 Win=20440 Len=0
17 0 304807	128 119 245 12	192 168 1 102	TCP	60 80 → 1161 [ACK] Seg=1 Ack=9013 Win=23360 Len=0

## คู่แรก 4, 6 ใช้เวลา = 0.02746 s

4 0.026477	192.168.1.102	128.119.245.12	TCP	619 1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=17520 Len=565 [TCP segment of a reassembled PDU]
4 0.020477	192.100.1.102	120.119.249.12		
5 0.041737	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [PSH, ACK] Seq=566 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
6 0.053937	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seg=1 Ack=566 Win=6780 Len=0

### คู่ 5, 9 ใช้เวลา = 0.035557

5 0.041737	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [PSH, ACK] Seq=566 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
6 0.053937	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0
7 0.054026	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK] Seq=2026 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
8 0.054690	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
9 0.077294	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760 Len=0
10 0 077105	100 100 1 100	100 110 015 10	TOD	454 4464 ON 54007 O 4045 4 1 4 11 47500 1 4460 5700 1 6 13 1 DOUZ

## คู่ 7, 12 ใช้เวลา = 0.070059

7 0.054026	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK] Seq=2026 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
8 0.054690	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
9 0.077294	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760 Len=0
10 0.077405	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK] Seq=4946 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
11 0.078157	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK] Seq=6406 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
12 0.124085	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=3486 Win=11680 Len=0
13 0 12/185	102 168 1 102	128 110 245 12	TCD	1201 1161 - 80 [DSH ACK] San-7866 Ack-1 Win-17520 Lan-1117 [TCD comment of a reassambled DNI]

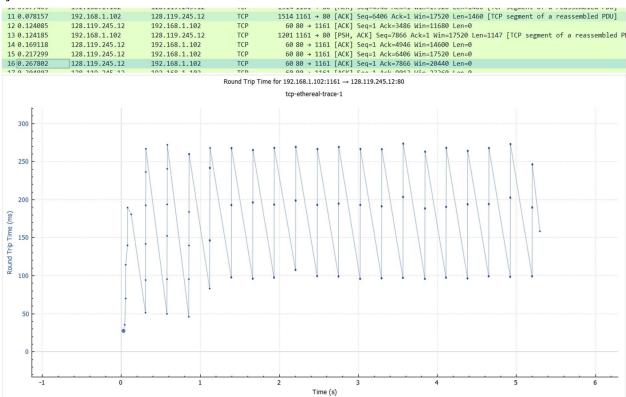
### คู่ 8, 14 ใช้เวลา = 0.114428

1	7 0.034020	172.100.1.102	120.117.247.12	101	1314 TIOT , OO [UCK] 3C4-5050 UCK-1 MIH-11350 CCH-1400 [ICL 3CBHCHC OL & LCA33CHIDICA LDO]
	8 0.054690	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK] Seq=3486 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
	9 0.077294	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760 Len=0
	10 0.077405	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK] Seq=4946 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
	11 0.078157	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK] Seq=6406 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
	12 0.124085	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=3486 Win=11680 Len=0
	13 0.124185	192.168.1.102	128.119.245.12	TCP	1201 1161 → 80 [PSH, ACK] Seq=7866 Ack=1 Win=17520 Len=1147 [TCP segment of a reassembled PDU]
	14 0.169118	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=4946 Win=14600 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

# คู่ 10, 15 ใช้เวลา = 0.139894

5 0.077254	120.117.277.12	172.100.1.102	101	oo oo , iioi [nek] oed-i nek-toto win-oroo ten-o
10 0.077405	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK] Seq=4946 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
11 0.078157	192.168.1.102	128.119.245.12	TCP	1514 1161 → 80 [ACK] Seq=6406 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
12 0.124085	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=3486 Win=11680 Len=0
13 0.124185	192.168.1.102	128.119.245.12	TCP	1201 1161 → 80 [PSH, ACK] Seq=7866 Ack=1 Win=17520 Len=1147 [TCP segment of a reassembled PDU]
14 0.169118	128.119.245.12	192.168.1.102	TCP	60 80 → 1161 [ACK] Seq=1 Ack=4946 Win=14600 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

## คู่ 11, 16 ใช้เวลา = 0.189645



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

```
128.119.245.12
 4 0.026477
                           192.168.1.102
                                                                                                                     619 1161 → 80 [PSH, ACK] Seq=1 Ack=1 Win=17520 Len=565 [TCP segment of a reassembled PDU]
                                                                                                                  1014 101 + 80 [PSH, AKK] Seq=166 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU] 1514 1161 + 80 [PSH, AKK] Seq=566 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU] 60 80 + 1161 [ACK] Seq=1 Ack=566 Win=6780 Len=0 1514 1161 + 80 [ACK] Seq=24056 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU] 1514 1161 + 80 [ACK] Seq=3486 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
  5 0.041737
                                                              128.119.245.12
 6 0.053937
                           128, 119, 245, 12
                                                             192,168,1,102
                                                                                                  TCP
 7 0.054026
                           192.168.1.102
                                                              128.119.245.12
 8 0.054690
                           192.168.1.102
                                                             128.119.245.12
                                                                                                  TCP
 9 0.077294
                                                                                                                      60 80 → 1161 [ACK] Seq=1 Ack=2026 Win=8760 Len=0
                                                                                                                   1514 1161 → 80 [ACK] Seq=4946 Ack=1 Win=17520 Len=1460 [TCP segment of a reassembled PDU]
10 0.077405
                           192,168,1,102
                                                             128, 119, 245, 12
                                                                                                  TCP
                                                                                                                   1514 | 1161 + 80 | [ACK] | Seg=6406 Ack=1 | Win=17520 | Len=1460 | [TCP | segment of a reassembled PDU] 60 80 + 1161 | [ACK] | Seg=1 | Ack=1486 | Win=11680 | Len=0
```

เซกเมนต์ที่ 1-6 คือ 4, 5, 7, 8, 10, 11 >> 565, 1460, 1460, 1460, 1460, 1460

Len=0

17520 Len=565 [TCP sen=17520 Len=1460 [TCF of Len=0

520 Len=1460 [TCP senements of Len=1

9. What is the minimum amount of available buffer space advertised at the received for the entire trace? Does

the lack of receiver buffer space ever throttle the sender?

จาก ack แรกที่ส่งกลับมา

> Flags: 0x010 (ACK)
Window size value: 6780
[Calculated window size: 6780]

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

ไม่มีการ retransmitted เนื่องจาก sequence number เพิ่มขึ้นเรื่อยๆ เมื่อดูในไฟล์

- 11. How much data does the receiver typically acknowledge in an ACK? Can you identify cases where the receiver is ACKing every other received segment (see Table 3.2 on page 250 in the text).
- 12. What is the throughput (bytes transferred per unit time) for the TCP connection? Explain how you calculated this value.

ขนาดของไฟล์ text = 148 KB (151.552 bytes) ใช้เวลาทั้งหมดคือ ตั้งแต่การส่งครั้งแรกจนรับ ack ครั้งสุดท้าย = 0.267802 - 0.026477 = 0.241325 >> throughput = 151552 ÷ 0.241325 = 627,999.5856210505

13. Use the Time-Sequence-Graph(Stevens) plotting tool to view the sequence number versus time plot of segments being sent from the client to the gaia.cs.umass.edu server. Can you identify where TCP's slowstart phase begins and ends, and where congestion avoidance takes over? Comment on ways in which the measured data differs from the idealized behavior of TCP that we've studied in the text.

## ก็คือช่วงที่ seg number นั้นไม่ยอมเพิ่มขึ้น

