California State University, Monterey Bay

Week 5 – Lab 5
Group 10

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CST311

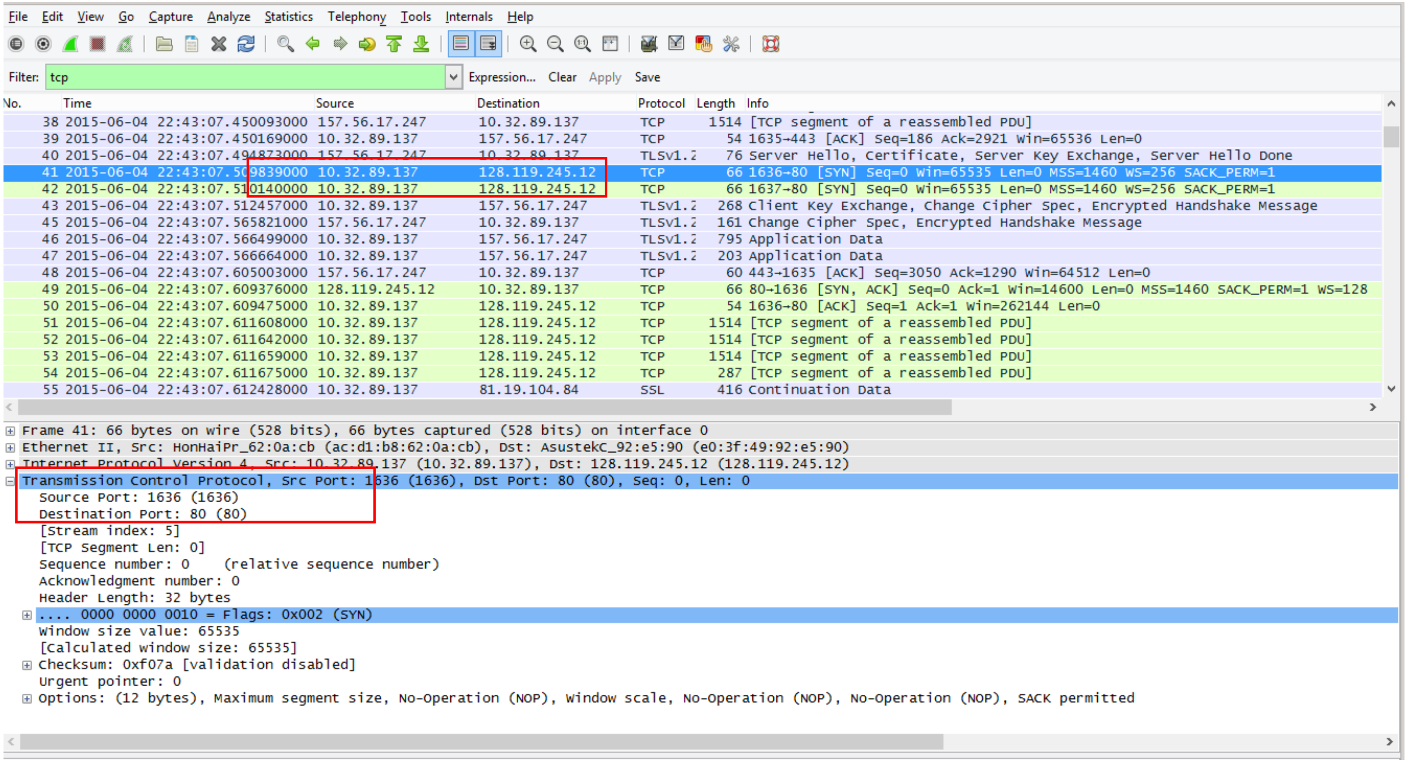
Introduction to Computer Networks

SUMMER 2015

Instructor: Dr. Anand Seetharam

CAPTURED TRACE

The following are the list of questions and related answers for this lab.



Filter: tcp

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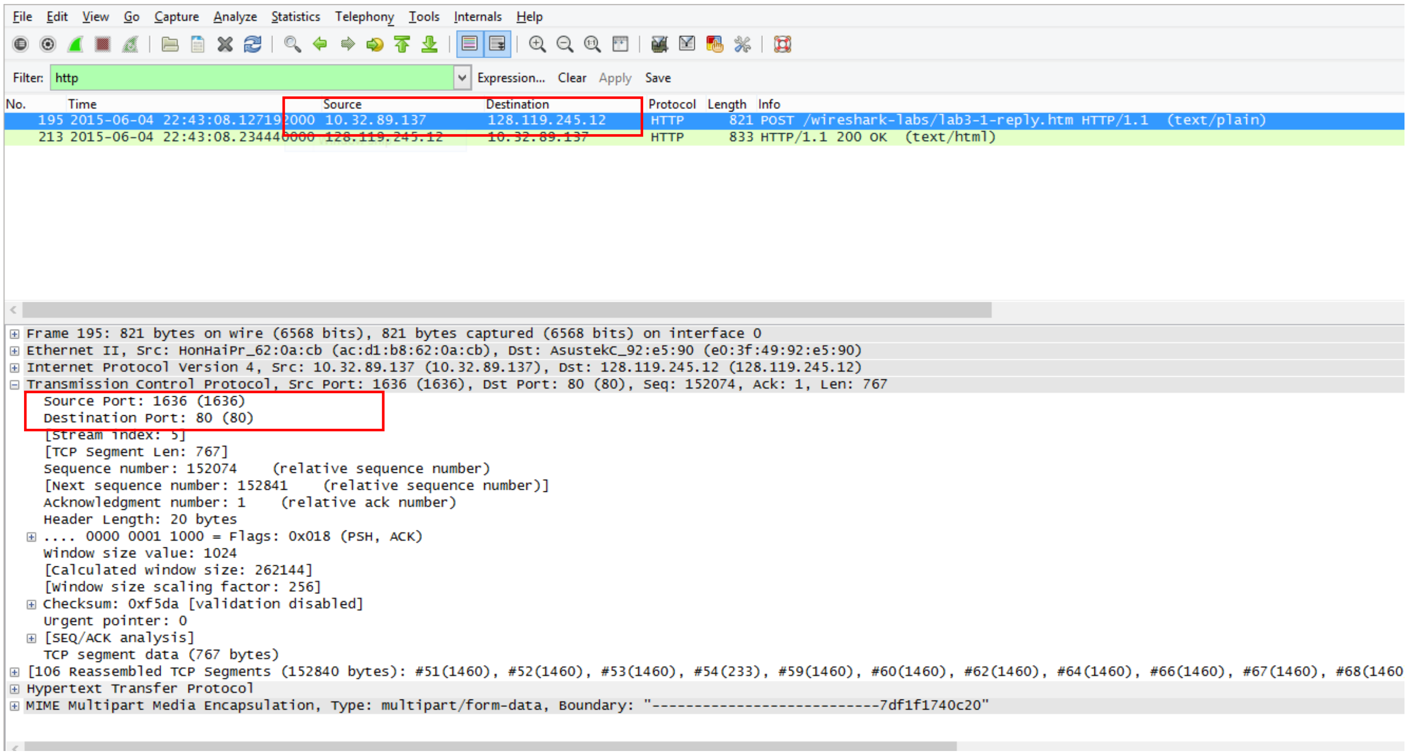
No.  Time                          Source          Destination     Protocol Length Info
  38 2015-06-04 22:43:07.450093000 157.56.17.247   10.32.89.137    TCP      1514 [TCP segment of a reassembled PDU]
  39 2015-06-04 22:43:07.450169000 10.32.89.137    157.56.17.247   TCP        54 1635→443 [ACK] Seq=186 Ack=2921 Win=65536 Len=0
  40 2015-06-04 22:43:07.494873000 157.56.17.247   10.32.89.137    TLSv1.2    76 Server Hello, Certificate, Server Key Exchange, Server Hello Done
  41 2015-06-04 22:43:07.509839000 10.32.89.137    128.119.245.12  TCP        66 1636→80 [SYN] Seq=0 Win=65535 Len=0 MSS=1460 WS=256 SACK_PERM=1
  42 2015-06-04 22:43:07.510140000 10.32.89.137    128.119.245.12  TCP        66 1637→80 [SYN] Seq=0 Win=65535 Len=0 MSS=1460 WS=256 SACK_PERM=1
  43 2015-06-04 22:43:07.512457000 10.32.89.137    157.56.17.247   TLSv1.2   268 Client Key Exchange, Change Cipher Spec, Encrypted Handshake Message
  45 2015-06-04 22:43:07.565821000 157.56.17.247   10.32.89.137    TLSv1.2   161 Change Cipher Spec, Encrypted Handshake Message
  46 2015-06-04 22:43:07.566499000 10.32.89.137    157.56.17.247   TLSv1.2   795 Application Data
  47 2015-06-04 22:43:07.566664000 10.32.89.137    157.56.17.247   TLSv1.2   203 Application Data
  48 2015-06-04 22:43:07.605003000 157.56.17.247   10.32.89.137    TCP        60 443→1635 [ACK] Seq=3050 Ack=1290 Win=64512 Len=0
  49 2015-06-04 22:43:07.609376000 128.119.245.12  10.32.89.137    TCP        66 80→1636 [SYN, ACK] Seq=0 Ack=1 Win=14600 Len=0 MSS=1460 SACK_PERM=1 WS=128
  50 2015-06-04 22:43:07.609475000 10.32.89.137    128.119.245.12  TCP        54 1636→80 [ACK] Seq=1 Ack=1 Win=262144 Len=0
  51 2015-06-04 22:43:07.611608000 10.32.89.137    128.119.245.12  TCP      1514 [TCP segment of a reassembled PDU]
  52 2015-06-04 22:43:07.611642000 10.32.89.137    128.119.245.12  TCP      1514 [TCP segment of a reassembled PDU]
  53 2015-06-04 22:43:07.611659000 10.32.89.137    128.119.245.12  TCP      1514 [TCP segment of a reassembled PDU]
  54 2015-06-04 22:43:07.611675000 10.32.89.137    128.119.245.12  TCP       287 [TCP segment of a reassembled PDU]
  55 2015-06-04 22:43:07.612428000 10.32.89.137    81.19.104.84    SSL       416 Continuation Data
```

```
⊞ Frame 41: 66 bytes on wire (528 bits), 66 bytes captured (528 bits) on interface 0
⊞ Ethernet II, Src: HonHaiPr_62:0a:cb (ac:d1:b8:62:0a:cb), Dst: AsustekC_92:e5:90 (e0:3f:49:92:e5:90)
⊞ Internet Protocol Version 4, Src: 10.32.89.137 (10.32.89.137), Dst: 128.119.245.12 (128.119.245.12)
⊟ Transmission Control Protocol, Src Port: 1636 (1636), Dst Port: 80 (80), Seq: 0, Len: 0
    Source Port: 1636 (1636)
    Destination Port: 80 (80)
    [Stream index: 5]
    [TCP Segment Len: 0]
    Sequence number: 0    (relative sequence number)
    Acknowledgment number: 0
    Header Length: 32 bytes
  ⊞ .... 0000 0000 0010 = Flags: 0x002 (SYN)
    Window size value: 65535
    [Calculated window size: 65535]
  ⊞ Checksum: 0xf07a [validation disabled]
    Urgent pointer: 0
  ⊞ Options: (12 bytes), Maximum segment size, No-Operation (NOP), Window scale, No-Operation (NOP), No-Operation (NOP), SACK permitted
```

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..
   - The source IP address was 10.32.89.137 using source port 1636..

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?
   - The destination IP address is 128.119.245.12 receiving on port 80.


File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: http
Expression... Clear Apply Save

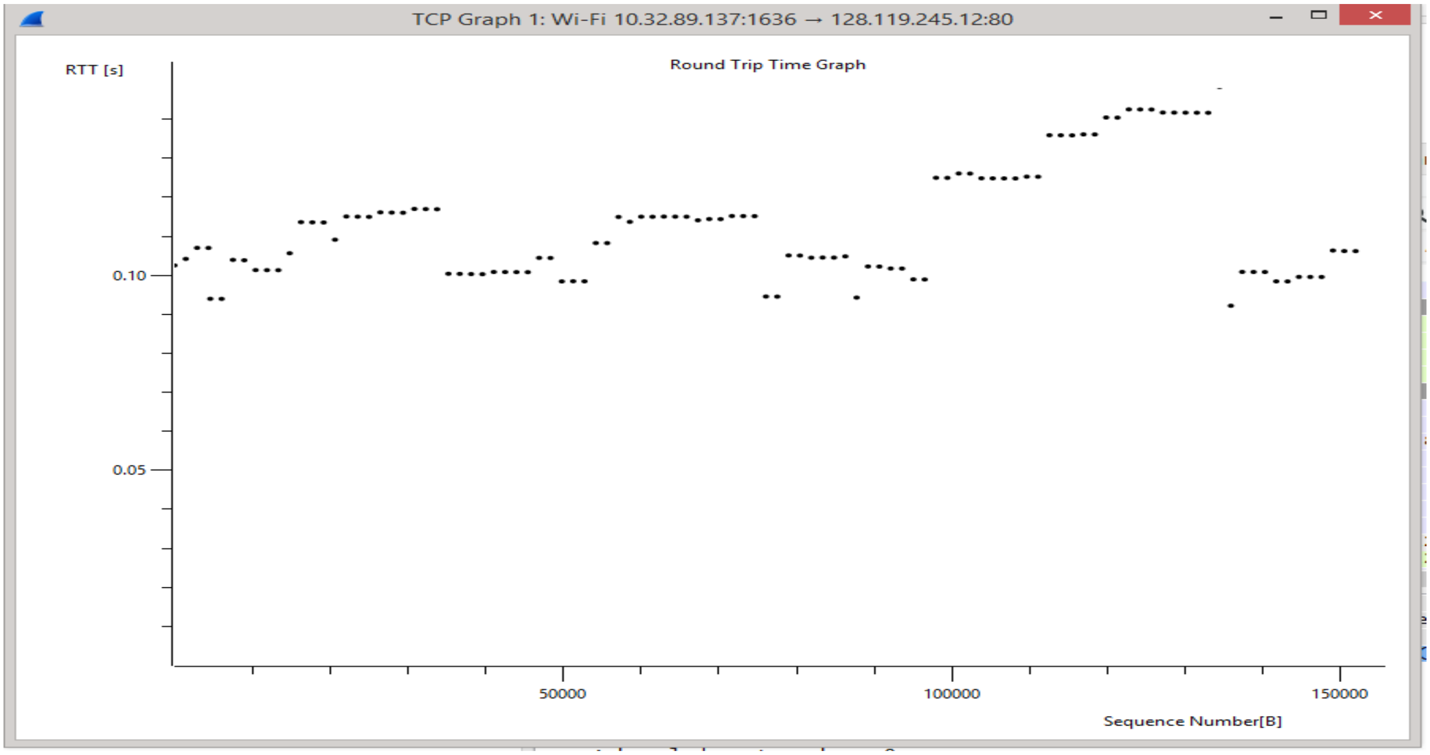
```
No.   Time                          Source          Destination      Protocol Length Info
  195 2015-06-04 22:43:08.127192000 10.32.89.137    128.119.245.12   HTTP       821 POST /wireshark-labs/lab3-1-reply.htm HTTP/1.1  (text/plain)
  213 2015-06-04 22:43:08.234440000 128.119.245.12  10.32.89.137     HTTP       833 HTTP/1.1 200 OK  (text/html)
```

```
⊞ Frame 195: 821 bytes on wire (6568 bits), 821 bytes captured (6568 bits) on interface 0
⊞ Ethernet II, Src: HonHaiPr_62:0a:cb (ac:d1:b8:62:0a:cb), Dst: AsustekC_92:e5:90 (e0:3f:49:92:e5:90)
⊞ Internet Protocol Version 4, Src: 10.32.89.137 (10.32.89.137), Dst: 128.119.245.12 (128.119.245.12)
⊟ Transmission Control Protocol, Src Port: 1636 (1636), Dst Port: 80 (80), Seq: 152074, Ack: 1, Len: 767
    Source Port: 1636 (1636)
    Destination Port: 80 (80)
    [Stream index: 5]
    [TCP Segment Len: 767]
    Sequence number: 152074    (relative sequence number)
    [Next sequence number: 152841    (relative sequence number)]
    Acknowledgment number: 1    (relative ack number)
    Header Length: 20 bytes
  ⊞ .... 0000 0001 1000 = Flags: 0x018 (PSH, ACK)
    Window size value: 1024
    [Calculated window size: 262144]
    [Window size scaling factor: 256]
  ⊞ Checksum: 0xf5da [validation disabled]
    Urgent pointer: 0
  ⊞ [SEQ/ACK analysis]
    TCP segment data (767 bytes)
⊞ [106 Reassembled TCP Segments (152840 bytes): #51(1460), #52(1460), #53(1460), #54(233), #59(1460), #60(1460), #62(1460), #64(1460), #66(1460), #67(1460), #68(1460
⊞ Hypertext Transfer Protocol
⊞ MIME Multipart Media Encapsulation, Type: multipart/form-data, Boundary: "---------------------------7df1f1740c20"
```

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?
    - My IP address source is 10.32.39.137 sending on port 1636.

TCP BASICS

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?
    - The sequence number of the segment used to initiate the TCP connection is 0. The message contains a SYN flag indicating that it is a SYN segment (See screen capture 1)
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?
    - The sequence number of the SYNACK segment is 0.
    - The value of the acknowledgement field is 1. This value is determined by the initial sequence number +1.
    - The message carries flags that show it to be a SYN ACK message.
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.
    - The sequence number of the TCP segment containing the HTTP Post Command is 152074 (See screen capture 2).



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 theTCP 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 239 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 239 for all subsequent segments

Estimated RTT packet 1 : 0.875 * .028 + 0.125 * .028= .028
Estimated RTT packet 2 : 0.875 * .042+ 0.125 * .035 = .035
Estimated RTT packet 3 : 0.875 * .054 + 0.125 * .070 = .070
Estimated RTT packet 4 : 0.875 * .055+ 0.125 * .114 = .114
Estimated RTT packet 5 : 0.875 * .077+ 0.125 * .140 = .140
Estimated RTT packet 6 : 0.875 * .078+ 0.125 * .190 = .190

Segment	Relative Segment Number	Segment Number	Time Sent	Acknowledgement Received	RTT	Estimated RTT
1	1	0dd601f	.026	.054	.028	.028
2	566	0dd6042	.042	.077	.035	.035
3	2026	0dd609d	.054	.124	.070	.070
4	3486	0dd60f9	.055	.169	.114	.114
5	4946	0dd60f9	.077	.217	.140	.140
6	6406	0dd61af	.078	.268	.190	.190

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

   Segment 1 = 565 bytes
   Segment 2 = 1460 bytes
   Segment 3 = 1460 bytes
   Segment 4 = 1460 bytes
   Segment 5 = 1460 bytes
   Segment 6 = 1460 bytes

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?
   - The minimum amount of available buffer space is advertised as the window size: 5840 bytes. The lack of receiver buffer space does not ever throttle the sender
10. Are there any retransmitted segments in the trace file? What did you check for (in the trace) in order to answer this question?
    - There are no retransmitted segments. To check this, I looked for any repeating segment numbers
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 247 in the text).
    - The receiver typically acknowledges 1460 bytes in an ack. If the data is doubled then that segment is acking every other
12. What is the throughput (bytes transferred per unit time) for the TCP connection? Explain how you calculated this value.
    - The file is 177851 bytes dive that by the total time 7.596 seconds and average throughput is 23413.77 bytes per second

TCP CONGESTION CONTROL IN ACTION

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.
    - The slowstart phase begins at about zero and ends at about .15 seconds in according to the graph then congestion takes over.