Analyzing the network performance for internet applications

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Problem 1

On linux you can use the command

```
traceroute www.targethost.com
```

and in the Windows command prompt you can use

```
tracert www.targethost.com
```

In either case, you will get three delay measurements. For those three measurements you can calculate the mean and standard deviation. Repeat the experiment at different times of the day and comment on any changes.

Morning 8 am:

```
Tracing route to targethost.com [172.67.160.151]
over a maximum of 30 hops:

  1     4 ms     1 ms     1 ms  10.113.0.1
  2     3 ms     2 ms     1 ms  static.ill.117.193.77.225.bsnl.in [117.193.77.225]

  3     3 ms     3 ms     3 ms  117.193.162.46
  4    19 ms    32 ms    19 ms  117.216.207.122
  5    21 ms    28 ms    35 ms  162.158.52.2
  6    21 ms    22 ms    20 ms  162.158.52.19
  7    26 ms    31 ms    23 ms  172.67.160.151

Trace complete.
```

Mean: 26.67 ms

Standard Deviation: 4.0414 ms

Afternoon 1 pm :

```
Tracing route to targethost.com [172.67.160.151]
over a maximum of 30 hops:

  1     2 ms     4 ms    79 ms  10.113.0.1
  2    69 ms     2 ms     1 ms  static.ill.117.193.77.225.bsnl.in [117.193.77.225]
  3     4 ms     4 ms     4 ms  117.193.162.46
  4     *        *        *     Request timed out.
  5   138 ms   120 ms   117 ms  162.158.52.2
  6     *      1739 ms   104 ms  162.158.52.19
  7   156 ms   160 ms   116 ms  172.67.160.151

Trace complete.
```

Mean: 144 ms

Standard Deviation: 24.3310 ms

Night 10 pm:

```
Tracing route to targethost.com [172.67.160.151]
over a maximum of 30 hops:

  1    19 ms   246 ms     3 ms  10.113.0.1
  2    25 ms    11 ms    17 ms  static.ill.117.193.77.225.bsnl.in [117.193.77.225]
  3   125 ms   232 ms     9 ms  117.193.162.46
  4     *       53 ms    34 ms  117.216.207.122
  5   156 ms   148 ms    54 ms  162.158.52.2
  6   122 ms   383 ms   677 ms  162.158.52.19
  7   247 ms    84 ms   225 ms  172.67.160.151

Trace complete.
```

Mean: 185.3333 ms

Standard Deviation: 88.4439 ms

The average length of time seems to increase notably during the night, but shortens significantly in the morning. This pattern suggests that lower demand in the morning leads to quicker response times, whereas higher demand at night causes delays to increase.

Problem 2

Analyze the different aspects of the HTTP protocol in the Wireshark: the basic GET/reply interaction, HTTP message formats, retrieving HTML files with embedded URLs, persistent or nonpersistent connections, and HTTP authentication/security

```
228  HTTP/1.1 308 Permanent Redirect
521  GET /subscribe HTTP/1.1
157  HTTP/1.1 200 OK  (text/html)
165  GET /connecttest.txt HTTP/1.1
779  HTTP/1.1 403 Forbidden  (text/html)
```
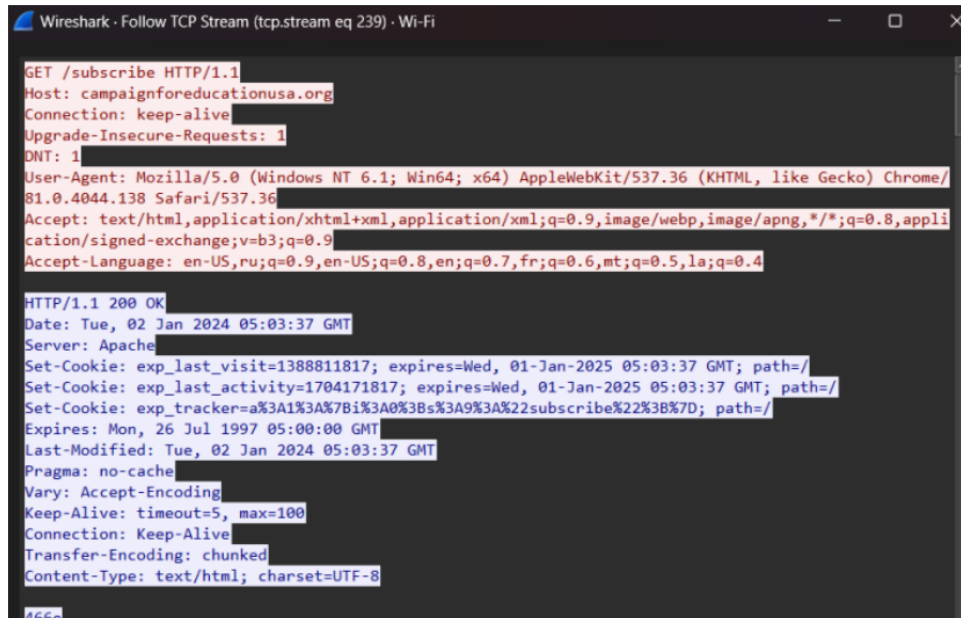
```
173944  293.533521    208.70.31.115       10.113.21.36        HTTP        228 H
174901  295.460883    10.113.21.36        166.78.238.17       HTTP        521 G
175780  297.319330    166.78.238.17       10.113.21.36        HTTP        1157 H
177453  302.646734    10.113.21.36        49.44.175.42        HTTP        165 G

▶ Frame 175780: 1157 bytes on wire (9256 bits), 1157 bytes captured (9256 bits) on interface \Device\
▶ Ethernet II, Src: c6:74:ad:8c:97:dd (c6:74:ad:8c:97:dd), Dst: AzureWaveTec_8e:86:cd (14:13:33:8e:86
▶ Internet Protocol Version 4, Src: 166.78.238.17, Dst: 10.113.21.36
▶ Transmission Control Protocol, Src Port: 80, Dst Port: 61884, Seq: 17521, Ack: 468, Len: 1103
▶ [13 Reassembled TCP Segments (18623 bytes): #175524(1460), #175525(1460), #175526(1460), #175527(14
▼ Hypertext Transfer Protocol, has 2 chunks (including last chunk)
  ▶ HTTP/1.1 200 OK\r\n
    Date: Tue, 02 Jan 2024 05:03:37 GMT\r\n
    Server: Apache\r\n
    Set-Cookie: exp_last_visit=1388811817; expires=Wed, 01-Jan-2025 05:03:37 GMT; path=/\r\n
    Set-Cookie: exp_last_activity=1704171817; expires=Wed, 01-Jan-2025 05:03:37 GMT; path=/\r\n
    Set-Cookie: exp_tracker=a%3A1%3A%7Bi%3A0%3Bs%3A9%3A%22subscribe%22%3B%7D; path=/\r\n
    Expires: Mon, 26 Jul 1997 05:00:00 GMT\r\n
    Last-Modified: Tue, 02 Jan 2024 05:03:37 GMT\r\n
    Pragma: no-cache\r\n
    Vary: Accept-Encoding\r\n
    Keep-Alive: timeout=5, max=100\r\n
    Connection: Keep-Alive\r\n
    Transfer-Encoding: chunked\r\n
    Content-Type: text/html; charset=UTF-8\r\n
    \r\n
    [HTTP response 1/1]
    [Time since request: 1.858447000 seconds]
    [Request in frame: 174901]
    [Request URI: http://campaignforeducationusa.org/subscribe]
  ▶ HTTP chunked response
    File Data: 18030 bytes
▶ Line-based text data: text/html (315 lines)
```

```
  ▶ Transmission Control Protocol, Src Port: 80, Dst Port: 61879, Seq: 1, Ack: 155, Len: 187
  ▼ Hypertext Transfer Protocol
    ▼ HTTP/1.1 200 OK\r\n
      ▼ [Expert Info (Chat/Sequence): HTTP/1.1 200 OK\r\n]
          [HTTP/1.1 200 OK\r\n]
          [Severity level: Chat]
          [Group: Sequence]
        Response Version: HTTP/1.1
        Status Code: 200
        [Status Code Description: OK]
        Response Phrase: OK
    ▼ Content-Length: 22\r\n
        [Content length: 22]
      Date: Tue, 02 Jan 2024 05:03:18 GMT\r\n
      Connection: close\r\n
      Content-Type: text/plain\r\n
      Cache-Control: max-age=30, must-revalidate\r\n
      \r\n
      [HTTP response 1/1]
      [Time since request: 1.150811000 seconds]
      [Request in frame: 169858]
      [Request URI: http://www.msftconnecttest.com/connecttest.txt]
      File Data: 22 bytes
  ▶ Line-based text data: text/plain (1 lines)
```

The above images showcases the interaction of an HTTP packet with TCP, illustrating the exchange between a GET request and a 200 OK response. It also presents the formats of both the request and response messages, consistently indicating the HTTP version each time. Additionally, it includes a status code and the type of request.

Problem 3

Download the open source startrinity software for continuous internet speed test tool - [Continuous internet speed test tool (startrinity.com)](https://startrinity.com)

Select any of the internet applications that takes long time to evaluate. Analyze for packet loss, delays in accessing the internet applications for a long time based on differences in the internet speed.

Example: Video conferencing services –gmeet, zoom, teams, Video streaming services – YouTube, gaming applications etc.

Start the continuity speed test and capture the frames in Wireshark while you are using the selected internet application for 10 to 15 minutes. Analyze the mean andstandard deviations of packet loss, delay with respect to changing internet speed from the csv file output of startrinity and analyze the throughput in wireshark
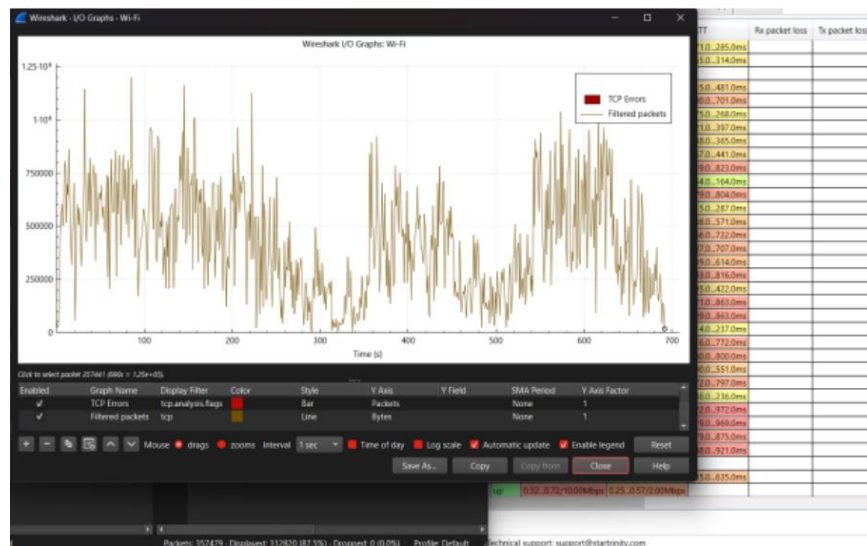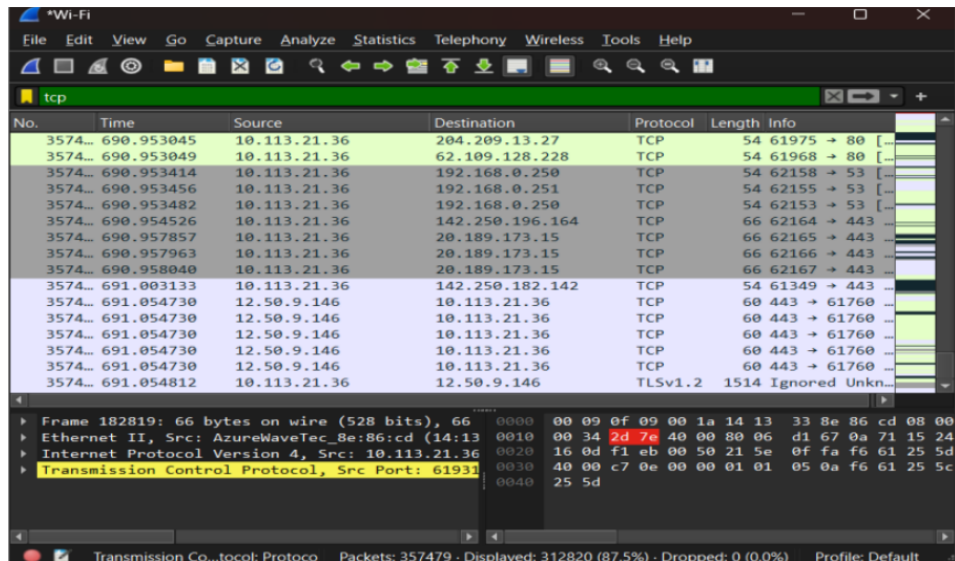
Local time from	Duration(s)	State	Download (Rx) bandwidth	Upload (Tx) bandwidth	RTT (ping) (ms) from	(ping) (ms) to	packet loss
02-01-2024 10:26	5.5375476	up	0.36...0.80/10.00Mbps	0.57...0.88/2.00Mbps	271	285	
02-01-2024 10:26	5.7323914	up	1.37...2.42/10.00Mbps	0.30...0.77/2.00Mbps	255	314	
02-01-2024 10:26	0.6261463	up	1.66...1.75/10.00Mbps	0.20...0.25/2.00Mbps			
02-01-2024 10:26	6.0851355	up	2.53...3.28/10.00Mbps	0.65...0.90/2.00Mbps	315	481	
02-01-2024 10:26	11.292721	up	2.18...2.98/10.00Mbps	1.05...1.70/2.00Mbps	400	701	
02-01-2024 10:26	5.332885	up	2.05...3.92/10.00Mbps	0.50...0.98/2.00Mbps	175	268	
02-01-2024 10:26	8.474808	up	2.86...4.71/10.00Mbps	0.75...0.98/2.00Mbps	221	397	
02-01-2024 10:27	111.15645	up	2.81...3.84/10.00Mbps	0.00...0.93/2.00Mbps	238	565	
02-01-2024 10:28	5.667111	up	1.49...3.65/10.00Mbps	0.08...0.88/2.00Mbps	367	441	
02-01-2024 10:29	17.603546	up	1.83...3.02/10.00Mbps	1.10...1.70/2.00Mbps	419	823	
02-01-2024 10:29	2.01811	up	2.17...2.41/10.00Mbps	1.70...1.70/2.00Mbps	164	164	
02-01-2024 10:29	9.007415	up	2.18...2.57/10.00Mbps	1.05...1.70/2.00Mbps	379	804	
02-01-2024 10:29	5.956294	up	2.13...3.17/10.00Mbps	0.93...1.15/2.00Mbps	115	287	
02-01-2024 10:29	2.675493	up	2.71...3.45/10.00Mbps	0.80...1.25/2.00Mbps	408	571	
02-01-2024 10:29	14.390937	up	2.19...3.38/10.00Mbps	1.33...1.70/2.00Mbps	366	722	
02-01-2024 10:30	4.676687	up	1.19...1.79/10.00Mbps	1.02...1.70/2.00Mbps	337	707	
02-01-2024 10:30	7.842443	up	1.61...2.50/10.00Mbps	1.40...1.70/2.00Mbps	339	614	
02-01-2024 10:30	12.89634	up	1.94...2.84/10.00Mbps	1.08...1.70/2.00Mbps	343	816	
02-01-2024 10:30	10.954906	up	1.53...1.99/10.00Mbps	0.65...1.62/2.00Mbps	195	422	
02-01-2024 10:30	10.85767	up	1.74...2.89/10.00Mbps	1.08...1.70/2.00Mbps	371	863	
02-01-2024 10:31	10.354975	up	2.03...3.16/10.00Mbps	1.55...1.70/2.00Mbps	529	863	
02-01-2024 10:31	10.007657	up	1.87...2.54/10.00Mbps	1.23...1.70/2.00Mbps	114	237	
02-01-2024 10:31	13.8028965	up	1.51...2.41/10.00Mbps	0.85...1.55/2.00Mbps	316	772	
02-01-2024 10:31	12.646149	up	1.45...2.21/10.00Mbps	1.20...1.48/2.00Mbps	380	800	
02-01-2024 10:31	6.7228904	up	1.20...1.90/10.00Mbps	1.00...1.30/2.00Mbps	500	551	
02-01-2024 10:32	16.581877	up	2.03...2.83/10.00Mbps	1.05...1.70/2.00Mbps	372	797	
02-01-2024 10:32	6.1942925	up	1.41...2.00/10.00Mbps	0.93...1.40/2.00Mbps	236	236	
02-01-2024 10:32	5.017048	up	1.12...1.73/10.00Mbps	0.57...0.95/2.00Mbps	522	972	
02-01-2024 10:32	0.9334523	up	1.47...1.80/10.00Mbps	0.85...1.02/2.00Mbps	619	969	
02-01-2024 10:32	5.82576	up	1.01...1.68/10.00Mbps	0.88...1.15/2.00Mbps	579	875	
02-01-2024 10:32	6.369087	up	1.19...1.94/10.00Mbps	0.62...0.98/2.00Mbps	588	921	

StarTrinityYoutube

Local time from	Duration(s)	State	Download (Rx) bandwidth	Upload (Tx) bandwidth	RTT (ping) (ms) from	(ping) (ms) to	packet loss	packet loss
02-01-2024 10:38	4.0683827	up	2.16...3.11/10.00Mbps	1.38...1.70/2.00Mbps	271	518		
02-01-2024 10:38	8.445482	up	2.03...3.31/10.00Mbps	1.42...1.70/2.00Mbps	349	788		
02-01-2024 10:39	8.757898	up	2.97...3.66/10.00Mbps	1.70...1.70/2.00Mbps	251	371		
02-01-2024 10:39	5.614693	up	1.52...2.97/10.00Mbps	1.30...1.70/2.00Mbps	516	667		
02-01-2024 10:39	6.21072	up	0.81...1.49/10.00Mbps	0.65...1.27/2.00Mbps	425	513		
02-01-2024 10:39	6.152882	up	0.72...2.04/10.00Mbps	0.65...1.20/2.00Mbps	247	606		
02-01-2024 10:39	5.8011446	up	0.94...2.02/10.00Mbps	0.65...1.70/2.00Mbps	380	716		
02-01-2024 10:39	17.799776	up	0.51...0.83/10.00Mbps	0.50...0.80/2.00Mbps	612	987		
02-01-2024 10:40	1.5661894	up	0.55...0.59/10.00Mbps	0.38...0.47/2.00Mbps				
02-01-2024 10:40	3.1292725	up	0.34...0.44/10.00Mbps	0.25...0.35/2.00Mbps				
Mean:	9.224433206				442.6617647	660.9265		
Standard Deviation:	12.28769904				195.8782343	210.7899		

The CSV file generated by StarTrinity indicates no packet loss. The lowest throughput was observed at 290 seconds with 781 bytes, while the highest throughput occurred at 531 seconds with 1.037 * 10^6 bytes. The mean and standard deviation values are available in the screenshots for reference.