

Contributors: Udith Reddy Alluri and Venkat Sai Rama

Working with Wireshark:

We will try to understand how each value is calculated with an example from one of the experiments. Experiment 3 from the list of Experiments.

The table was obtained from Statistics -> Conversations > IPV4.

Ethernet · 3		IPv4 · 25	IPv6	TCP · 36	UDP · 12										
Address A	Address B	Packets	Bytes	Packets A → B	Bytes A → B	Packets B → A	Bytes B → A	Rel Start	Duration	Bits/s A → B	Bits/s B → A				
192.168.137.89	192.168.137.1	9,640	7.555 MiB	7,016	7.375 MiB	2,624	184.040 KiB	0.000000	370.5512	163.042 KiB	3.973 KiB				
192.168.137.89	91.199.81.203	15,444	3.132 MiB	6,828	1.779 MiB	8,616	1.352 MiB	5.711991	364.9152	39.945 KiB	30.353 KiB				
192.168.137.87	91.199.81.203	14,587	3.083 MiB	7,025	1.266 MiB	7,562	1.817 MiB	39.970517	330.6758	31.364 KiB	45.012 KiB				
192.168.137.89	13.69.68.17	1,316	558.663 KiB	829	356.670 KiB	487	201.993 KiB	0.367528	369.7639	7.716 KiB	4.370 KiB				
192.168.137.87	20.189.173.13	485	460.915 KiB	333	445.866 KiB	152	15.049 KiB	159.686630	1.8415	1.892 MiB	65.375 KiB				
192.168.137.87	13.69.68.17	450	198.118 KiB	273	114.344 KiB	177	83.774 KiB	0.258875	369.6323	2.475 KiB	1.813 KiB				
192.168.137.89	13.69.109.131	134	131.448 KiB	95	124.143 KiB	39	7.306 KiB	340.769055	0.9347	1.038 MiB	62.529 KiB				
192.168.137.89	20.189.173.13	155	87.027 KiB	83	85.363 KiB	72	11.765 KiB	30.000145	0.5730	1.161 MiB	164.020 KiB				

Figure 1: A picture showing Wireshark conversations while performing an experiment

There are many values but for the sake of information we took only those Ips in to consideration which have a size of >100KiB.

As we know we need to calculate different metrics mentioned. Here is How we will calculate different Fields mentioned Firstly we sorted the IPS according to the amount of information and neglected the IPs which delivered information less than 100 KiB.

Different metrics involved were calculated as follows:

	Server(ip.dst=)	RTT	Geolocation	CPU utilization	Gpu Utilization	Protocol
1	192.168.137.1	NA	HoloLens IP			49 http
2	91.199.81.203	6.7ms	GERMANY, Hamburg, 20457, Hongkongstr		71%	49 http
3	91.199.81.203	6.7ms	GERMANY, Hamburg, 20457, Hongkongstr		73%	50 http
4	13.69.68.17	86.511ms	US, WA, Redmond, One Microsoft Way, 98052		71%	49 http
5	20.189.173.13	8.72ms	US, WA, Redmond, One Microsoft Way, 98052		84%	51 http
6	13.69.68.17	105.355ms	US, WA, Redmond, One Microsoft Way, 98052		71%	51 http
7	13.69.109.131		US, WA, Redmond, One Microsoft Way, 98052		56%	40 http

Framerate	Datetime	Throughput	Duration	RTT	Data
30	31-Mar-23	163.042 KB	370.5512		7.555 MB
30	31-03-2023	39.945 KB	364.9152	6.7ms	3.132 MB
30	31-03-2023	31.364 KB	330.67	6.7ms	3.083 MB
30	31-03-2023	7.716 KB	369.7639	86.511ms	558KB
30	31-03-2023	1.892 MB	1.8415		460.9KB
30	31-03-2023	2.475 KB	369.6323	105.355m	198KB
30	31-03-2023	1.038 MB	0.9347		131KB
Framerate almost remained constant					

Figure 2: A picture showing the calculated final values

1.1 Server Ip.dst :

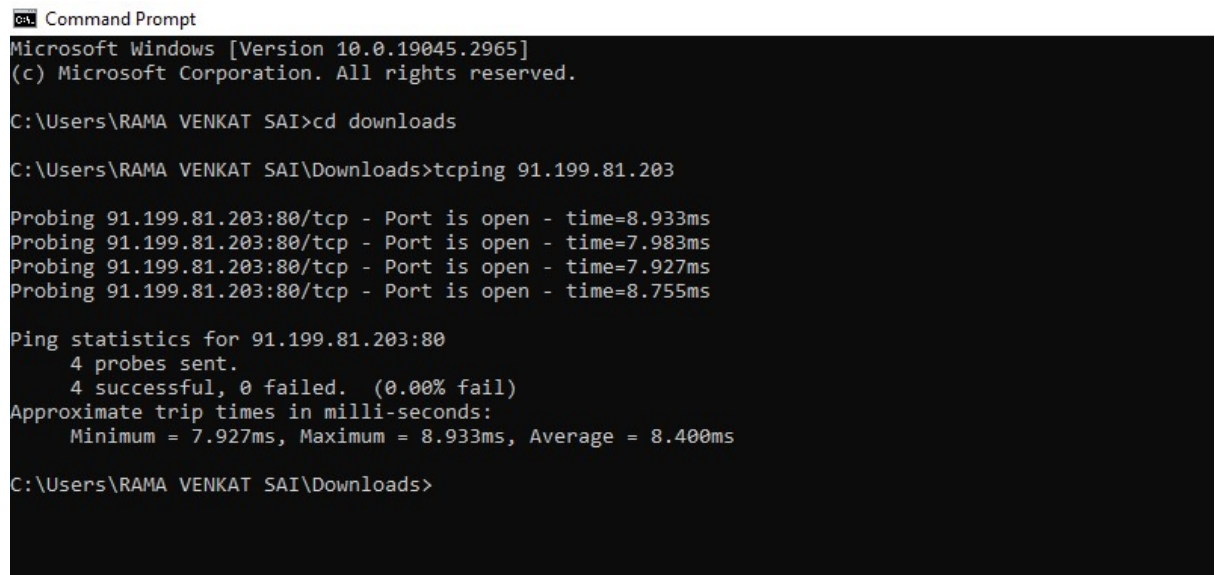
This can easily be calculated from wireshark destination address i.e; Address B mentioned in Figure 1. As we already know that Address B is the server destination address

1.2 RTT

RTT is measured by using tcping which is installed on my pc folder and just used the command tcping from my command prompt and found out the RTT.

We can use echo and make multiple requests to tcping rather than calculating them Individually.

Example command tcping 91.199.81.203



```
Command Prompt
Microsoft Windows [Version 10.0.19045.2965]
(c) Microsoft Corporation. All rights reserved.

C:\Users\RAMA VENKAT SAI>cd downloads
C:\Users\RAMA VENKAT SAI\Downloads>tcping 91.199.81.203

Probing 91.199.81.203:80/tcp - Port is open - time=8.933ms
Probing 91.199.81.203:80/tcp - Port is open - time=7.983ms
Probing 91.199.81.203:80/tcp - Port is open - time=7.927ms
Probing 91.199.81.203:80/tcp - Port is open - time=8.755ms

Ping statistics for 91.199.81.203:80
    4 probes sent.
    4 successful, 0 failed. (0.00% fail)
Approximate trip times in milli-seconds:
    Minimum = 7.927ms, Maximum = 8.933ms, Average = 8.400ms

C:\Users\RAMA VENKAT SAI\Downloads>
```

Figure 3: A picture showing tcping command executed on IP address

1.3 Geolocation

The location is found by using ipinfo.io just by entering the Ip address we will be able to get the destination. There are numerous sites where you can find if this site is down

Site used: <https://ipinfo.io>

1.4 CPU/GPU Utilisation

The Utilization was calculated from the Windows device portal for every 5 seconds we noted the value. We took the value for every 5 seconds because if we calculate for every 1 second the values are more and not easier to note so we considered it for every 5s as it would be easier to calculate all the CPU/GPU utilization. we calculated it for separate server address mentioned in wire shark by How long it is present. The variance and other values can be easily obtained by selecting the column and variance option in excel. For example if you want to calculate the variance from 21st second to 28th second. We will pick up nearest values i.e; the value at 20th second and 30th second and the 25th second which is in between and calculate the variance.

The values are calculated from windows device portal which can be accessed by the holo lens IP we screen recorded the following and made relevant calculations.

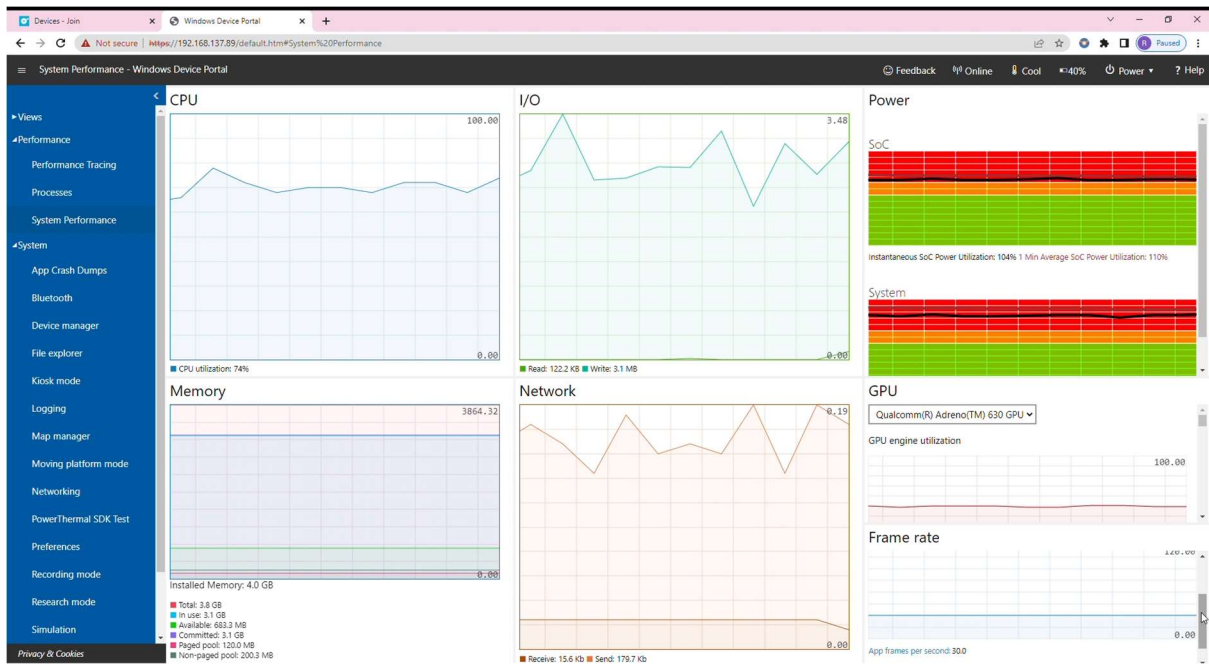


Figure 4: A picture showing windows device portal with various metrics

1.5 Framerate

The framerate is almost constant at every instant except when the recording is topped. The framerate is on average 30 frames per second, as measured from windows device portal.(Figure 4)

1.6 Geolocation

The location is found by using ipinfo.io just by entering the Ip address we will be able to get the destination.

1.7 Throughput

The term means the number of information/ bits transferred. This can be easily obtained from the conversations in Wireshark. i.e., the Bits transferred from A->B. As you can observe in figure 1

1.8 Protocol

All the Ip addresses used the port 80 which corresponds to Http. (See Figure 3)

1.9 Duration, Data:

They can be obtained from Wireshark conversations.

END TO END LATENCY

Latency, in the context of computer networks and communication systems, refers to the time it takes for a signal, data packet, or message to travel from its source to its destination. It is often measured as the delay between the sender transmitting the data and the receiver obtaining it. We conducted a series of experiments to calculate latency corresponding to different VPNs.

Firstly, User1 is connected to VPN. We used any connect as a VPN provider. User2 is connected to Local network without any VPN. The experiments are done with meetings (where people meet for a scheduled time) and Drop-ins (they are permanent meetings the users can join straight-away without any need to schedule meeting)

A series of experiments are done by changing slides and dictating text to sticky notes and by looking at the microsecond clock at least available on Holo-Lens2. After that, the calculations are made by splitting video in to frames by using ffmpeg (a popular open-source multimedia framework that allows you to encode, decode, transcode, and stream audio and video files.). As mentioned, the initial delay is calculated by the milli second clock which both users looked at during the initial phase of the experiment. From that we will get the initial delay. The final delay can be obtained by the frame difference between the two users. For example, if the initial difference between the clocks is 10ms and the frame difference is 10 frames then the Total delay = Initial difference + (Frame difference * Frame duration) Total delay = (10ms) + (10 frames * 33ms) Total delay = 10ms + 330ms Total delay = 340ms.

Suppose the initial difference between the clocks is -10ms (first user's clock is 10ms ahead). If the frame difference is 10 frames, and each frame takes 33ms, the total delay can be calculated as follows: Total delay = Initial difference + (Frame difference * Frame duration) Total delay = (-10ms) + (10 frames * 33ms) Total delay = -10ms + 330ms Total delay = 320ms.

The frame rate is 33.33 because there are 30 frames per second so the frame rate is calculated for every milli second and 1second = 1000ms. So the frame rate is $1000/30 = 33.33$.

We also verified the time difference between the frames given by ffmpeg is 33ms by analyzing the first 10 frames where both users look at the microseconds clock.