COMP90007 Internet Technologies

Project 1 – Network Analysis

Name: Leonard DU

Student Username: zongchengd

Section 2

Ans 2.1 Looking at Fig 2.1.1, Fig 2.1.2 and Fig 2.1.3 in section 2 of the appendix, we can get the meanings of different command line parameters.

-n: Only use IP address to display. The command in Fig 2.1.1 has '-nw 1' parameter which has different IP addresses in the head of every line, but the command in Fig 2.1.2 only has '-w 1' parameter which has IP addresses and hostnames in some lines.

-w 1: 'w' means waiting time. This parameter uses to set the max time (now is 1 second) to wait for response to every probe in seconds. In Fig 2.1.1, the max waiting time for each response is 1 second since the command contains '-w 1'. However, in Fig 2.1.3 the max waiting time is 5 seconds because there is no '- w 1' , and the default value of this parameter is 5.0.

'-n' is really important since for many users, they don't want to know the hostnames which is useless at most time and maybe very long like mass. Besides, **'-w'** is also useful because if the maximum time is not set and no response returns from next host, the source host may wait 5 seconds. In most cases, this is a wast of time.

Ans 2.2 In this part, I choose 10 iperf servers around all the world. Using traceroute command, we can get IP addresses and hop count using only hostname. Through a lot of calculations, the following Table 2.1 is obtained.

	Hostname	IP address	Hop count	Location	Distance(km)
1	iperf.he.net	216.218.227.10	17	Fremont	12676.693
2	bouygues.testdebit.info	89.84.1.222	25	Crosne	16784.361
3	ikoula.testdebit.info	213.246.63.45	29	Paris	16790.44
4	st2.nn.ertelecom.ru	91.144.184.232	24	Nizhnij Novgorod	14057.926
5	iperf.biznetnetworks.com	117.102.109.186	16	South Jakarta	5203.442
6	iperf.scottlinux.com	45.33.39.39	15	Los Angeles	12773.302
7	iperf.eenet.ee	193.40.55.7	24	Tallinn	15220.987
8	ping.online.net	62.210.18.40	17	Vitry-sur-Seine	16788.619
9	bouygues.iperf.fr	89.84.1.222	25	Crosne	16784.361
10	ping-90ms.online.net	62.210.18.41	17	Vitry-sur-Seine	16788.619

Table 2.1

In Table 2.1, There are geographic locations and distances between servers' cities and Melbourne where is the city of my IP address. All the intermediate processes are including in Section 2 of the appendix. In order to determine the correlation of 'Hop count' and 'Distance', using the plot method in Excel, I got the Fig 2.2 followed.

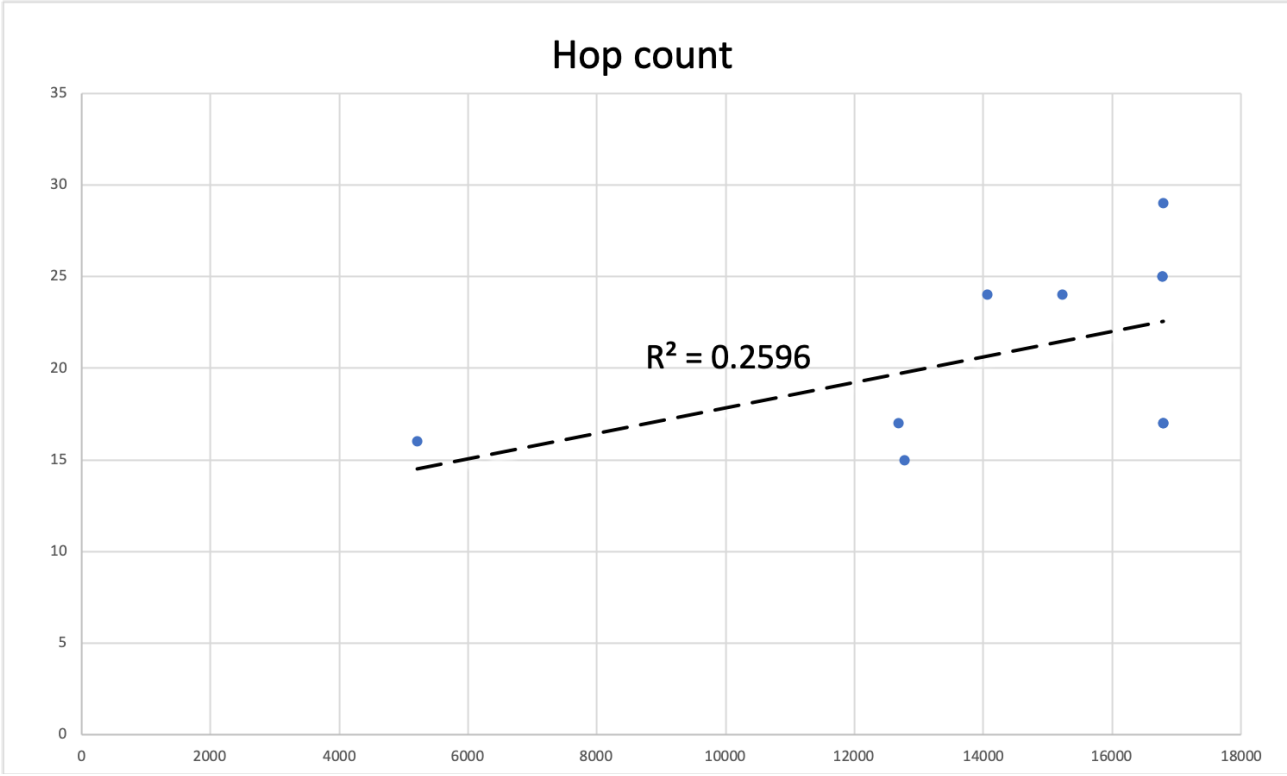

Fig 2.2

In conclusion, There is no obvious correlation between distance and hop count since R^2 is only 0.2596. Statistically, a small R^2 represents no correlation at all. The process of 'traceroute' can be regarded as a tram ride. In most cases, the farther the distance is, the more frequent the transfer is. But why there is no correlation in our experiment? Still using the trams as an example, if an accident happens on a road, we need to bypass it. In network, we use routing algorithms to determine the location of the next node. **Although distance is an important factor in routing algorithm, there are lots of other factors, for example, bandwidth, delay, load and reliability of next note.** Therefore, it is normal that there is no correlation without controlling other influencing factors.

Section 3

Ans 3.1 In section 3 and 4, I used 10 different iperf servers around all the world since **some servers in Section 2 cannot response command 'iperf' and 'iperf3'.** I will show the method to get the locations and geographical distances in Section 3 of appendix. For every host servers, we can get

delays and jitters by running ‘ping -c 10 [hostname]’ 3 times. Through a lot of calculations, the following Table 3.1 is obtained.

	Hostname	IP address	3 times delays(ms)	AVG of delays(ms)	3 times jitters(ms)	AVG of jitters(ms)	Distance(km)
1	bouygues.testdebit.info	89.84.1.222	287.209	287.150	0.635	0.696	16784.361
			287.164		0.78		
			287.078		0.672		
2	st2.nn.ertelecom.ru	91.144.184.232	345.138	345.434	0.845	1.054	14057.926
			345.698		1.138		
			345.467		1.178		
3	iperf.biznetnetworks.com	117.102.109.186	93.181	93.175	0.312	0.170	5203.442
			93.18		0.052		
			93.165		0.147		
4	iperf.volia.net	77.120.3.236	345.388	345.605	0.83	1.015	14778.164
			345.779		1.336		
			345.647		0.88		
5	ping.online.net	62.210.18.40	306.911	306.916	0.554	0.572	16788.619
			306.92		0.607		
			306.917		0.554		
6	ping-90ms.online.net	62.210.18.41	396.921	396.902	0.489	0.639	16788.619
			396.9		0.631		
			396.884		0.797		
7	speedtest.serverius.net	178.21.16.76	285.008	284.711	0.417	0.494	16485.184
			284.14		0.528		
			284.986		0.536		
8	speedtest.hostkey.ru	31.192.104.200	347.268	347.292	0.458	0.584	14425.808
			347.325		0.647		
			347.282		0.646		
9	ping-ams1.online.net	163.172.208.7	283.655	284.089	0.602	0.721	16545.274
			284.712		0.77		
			283.9		0.792		
10	speedtest.wtnet.de	213.209.106.95	308.354	308.336	0.48	0.502	16183.911
			308.286		0.559		
			308.369		0.466		

Table 3.1

In table 3.1, there are lots of intermediate processes which is displayed in Section 3 of the appendix. Using the plot and average functions in Excel, it’s easy to get the Fig 3.1 which shows the correlation between the mean of delays and distance and Fig 3.2 which shows the correlation between the mean of jitters and distance.

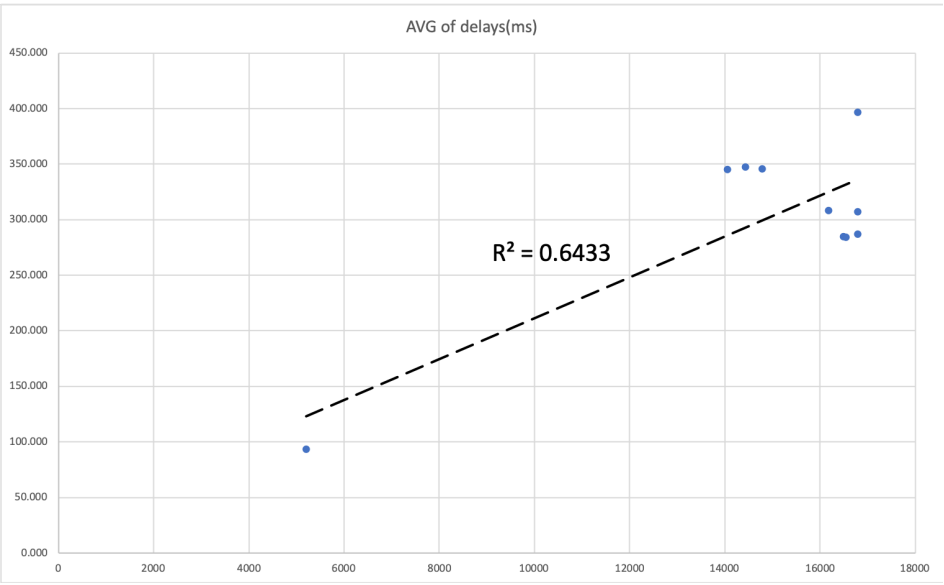

Fig 3.1

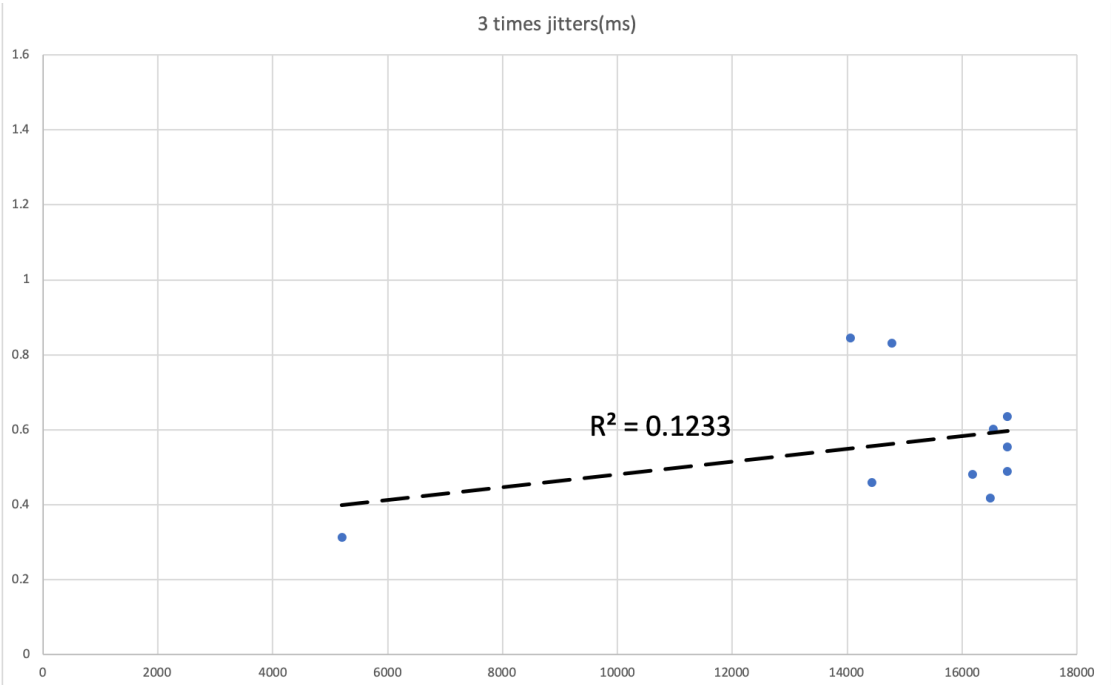

Fig 3.2

Ans 3.2 Looking at Fig 3.1 and Fig 3.2, we can get the conclusion that there is no correlation between delay and jitter as a function of distance since the R^2s are really small. Statistically, if R^2 is larger than 0.8, we believe there is a strong relation between both factors.

It's easy to understand why no obvious correlation. There are lots of other factors which have influences on delay and jitter. For example, download/ upload speed and users sharing the network. If a person uses a 10M network to see videos in Youtube, the download/ upload speed maybe 10M, and the videos are very smooth because the delay is really small. However, if 2 persons use same 10M network to see videos in Youtube, the download/ upload speed for each person maybe only 5M, and the videos are jammed because of a large delay. Besides, we all know the smallest delay of same network usually happen in midnight. The reason is uses sharing the network are few because most people sleep in midnight.

Section 4

Ans 4.1 The bandwidth delay product (bdp) is the maximum bits which a network link can contain when it is filled.

bandwidth delay product = bandwidth * delay

For every host servers, we can get bandwidths by running 'iperf -c [hostname]' or 'iperf3 -c [hostname]' 3 times. Through a lot of calculations, the following Table 4.1 is obtained.

In table 4.1, there are lots of intermediate processes which is displayed in Section 4 of the appendix.

	Hostname	IP address	3 times bandwidth(M)	AVG of bandwidth(M)
1	bouygues.testdebit.info	89.84.1.222	83.3	82.933
			83.7	
			81.8	
2	st2.nn.ertelecom.ru	91.144.184.232	12.6	11.800
			10	
			12.8	
3	iperf.biznetnetworks.com	117.102.109.186	228	227.667
			229	
			226	
4	iperf.volia.net	77.120.3.236	46.2	50.033
			52	
			51.9	
5	ping.online.net	62.210.18.40	79.5	80.200
			80.4	
			80.7	
6	ping-90ms.online.net	62.210.18.41	55	55.133
			54.5	
			55.9	
7	speedtest.serverius.net	178.21.16.76	15.1	14.333
			14.3	
			13.6	
8	speedtest.hostkey.ru	31.192.104.200	32.3	28.800
			26.7	
			27.4	
9	ping-ams1.online.net	163.172.208.7	84.9	84.833
			84.3	
			85.3	
10	speedtest.wtnet.de	213.209.106.95	60.8	60.400
			58.6	
			61.8	

Table 4.1

Ans 4.2 Using the means of round-trip delay time in Section 3 and means of bandwidth, we can calculate the bandwidth delay product for each host. In order to make the following calculations easier, we use logarithmic function. Through a lot of calculations, the following Table 4.2 is obtained.

	Hostname	IP address	3 times bandwidth(M)	AVG of bandwidth(M)	AVG of delays(ms)	bandwidth delay product (kb)	log10(bdp
1	bouygues.testdebit.info	89.84.1.222	83.3 83.7 81.8	82.933	82.933	6877.938	3.83746
2	st2.nn.ertelecom.ru	91.144.184.232	12.6 10 12.8	11.800	11.800	139.240	2.14376
3	iperf.biznetnetworks.com	117.102.109.186	228 229 226	227.667	227.667	51832.111	4.71460
4	iperf.volia.net	77.120.3.236	46.2 52 51.9	50.033	50.033	2503.334	3.39852
5	ping.online.net	62.210.18.40	79.5 80.4 80.7	80.200	80.200	6432.040	3.80835
6	ping-90ms.online.net	62.210.18.41	55 54.5 55.9	55.133	55.133	3039.684	3.48283
7	speedtest.serverius.net	178.21.16.76	15.1 14.3 13.6	14.333	14.333	205.444	2.31269
8	speedtest.hostkey.ru	31.192.104.200	32.3 26.7 27.4	28.800	28.800	829.440	2.91878
9	ping-ams1.online.net	163.172.208.7	84.9 84.3 85.3	84.833	84.833	7196.694	3.85713
.0	speedtest.wtnet.de	213.209.106.95	60.8 58.6 61.8	60.400	60.400	3648.160	3.56207

Table 4.2

Using the plot function in Excel, we can get the bar chart of $log_{10}(bdp)$. Since the values of bandwidth delay product are in a large range, we use logarithmic function to make them more obvious. Then we can get the Fig 4.2.

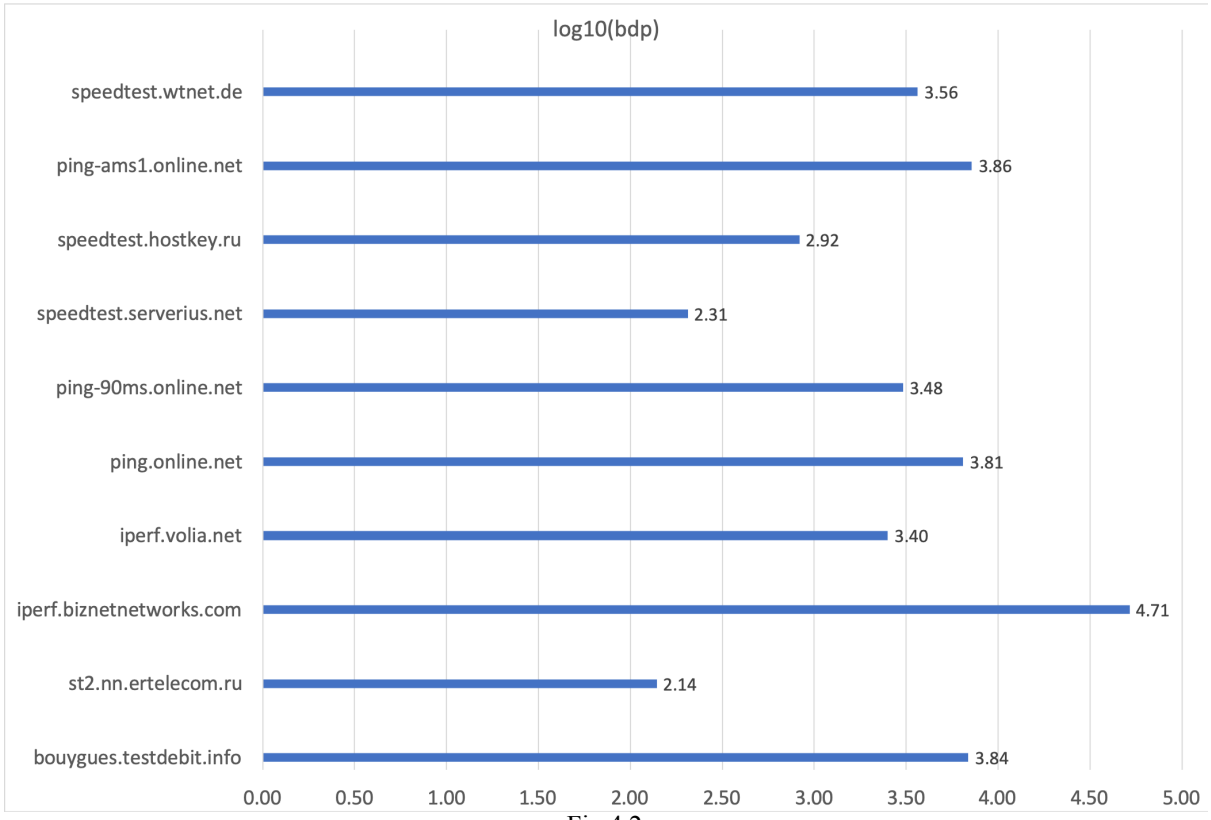

Fig 4.2

There is no doubt that actual internet link speed and network environment can influence the bandwidth delay product. We can get this conclusion easily from Table 4.2 and Fig 4.2. For internet link speed, it can directly influence the bandwidth. Besides, for network environment, it can directly influence the delay since better environment means smaller delay. Because the bandwidth delay product is equal to bandwidth times delay, actual internet link speed and network environment have correlations bandwidth delay product with by influencing its factors.

In my experiments, there are outliers. However, the outliers didn't have a significant impact on the final result because we used the average of multiple sets of data.

Ans 4.3 Using Excel, we can draw the scatter of hop count and $log_{10}(bdp)$. Fig 4.3 shows the correlation.

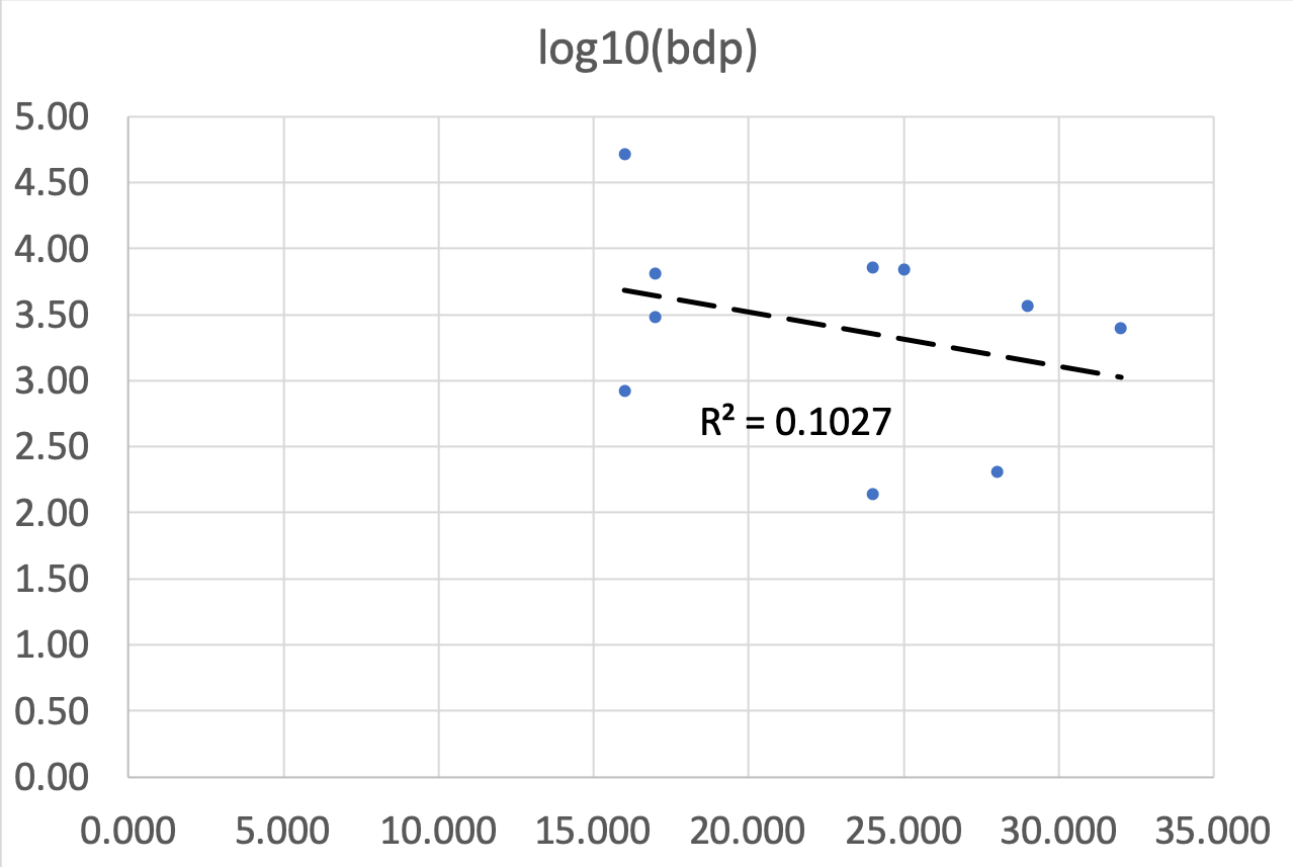

Fig 4.3

The R^2 is 0.1027, a very small value. Therefore, we can get conclusion that there is no correlation between hop count and bandwidth delay product. In my opinion, the hop count is determined by routing algorithms. Absolutely, the capacity of a link (bdp) is one factor of routing algorithms. However, because of lots of other factors in Section2, we cannot get the correlation even if we omit the outliers.

Ans 4.4 In real life, many factors can affect the accuracy and reliability of experiment results. For example, the number of users sharing the network. During the day, this number is variable since people are moving through different sub-networks. But at midnight, most people sleep, this number has very small change. Therefore, when I did my experiment, I choose the midnight to run all the commands in order to get more reliable results.

Reference

ANDREW S. TANENBAUM and DAVID J. WETHERALL. COMPUTER NETWORKS. Boston: Pearson Education, 2011.

Karthikeya Boyini, 2002, Bandwidth Delay Product, viewed 17th September 2019, <https://www.tutorialspoint.com/bandwidth-delay-product>.

IBM Knowledge Center, 2019, Traceroute command, viewed 17th September 2019, <https://www.ibm.com/support/knowledgecenter/TI0003N/p8hcg/p8hcg_traceroute.htm>.

Appendix

Section 2

Command: traceroute -nw 1 iperf.he.net

```
[-bash-4.1$ traceroute -nw 1 iperf.he.net
traceroute to iperf.he.net (216.218.227.10), 30 hops max, 60 byte packets
 1  128.250.106.3  0.897 ms  0.935 ms  0.978 ms
 2  172.18.86.73  0.540 ms  0.591 ms  0.582 ms
 3  172.18.65.17  0.565 ms  0.504 ms  0.543 ms
 4  172.19.1.181  0.536 ms  0.577 ms  0.459 ms
 5  172.19.1.182  0.540 ms  0.583 ms  0.525 ms
 6  172.18.66.254  0.507 ms  0.447 ms *
 7  138.44.64.62  0.636 ms  0.656 ms  0.649 ms
 8  113.197.15.21  0.906 ms  0.951 ms  1.059 ms
 9  113.197.15.8  12.330 ms  12.376 ms  12.427 ms
10  113.197.15.2  13.472 ms  13.512 ms  13.518 ms
11  113.197.15.143  13.681 ms  13.661 ms  13.626 ms
12  202.158.194.121  156.244 ms  156.202 ms  156.140 ms
13  206.81.80.40  155.993 ms  156.016 ms  155.946 ms
14  184.105.64.138  159.268 ms  159.215 ms  159.337 ms
15  184.104.193.25  171.904 ms  170.312 ms  170.397 ms
16  184.105.65.210  171.217 ms  172.079 ms  172.196 ms
17  216.218.227.10  167.729 ms  166.672 ms  166.710 ms
```

Fig 2.1.1

Command: traceroute -w 1 iperf.he.net

```
l$ traceroute -w 1 iperf.he.net
te to iperf.he.net (216.218.227.10), 30 hops max, 60 byte packets
250.106.3 (128.250.106.3)  0.797 ms  0.845 ms  0.878 ms
266-vss-vpn-research-v3755.unimelb.net.au (172.18.86.73)  0.357 ms  0.463 ms  0
00_po101.unimelb.net.au (172.18.65.17)  0.506 ms  0.497 ms  0.534 ms
19.1.181 (172.19.1.181)  0.463 ms  0.453 ms  0.497 ms
19.1.182 (172.19.1.182)  0.477 ms  0.515 ms  0.503 ms
56-te-2-2.unimelb.net.au (172.18.66.254)  0.435 ms *  0.423 ms
44.64.62 (138.44.64.62)  0.509 ms  0.530 ms  0.585 ms
-1-0.pe1.wmlb.vic.aarnet.net.au (113.197.15.21)  0.868 ms  0.918 ms  0.946 ms
-3-0.pe1.eskp.nsw.aarnet.net.au (113.197.15.8)  12.410 ms  12.456 ms  12.512 ms
-1-0.pe1.mcqp.nsw.aarnet.net.au (113.197.15.2)  13.479 ms  13.507 ms  13.621 ms
-1-0.pe1.bkvl.nsw.aarnet.net.au (113.197.15.143)  13.746 ms  13.783 ms  13.822
-2-5.bdr1.b.sea.aarnet.net.au (202.158.194.121)  155.805 ms  155.841 ms  155.83
e14-2.core1.sea1.he.net (206.81.80.40)  155.819 ms  155.856 ms  155.909 ms
e15-1.core1.pdx1.he.net (184.105.64.138)  159.151 ms  169.988 ms  170.197 ms
e5-2.core1.pao1.he.net (184.104.193.25)  171.808 ms  171.759 ms  171.748 ms
9.core4.fmt1.he.net (184.105.65.210)  172.046 ms  172.120 ms  170.935 ms
218.227.10 (216.218.227.10)  166.459 ms  167.617 ms  166.448 ms
```

Fig 2.1.2

Command: traceroute -n iperf.he.net

```
$ traceroute -n iperf.he.net
e to iperf.he.net (216.218.227.10), 30 hops max, 60 byte packets
50.106.3  0.733 ms  0.771 ms  0.800 ms
8.86.73  0.458 ms  0.444 ms  0.463 ms
8.65.17  0.501 ms  0.623 ms  0.605 ms
9.1.181  0.639 ms  0.619 ms  0.558 ms
9.1.182  0.603 ms  0.586 ms  0.525 ms
8.66.254  0.515 ms * *
4.64.62  0.651 ms  0.626 ms  0.564 ms
97.15.21  0.912 ms  0.941 ms  1.049 ms
97.15.8  12.295 ms  12.329 ms  12.371 ms
97.15.2  13.948 ms  13.972 ms  14.014 ms
97.15.143  13.681 ms  13.716 ms  13.649 ms
58.194.121  155.745 ms  155.750 ms  155.707 ms
1.80.40  155.798 ms  155.803 ms  155.859 ms
05.64.138  159.246 ms  159.248 ms  159.097 ms
04.193.25  171.456 ms  170.272 ms  170.401 ms
05.65.210  170.740 ms  172.047 ms  170.852 ms
18.227.10  167.443 ms  166.329 ms  167.462 ms
```

Fig 2.1.3

Command: traceroute -nw 1 iperf.he.net

```
[-bash-4.1$ traceroute -nw 1 iperf.he.net
traceroute to iperf.he.net (216.218.227.10), 30 hops max, 60 byte packets
 1  128.250.106.3  0.569 ms  0.625 ms  0.715 ms
 2  172.18.86.73  0.437 ms  0.564 ms  0.471 ms
 3  172.18.65.17  0.533 ms  0.510 ms  0.495 ms
 4  172.19.1.181  0.467 ms  0.465 ms  0.481 ms
 5  172.19.1.182  0.532 ms  0.521 ms  0.566 ms
 6  172.18.66.254  0.490 ms *  0.435 ms
 7  138.44.64.62  0.599 ms  0.623 ms  0.611 ms
 8  113.197.15.21  0.911 ms  0.891 ms  1.004 ms
 9  113.197.15.8  14.013 ms  14.065 ms  14.171 ms
10  113.197.15.2  13.420 ms  13.439 ms  13.494 ms
11  113.197.15.143  13.752 ms  13.680 ms  13.657 ms
12  202.158.194.121  155.728 ms  155.716 ms  155.702 ms
13  206.81.80.40  155.765 ms  155.804 ms  155.767 ms
14  184.105.64.138  159.180 ms  159.306 ms  159.402 ms
15  184.104.193.25  170.317 ms  171.538 ms  170.291 ms
16  184.105.65.210  171.030 ms  171.096 ms  171.968 ms
17  216.218.227.10  166.587 ms  167.712 ms  166.686 ms
```

Fig 2.2.1-1

Find location of iperf.he.net:

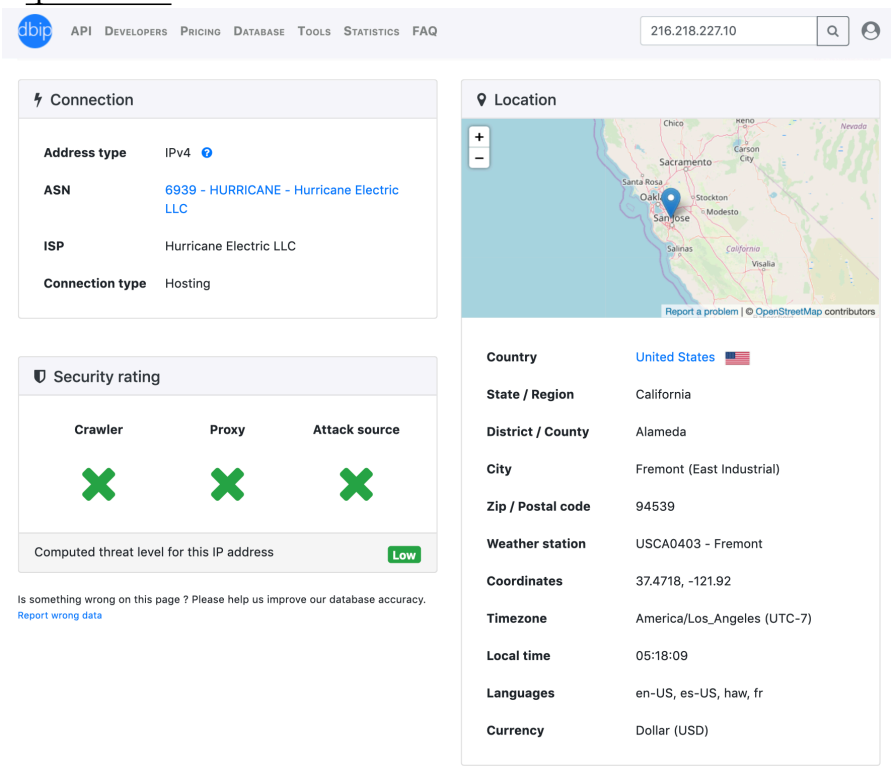

Fig 2.2.1-2

Calculate distance of iperf.he.net :

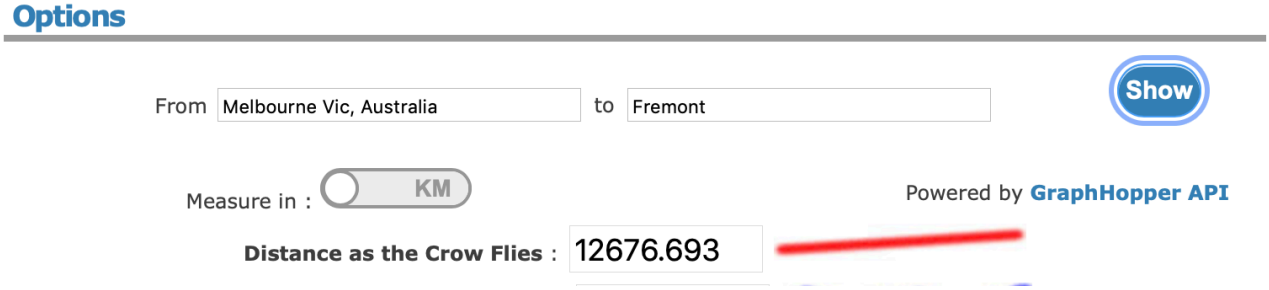

Fig 2.2.1-3

Command: traceroute -nw 1 bouygues.testdebit.info :

```
[-bash-4.1$ traceroute -nw 1 bouygues.testdebit.info
traceroute to bouygues.testdebit.info (89.84.1.222), 30 hops max, 60 byte packets
 1  128.250.106.2  0.974 ms  0.977 ms  1.014 ms
 2  172.18.86.73  0.368 ms  0.391 ms  0.427 ms
 3  172.18.65.21  0.478 ms  0.464 ms  0.485 ms
 4  172.19.1.181  0.412 ms  0.429 ms  0.459 ms
 5  172.19.1.182  0.434 ms  0.470 ms  0.508 ms
 6  172.18.66.254  0.492 ms  0.438 ms *
 7  138.44.64.62  0.486 ms  0.588 ms  0.562 ms
 8  113.197.15.21  0.799 ms  0.831 ms  0.889 ms
 9  113.197.15.8  12.188 ms  12.253 ms  12.282 ms
10  113.197.15.2  13.417 ms  13.460 ms  13.468 ms
11  113.197.15.143  14.607 ms  14.626 ms  14.581 ms
12  202.158.194.121  157.509 ms  157.646 ms  157.631 ms
13  64.125.193.129  157.823 ms  157.820 ms  157.751 ms
14  64.125.29.0  285.150 ms  285.064 ms  285.005 ms
15  * * *
16  64.125.29.208  308.262 ms  308.228 ms  308.246 ms
17  64.125.29.127  287.063 ms  286.899 ms  286.877 ms
18  64.125.29.24  283.998 ms  284.055 ms  283.977 ms
19  64.125.29.85  283.997 ms  284.064 ms  283.976 ms
20  64.125.29.95  284.733 ms  284.765 ms  284.742 ms
21  * * *
22  62.34.2.57  287.779 ms  287.702 ms  287.714 ms
23  212.194.171.68  286.916 ms  287.000 ms  286.891 ms
24  89.89.101.141  287.281 ms  287.338 ms  287.100 ms
25  89.84.1.222  286.879 ms  286.904 ms  286.891 ms
```

Fig 2.2.2-1

Find location of bouygues.testdebit.info :

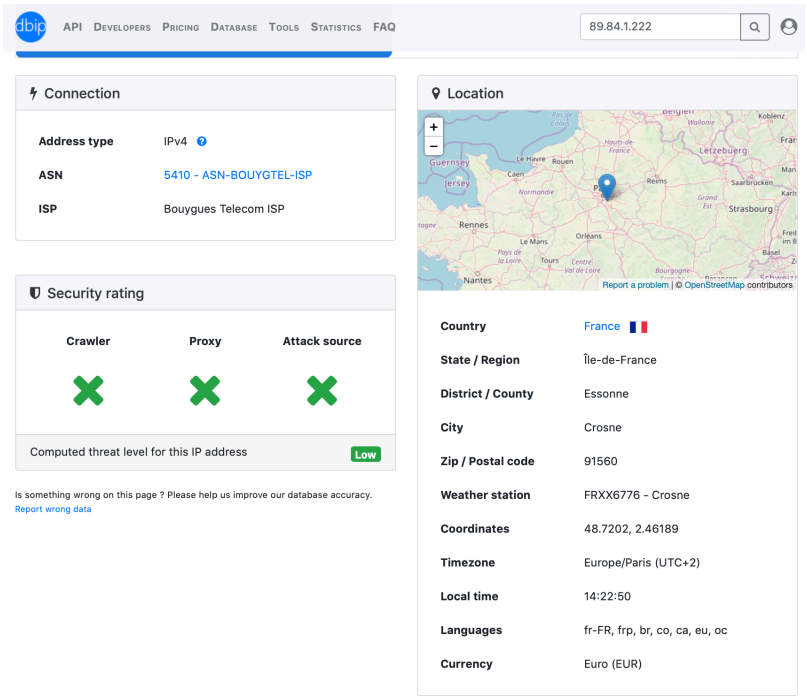

Fig 2.2.2-2

Calculate distance of bouygues.testdebit.info :

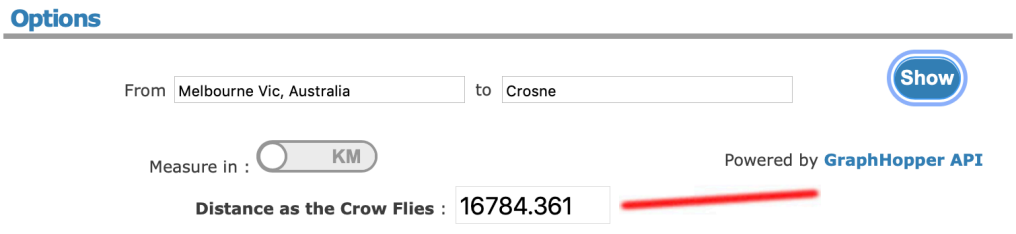

Fig 2.2.2-3

Command: traceroute -nw 1 ikoula.testdebit.info :

```
[-bash-4.1$ traceroute -nw 1 ikoula.testdebit.info
traceroute to ikoula.testdebit.info (213.246.63.45), 30 hops max, 60 byte packets
 1  128.250.106.2  0.705 ms  0.744 ms  1.200 ms
 2  172.18.86.73  0.405 ms  0.453 ms  0.497 ms
 3  172.18.65.21  0.425 ms  0.469 ms  0.563 ms
 4  172.19.1.181  0.382 ms  0.422 ms  0.511 ms
 5  172.19.1.182  0.500 ms  0.496 ms  0.483 ms
 6  172.18.66.254  0.454 ms  0.405 ms *
 7  138.44.64.62  0.601 ms  0.580 ms  0.606 ms
 8  113.197.15.21  0.906 ms  0.840 ms  0.838 ms
 9  113.197.15.8  12.303 ms  12.330 ms  12.382 ms
10  113.197.15.2  13.386 ms  13.412 ms  13.520 ms
11  113.197.15.143  13.850 ms  13.766 ms  13.819 ms
12  202.158.194.121  155.834 ms  155.795 ms  155.780 ms
13  198.104.202.61  155.808 ms  155.777 ms  155.711 ms
14  129.250.5.97  281.843 ms  281.833 ms 129.250.5.85  281.930 ms
15  129.250.2.9  158.877 ms  158.878 ms  158.751 ms
16  129.250.4.14  215.066 ms  215.049 ms  214.999 ms
17  129.250.2.19  283.184 ms  281.963 ms  284.301 ms
18  129.250.4.245  280.749 ms  280.828 ms  282.023 ms
19  83.231.233.146  281.291 ms  278.809 ms  279.962 ms
20  100.99.0.22  300.233 ms  300.179 ms  300.004 ms
21  100.99.0.2  285.054 ms  286.127 ms  286.078 ms
22  100.99.0.10  287.821 ms  286.781 ms  285.455 ms
23  * * *
24  213.246.32.126  305.547 ms  304.319 ms  303.275 ms
25  213.246.50.213  305.745 ms  306.838 ms  305.793 ms
26  213.246.32.61  300.140 ms  297.999 ms  300.073 ms
27  213.246.50.169  298.353 ms  299.110 ms  299.123 ms
28  213.246.32.57  298.973 ms  299.022 ms 213.246.50.162  297.435 ms
29  213.246.63.45  300.057 ms * 213.246.50.182  297.902 ms
```

Fig 2.2.3-1

Find location of ikoula.testdebit.info :

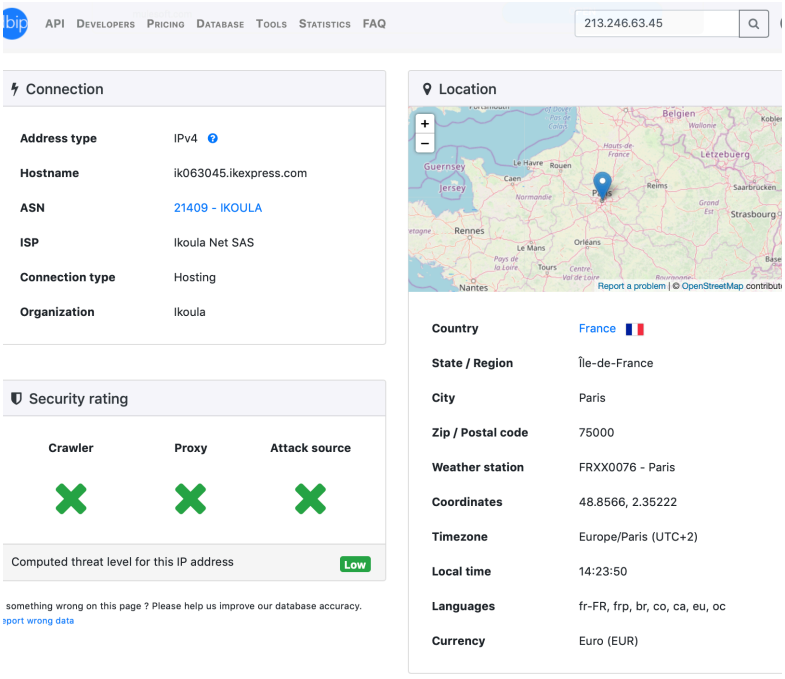

Fig 2.2.3-2

Calculate distance of ikoula.testdebit.info :

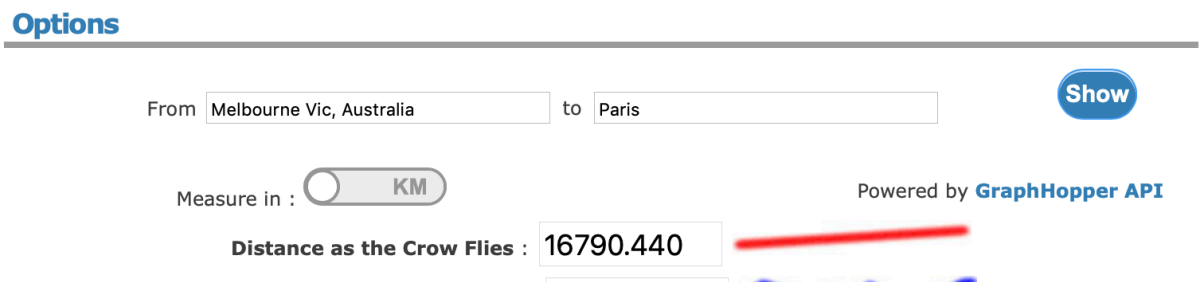

Fig 2.2.3-3

Command: traceroute -nw 1 st2.nn.ertelecom.ru :

```
bash-4.1$ traceroute -nw 1 st2.nn.ertelecom.ru
raceroute to st2.nn.ertelecom.ru (91.144.184.232), 30 hops max, 60 byte packets
1  128.250.106.3  0.876 ms  0.902 ms  0.941 ms
2  172.18.86.73  0.360 ms  0.399 ms  0.454 ms
3  172.18.65.21  0.504 ms  0.496 ms  0.479 ms
4  172.19.1.181  0.396 ms  0.450 ms  0.495 ms
5  172.19.1.182  0.482 ms  0.513 ms  0.501 ms
6  172.18.66.254  0.424 ms *  0.374 ms
7  138.44.64.62  0.652 ms  0.617 ms  0.549 ms
8  113.197.15.21  0.925 ms  0.936 ms  0.980 ms
9  113.197.15.8  12.274 ms  12.285 ms  12.394 ms
0  113.197.15.2  13.414 ms  13.451 ms  13.413 ms
1  113.197.15.143  13.678 ms  13.715 ms  13.764 ms
2  202.158.194.121  155.739 ms  155.742 ms  155.726 ms
3  198.104.202.61  158.379 ms  158.395 ms  158.280 ms
4  129.250.5.85  155.934 ms  155.936 ms  155.956 ms
5  213.248.70.12  172.175 ms  172.082 ms  172.079 ms
6  62.115.117.49  206.527 ms  206.789 ms  206.860 ms
7  80.91.246.163  332.442 ms 62.115.137.58  335.554 ms  335.476 ms
8  213.155.134.51  332.680 ms  332.819 ms 80.91.254.90  334.791 ms
9  62.115.139.168  330.998 ms  332.002 ms  331.072 ms
0  80.91.250.98  335.932 ms 80.91.249.78  335.888 ms  331.728 ms
1  62.115.148.175  329.689 ms  328.943 ms  331.358 ms
2  109.194.232.26  364.336 ms  351.866 ms  352.636 ms
3  * * *
4  91.144.184.232  348.639 ms  345.781 ms  345.190 ms
```

Fig 2.2.4-1

Find location of st2.nn.ertelecom.ru :

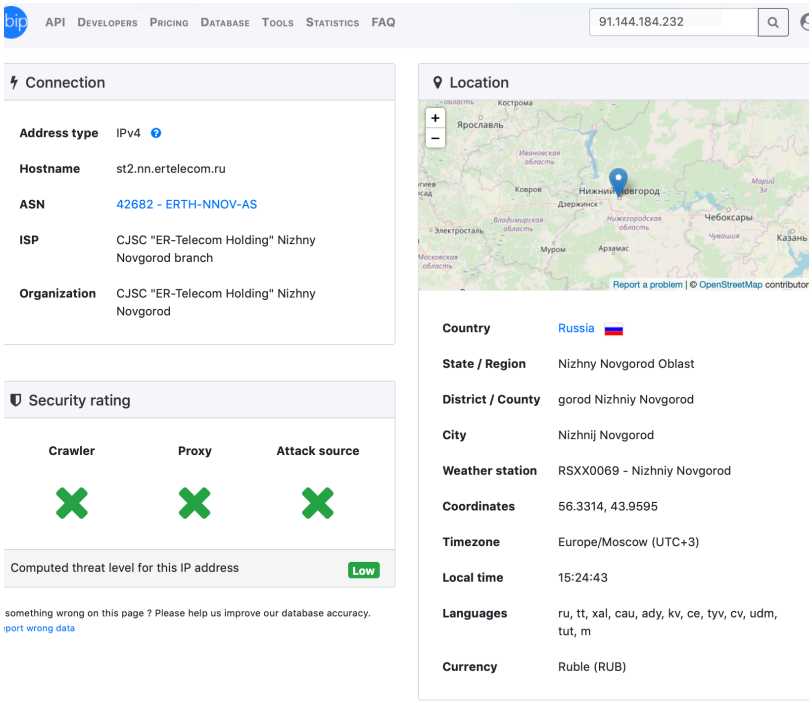

Fig 2.2.4-2

Calculate distance of st2.nn.ertelecom.ru :

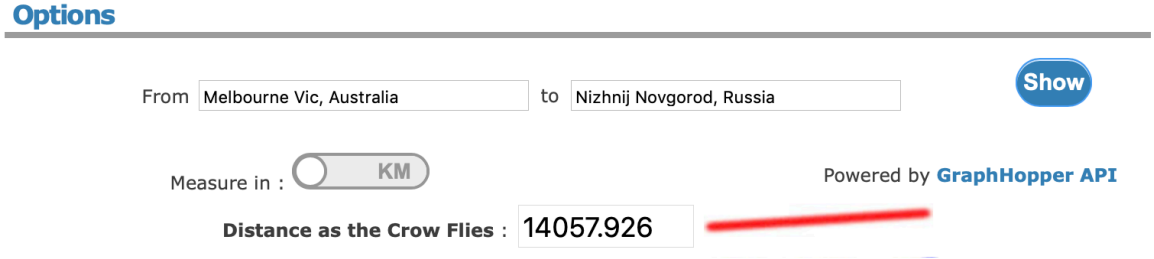

Fig 2.2.4-3

Command: traceroute -nw 1 iperf.biznetnetworks.com :

```
aceroute -nw 1 iperf.biznetnetworks.com
 iperf.biznetnetworks.com (117.102.109.186), 30 hops max, 60 b
06.2  0.643 ms  0.717 ms  0.885 ms
.73  0.365 ms  0.404 ms  0.454 ms
.21  0.529 ms  0.503 ms  0.488 ms
181  0.466 ms  0.457 ms  0.473 ms
182  0.460 ms  0.509 ms  0.495 ms
.254  0.416 ms  0.407 ms *
.62  0.562 ms  0.550 ms  0.594 ms
5.21  0.830 ms  0.881 ms  0.929 ms
5.29  9.684 ms  9.702 ms  9.809 ms
5.41  35.841 ms  35.869 ms  35.921 ms
5.237  82.650 ms  82.690 ms  82.650 ms
5.234  81.994 ms  81.955 ms  82.095 ms
.29  85.204 ms  85.197 ms  85.139 ms
87.25  94.452 ms  94.462 ms  94.341 ms
9.106  93.925 ms  94.039 ms  94.143 ms
09.186  93.213 ms !X  93.196 ms !X  93.171 ms !X
```

Fig 2.2.5-1

Find location of iperf.biznetnetworks.com :

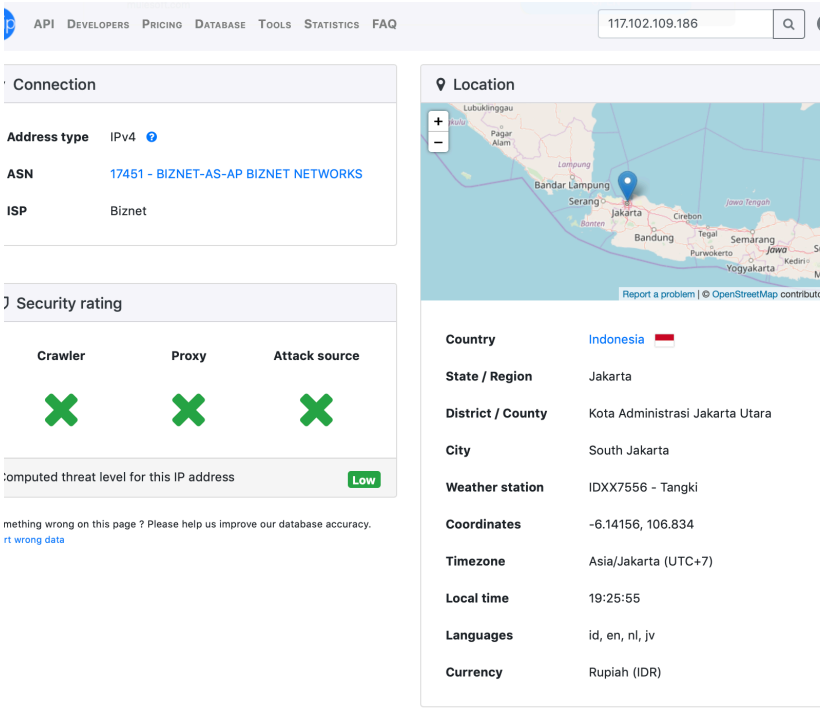

Fig 2.2.5-2

Calculate distance of iperf.biznetnetworks.com :

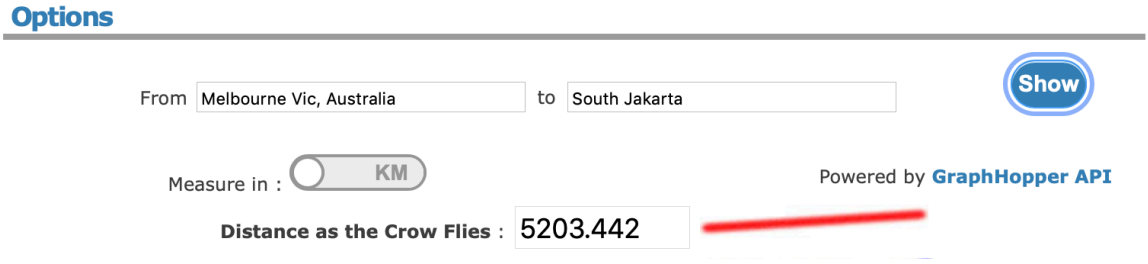

Fig 2.2.5-3

Command: traceroute -nw 1 iperf.scottlinux.com :

```
oute -nw 1 iperf.scottlinux.com
rf.scottlinux.com (45.33.39.39), 30 hops max, 60 byte pack
  1.104 ms  1.107 ms  1.139 ms
 0.430 ms  0.423 ms  0.399 ms
 0.496 ms  0.539 ms  0.522 ms
 225.218 ms  225.248 ms  225.291 ms
 0.479 ms  0.502 ms  0.483 ms
  0.404 ms * *
 0.497 ms  0.540 ms  0.527 ms
  0.989 ms  0.979 ms  1.032 ms
 12.292 ms  12.292 ms  12.240 ms
8  13.023 ms  13.055 ms  13.055 ms
7  13.144 ms  13.123 ms  12.995 ms
73  158.914 ms  158.903 ms  158.907 ms
8  168.130 ms  168.131 ms  168.108 ms
7  168.308 ms 173.230.159.65  168.771 ms 173.230.159.67  1
168.166 ms  168.064 ms  168.268 ms
```

Fig 2.2.6-1

Find location of iperf.scottlinux.com :

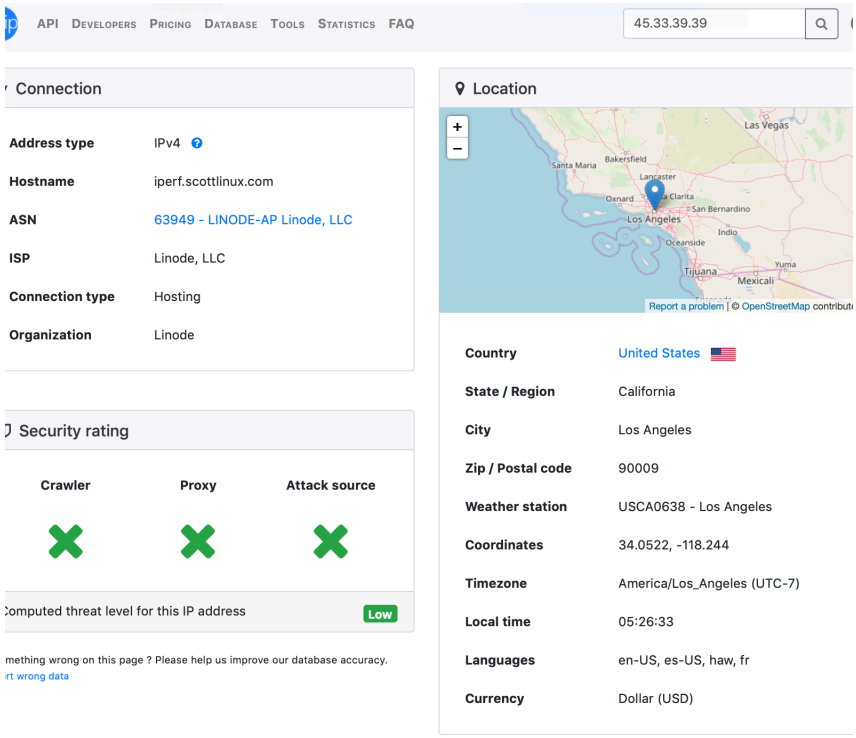

Fig 2.2.6-2

Calculate distance of iperf.scottlinux.com :

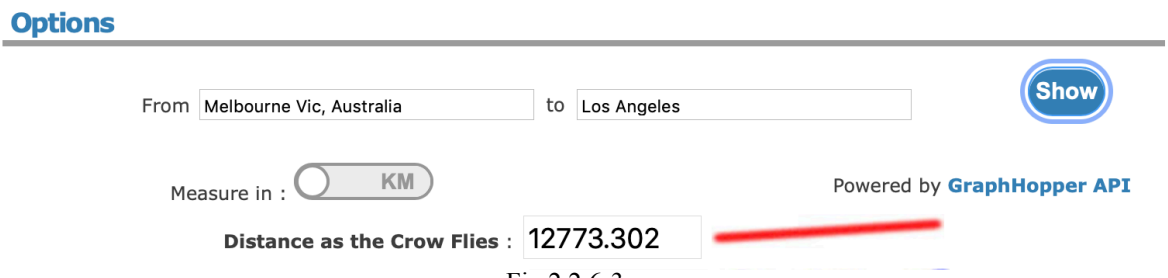

Fig 2.2.6-3

Command: traceroute -nw 1 iperf.eenet.ee :

```
ash-4.1$ traceroute -nw 1 iperf.eenet.ee
aceroute to iperf.eenet.ee (193.40.55.7), 30 hops max, 60 byte packets
  128.250.106.3  1.551 ms  1.591 ms  1.898 ms
  172.18.86.73  0.422 ms  0.351 ms  0.457 ms
  172.18.65.21  0.512 ms  0.511 ms  0.495 ms
  172.19.1.181  0.480 ms  0.400 ms  0.519 ms
  172.19.1.182  0.514 ms  0.499 ms  0.533 ms
  172.18.66.254  0.474 ms  0.369 ms *
  138.44.64.62  0.563 ms  0.625 ms  0.565 ms
  113.197.15.21  1.545 ms  1.599 ms  1.680 ms
  113.197.15.29  9.618 ms  9.760 ms  9.654 ms
  113.197.15.41  35.863 ms  35.903 ms  35.934 ms
  113.197.15.237  92.296 ms  92.299 ms  92.295 ms
  113.197.15.234  82.015 ms  81.982 ms  81.981 ms
  138.44.226.7  253.016 ms  252.979 ms  253.009 ms
  62.40.98.128  260.552 ms  260.557 ms  260.527 ms
  62.40.98.187  267.060 ms  267.024 ms  267.008 ms
  62.40.98.131  283.521 ms  283.434 ms  283.360 ms
  62.40.98.12  297.792 ms  297.785 ms  294.632 ms
  62.40.98.4  294.829 ms  294.810 ms  294.720 ms
  62.40.98.173  300.127 ms  300.135 ms  300.142 ms
  62.40.98.174  305.263 ms  305.265 ms  305.202 ms
  62.40.98.0  305.226 ms  305.181 ms  305.209 ms
  62.40.124.50  305.487 ms  305.417 ms  305.363 ms
  193.40.132.162  308.432 ms  308.399 ms  308.392 ms
  193.40.55.7  308.488 ms  308.483 ms  308.503 ms
```

Fig 2.2.7-1

Find location of iperf.eenet.ee :

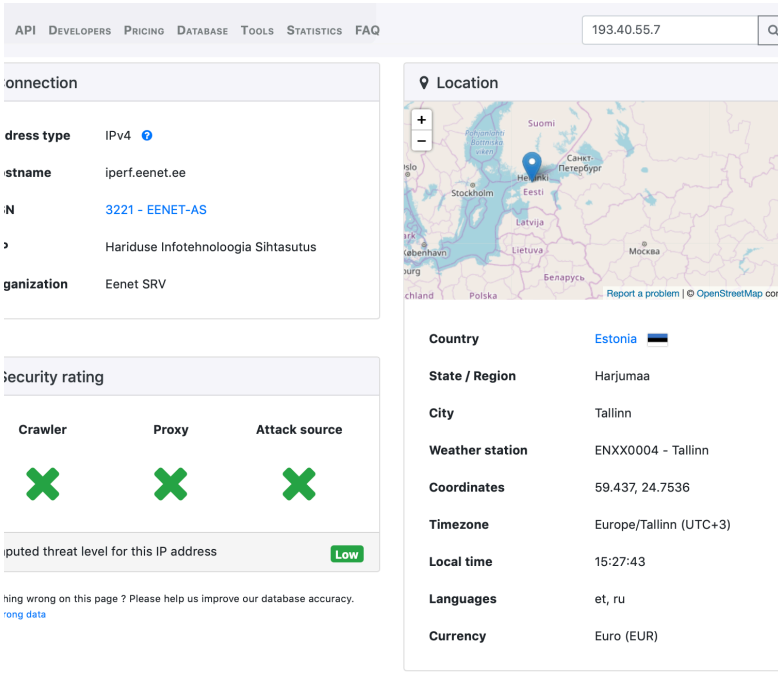

Fig 2.2.7-2

Calculate distance of iperf.eenet.ee :

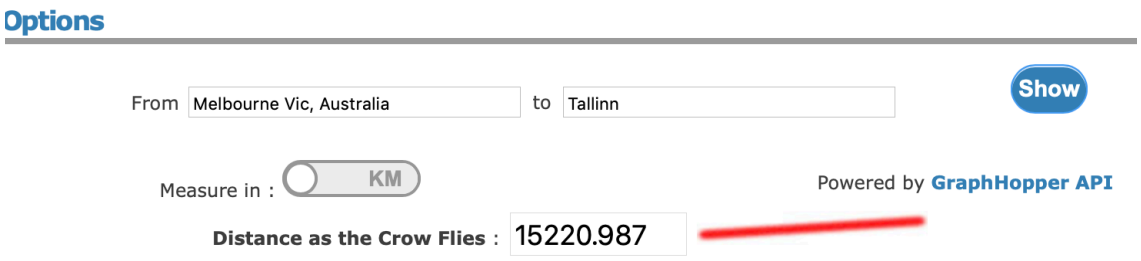

Fig 2.2.7-3

Command: traceroute -nw 1 ping.online.net :

```
; traceroute -nw 1 ping.online.net
; to ping.online.net (62.210.18.40), 30 hops max, 60 byte packets
50.106.3  0.912 ms  0.940 ms  1.409 ms
3.86.73  0.341 ms  0.381 ms  0.430 ms
3.65.17  1.498 ms  1.486 ms  1.522 ms
).1.181  0.437 ms  0.493 ms  0.486 ms
).1.182  0.468 ms  0.503 ms  0.490 ms
3.66.254  0.428 ms * *
4.64.62  0.552 ms  0.548 ms  0.587 ms
)7.15.21  0.874 ms  0.919 ms  0.965 ms
)7.15.8  14.310 ms  14.365 ms  14.218 ms
)7.15.2  13.373 ms  13.342 ms  13.411 ms
)7.15.143  13.657 ms  13.672 ms  13.639 ms
58.194.177  167.971 ms  168.011 ms  167.968 ms
2.176.70  168.027 ms  168.070 ms  168.104 ms
2.210.107  323.178 ms  323.114 ms  320.044 ms
44.168.103  301.441 ms  307.448 ms  301.353 ms
54.1.107  301.305 ms  307.475 ms  301.288 ms
).18.40  306.872 ms  303.773 ms  306.948 ms
; traceroute -nw 1 bouygues.iperf.fr
```

Fig 2.2.8-1

Find location of ping.online.net :

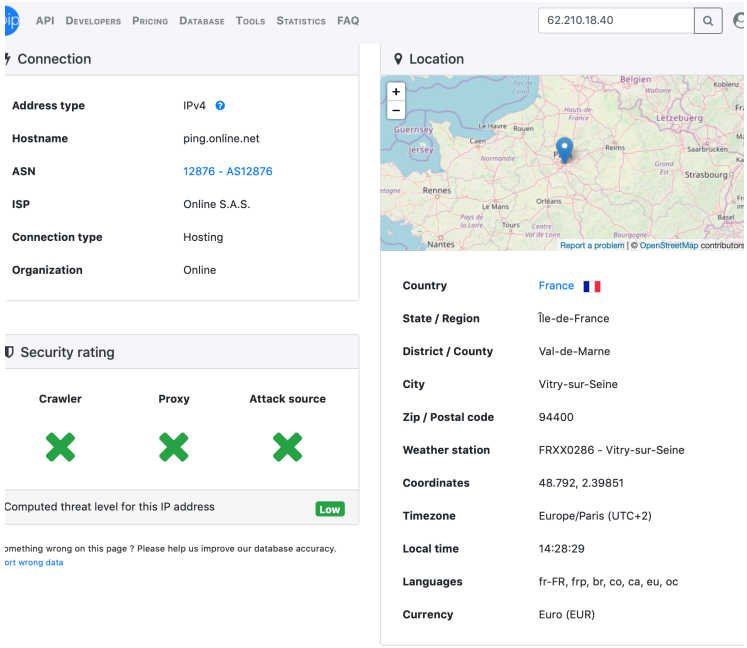

Fig 2.2.8-2

Calculate distance of ping.online.net:

Fig 2.2.8-3

Command: traceroute -nw 1 bouygues.iperf.fr :

```
traceroute to bouygues.iperf.fr (89.84.1.222), 30 hops max, 60 byte packets
 1  128.250.106.2  1.250 ms  1.272 ms  1.326 ms
 2  172.18.86.73  0.447 ms  0.509 ms  0.374 ms
 3  172.18.65.21  0.500 ms  0.478 ms  0.525 ms
 4  172.19.1.181  44.205 ms  44.295 ms  44.222 ms
 5  172.19.1.182  0.602 ms  0.470 ms  0.515 ms
 6  172.18.66.254  0.451 ms  0.409 ms *
 7  138.44.64.62  0.636 ms  0.573 ms  0.595 ms
 8  113.197.15.21  1.262 ms  1.306 ms  1.417 ms
 9  113.197.15.8  12.285 ms  12.289 ms  12.223 ms
10  113.197.15.2  13.464 ms  13.463 ms  13.494 ms
11  113.197.15.143  13.694 ms  13.733 ms  13.757 ms
12  202.158.194.121  156.746 ms  156.723 ms  156.665 ms
13  64.125.193.129  155.785 ms  155.794 ms  155.764 ms
14  64.125.29.0  289.594 ms  289.554 ms  289.501 ms
15  * * *
16  64.125.29.208  284.185 ms  284.162 ms  284.198 ms
17  64.125.29.127  283.999 ms  283.944 ms  283.976 ms
18  64.125.29.24  284.258 ms  284.116 ms  284.115 ms
19  64.125.29.85  284.090 ms  284.124 ms  283.901 ms
20  64.125.29.95  284.342 ms  284.255 ms  284.255 ms
21  * * *
22  62.34.2.57  288.601 ms  288.605 ms  288.540 ms
23  212.194.171.68  287.096 ms  287.122 ms  287.004 ms
24  89.89.101.141  287.151 ms  287.174 ms  287.286 ms
```

Fig 2.2.9-1

Find location of bouygues.iperf.fr :

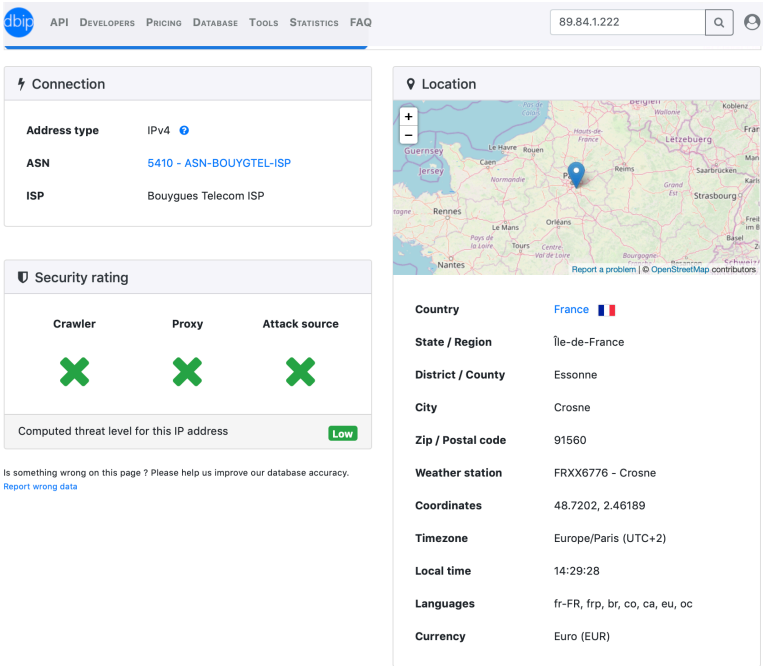

Fig 2.2.9-2

Calculate distance of bouygues.iperf.fr:

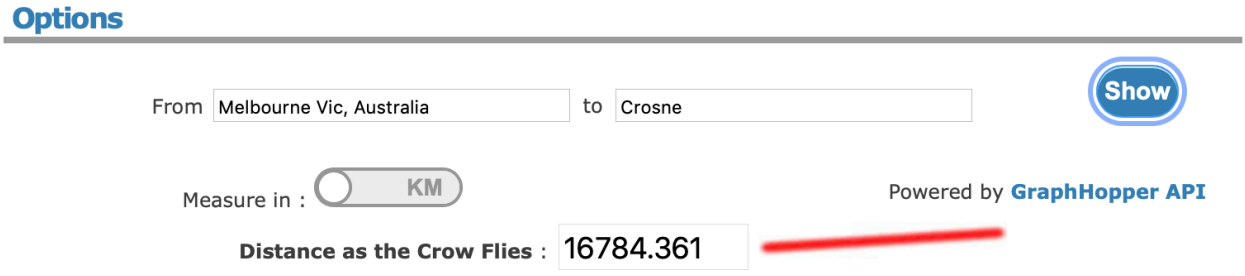

Fig 2.2.9-3

Command: traceroute -nw 1 ping-90ms.online.net :

```
1$ traceroute -nw 1 ping-90ms.online.net
te to ping-90ms.online.net (62.210.18.41), 30 hops max, 60 byte
250.106.3  0.749 ms  0.783 ms  0.813 ms
18.86.73  0.356 ms  0.383 ms  0.427 ms
18.65.21  0.472 ms  0.540 ms  0.519 ms
19.1.181  0.492 ms  0.488 ms  0.512 ms
19.1.182  0.500 ms  0.600 ms  0.536 ms
18.66.254  0.511 ms  0.523 ms  0.545 ms
44.64.62  0.604 ms  0.640 ms  0.620 ms
197.15.21  2.308 ms  2.234 ms  2.332 ms
197.15.8  12.331 ms  12.356 ms  12.447 ms
197.15.2  13.391 ms  13.313 ms  13.432 ms
197.15.143  13.750 ms  13.774 ms  13.815 ms
158.194.177  168.038 ms  167.938 ms  167.920 ms
32.176.70  168.110 ms  170.627 ms  170.691 ms
22.210.195  323.052 ms 195.22.210.107  324.861 ms  320.380 ms
144.168.103  307.143 ms  301.041 ms  304.364 ms
154.1.107  301.372 ms  304.569 ms  304.615 ms
10.18.41  396.901 ms  397.025 ms  397.055 ms
```

Fig 2.2.10-1

Find location of ping-90ms.online.net :

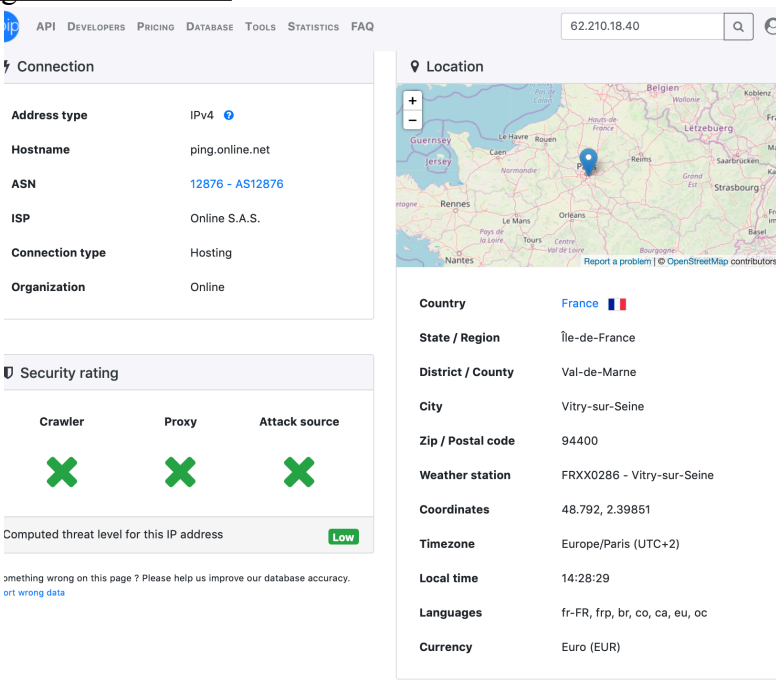

Fig 2.2.10-2

Calculate distance of ping-90ms.online.net :

Fig 2.2.10-3

Section 3

Command: ping -c 10 bouygues.testdebit.info:

```
[-bash-4.1$ ping -c 10 bouygues.testdebit.info
PING bouygues.testdebit.info (89.84.1.222) 56(84) bytes of data.
64 bytes from 89.84.1.222: icmp_seq=1 ttl=41 time=286 ms
64 bytes from 89.84.1.222: icmp_seq=2 ttl=41 time=287 ms
64 bytes from 89.84.1.222: icmp_seq=3 ttl=41 time=286 ms
64 bytes from 89.84.1.222: icmp_seq=4 ttl=41 time=286 ms
64 bytes from 89.84.1.222: icmp_seq=5 ttl=41 time=287 ms
64 bytes from 89.84.1.222: icmp_seq=6 ttl=41 time=286 ms
64 bytes from 89.84.1.222: icmp_seq=7 ttl=41 time=286 ms
64 bytes from 89.84.1.222: icmp_seq=8 ttl=41 time=287 ms
64 bytes from 89.84.1.222: icmp_seq=9 ttl=41 time=287 ms
64 bytes from 89.84.1.222: icmp_seq=10 ttl=41 time=288 ms

--- bouygues.testdebit.info ping statistics ---
10 packets transmitted, 10 received, 0% packet loss, time 9300ms
rtt min/avg/max/mdev = 286.822/287.209/288.521/0.635 ms
[-bash-4.1$ ping -c 10 bouygues.testdebit.info
PING bouygues.testdebit.info (89.84.1.222) 56(84) bytes of data.
64 bytes from 89.84.1.222: icmp_seq=1 ttl=41 time=286 ms
64 bytes from 89.84.1.222: icmp_seq=2 ttl=41 time=286 ms
64 bytes from 89.84.1.222: icmp_seq=3 ttl=41 time=289 ms
64 bytes from 89.84.1.222: icmp_seq=4 ttl=41 time=286 ms
64 bytes from 89.84.1.222: icmp_seq=5 ttl=41 time=286 ms
64 bytes from 89.84.1.222: icmp_seq=6 ttl=41 time=286 ms
64 bytes from 89.84.1.222: icmp_seq=7 ttl=41 time=286 ms
64 bytes from 89.84.1.222: icmp_seq=8 ttl=41 time=287 ms
64 bytes from 89.84.1.222: icmp_seq=9 ttl=41 time=286 ms
64 bytes from 89.84.1.222: icmp_seq=10 ttl=41 time=286 ms

--- bouygues.testdebit.info ping statistics ---
10 packets transmitted, 10 received, 0% packet loss, time 9296ms
rtt min/avg/max/mdev = 286.889/287.164/289.143/0.780 ms
[-bash-4.1$ ping -c 10 bouygues.testdebit.info
PING bouygues.testdebit.info (89.84.1.222) 56(84) bytes of data.
64 bytes from 89.84.1.222: icmp_seq=1 ttl=41 time=286 ms
64 bytes from 89.84.1.222: icmp_seq=2 ttl=41 time=286 ms
64 bytes from 89.84.1.222: icmp_seq=3 ttl=41 time=286 ms
64 bytes from 89.84.1.222: icmp_seq=4 ttl=41 time=287 ms
64 bytes from 89.84.1.222: icmp_seq=5 ttl=41 time=286 ms
64 bytes from 89.84.1.222: icmp_seq=6 ttl=41 time=287 ms
64 bytes from 89.84.1.222: icmp_seq=7 ttl=41 time=287 ms
64 bytes from 89.84.1.222: icmp_seq=8 ttl=41 time=286 ms
64 bytes from 89.84.1.222: icmp_seq=9 ttl=41 time=286 ms
64 bytes from 89.84.1.222: icmp_seq=10 ttl=41 time=287 ms

--- bouygues.testdebit.info ping statistics ---
10 packets transmitted, 10 received, 0% packet loss, time 9297ms
rtt min/avg/max/mdev = 286.875/287.078/287.644/0.672 ms
-bash-4.1$
```

Fig 3.1.1

Command: ping -c 10 st2.nn.ertelecom.ru:

```
.1$ ping -c 10 st2.nn.ertelecom.ru
2.nn.ertelecom.ru (91.144.184.232) 56(84) bytes of data.
s from st2.nn.ertelecom.ru (91.144.184.232): icmp_seq=1 ttl=42 time=344
s from st2.nn.ertelecom.ru (91.144.184.232): icmp_seq=2 ttl=42 time=344
s from st2.nn.ertelecom.ru (91.144.184.232): icmp_seq=3 ttl=42 time=345
s from st2.nn.ertelecom.ru (91.144.184.232): icmp_seq=4 ttl=42 time=344
s from st2.nn.ertelecom.ru (91.144.184.232): icmp_seq=5 ttl=42 time=344
s from st2.nn.ertelecom.ru (91.144.184.232): icmp_seq=6 ttl=42 time=344
s from st2.nn.ertelecom.ru (91.144.184.232): icmp_seq=7 ttl=42 time=344
s from st2.nn.ertelecom.ru (91.144.184.232): icmp_seq=8 ttl=42 time=345
s from st2.nn.ertelecom.ru (91.144.184.232): icmp_seq=9 ttl=42 time=344
s from st2.nn.ertelecom.ru (91.144.184.232): icmp_seq=10 ttl=42 time=34

.nn.ertelecom.ru ping statistics ---
ets transmitted, 10 received, 0% packet loss, time 9359ms
/avg/max/mdev = 344.780/345.138/346.277/0.845 ms
.1$ ping -c 10 st2.nn.ertelecom.ru
2.nn.ertelecom.ru (91.144.184.232) 56(84) bytes of data.
s from st2.nn.ertelecom.ru (91.144.184.232): icmp_seq=1 ttl=42 time=345
s from st2.nn.ertelecom.ru (91.144.184.232): icmp_seq=2 ttl=42 time=348
s from st2.nn.ertelecom.ru (91.144.184.232): icmp_seq=3 ttl=42 time=344
s from st2.nn.ertelecom.ru (91.144.184.232): icmp_seq=4 ttl=42 time=344
s from st2.nn.ertelecom.ru (91.144.184.232): icmp_seq=5 ttl=42 time=344
s from st2.nn.ertelecom.ru (91.144.184.232): icmp_seq=6 ttl=42 time=345
s from st2.nn.ertelecom.ru (91.144.184.232): icmp_seq=7 ttl=42 time=346
s from st2.nn.ertelecom.ru (91.144.184.232): icmp_seq=8 ttl=42 time=345
s from st2.nn.ertelecom.ru (91.144.184.232): icmp_seq=9 ttl=42 time=345
s from st2.nn.ertelecom.ru (91.144.184.232): icmp_seq=10 ttl=42 time=34

.nn.ertelecom.ru ping statistics ---
ets transmitted, 10 received, 0% packet loss, time 9356ms
/avg/max/mdev = 344.810/345.698/348.104/1.138 ms
.1$ ping -c 10 st2.nn.ertelecom.ru
2.nn.ertelecom.ru (91.144.184.232) 56(84) bytes of data.
s from st2.nn.ertelecom.ru (91.144.184.232): icmp_seq=1 ttl=42 time=344
s from st2.nn.ertelecom.ru (91.144.184.232): icmp_seq=2 ttl=42 time=347
s from st2.nn.ertelecom.ru (91.144.184.232): icmp_seq=3 ttl=42 time=345
s from st2.nn.ertelecom.ru (91.144.184.232): icmp_seq=4 ttl=42 time=344
s from st2.nn.ertelecom.ru (91.144.184.232): icmp_seq=5 ttl=42 time=347
s from st2.nn.ertelecom.ru (91.144.184.232): icmp_seq=6 ttl=42 time=344
s from st2.nn.ertelecom.ru (91.144.184.232): icmp_seq=7 ttl=42 time=344
s from st2.nn.ertelecom.ru (91.144.184.232): icmp_seq=8 ttl=42 time=344
s from st2.nn.ertelecom.ru (91.144.184.232): icmp_seq=9 ttl=42 time=344
s from st2.nn.ertelecom.ru (91.144.184.232): icmp_seq=10 ttl=42 time=34

.nn.ertelecom.ru ping statistics ---
ets transmitted, 10 received, 0% packet loss, time 9348ms
/avg/max/mdev = 344.797/345.467/347.516/1.178 ms
.1$
```

Fig 3.1.2

Command: ping -c 10 iperf.biznetnetworks.com:

```
bash-4.1$ ping -c 10 iperf.biznetnetworks.com
ING iperf.biznetnetworks.com (117.102.109.186) 56(84) bytes of data.
4 bytes from 117.102.109.186: icmp_seq=1 ttl=52 time=93.1 ms
4 bytes from 117.102.109.186: icmp_seq=2 ttl=52 time=93.1 ms
4 bytes from 117.102.109.186: icmp_seq=3 ttl=52 time=93.2 ms
4 bytes from 117.102.109.186: icmp_seq=4 ttl=52 time=93.1 ms
4 bytes from 117.102.109.186: icmp_seq=5 ttl=52 time=93.1 ms
4 bytes from 117.102.109.186: icmp_seq=6 ttl=52 time=93.1 ms
4 bytes from 117.102.109.186: icmp_seq=7 ttl=52 time=93.2 ms
4 bytes from 117.102.109.186: icmp_seq=8 ttl=52 time=93.0 ms
4 bytes from 117.102.109.186: icmp_seq=9 ttl=52 time=93.3 ms
4 bytes from 117.102.109.186: icmp_seq=10 ttl=52 time=93.1 ms

-- iperf.biznetnetworks.com ping statistics ---
0 packets transmitted, 10 received, 0% packet loss, time 9104ms
tt min/avg/max/mdev = 93.095/93.181/93.348/0.312 ms
bash-4.1$ ping -c 10 iperf.biznetnetworks.com
ING iperf.biznetnetworks.com (117.102.109.186) 56(84) bytes of data.
4 bytes from 117.102.109.186: icmp_seq=1 ttl=52 time=93.1 ms
4 bytes from 117.102.109.186: icmp_seq=2 ttl=52 time=93.1 ms
4 bytes from 117.102.109.186: icmp_seq=3 ttl=52 time=93.2 ms
4 bytes from 117.102.109.186: icmp_seq=4 ttl=52 time=93.2 ms
4 bytes from 117.102.109.186: icmp_seq=5 ttl=52 time=93.2 ms
4 bytes from 117.102.109.186: icmp_seq=6 ttl=52 time=93.2 ms
4 bytes from 117.102.109.186: icmp_seq=7 ttl=52 time=93.1 ms
4 bytes from 117.102.109.186: icmp_seq=8 ttl=52 time=93.1 ms
4 bytes from 117.102.109.186: icmp_seq=9 ttl=52 time=93.1 ms
4 bytes from 117.102.109.186: icmp_seq=10 ttl=52 time=93.1 ms

-- iperf.biznetnetworks.com ping statistics ---
0 packets transmitted, 10 received, 0% packet loss, time 9102ms
tt min/avg/max/mdev = 93.112/93.180/93.258/0.052 ms
bash-4.1$ ping -c 10 iperf.biznetnetworks.com
ING iperf.biznetnetworks.com (117.102.109.186) 56(84) bytes of data.
4 bytes from 117.102.109.186: icmp_seq=1 ttl=52 time=93.1 ms
4 bytes from 117.102.109.186: icmp_seq=2 ttl=52 time=93.1 ms
4 bytes from 117.102.109.186: icmp_seq=3 ttl=52 time=93.1 ms
4 bytes from 117.102.109.186: icmp_seq=4 ttl=52 time=93.2 ms
4 bytes from 117.102.109.186: icmp_seq=5 ttl=52 time=93.0 ms
4 bytes from 117.102.109.186: icmp_seq=6 ttl=52 time=93.2 ms
4 bytes from 117.102.109.186: icmp_seq=7 ttl=52 time=93.1 ms
4 bytes from 117.102.109.186: icmp_seq=8 ttl=52 time=93.2 ms
4 bytes from 117.102.109.186: icmp_seq=9 ttl=52 time=93.1 ms
4 bytes from 117.102.109.186: icmp_seq=10 ttl=52 time=93.1 ms

-- iperf.biznetnetworks.com ping statistics ---
0 packets transmitted, 10 received, 0% packet loss, time 9101ms
tt min/avg/max/mdev = 93.062/93.165/93.256/0.147 ms
bash-4.1$
```

Fig 3.1.3

Command: ping -c 10 iperf.volia.net:

```
.1$ ping -c 10 iperf.volia.net
eedtest.volia.net (77.120.3.236) 56(84) bytes of data.
s from speedtest.volia.com (77.120.3.236): icmp_seq=1 ttl=31 time=345
s from speedtest.volia.com (77.120.3.236): icmp_seq=2 ttl=31 time=345
s from speedtest.volia.com (77.120.3.236): icmp_seq=3 ttl=31 time=345
s from speedtest.volia.com (77.120.3.236): icmp_seq=4 ttl=31 time=346
s from speedtest.volia.com (77.120.3.236): icmp_seq=5 ttl=31 time=345
s from speedtest.volia.com (77.120.3.236): icmp_seq=6 ttl=31 time=345
s from speedtest.volia.com (77.120.3.236): icmp_seq=7 ttl=31 time=345
s from speedtest.volia.com (77.120.3.236): icmp_seq=8 ttl=31 time=345
s from speedtest.volia.com (77.120.3.236): icmp_seq=9 ttl=31 time=345
s from speedtest.volia.com (77.120.3.236): icmp_seq=10 ttl=31 time=345

edtest.volia.net ping statistics ---
ets transmitted, 10 received, 0% packet loss, time 9354ms
/avg/max/mdev = 345.126/345.388/346.264/0.830 ms
.1$ ping -c 10 iperf.volia.net
eedtest.volia.net (77.120.3.236) 56(84) bytes of data.
s from speedtest.volia.com (77.120.3.236): icmp_seq=1 ttl=31 time=345
s from speedtest.volia.com (77.120.3.236): icmp_seq=2 ttl=31 time=345
s from speedtest.volia.com (77.120.3.236): icmp_seq=3 ttl=31 time=345
s from speedtest.volia.com (77.120.3.236): icmp_seq=4 ttl=31 time=345
s from speedtest.volia.com (77.120.3.236): icmp_seq=5 ttl=31 time=345
s from speedtest.volia.com (77.120.3.236): icmp_seq=6 ttl=31 time=347
s from speedtest.volia.com (77.120.3.236): icmp_seq=7 ttl=31 time=345
s from speedtest.volia.com (77.120.3.236): icmp_seq=8 ttl=31 time=345
s from speedtest.volia.com (77.120.3.236): icmp_seq=9 ttl=31 time=348
s from speedtest.volia.com (77.120.3.236): icmp_seq=10 ttl=31 time=345

edtest.volia.net ping statistics ---
ets transmitted, 10 received, 0% packet loss, time 9345ms
/avg/max/mdev = 345.128/345.779/348.412/1.336 ms
.1$ ping -c 10 iperf.volia.net
eedtest.volia.net (77.120.3.236) 56(84) bytes of data.
s from speedtest.volia.com (77.120.3.236): icmp_seq=1 ttl=31 time=345
s from speedtest.volia.com (77.120.3.236): icmp_seq=2 ttl=31 time=345
s from speedtest.volia.com (77.120.3.236): icmp_seq=3 ttl=31 time=346
s from speedtest.volia.com (77.120.3.236): icmp_seq=4 ttl=31 time=345
s from speedtest.volia.com (77.120.3.236): icmp_seq=5 ttl=31 time=346
s from speedtest.volia.com (77.120.3.236): icmp_seq=6 ttl=31 time=346
s from speedtest.volia.com (77.120.3.236): icmp_seq=7 ttl=31 time=345
s from speedtest.volia.com (77.120.3.236): icmp_seq=8 ttl=31 time=345
s from speedtest.volia.com (77.120.3.236): icmp_seq=9 ttl=31 time=345
s from speedtest.volia.com (77.120.3.236): icmp_seq=10 ttl=31 time=345

edtest.volia.net ping statistics ---
ets transmitted, 10 received, 0% packet loss, time 9354ms
/avg/max/mdev = 345.137/345.647/346.729/0.880 ms
.1$
```

Fig 3.1.4-1

Find location of iperf.volia.net:

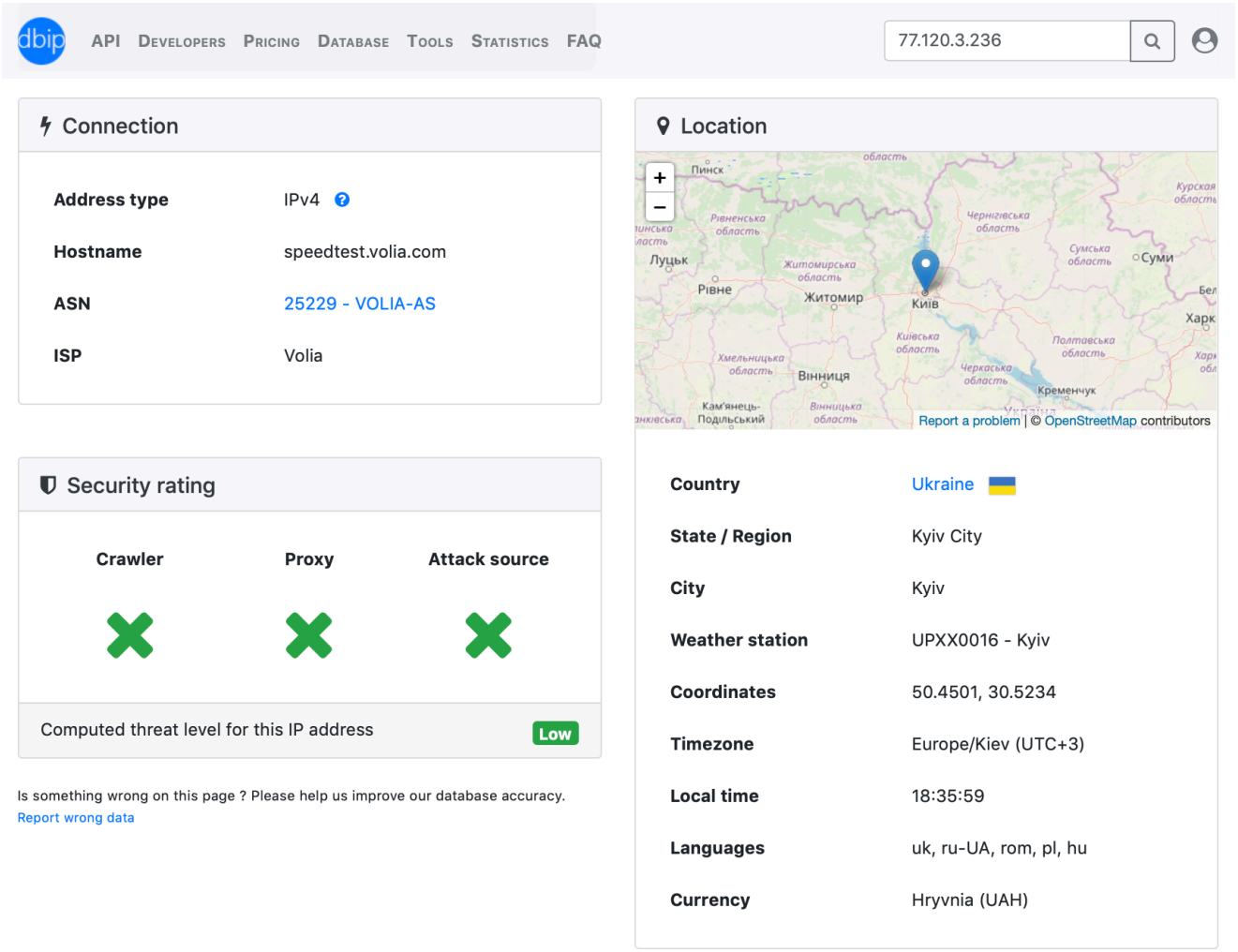

Fig 3.1.4-2

Calculate distance of iperf.volia.net:

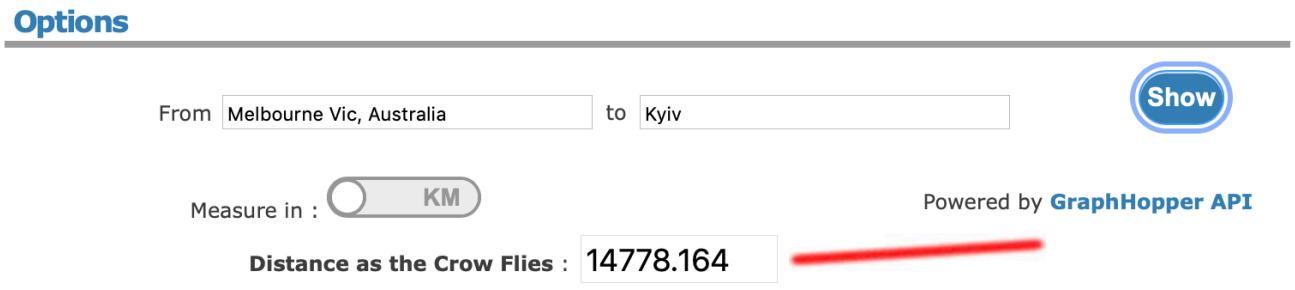

Fig 3.1.4-3

Command: ping -c 10 ping.online.net:

```
sh-4.1$ ping -c 10 ping.online.net
G ping.online.net (62.210.18.40) 56(84) bytes of data.
bytes from ping.online.net (62.210.18.40): icmp_seq=1 ttl=42 time=306 m
bytes from ping.online.net (62.210.18.40): icmp_seq=2 ttl=42 time=306 m
bytes from ping.online.net (62.210.18.40): icmp_seq=3 ttl=42 time=306 m
bytes from ping.online.net (62.210.18.40): icmp_seq=4 ttl=42 time=306 m
bytes from ping.online.net (62.210.18.40): icmp_seq=5 ttl=42 time=306 m
bytes from ping.online.net (62.210.18.40): icmp_seq=6 ttl=42 time=306 m
bytes from ping.online.net (62.210.18.40): icmp_seq=7 ttl=42 time=306 m
bytes from ping.online.net (62.210.18.40): icmp_seq=8 ttl=42 time=306 m
bytes from ping.online.net (62.210.18.40): icmp_seq=9 ttl=42 time=306 m
bytes from ping.online.net (62.210.18.40): icmp_seq=10 ttl=42 time=306

 ping.online.net ping statistics ---
packets transmitted, 10 received, 0% packet loss, time 9310ms
 min/avg/max/mdev = 306.857/306.911/306.939/0.554 ms
sh-4.1$ ping -c 10 ping.online.net
G ping.online.net (62.210.18.40) 56(84) bytes of data.
bytes from ping.online.net (62.210.18.40): icmp_seq=1 ttl=42 time=306 m
bytes from ping.online.net (62.210.18.40): icmp_seq=2 ttl=42 time=306 m
bytes from ping.online.net (62.210.18.40): icmp_seq=3 ttl=42 time=306 m
bytes from ping.online.net (62.210.18.40): icmp_seq=4 ttl=42 time=306 m
bytes from ping.online.net (62.210.18.40): icmp_seq=5 ttl=42 time=306 m
bytes from ping.online.net (62.210.18.40): icmp_seq=6 ttl=42 time=306 m
bytes from ping.online.net (62.210.18.40): icmp_seq=7 ttl=42 time=306 m
bytes from ping.online.net (62.210.18.40): icmp_seq=8 ttl=42 time=306 m
bytes from ping.online.net (62.210.18.40): icmp_seq=9 ttl=42 time=306 m
bytes from ping.online.net (62.210.18.40): icmp_seq=10 ttl=42 time=306

 ping.online.net ping statistics ---
packets transmitted, 10 received, 0% packet loss, time 9309ms
 min/avg/max/mdev = 306.868/306.920/306.974/0.607 ms
sh-4.1$ ping -c 10 ping.online.net
G ping.online.net (62.210.18.40) 56(84) bytes of data.
bytes from ping.online.net (62.210.18.40): icmp_seq=1 ttl=42 time=306 m
bytes from ping.online.net (62.210.18.40): icmp_seq=2 ttl=42 time=306 m
bytes from ping.online.net (62.210.18.40): icmp_seq=3 ttl=42 time=306 m
bytes from ping.online.net (62.210.18.40): icmp_seq=4 ttl=42 time=306 m
bytes from ping.online.net (62.210.18.40): icmp_seq=5 ttl=42 time=306 m
bytes from ping.online.net (62.210.18.40): icmp_seq=6 ttl=42 time=306 m
bytes from ping.online.net (62.210.18.40): icmp_seq=7 ttl=42 time=306 m
bytes from ping.online.net (62.210.18.40): icmp_seq=8 ttl=42 time=306 m
bytes from ping.online.net (62.210.18.40): icmp_seq=9 ttl=42 time=306 m
bytes from ping.online.net (62.210.18.40): icmp_seq=10 ttl=42 time=306

 ping.online.net ping statistics ---
packets transmitted, 10 received, 0% packet loss, time 9321ms
 min/avg/max/mdev = 306.881/306.917/306.997/0.554 ms
sh-4.1$
```

Fig 3.1.5

Command: ping -c 10 ping-90ms.online.net:

```
4.1$ ping -c 10 ping-90ms.online.net
ing-90ms.online.net (62.210.18.41) 56(84) bytes of data.
es from ping90ms.online.net (62.210.18.41): icmp_seq=1 ttl=42 time=396
es from ping90ms.online.net (62.210.18.41): icmp_seq=2 ttl=42 time=396
es from ping90ms.online.net (62.210.18.41): icmp_seq=3 ttl=42 time=396
es from ping90ms.online.net (62.210.18.41): icmp_seq=4 ttl=42 time=396
es from ping90ms.online.net (62.210.18.41): icmp_seq=5 ttl=42 time=396
es from ping90ms.online.net (62.210.18.41): icmp_seq=6 ttl=42 time=396
es from ping90ms.online.net (62.210.18.41): icmp_seq=7 ttl=42 time=396
es from ping90ms.online.net (62.210.18.41): icmp_seq=8 ttl=42 time=396
es from ping90ms.online.net (62.210.18.41): icmp_seq=9 ttl=42 time=396
es from ping90ms.online.net (62.210.18.41): icmp_seq=10 ttl=42 time=39

ng-90ms.online.net ping statistics ---
kets transmitted, 10 received, 0% packet loss, time 9407ms
n/avg/max/mdev = 396.881/396.921/396.969/0.489 ms
4.1$ ping -c 10 ping-90ms.online.net
ing-90ms.online.net (62.210.18.41) 56(84) bytes of data.
es from ping90ms.online.net (62.210.18.41): icmp_seq=1 ttl=42 time=396
es from ping90ms.online.net (62.210.18.41): icmp_seq=2 ttl=42 time=396
es from ping90ms.online.net (62.210.18.41): icmp_seq=3 ttl=42 time=396
es from ping90ms.online.net (62.210.18.41): icmp_seq=4 ttl=42 time=396
es from ping90ms.online.net (62.210.18.41): icmp_seq=5 ttl=42 time=396
es from ping90ms.online.net (62.210.18.41): icmp_seq=6 ttl=42 time=396
es from ping90ms.online.net (62.210.18.41): icmp_seq=7 ttl=42 time=396
es from ping90ms.online.net (62.210.18.41): icmp_seq=8 ttl=42 time=396
es from ping90ms.online.net (62.210.18.41): icmp_seq=9 ttl=42 time=396
es from ping90ms.online.net (62.210.18.41): icmp_seq=10 ttl=42 time=39

ng-90ms.online.net ping statistics ---
kets transmitted, 10 received, 0% packet loss, time 9408ms
n/avg/max/mdev = 396.824/396.900/396.956/0.631 ms
4.1$ ping -c 10 ping-90ms.online.net
ing-90ms.online.net (62.210.18.41) 56(84) bytes of data.
es from ping90ms.online.net (62.210.18.41): icmp_seq=1 ttl=42 time=396
es from ping90ms.online.net (62.210.18.41): icmp_seq=2 ttl=42 time=396
es from ping90ms.online.net (62.210.18.41): icmp_seq=3 ttl=42 time=396
es from ping90ms.online.net (62.210.18.41): icmp_seq=4 ttl=42 time=396
es from ping90ms.online.net (62.210.18.41): icmp_seq=5 ttl=42 time=396
es from ping90ms.online.net (62.210.18.41): icmp_seq=6 ttl=42 time=396
es from ping90ms.online.net (62.210.18.41): icmp_seq=7 ttl=42 time=396
es from ping90ms.online.net (62.210.18.41): icmp_seq=8 ttl=42 time=396
es from ping90ms.online.net (62.210.18.41): icmp_seq=9 ttl=42 time=396
es from ping90ms.online.net (62.210.18.41): icmp_seq=10 ttl=42 time=39

ng-90ms.online.net ping statistics ---
kets transmitted, 10 received, 0% packet loss, time 9410ms
n/avg/max/mdev = 396.809/396.884/396.936/0.797 ms
4.1$
```

Fig 3.1.6

Command: ping -c 10 speedtest.serverius.net:

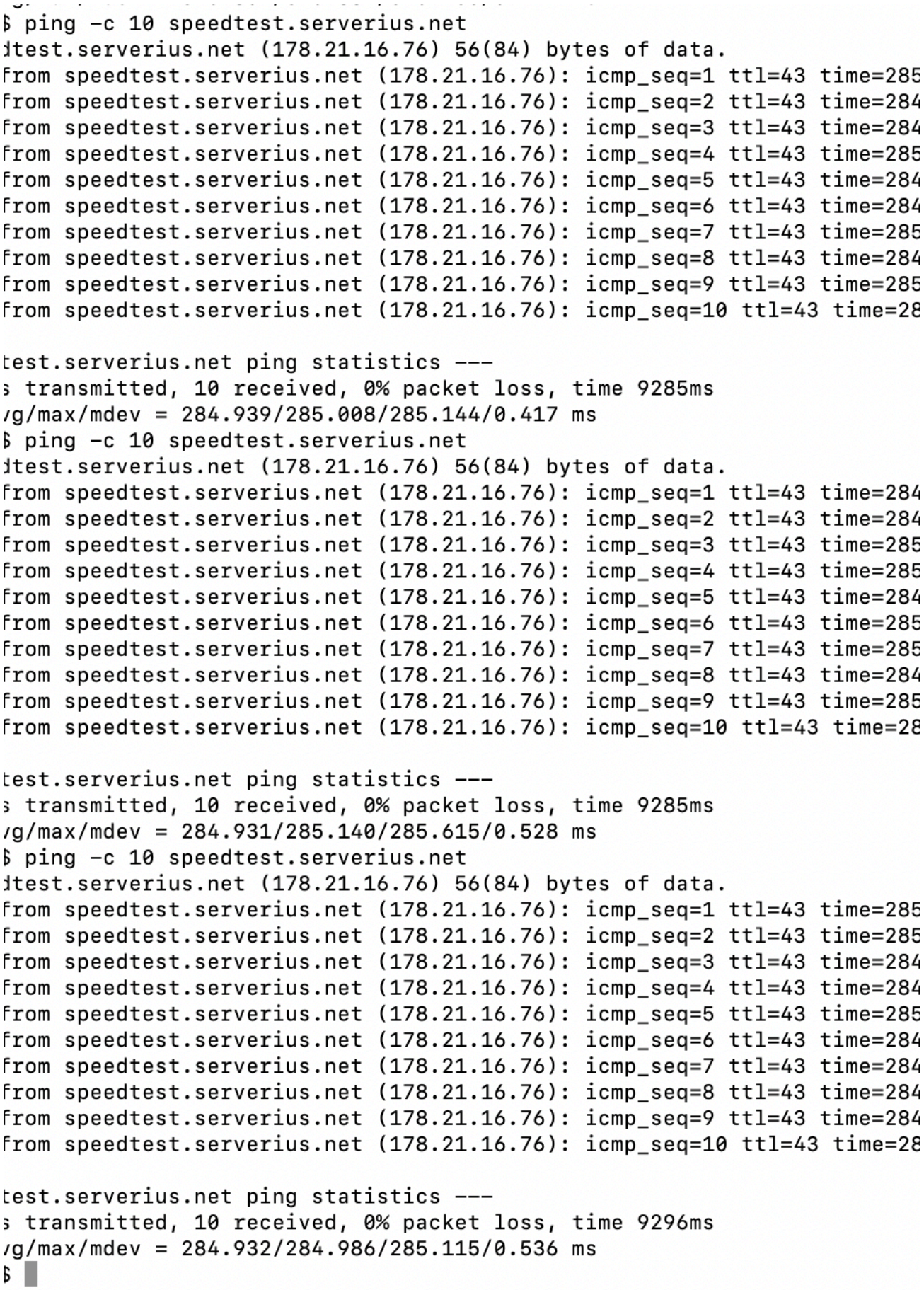

Fig 3.1.7-1

Find location of speedtest.serverius.net:

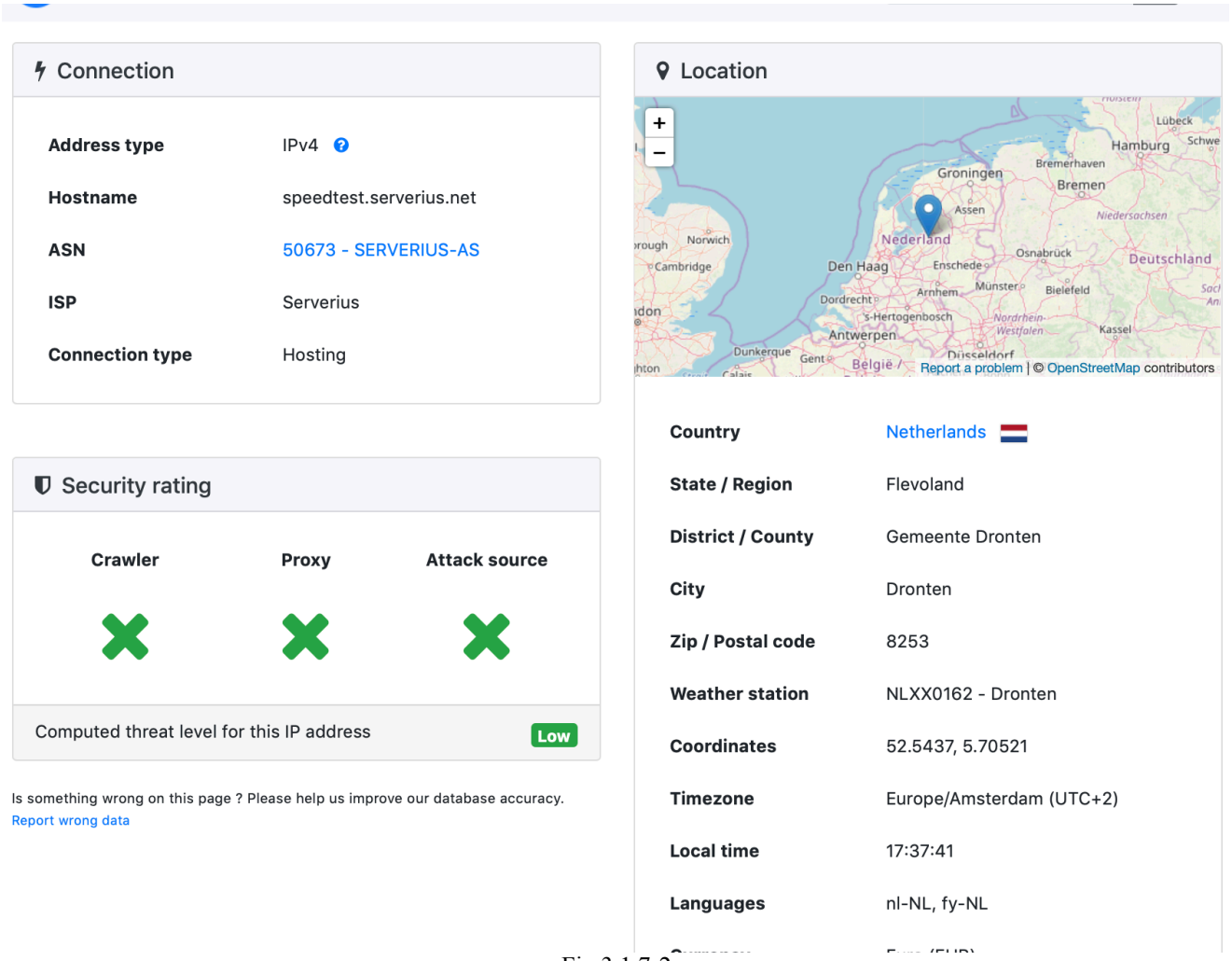

Fig 3.1.7-2

Calculate distance of speedtest.serverius.net:

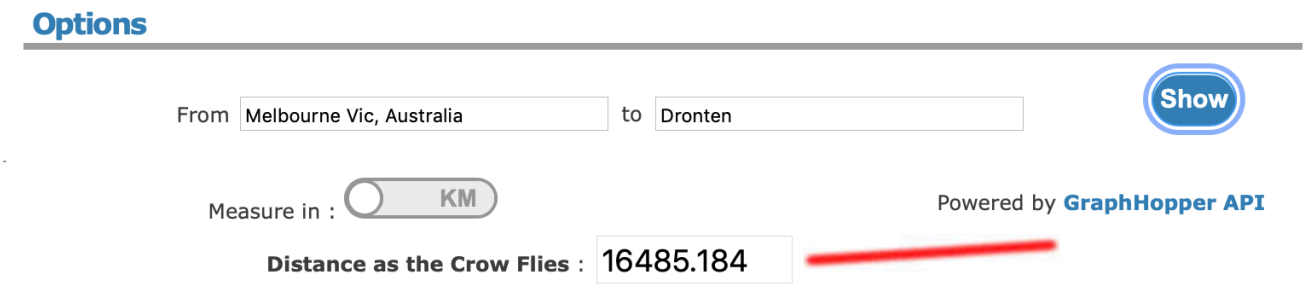

Fig 3.1.7-3

Command: ping -c 10 speedtest.hostkey.ru:

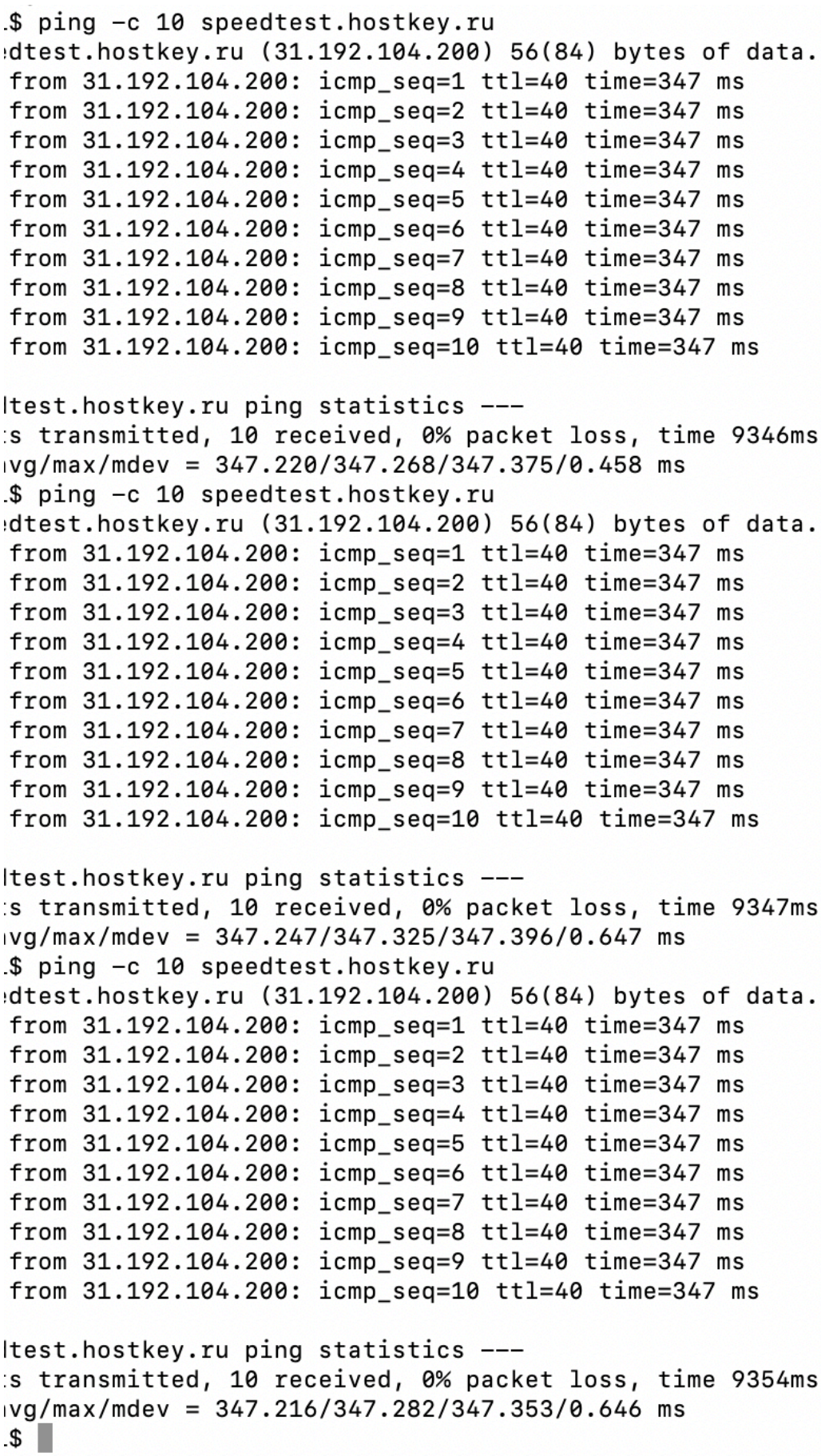

Fig 3.1.8-1

Find location of speedtest.hostkey.ru:

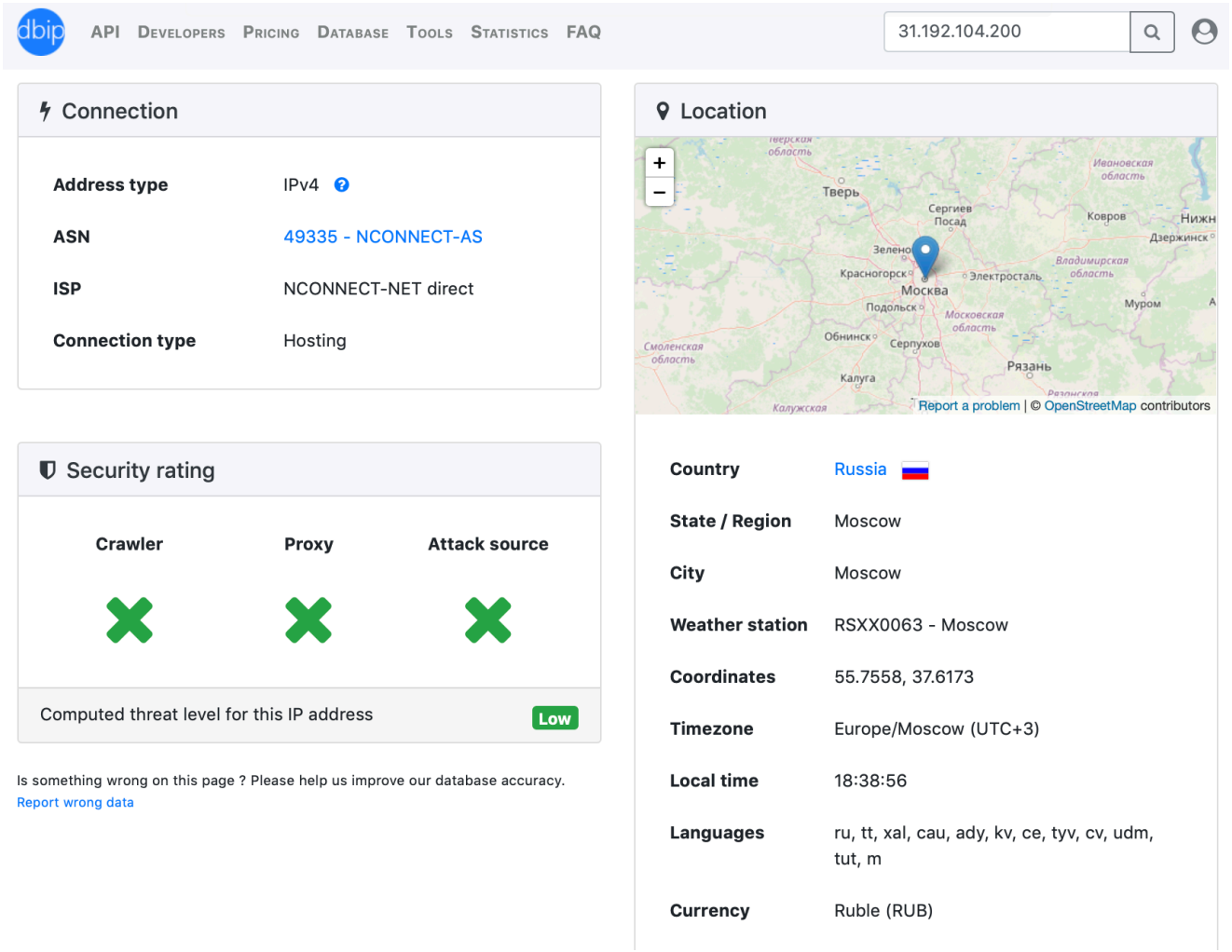

Fig 3.1.8-2

Calculate distance of speedtest.hostkey.ru:

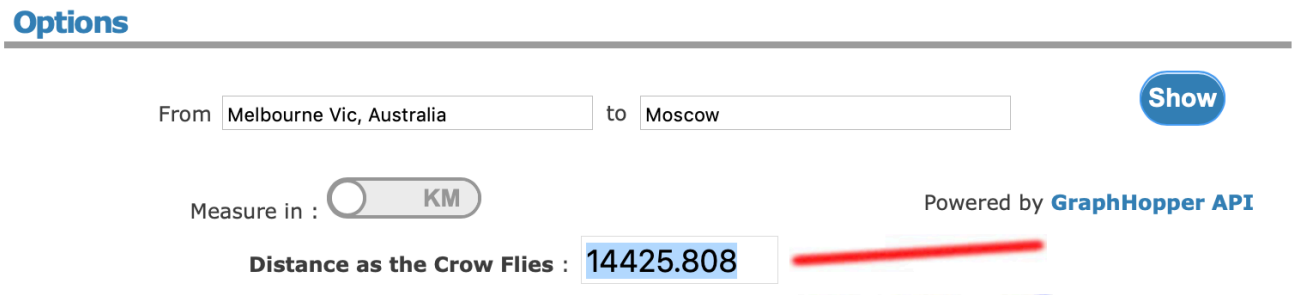

Fig 3.1.8-3

Command: ping -c 10 ping-ams1.online.net:

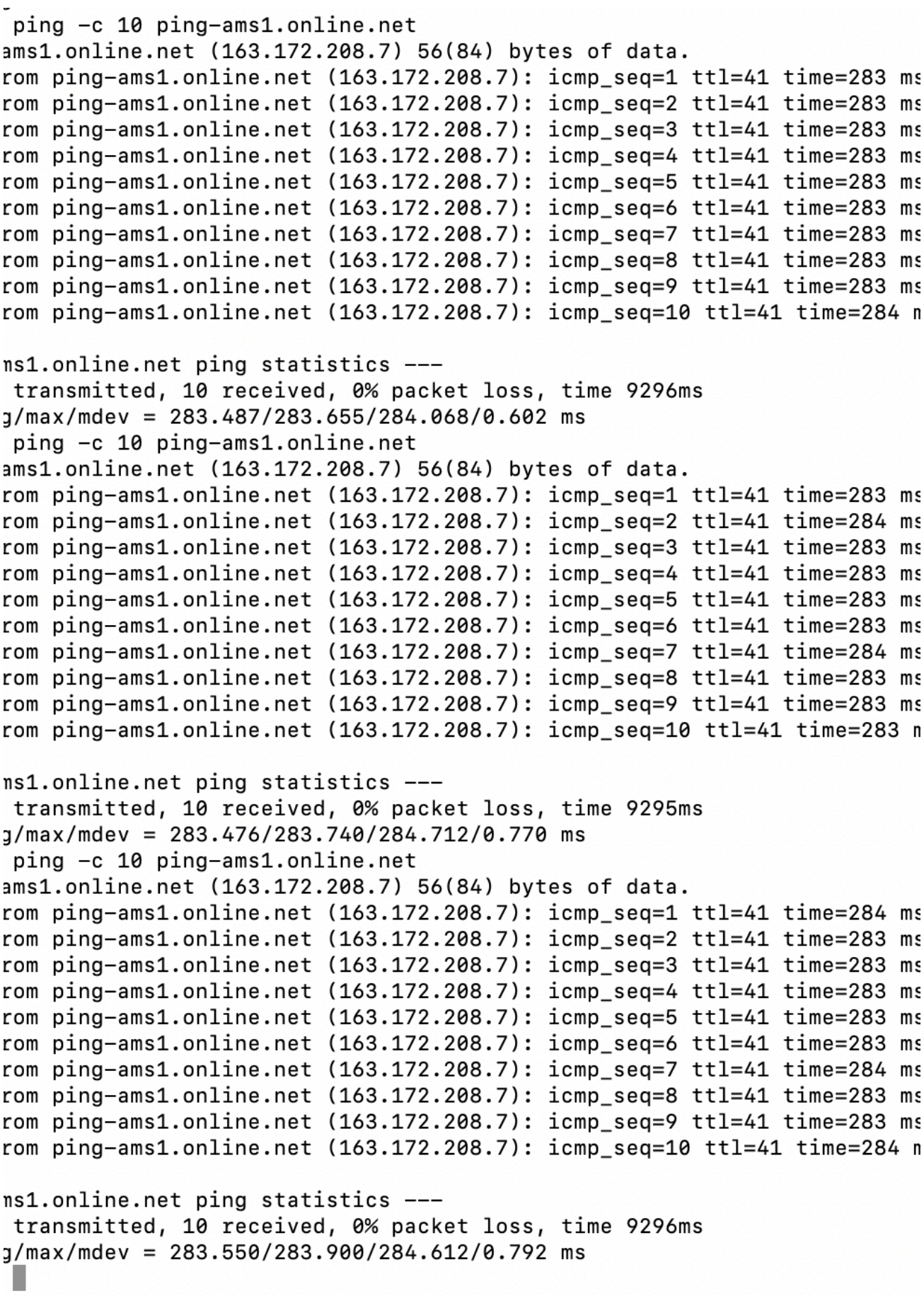

Fig 3.1.9-1

Find location of ping-ams1.online.net:

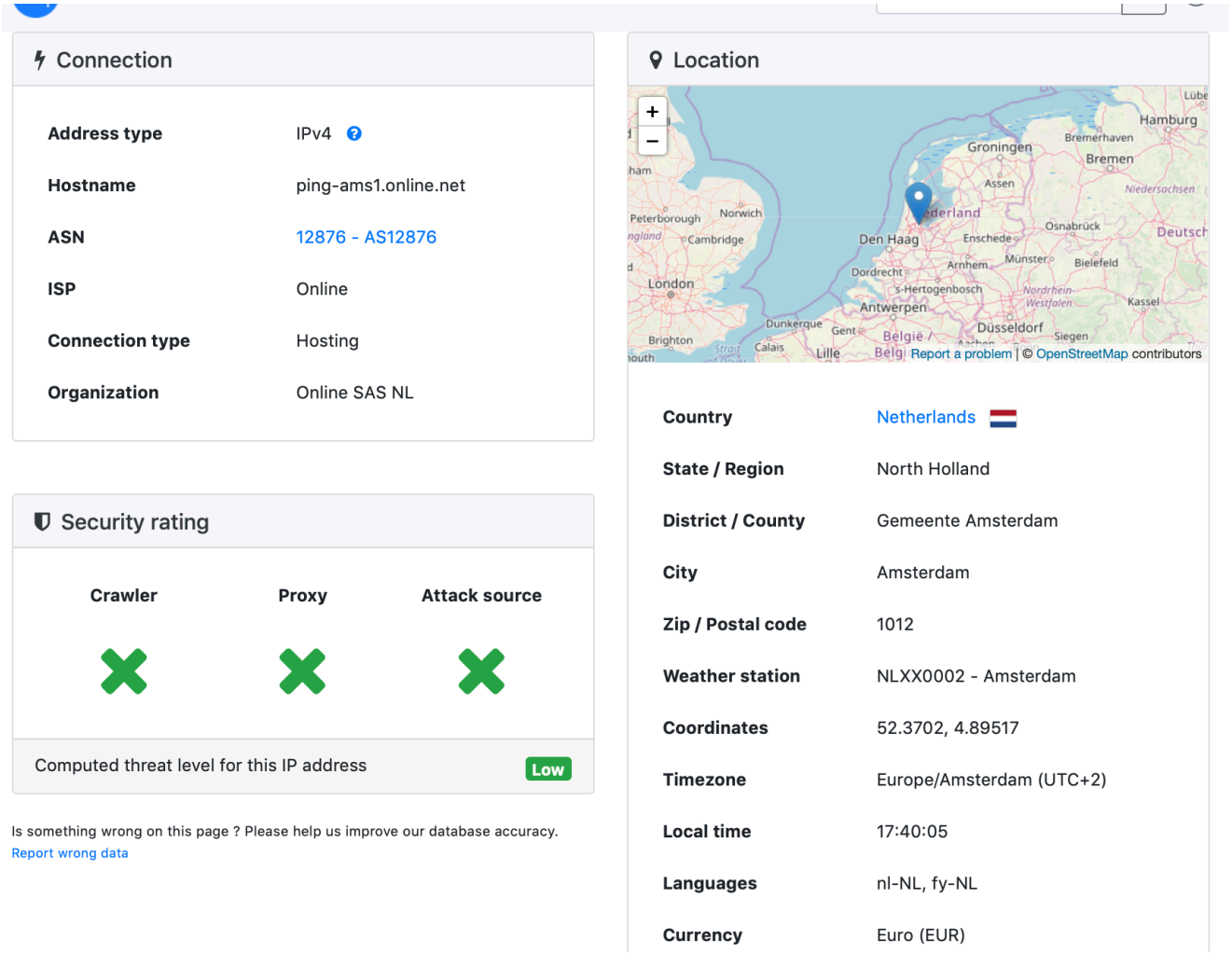

Fig 3.1.9-2

Calculate distance of ping-ams1.online.net:

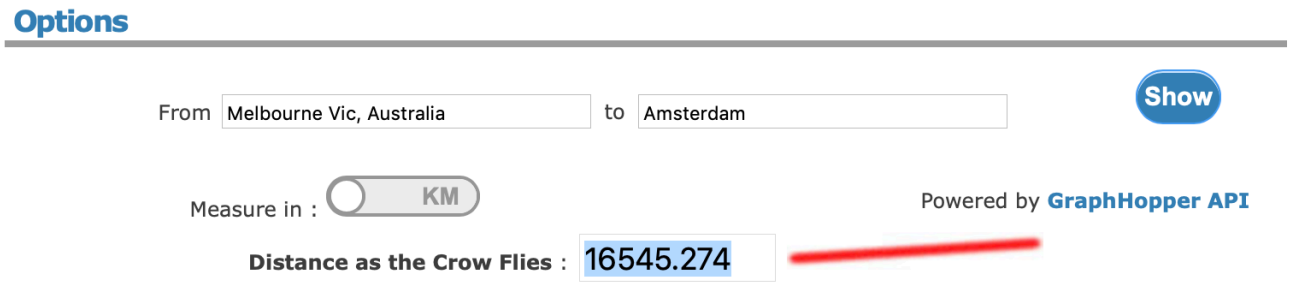

Fig 3.1.9-3

Command: ping -c 10 speedtest.wtnet.de:

```
l$ ping -c 10 speedtest.wtnet.de
edtest.wtnet.de (213.209.106.95) 56(84) bytes of data.
 from speedtest.wtnet.de (213.209.106.95): icmp_seq=1 ttl=42 time=308 m
 from speedtest.wtnet.de (213.209.106.95): icmp_seq=2 ttl=42 time=308 m
 from speedtest.wtnet.de (213.209.106.95): icmp_seq=3 ttl=42 time=308 m
 from speedtest.wtnet.de (213.209.106.95): icmp_seq=4 ttl=42 time=308 m
 from speedtest.wtnet.de (213.209.106.95): icmp_seq=5 ttl=42 time=308 m
 from speedtest.wtnet.de (213.209.106.95): icmp_seq=6 ttl=42 time=308 m
 from speedtest.wtnet.de (213.209.106.95): icmp_seq=7 ttl=42 time=308 m
 from speedtest.wtnet.de (213.209.106.95): icmp_seq=8 ttl=42 time=308 m
 from speedtest.wtnet.de (213.209.106.95): icmp_seq=9 ttl=42 time=308 m
 from speedtest.wtnet.de (213.209.106.95): icmp_seq=10 ttl=42 time=308

dtest.wtnet.de ping statistics ---
ts transmitted, 10 received, 0% packet loss, time 9316ms
avg/max/mdev = 308.225/308.354/308.981/0.480 ms
l$ ping -c 10 speedtest.wtnet.de
edtest.wtnet.de (213.209.106.95) 56(84) bytes of data.
 from speedtest.wtnet.de (213.209.106.95): icmp_seq=1 ttl=42 time=308 m
 from speedtest.wtnet.de (213.209.106.95): icmp_seq=2 ttl=42 time=308 m
 from speedtest.wtnet.de (213.209.106.95): icmp_seq=3 ttl=42 time=308 m
 from speedtest.wtnet.de (213.209.106.95): icmp_seq=4 ttl=42 time=308 m
 from speedtest.wtnet.de (213.209.106.95): icmp_seq=5 ttl=42 time=308 m
 from speedtest.wtnet.de (213.209.106.95): icmp_seq=6 ttl=42 time=308 m
 from speedtest.wtnet.de (213.209.106.95): icmp_seq=7 ttl=42 time=308 m
 from speedtest.wtnet.de (213.209.106.95): icmp_seq=8 ttl=42 time=308 m
 from speedtest.wtnet.de (213.209.106.95): icmp_seq=9 ttl=42 time=308 m
 from speedtest.wtnet.de (213.209.106.95): icmp_seq=10 ttl=42 time=308

dtest.wtnet.de ping statistics ---
ts transmitted, 10 received, 0% packet loss, time 9317ms
avg/max/mdev = 308.218/308.286/308.465/0.559 ms
l$ ping -c 10 speedtest.wtnet.de
edtest.wtnet.de (213.209.106.95) 56(84) bytes of data.
 from speedtest.wtnet.de (213.209.106.95): icmp_seq=1 ttl=42 time=308 m
 from speedtest.wtnet.de (213.209.106.95): icmp_seq=2 ttl=42 time=308 m
 from speedtest.wtnet.de (213.209.106.95): icmp_seq=3 ttl=42 time=308 m
 from speedtest.wtnet.de (213.209.106.95): icmp_seq=4 ttl=42 time=308 m
 from speedtest.wtnet.de (213.209.106.95): icmp_seq=5 ttl=42 time=308 m
 from speedtest.wtnet.de (213.209.106.95): icmp_seq=6 ttl=42 time=308 m
 from speedtest.wtnet.de (213.209.106.95): icmp_seq=7 ttl=42 time=308 m
 from speedtest.wtnet.de (213.209.106.95): icmp_seq=8 ttl=42 time=308 m
 from speedtest.wtnet.de (213.209.106.95): icmp_seq=9 ttl=42 time=308 m
 from speedtest.wtnet.de (213.209.106.95): icmp_seq=10 ttl=42 time=308

dtest.wtnet.de ping statistics ---
ts transmitted, 10 received, 0% packet loss, time 9308ms
avg/max/mdev = 308.247/308.369/308.889/0.466 ms
l$
```

Fig 3.1.10-1

Find location of speedtest.wtnet.de:

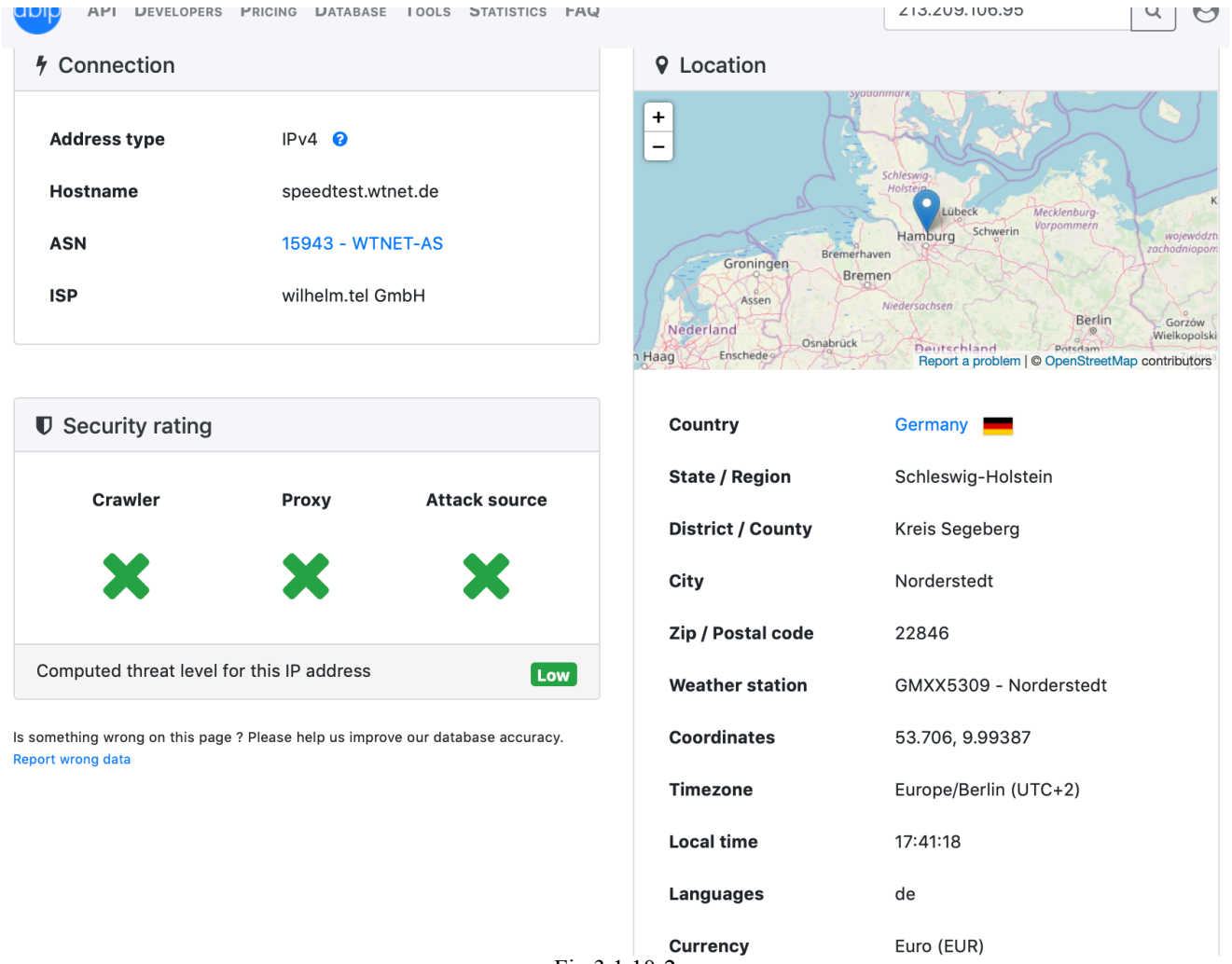

Fig 3.1.10-2

Calculate distance of speedtest.wtnet.de:

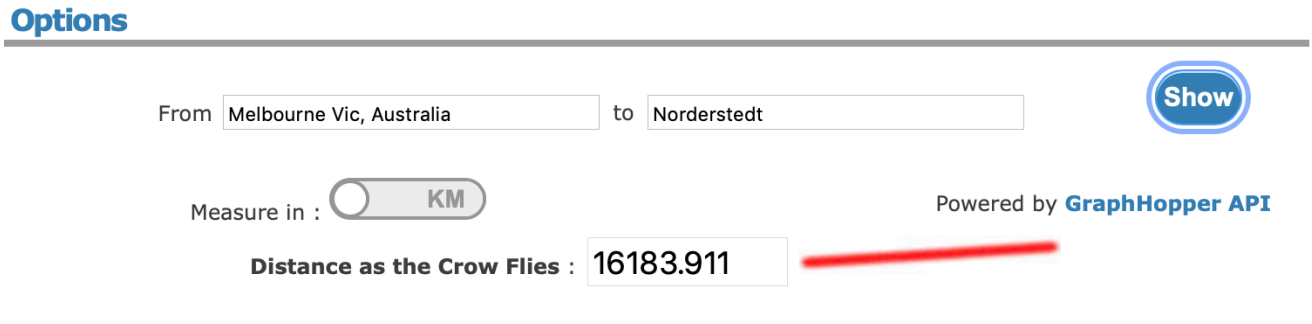

Fig 3.1.10-3

Command: iperf3 -c bouygues.testdebit.info:

```
[-bash-4.2$ iperf3 -c bouygues.testdebit.info
Connecting to host bouygues.testdebit.info, port 5201
[  4] local 128.250.106.77 port 58098 connected to 89.84.1.222 port 5201
[ ID] Interval           Transfer     Bandwidth       Retr  Cwnd
[  4]   0.00-1.00   sec   307 KBytes  2.51 Mbits/sec    0   55.1 KBytes
[  4]   1.00-2.00   sec  1.82 MBytes  15.3 Mbits/sec    0    436 KBytes
[  4]   2.00-3.00   sec  7.24 MBytes  60.8 Mbits/sec    7   6.67 MBytes
[  4]   3.00-4.00   sec  11.2 MBytes  94.4 Mbits/sec    0   7.53 MBytes
[  4]   4.00-5.00   sec  15.0 MBytes   126 Mbits/sec    0   7.53 MBytes
[  4]   5.00-6.00   sec  11.2 MBytes  94.4 Mbits/sec    0   7.53 MBytes
[  4]   6.00-7.00   sec  15.0 MBytes   126 Mbits/sec    0   7.53 MBytes
[  4]   7.00-8.00   sec  11.2 MBytes  94.4 Mbits/sec    0   7.53 MBytes
[  4]   8.00-9.00   sec  15.0 MBytes   126 Mbits/sec    0   7.53 MBytes
[  4]   9.00-10.00  sec  11.2 MBytes  94.4 Mbits/sec    0   7.53 MBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bandwidth       Retr
[  4]   0.00-10.00  sec  99.4 MBytes  83.3 Mbits/sec    7             sender
[  4]   0.00-10.00  sec  99.4 MBytes  83.3 Mbits/sec                  receiver

iperf Done.
```

Fig 4.1.1-1

```
[-bash-4.2$ iperf3 -c bouygues.testdebit.info
Connecting to host bouygues.testdebit.info, port 5201
[  4] local 128.250.106.77 port 58106 connected to 89.84.1.222 port 5201
[ ID] Interval           Transfer     Bandwidth       Retr  Cwnd
[  4]   0.00-1.00   sec   301 KBytes  2.47 Mbits/sec    0   55.1 KBytes
[  4]   1.00-2.00   sec  2.02 MBytes  17.0 Mbits/sec    0    437 KBytes
[  4]   2.00-3.00   sec  7.50 MBytes  62.9 Mbits/sec    0   6.08 MBytes
[  4]   3.00-4.00   sec  11.2 MBytes  94.4 Mbits/sec    0   7.51 MBytes
[  4]   4.00-5.00   sec  15.0 MBytes   126 Mbits/sec    0   7.51 MBytes
[  4]   5.00-6.00   sec  11.2 MBytes  94.4 Mbits/sec    0   7.51 MBytes
[  4]   6.00-7.00   sec  15.0 MBytes   126 Mbits/sec    0   7.51 MBytes
[  4]   7.00-8.00   sec  11.2 MBytes  94.4 Mbits/sec    7   7.51 MBytes
[  4]   8.00-9.00   sec  15.0 MBytes   126 Mbits/sec    0   7.51 MBytes
[  4]   9.00-10.00  sec  11.2 MBytes  94.4 Mbits/sec    0   7.51 MBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bandwidth       Retr
[  4]   0.00-10.00  sec  99.8 MBytes  83.7 Mbits/sec    7             sender
[  4]   0.00-10.00  sec  99.8 MBytes  83.7 Mbits/sec                  receiver

iperf Done.
```

Fig 4.1.1-2

```
Connecting to host bouygues.testdebit.info, port 5201
[  4] local 128.250.106.77 port 58110 connected to 89.84.1.222 port 5201
iperf3: error - control socket has closed unexpectedly
[-bash-4.2$ iperf3 -c bouygues.testdebit.info
Connecting to host bouygues.testdebit.info, port 5201
[  4] local 128.250.106.77 port 58114 connected to 89.84.1.222 port 5201
[ ID] Interval           Transfer     Bandwidth       Retr  Cwnd
[  4]   0.00-1.00   sec   372 KBytes  3.05 Mbits/sec    0   53.7 KBytes
[  4]   1.00-2.00   sec  2.20 MBytes  18.5 Mbits/sec    0    428 KBytes
[  4]   2.00-3.00   sec  7.50 MBytes  62.9 Mbits/sec   16   6.26 MBytes
[  4]   3.00-4.00   sec  11.2 MBytes  94.4 Mbits/sec    0   7.50 MBytes
[  4]   4.00-5.00   sec  15.0 MBytes   126 Mbits/sec    0   7.50 MBytes
[  4]   5.00-6.00   sec  11.2 MBytes  94.4 Mbits/sec    0   7.50 MBytes
[  4]   6.00-7.00   sec  15.0 MBytes   126 Mbits/sec    0   7.50 MBytes
[  4]   7.00-8.00   sec  8.75 MBytes  73.4 Mbits/sec    2   5.25 MBytes
[  4]   8.00-9.00   sec  15.0 MBytes   126 Mbits/sec    0   5.25 MBytes
[  4]   9.00-10.00  sec  11.2 MBytes  94.4 Mbits/sec    0   5.25 MBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bandwidth       Retr
[  4]   0.00-10.00  sec  97.6 MBytes  81.8 Mbits/sec   18             sender
[  4]   0.00-10.00  sec  97.6 MBytes  81.8 Mbits/sec                  receiver
```

Fig 4.1.1-3

Command: iperf3 -c st2.nn.ertelecom.ru:

```
-bash-4.2$ iperf3 -c st2.nn.ertelecom.ru
Connecting to host st2.nn.ertelecom.ru, port 5201
[  4] local 128.250.106.77 port 40584 connected to 91.144.184.232 port 5201
[ ID] Interval           Transfer     Bandwidth       Retr  Cwnd
[  4]   0.00-1.00   sec   153 KBytes  1.25 Mbits/sec    0   28.3 KBytes
[  4]   1.00-2.00   sec  1.22 MBytes  10.2 Mbits/sec    0    226 KBytes
[  4]   2.00-3.00   sec  2.37 MBytes  19.9 Mbits/sec   70   1.16 MBytes
[  4]   3.00-4.00   sec  2.50 MBytes  21.0 Mbits/sec  484    636 KBytes
[  4]   4.00-5.00   sec  1.25 MBytes  10.5 Mbits/sec  179    564 KBytes
[  4]   5.00-6.00   sec  2.50 MBytes  21.0 Mbits/sec    0    539 KBytes
[  4]   6.00-7.00   sec  1.25 MBytes  10.5 Mbits/sec    0    574 KBytes
[  4]   7.00-8.00   sec  1.25 MBytes  10.5 Mbits/sec    0    590 KBytes
[  4]   8.00-9.00   sec  1.25 MBytes  10.5 Mbits/sec    0    602 KBytes
[  4]   9.00-10.00  sec  1.25 MBytes  10.5 Mbits/sec    0    607 KBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bandwidth       Retr
[  4]   0.00-10.00  sec  15.0 MBytes  12.6 Mbits/sec  733             sender
[  4]   0.00-10.00  sec  13.2 MBytes  11.0 Mbits/sec                  receiver

iperf Done.
-bash-4.2$ iperf3 -c st2.nn.ertelecom.ru
Connecting to host st2.nn.ertelecom.ru, port 5201
[  4] local 128.250.106.77 port 40610 connected to 91.144.184.232 port 5201
[ ID] Interval           Transfer     Bandwidth       Retr  Cwnd
[  4]   0.00-1.00   sec  82.0 KBytes   671 Kbits/sec    0   28.3 KBytes
[  4]   1.00-2.00   sec  1.22 MBytes  10.3 Mbits/sec    0    225 KBytes
[  4]   2.00-3.00   sec  1.86 MBytes  15.6 Mbits/sec  103    478 KBytes
[  4]   3.00-4.00   sec  2.50 MBytes  21.0 Mbits/sec    0    387 KBytes
[  4]   4.00-5.00   sec  1.25 MBytes  10.5 Mbits/sec    0    419 KBytes
[  4]   5.00-6.00   sec  0.00 Bytes  0.00 bits/sec    0    437 KBytes
[  4]   6.00-7.00   sec  2.50 MBytes  21.0 Mbits/sec    0    445 KBytes
[  4]   7.00-8.00   sec  0.00 Bytes  0.00 bits/sec    0    447 KBytes
[  4]   8.00-9.00   sec  1.25 MBytes  10.5 Mbits/sec    0    447 KBytes
[  4]   9.00-10.00  sec  1.25 MBytes  10.5 Mbits/sec    0    448 KBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bandwidth       Retr
[  4]   0.00-10.00  sec  11.9 MBytes  10.0 Mbits/sec  103             sender
[  4]   0.00-10.00  sec  9.67 MBytes  8.11 Mbits/sec                  receiver

iperf Done.
-bash-4.2$ iperf3 -c st2.nn.ertelecom.ru
Connecting to host st2.nn.ertelecom.ru, port 5201
[  4] local 128.250.106.77 port 40616 connected to 91.144.184.232 port 5201
[ ID] Interval           Transfer     Bandwidth       Retr  Cwnd
[  4]   0.00-1.00   sec   178 KBytes  1.46 Mbits/sec    0   28.3 KBytes
[  4]   1.00-2.00   sec  1.10 MBytes  9.21 Mbits/sec    0    222 KBytes
[  4]   2.00-3.00   sec  2.73 MBytes  22.9 Mbits/sec   68   1.06 MBytes
[  4]   3.00-4.00   sec  2.50 MBytes  21.0 Mbits/sec  597    192 KBytes
[  4]   4.00-5.00   sec  0.00 Bytes  0.00 bits/sec   31    478 KBytes
[  4]   5.00-6.00   sec  2.50 MBytes  21.0 Mbits/sec    0    518 KBytes
[  4]   6.00-7.00   sec  1.25 MBytes  10.5 Mbits/sec    0    550 KBytes
[  4]   7.00-8.00   sec  1.25 MBytes  10.5 Mbits/sec    0    570 KBytes
[  4]   8.00-9.00   sec  2.50 MBytes  21.0 Mbits/sec    0    578 KBytes
[  4]   9.00-10.00  sec  1.25 MBytes  10.5 Mbits/sec   11    539 KBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bandwidth       Retr
[  4]   0.00-10.00  sec  15.3 MBytes  12.8 Mbits/sec  707             sender
[  4]   0.00-10.00  sec  12.4 MBytes  10.4 Mbits/sec                  receiver

iperf Done.
-bash-4.2$
```

Fig 4.1.2

Command: iperf3 -c iperf.biznetnetworks.com:

```
Connecting to host iperf.biznetnetworks.com, port 5201
[  4] local 128.250.106.77 port 48918 connected to 117.102.109.186 port 5201
[ ID] Interval           Transfer     Bandwidth       Retr  Cwnd
[  4]   0.00-1.00   sec  4.14 MBytes  34.7 Mbits/sec    1    976 KBytes
[  4]   1.00-2.00   sec  20.0 MBytes   168 Mbits/sec    1   6.02 MBytes
[  4]   2.00-3.00   sec  31.2 MBytes   262 Mbits/sec    2   6.02 MBytes
[  4]   3.00-4.00   sec  30.0 MBytes   252 Mbits/sec    1   6.02 MBytes
[  4]   4.00-5.00   sec  31.2 MBytes   262 Mbits/sec    0   6.02 MBytes
[  4]   5.00-6.00   sec  32.5 MBytes   273 Mbits/sec    0   6.02 MBytes
[  4]   6.00-7.00   sec  28.8 MBytes   241 Mbits/sec    0   6.02 MBytes
[  4]   7.00-8.00   sec  32.5 MBytes   273 Mbits/sec    0   6.02 MBytes
[  4]   8.00-9.00   sec  32.5 MBytes   273 Mbits/sec    0   6.02 MBytes
[  4]   9.00-10.00  sec  28.8 MBytes   241 Mbits/sec    0   6.02 MBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bandwidth       Retr
[  4]   0.00-10.00  sec   272 MBytes   228 Mbits/sec    5             sender
[  4]   0.00-10.00  sec   271 MBytes   228 Mbits/sec                  receiver

iperf Done.
-bash-4.2$ iperf3 -c iperf.biznetnetworks.com
Connecting to host iperf.biznetnetworks.com, port 5201
[  4] local 128.250.106.77 port 48922 connected to 117.102.109.186 port 5201
[ ID] Interval           Transfer     Bandwidth       Retr  Cwnd
[  4]   0.00-1.00   sec  3.88 MBytes  32.5 Mbits/sec    1   1.12 MBytes
[  4]   1.00-2.00   sec  21.2 MBytes   178 Mbits/sec    1   6.00 MBytes
[  4]   2.00-3.00   sec  31.2 MBytes   262 Mbits/sec    1   6.00 MBytes
[  4]   3.00-4.00   sec  30.0 MBytes   252 Mbits/sec    0   6.00 MBytes
[  4]   4.00-5.00   sec  32.5 MBytes   273 Mbits/sec    1   6.00 MBytes
[  4]   5.00-6.00   sec  31.2 MBytes   262 Mbits/sec    0   6.00 MBytes
[  4]   6.00-7.00   sec  30.0 MBytes   252 Mbits/sec    0   6.00 MBytes
[  4]   7.00-8.00   sec  31.2 MBytes   262 Mbits/sec    0   6.00 MBytes
[  4]   8.00-9.00   sec  32.5 MBytes   273 Mbits/sec    0   6.00 MBytes
[  4]   9.00-10.00  sec  28.8 MBytes   241 Mbits/sec    1   6.00 MBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bandwidth       Retr
[  4]   0.00-10.00  sec   273 MBytes   229 Mbits/sec    5             sender
[  4]   0.00-10.00  sec   273 MBytes   229 Mbits/sec                  receiver

iperf Done.
-bash-4.2$ iperf3 -c iperf.biznetnetworks.com
Connecting to host iperf.biznetnetworks.com, port 5201
[  4] local 128.250.106.77 port 48926 connected to 117.102.109.186 port 5201
[ ID] Interval           Transfer     Bandwidth       Retr  Cwnd
[  4]   0.00-1.00   sec  3.65 MBytes  30.6 Mbits/sec    0    745 KBytes
[  4]   1.00-2.00   sec  17.5 MBytes   147 Mbits/sec    1   6.02 MBytes
[  4]   2.00-3.00   sec  32.5 MBytes   273 Mbits/sec    1   6.02 MBytes
[  4]   3.00-4.00   sec  28.8 MBytes   241 Mbits/sec    0   6.02 MBytes
[  4]   4.00-5.00   sec  32.5 MBytes   273 Mbits/sec    1   6.02 MBytes
[  4]   5.00-6.00   sec  32.5 MBytes   273 Mbits/sec    1   6.02 MBytes
[  4]   6.00-7.00   sec  28.8 MBytes   241 Mbits/sec    0   6.02 MBytes
[  4]   7.00-8.00   sec  32.5 MBytes   273 Mbits/sec    0   6.02 MBytes
[  4]   8.00-9.00   sec  31.2 MBytes   262 Mbits/sec    0   6.02 MBytes
[  4]   9.00-10.00  sec  30.0 MBytes   252 Mbits/sec    0   6.02 MBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bandwidth       Retr
[  4]   0.00-10.00  sec   270 MBytes   226 Mbits/sec    4             sender
[  4]   0.00-10.00  sec   269 MBytes   226 Mbits/sec                  receiver

iperf Done.
```

Fig 4.1.3

Command: iperf3 -c iperf.volia.net:

```
-bash-4.2$ iperf3 -c iperf.volia.net
Connecting to host iperf.volia.net, port 5201
[  4] local 128.250.106.77 port 52996 connected to 77.120.3.236 port 5201
[ ID] Interval           Transfer     Bandwidth       Retr  Cwnd
[  4]   0.00-1.00   sec   153 KBytes  1.25 Mbits/sec    0   28.3 KBytes
[  4]   1.00-2.00   sec  1.02 MBytes  8.55 Mbits/sec    0    226 KBytes
[  4]   2.00-3.00   sec  3.92 MBytes  32.9 Mbits/sec    0   1.49 MBytes
[  4]   3.00-4.00   sec  7.50 MBytes  62.9 Mbits/sec    0   6.01 MBytes
[  4]   4.00-5.00   sec  8.75 MBytes  73.4 Mbits/sec    0   6.01 MBytes
[  4]   5.00-6.00   sec  8.75 MBytes  73.4 Mbits/sec    0   6.01 MBytes
[  4]   6.00-7.00   sec  2.50 MBytes  21.0 Mbits/sec  1203   4.20 MBytes
[  4]   7.00-8.00   sec  7.50 MBytes  62.9 Mbits/sec    0   4.21 MBytes
[  4]   8.00-9.00   sec  8.75 MBytes  73.4 Mbits/sec    0   4.21 MBytes
[  4]   9.00-10.00  sec  6.25 MBytes  52.4 Mbits/sec  412   2.43 MBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bandwidth       Retr
[  4]   0.00-10.00  sec  55.1 MBytes  46.2 Mbits/sec  1615             sender
[  4]   0.00-10.00  sec  51.7 MBytes  43.4 Mbits/sec                  receiver

iperf Done.
-bash-4.2$ iperf3 -c iperf.volia.net
Connecting to host iperf.volia.net, port 5201
[  4] local 128.250.106.77 port 53000 connected to 77.120.3.236 port 5201
[ ID] Interval           Transfer     Bandwidth       Retr  Cwnd
[  4]   0.00-1.00   sec   153 KBytes  1.25 Mbits/sec    0   28.3 KBytes
[  4]   1.00-2.00   sec  1.21 MBytes  10.2 Mbits/sec    0    226 KBytes
[  4]   2.00-3.00   sec  3.18 MBytes  26.6 Mbits/sec    0   1.76 MBytes
[  4]   3.00-4.00   sec  8.75 MBytes  73.4 Mbits/sec    0   6.05 MBytes
[  4]   4.00-5.00   sec  8.75 MBytes  73.4 Mbits/sec    0   6.05 MBytes
[  4]   5.00-6.00   sec  8.75 MBytes  73.4 Mbits/sec    0   6.05 MBytes
[  4]   6.00-7.00   sec  8.75 MBytes  73.4 Mbits/sec    0   6.05 MBytes
[  4]   7.00-8.00   sec  8.75 MBytes  73.4 Mbits/sec    0   6.05 MBytes
[  4]   8.00-9.00   sec  8.75 MBytes  73.4 Mbits/sec    0   6.05 MBytes
[  4]   9.00-10.00  sec  5.00 MBytes  41.9 Mbits/sec    0   6.05 MBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bandwidth       Retr
[  4]   0.00-10.00  sec  62.0 MBytes  52.0 Mbits/sec    0             sender
[  4]   0.00-10.00  sec  62.0 MBytes  52.0 Mbits/sec                  receiver

iperf Done.
-bash-4.2$ iperf3 -c iperf.volia.net
Connecting to host iperf.volia.net, port 5201
[  4] local 128.250.106.77 port 53006 connected to 77.120.3.236 port 5201
[ ID] Interval           Transfer     Bandwidth       Retr  Cwnd
[  4]   0.00-1.00   sec   173 KBytes  1.41 Mbits/sec    0   28.3 KBytes
[  4]   1.00-2.00   sec  1.13 MBytes  9.49 Mbits/sec    0    222 KBytes
[  4]   2.00-3.00   sec  3.05 MBytes  25.6 Mbits/sec    0   1.73 MBytes
[  4]   3.00-4.00   sec  8.75 MBytes  73.4 Mbits/sec    0   6.01 MBytes
[  4]   4.00-5.00   sec  8.75 MBytes  73.4 Mbits/sec    0   6.01 MBytes
[  4]   5.00-6.00   sec  8.75 MBytes  73.4 Mbits/sec    0   6.01 MBytes
[  4]   6.00-7.00   sec  5.00 MBytes  41.9 Mbits/sec    0   6.01 MBytes
[  4]   7.00-8.00   sec  8.75 MBytes  73.4 Mbits/sec    0   6.01 MBytes
[  4]   8.00-9.00   sec  8.75 MBytes  73.4 Mbits/sec    0   6.01 MBytes
[  4]   9.00-10.00  sec  8.75 MBytes  73.4 Mbits/sec    0   6.01 MBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bandwidth       Retr
[  4]   0.00-10.00  sec  61.9 MBytes  51.9 Mbits/sec    0             sender
[  4]   0.00-10.00  sec  61.9 MBytes  51.9 Mbits/sec                  receiver

iperf Done.
-bash-4.2$
```

Fig 4.1.4

Command: iperf3 -c ping.online.net:

```
bash-4.2$ iperf3 -c ping.online.net
onnecting to host ping.online.net, port 5201
  4] local 128.250.106.77 port 48810 connected to 62.210.18.40 port 5201
 ID] Interval           Transfer     Bandwidth       Retr  Cwnd
  4]   0.00-1.00   sec   420 KBytes  3.44 Mbits/sec    0   56.6 KBytes
  4]   1.00-2.00   sec  2.05 MBytes  17.2 Mbits/sec    0    369 KBytes
  4]   2.00-3.00   sec  3.62 MBytes  30.4 Mbits/sec    0   2.79 MBytes
  4]   3.00-4.00   sec  13.8 MBytes   115 Mbits/sec    0   7.53 MBytes
  4]   4.00-5.00   sec  11.2 MBytes  94.4 Mbits/sec    0   7.53 MBytes
  4]   5.00-6.00   sec  11.2 MBytes  94.4 Mbits/sec    0   7.53 MBytes
  4]   6.00-7.00   sec  15.0 MBytes   126 Mbits/sec    0   7.53 MBytes
  4]   7.00-8.00   sec  11.2 MBytes  94.4 Mbits/sec    0   7.53 MBytes
  4]   8.00-9.00   sec  11.2 MBytes  94.4 Mbits/sec    0   7.53 MBytes
  4]   9.00-10.00  sec  15.0 MBytes   126 Mbits/sec    0   7.53 MBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
 ID] Interval           Transfer     Bandwidth       Retr
  4]   0.00-10.00  sec  94.8 MBytes  79.5 Mbits/sec    0             sender
  4]   0.00-10.00  sec  94.8 MBytes  79.5 Mbits/sec                  receiver

erf Done.
bash-4.2$ iperf3 -c ping.online.net
onnecting to host ping.online.net, port 5201
  4] local 128.250.106.77 port 48814 connected to 62.210.18.40 port 5201
 ID] Interval           Transfer     Bandwidth       Retr  Cwnd
  4]   0.00-1.00   sec   318 KBytes  2.61 Mbits/sec    0   56.6 KBytes
  4]   1.00-2.00   sec  1.74 MBytes  14.6 Mbits/sec    0    436 KBytes
  4]   2.00-3.00   sec  4.99 MBytes  41.9 Mbits/sec    0   3.37 MBytes
  4]   3.00-4.00   sec  13.8 MBytes   115 Mbits/sec    0   7.54 MBytes
  4]   4.00-5.00   sec  11.2 MBytes  94.4 Mbits/sec    0   7.54 MBytes
  4]   5.00-6.00   sec  11.2 MBytes  94.4 Mbits/sec    9   7.54 MBytes
  4]   6.00-7.00   sec  15.0 MBytes   126 Mbits/sec    0   7.54 MBytes
  4]   7.00-8.00   sec  11.2 MBytes  94.4 Mbits/sec    0   7.54 MBytes
  4]   8.00-9.00   sec  11.2 MBytes  94.4 Mbits/sec    0   7.54 MBytes
  4]   9.00-10.00  sec  15.0 MBytes   126 Mbits/sec    0   7.54 MBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
 ID] Interval           Transfer     Bandwidth       Retr
  4]   0.00-10.00  sec  95.8 MBytes  80.4 Mbits/sec    9             sender
  4]   0.00-10.00  sec  95.8 MBytes  80.4 Mbits/sec                  receiver

erf Done.
bash-4.2$ iperf3 -c ping.online.net
onnecting to host ping.online.net, port 5201
  4] local 128.250.106.77 port 48818 connected to 62.210.18.40 port 5201
 ID] Interval           Transfer     Bandwidth       Retr  Cwnd
  4]   0.00-1.00   sec   337 KBytes  2.76 Mbits/sec    0   56.6 KBytes
  4]   1.00-2.00   sec  2.17 MBytes  18.2 Mbits/sec    0    441 KBytes
  4]   2.00-3.00   sec  3.68 MBytes  30.9 Mbits/sec    0   3.43 MBytes
  4]   3.00-4.00   sec  15.0 MBytes   126 Mbits/sec    0   7.53 MBytes
  4]   4.00-5.00   sec  11.2 MBytes  94.4 Mbits/sec    0   7.53 MBytes
  4]   5.00-6.00   sec  11.2 MBytes  94.4 Mbits/sec    0   7.53 MBytes
  4]   6.00-7.00   sec  15.0 MBytes   126 Mbits/sec    0   7.53 MBytes
  4]   7.00-8.00   sec  11.2 MBytes  94.4 Mbits/sec    0   7.53 MBytes
  4]   8.00-9.00   sec  11.2 MBytes  94.4 Mbits/sec    0   7.53 MBytes
  4]   9.00-10.00  sec  15.0 MBytes   126 Mbits/sec    0   7.53 MBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
 ID] Interval           Transfer     Bandwidth       Retr
  4]   0.00-10.00  sec  96.2 MBytes  80.7 Mbits/sec    0             sender
  4]   0.00-10.00  sec  96.2 MBytes  80.7 Mbits/sec                  receiver

erf Done.
bash-4.2$
```

Fig 4.1.5

Command: iperf3 -c ping-90ms.online.net:

```
Connecting to host ping-90ms.online.net, port 5201
[  4] local 128.250.106.77 port 34864 connected to 62.210.18.41 port 5201
[ ID] Interval           Transfer     Bandwidth       Retr  Cwnd
[  4]   0.00-1.00   sec   163 KBytes  1.33 Mbits/sec    0   28.3 KBytes
[  4]   1.00-2.00   sec  1.18 MBytes  9.86 Mbits/sec    0    223 KBytes
[  4]   2.00-3.00   sec  2.99 MBytes  25.1 Mbits/sec    0    741 KBytes
[  4]   3.00-4.00   sec  5.00 MBytes  42.0 Mbits/sec    0   5.55 MBytes
[  4]   4.00-5.00   sec  7.50 MBytes  62.9 Mbits/sec    0   7.51 MBytes
[  4]   5.00-6.00   sec  11.2 MBytes  94.4 Mbits/sec    0   7.51 MBytes
[  4]   6.00-7.00   sec  7.50 MBytes  62.9 Mbits/sec    0   7.51 MBytes
[  4]   7.00-8.00   sec  11.2 MBytes  94.4 Mbits/sec    0   7.51 MBytes
[  4]   8.00-9.00   sec  7.50 MBytes  62.9 Mbits/sec    0   7.51 MBytes
[  4]   9.00-10.00  sec  11.2 MBytes  94.4 Mbits/sec    0   7.51 MBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bandwidth       Retr
[  4]   0.00-10.00  sec  65.6 MBytes  55.0 Mbits/sec    0             sender
[  4]   0.00-10.00  sec  65.6 MBytes  55.0 Mbits/sec                  receiver

iperf Done.
-bash-4.2$ iperf3 -c ping-90ms.online.net
Connecting to host ping-90ms.online.net, port 5201
[  4] local 128.250.106.77 port 34870 connected to 62.210.18.41 port 5201
[ ID] Interval           Transfer     Bandwidth       Retr  Cwnd
[  4]   0.00-1.00   sec   163 KBytes  1.33 Mbits/sec    0   28.3 KBytes
[  4]   1.00-2.00   sec  1.01 MBytes  8.43 Mbits/sec    0    222 KBytes
[  4]   2.00-3.00   sec  2.61 MBytes  21.9 Mbits/sec    0    742 KBytes
[  4]   3.00-4.00   sec  5.00 MBytes  42.0 Mbits/sec    0   5.72 MBytes
[  4]   4.00-5.00   sec  7.50 MBytes  62.9 Mbits/sec    0   7.53 MBytes
[  4]   5.00-6.00   sec  11.2 MBytes  94.4 Mbits/sec    0   7.53 MBytes
[  4]   6.00-7.00   sec  7.50 MBytes  62.9 Mbits/sec    0   7.53 MBytes
[  4]   7.00-8.00   sec  11.2 MBytes  94.4 Mbits/sec    0   7.53 MBytes
[  4]   8.00-9.00   sec  7.50 MBytes  62.9 Mbits/sec    0   7.53 MBytes
[  4]   9.00-10.00  sec  11.2 MBytes  94.4 Mbits/sec    0   7.53 MBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bandwidth       Retr
[  4]   0.00-10.00  sec  65.0 MBytes  54.5 Mbits/sec    0             sender
[  4]   0.00-10.00  sec  65.0 MBytes  54.5 Mbits/sec                  receiver

iperf Done.
-bash-4.2$ iperf3 -c ping-90ms.online.net
Connecting to host ping-90ms.online.net, port 5201
[  4] local 128.250.106.77 port 34880 connected to 62.210.18.41 port 5201
[ ID] Interval           Transfer     Bandwidth       Retr  Cwnd
[  4]   0.00-1.00   sec   198 KBytes  1.62 Mbits/sec    0   28.3 KBytes
[  4]   1.00-2.00   sec  1.13 MBytes  9.48 Mbits/sec    0    222 KBytes
[  4]   2.00-3.00   sec  2.80 MBytes  23.5 Mbits/sec    0    880 KBytes
[  4]   3.00-4.00   sec  6.25 MBytes  52.4 Mbits/sec    0   6.64 MBytes
[  4]   4.00-5.00   sec  7.50 MBytes  62.9 Mbits/sec    0   7.53 MBytes
[  4]   5.00-6.00   sec  11.2 MBytes  94.4 Mbits/sec    0   7.53 MBytes
[  4]   6.00-7.00   sec  7.50 MBytes  62.9 Mbits/sec    0   7.53 MBytes
[  4]   7.00-8.00   sec  11.2 MBytes  94.4 Mbits/sec    0   7.53 MBytes
[  4]   8.00-9.00   sec  7.50 MBytes  62.9 Mbits/sec    0   7.53 MBytes
[  4]   9.00-10.00  sec  11.2 MBytes  94.4 Mbits/sec    0   7.53 MBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bandwidth       Retr
[  4]   0.00-10.00  sec  66.6 MBytes  55.9 Mbits/sec    0             sender
[  4]   0.00-10.00  sec  66.6 MBytes  55.9 Mbits/sec                  receiver

iperf Done.
-bash-4.2$
```

Fig 4.1.6

Command: iperf -c speedtest.serverius.net:

```
-bash-4.1$ iperf -c speedtest.serverius.net
------------------------------------------------------------
Client connecting to speedtest.serverius.net, TCP port 5001
TCP window size: 19.3 KByte (default)
------------------------------------------------------------
[  3] local 128.250.106.38 port 43836 connected with 178.21.16.76 port 5001
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0-10.2 sec  18.5 MBytes  15.1 Mbits/sec
-bash-4.1$ iperf -c speedtest.serverius.net
------------------------------------------------------------
Client connecting to speedtest.serverius.net, TCP port 5001
TCP window size: 19.3 KByte (default)
------------------------------------------------------------
[  3] local 128.250.106.38 port 43838 connected with 178.21.16.76 port 5001
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0-10.3 sec  17.5 MBytes  14.3 Mbits/sec
-bash-4.1$ iperf -c speedtest.serverius.net
------------------------------------------------------------
Client connecting to speedtest.serverius.net, TCP port 5001
TCP window size: 19.3 KByte (default)
------------------------------------------------------------
[  3] local 128.250.106.38 port 43842 connected with 178.21.16.76 port 5001
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0-10.3 sec  16.6 MBytes  13.6 Mbits/sec
-bash-4.1$
```

Fig 4.1.7

Command: iperf3 -c speedtest.hostkey.ru:

```
Connecting to host speedtest.hostkey.ru, port 5201
[  4] local 128.250.106.77 port 55872 connected to 31.192.104.200 port 5201
[ ID] Interval           Transfer     Bandwidth       Retr  Cwnd
[  4]   0.00-1.00   sec   181 KBytes  1.48 Mbits/sec    0   28.3 KBytes
[  4]   1.00-2.00   sec  1.29 MBytes  10.8 Mbits/sec    0    225 KBytes
[  4]   2.00-3.00   sec  3.11 MBytes  26.1 Mbits/sec    0   1.60 MBytes
[  4]   3.00-4.00   sec  3.75 MBytes  31.5 Mbits/sec  490   2.10 MBytes
[  4]   4.00-5.00   sec  5.00 MBytes  41.9 Mbits/sec  141   1.53 MBytes
[  4]   5.00-6.00   sec  3.75 MBytes  31.5 Mbits/sec    0   1.62 MBytes
[  4]   6.00-7.00   sec  5.00 MBytes  41.9 Mbits/sec    0   1.70 MBytes
[  4]   7.00-8.00   sec  5.00 MBytes  41.9 Mbits/sec    0   1.76 MBytes
[  4]   8.00-9.00   sec  6.25 MBytes  52.4 Mbits/sec    0   1.80 MBytes
[  4]   9.00-10.00  sec  5.00 MBytes  41.9 Mbits/sec    0   1.82 MBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bandwidth       Retr
[  4]   0.00-10.00  sec  38.3 MBytes  32.2 Mbits/sec  631             sender
[  4]   0.00-10.00  sec  37.2 MBytes  31.2 Mbits/sec                  receiver

iperf Done.
-bash-4.2$ iperf3 -c speedtest.hostkey.ru
Connecting to host speedtest.hostkey.ru, port 5201
[  4] local 128.250.106.77 port 55886 connected to 31.192.104.200 port 5201
[ ID] Interval           Transfer     Bandwidth       Retr  Cwnd
[  4]   0.00-1.00   sec   170 KBytes  1.39 Mbits/sec    0   28.3 KBytes
[  4]   1.00-2.00   sec  1.12 MBytes  9.43 Mbits/sec    0    225 KBytes
[  4]   2.00-3.00   sec  2.99 MBytes  25.1 Mbits/sec    0   1.48 MBytes
[  4]   3.00-4.00   sec  3.75 MBytes  31.5 Mbits/sec  641   1.79 MBytes
[  4]   4.00-5.00   sec  5.00 MBytes  42.0 Mbits/sec  228   2.15 MBytes
[  4]   5.00-6.00   sec  2.50 MBytes  21.0 Mbits/sec  110   1.51 MBytes
[  4]   6.00-7.00   sec  6.25 MBytes  52.5 Mbits/sec   75   1.08 MBytes
[  4]   7.00-8.00   sec  2.50 MBytes  21.0 Mbits/sec    0   1.16 MBytes
[  4]   8.00-9.00   sec  3.75 MBytes  31.5 Mbits/sec    0   1.22 MBytes
[  4]   9.00-10.00  sec  3.75 MBytes  31.5 Mbits/sec    0   1.27 MBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bandwidth       Retr
[  4]   0.00-10.00  sec  31.8 MBytes  26.7 Mbits/sec  1054             sender
[  4]   0.00-10.00  sec  30.1 MBytes  25.3 Mbits/sec                  receiver

iperf Done.
-bash-4.2$ iperf3 -c speedtest.hostkey.ru
Connecting to host speedtest.hostkey.ru, port 5201
[  4] local 128.250.106.77 port 55890 connected to 31.192.104.200 port 5201
[ ID] Interval           Transfer     Bandwidth       Retr  Cwnd
[  4]   0.00-1.00   sec   181 KBytes  1.48 Mbits/sec    0   28.3 KBytes
[  4]   1.00-2.00   sec  1.30 MBytes  10.9 Mbits/sec    0    226 KBytes
[  4]   2.00-3.00   sec  3.68 MBytes  30.9 Mbits/sec    0   1.76 MBytes
[  4]   3.00-4.00   sec  3.75 MBytes  31.5 Mbits/sec  694   2.30 MBytes
[  4]   4.00-5.00   sec  5.00 MBytes  41.9 Mbits/sec  468   1.43 MBytes
[  4]   5.00-6.00   sec  3.75 MBytes  31.5 Mbits/sec    0   1.20 MBytes
[  4]   6.00-7.00   sec  2.50 MBytes  21.0 Mbits/sec    0   1.25 MBytes
[  4]   7.00-8.00   sec  3.75 MBytes  31.5 Mbits/sec    0   1.31 MBytes
[  4]   8.00-9.00   sec  3.75 MBytes  31.5 Mbits/sec    0   1.35 MBytes
[  4]   9.00-10.00  sec  5.00 MBytes  41.9 Mbits/sec    0   1.37 MBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bandwidth       Retr
[  4]   0.00-10.00  sec  32.7 MBytes  27.4 Mbits/sec  1162             sender
[  4]   0.00-10.00  sec  30.6 MBytes  25.7 Mbits/sec                  receiver

iperf Done.
-bash-4.2$
```

Fig 4.1.8

Command: iperf3 -c ping-ams1.online.net:

```
bash-4.2$ iperf3 -c ping-ams1.online.net
onnecting to host ping-ams1.online.net, port 5201
  4] local 128.250.106.77 port 42290 connected to 163.172.208.7 port 5201
 ID] Interval           Transfer     Bandwidth       Retr  Cwnd
  4]   0.00-1.00   sec   324 KBytes  2.65 Mbits/sec    0   56.6 KBytes
  4]   1.00-2.00   sec  3.42 MBytes  28.7 Mbits/sec    0    902 KBytes
  4]   2.00-3.00   sec  6.25 MBytes  52.4 Mbits/sec    0   6.25 MBytes
  4]   3.00-4.00   sec  15.0 MBytes   126 Mbits/sec    0   7.50 MBytes
  4]   4.00-5.00   sec  11.2 MBytes  94.4 Mbits/sec    0   7.50 MBytes
  4]   5.00-6.00   sec  15.0 MBytes   126 Mbits/sec    0   7.50 MBytes
  4]   6.00-7.00   sec  11.2 MBytes  94.4 Mbits/sec    0   7.50 MBytes
  4]   7.00-8.00   sec  13.8 MBytes   115 Mbits/sec    0   7.50 MBytes
  4]   8.00-9.00   sec  12.5 MBytes   105 Mbits/sec   14   7.50 MBytes
  4]   9.00-10.00  sec  12.5 MBytes   105 Mbits/sec    0   7.50 MBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
 ID] Interval           Transfer     Bandwidth       Retr
  4]   0.00-10.00  sec   101 MBytes  84.9 Mbits/sec   14             sender
  4]   0.00-10.00  sec   101 MBytes  84.9 Mbits/sec                  receiver

perf Done.
bash-4.2$ iperf3 -c ping-ams1.online.net
onnecting to host ping-ams1.online.net, port 5201
  4] local 128.250.106.77 port 42294 connected to 163.172.208.7 port 5201
 ID] Interval           Transfer     Bandwidth       Retr  Cwnd
  4]   0.00-1.00   sec   301 KBytes  2.47 Mbits/sec    0   56.6 KBytes
  4]   1.00-2.00   sec  3.92 MBytes  32.9 Mbits/sec    0    809 KBytes
  4]   2.00-3.00   sec  5.00 MBytes  41.9 Mbits/sec    0   5.44 MBytes
  4]   3.00-4.00   sec  15.0 MBytes   126 Mbits/sec    0   7.61 MBytes
  4]   4.00-5.00   sec  11.2 MBytes  94.4 Mbits/sec    0   7.61 MBytes
  4]   5.00-6.00   sec  15.0 MBytes   126 Mbits/sec    0   7.61 MBytes
  4]   6.00-7.00   sec  11.2 MBytes  94.4 Mbits/sec    0   7.61 MBytes
  4]   7.00-8.00   sec  13.8 MBytes   115 Mbits/sec    0   7.61 MBytes
  4]   8.00-9.00   sec  12.5 MBytes   105 Mbits/sec    0   7.61 MBytes
  4]   9.00-10.00  sec  12.5 MBytes   105 Mbits/sec    0   7.61 MBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
 ID] Interval           Transfer     Bandwidth       Retr
  4]   0.00-10.00  sec   100 MBytes  84.3 Mbits/sec    0             sender
  4]   0.00-10.00  sec   100 MBytes  84.3 Mbits/sec                  receiver

perf Done.
bash-4.2$ iperf3 -c ping-ams1.online.net
onnecting to host ping-ams1.online.net, port 5201
  4] local 128.250.106.77 port 42298 connected to 163.172.208.7 port 5201
 ID] Interval           Transfer     Bandwidth       Retr  Cwnd
  4]   0.00-1.00   sec   345 KBytes  2.83 Mbits/sec    0   56.6 KBytes
  4]   1.00-2.00   sec  3.80 MBytes  31.9 Mbits/sec    0    812 KBytes
  4]   2.00-3.00   sec  5.00 MBytes  41.9 Mbits/sec    0   5.88 MBytes
  4]   3.00-4.00   sec  15.0 MBytes   126 Mbits/sec    0   7.51 MBytes
  4]   4.00-5.00   sec  11.2 MBytes  94.4 Mbits/sec    0   7.51 MBytes
  4]   5.00-6.00   sec  15.0 MBytes   126 Mbits/sec    0   7.51 MBytes
  4]   6.00-7.00   sec  11.2 MBytes  94.4 Mbits/sec    0   7.51 MBytes
  4]   7.00-8.00   sec  15.0 MBytes   126 Mbits/sec    0   7.51 MBytes
  4]   8.00-9.00   sec  11.2 MBytes  94.4 Mbits/sec    0   7.51 MBytes
  4]   9.00-10.00  sec  13.8 MBytes   115 Mbits/sec    0   7.51 MBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
 ID] Interval           Transfer     Bandwidth       Retr
  4]   0.00-10.00  sec   102 MBytes  85.3 Mbits/sec    0             sender
  4]   0.00-10.00  sec   102 MBytes  85.3 Mbits/sec                  receiver

perf Done.
bash-4.2$
```

Fig 4.1.9

Command: iperf3 -c speedtest.wtnet.de:

```
-bash-4.2$ iperf3 -c speedtest.wtnet.de
Connecting to host speedtest.wtnet.de, port 5201
[  4] local 128.250.106.77 port 37148 connected to 213.209.106.95 port 5201
[ ID] Interval           Transfer     Bandwidth       Retr  Cwnd
[  4]   0.00-1.00   sec  1.23 MBytes  10.3 Mbits/sec    0   56.6 KBytes
[  4]   1.00-2.00   sec  2.50 MBytes  21.0 Mbits/sec    0    450 KBytes
[  4]   2.00-3.00   sec  2.50 MBytes  21.0 Mbits/sec    1   3.44 MBytes
[  4]   3.00-4.00   sec  7.50 MBytes  62.9 Mbits/sec    2   6.00 MBytes
[  4]   4.00-5.00   sec  12.5 MBytes   105 Mbits/sec    0   6.00 MBytes
[  4]   5.00-6.00   sec  8.75 MBytes  73.4 Mbits/sec    0   6.00 MBytes
[  4]   6.00-7.00   sec  8.75 MBytes  73.4 Mbits/sec    0   6.00 MBytes
[  4]   7.00-8.00   sec  8.75 MBytes  73.4 Mbits/sec    0   6.00 MBytes
[  4]   8.00-9.00   sec  11.2 MBytes  94.4 Mbits/sec    0   6.00 MBytes
[  4]   9.00-10.00  sec  8.75 MBytes  73.4 Mbits/sec    0   6.00 MBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bandwidth       Retr
[  4]   0.00-10.00  sec  72.5 MBytes  60.8 Mbits/sec    3             sender
[  4]   0.00-10.00  sec  72.2 MBytes  60.6 Mbits/sec                  receiver

iperf Done.
-bash-4.2$ iperf3 -c speedtest.wtnet.de
Connecting to host speedtest.wtnet.de, port 5201
[  4] local 128.250.106.77 port 37152 connected to 213.209.106.95 port 5201
[ ID] Interval           Transfer     Bandwidth       Retr  Cwnd
[  4]   0.00-1.00   sec  1017 KBytes  8.33 Mbits/sec    0   56.6 KBytes
[  4]   1.00-2.00   sec  2.63 MBytes  22.0 Mbits/sec    0    438 KBytes
[  4]   2.00-3.00   sec  2.50 MBytes  21.0 Mbits/sec    0   3.22 MBytes
[  4]   3.00-4.00   sec  6.25 MBytes  52.4 Mbits/sec    0   5.45 MBytes
[  4]   4.00-5.00   sec  11.2 MBytes  94.4 Mbits/sec    0   6.00 MBytes
[  4]   5.00-6.00   sec  8.75 MBytes  73.4 Mbits/sec    0   6.00 MBytes
[  4]   6.00-7.00   sec  8.75 MBytes  73.4 Mbits/sec    0   6.00 MBytes
[  4]   7.00-8.00   sec  8.75 MBytes  73.4 Mbits/sec    0   6.00 MBytes
[  4]   8.00-9.00   sec  11.2 MBytes  94.4 Mbits/sec    0   6.00 MBytes
[  4]   9.00-10.00  sec  8.75 MBytes  73.4 Mbits/sec    0   6.00 MBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bandwidth       Retr
[  4]   0.00-10.00  sec  69.9 MBytes  58.6 Mbits/sec    0             sender
[  4]   0.00-10.00  sec  69.9 MBytes  58.6 Mbits/sec                  receiver

iperf Done.
-bash-4.2$ iperf3 -c speedtest.wtnet.de
Connecting to host speedtest.wtnet.de, port 5201
[  4] local 128.250.106.77 port 37156 connected to 213.209.106.95 port 5201
[ ID] Interval           Transfer     Bandwidth       Retr  Cwnd
[  4]   0.00-1.00   sec  1.02 MBytes  8.56 Mbits/sec    0   56.6 KBytes
[  4]   1.00-2.00   sec  2.68 MBytes  22.5 Mbits/sec    0    450 KBytes
[  4]   2.00-3.00   sec  2.50 MBytes  21.0 Mbits/sec    0   3.50 MBytes
[  4]   3.00-4.00   sec  8.75 MBytes  73.4 Mbits/sec    0   6.01 MBytes
[  4]   4.00-5.00   sec  11.2 MBytes  94.4 Mbits/sec    2   6.01 MBytes
[  4]   5.00-6.00   sec  8.75 MBytes  73.4 Mbits/sec    0   6.01 MBytes
[  4]   6.00-7.00   sec  8.75 MBytes  73.4 Mbits/sec    0   6.01 MBytes
[  4]   7.00-8.00   sec  8.75 MBytes  73.4 Mbits/sec    0   6.01 MBytes
[  4]   8.00-9.00   sec  12.5 MBytes   105 Mbits/sec    0   6.01 MBytes
[  4]   9.00-10.00  sec  8.75 MBytes  73.4 Mbits/sec    0   6.01 MBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bandwidth       Retr
[  4]   0.00-10.00  sec  73.7 MBytes  61.8 Mbits/sec    2             sender
[  4]   0.00-10.00  sec  73.0 MBytes  61.2 Mbits/sec                  receiver

iperf Done.
-bash-4.2$
```

Fig 4.1.10