Network Analysis Project, Project 1

Name & Student ID & Login User Name
1214448 YueyuanZhang YUEYUANZ

Catalog

2 Measuring the hop count

2.1 Specific task description

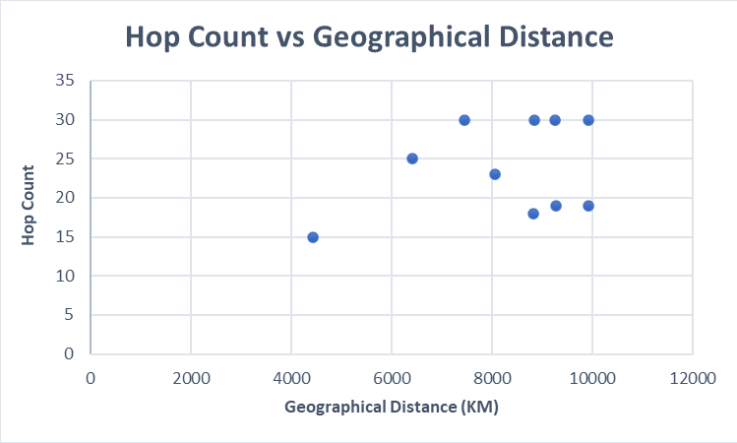
What do the command line parameters -n w 1 (equivalently -d -w 1 on Windows) mean in the example given above and what is the importance in using them?

In Windows,

- -d means addresses are not resolved to host names, so the router path can be displayed much faster.
- -w 1 means the timeout to wait for each reply is 1 millisecond, which helps analyze network latency and network failures.

2.2 Determine the hop count

Host	Location	IP Address	Hop count	Distance(KM)
cis.unimelb.edu.au	Australia	128.250.59.35	23	8055.19
iperf.he.net	USA	2001:470:0:236::2	19	9923.91
bouygues.testdebit.info	France	2001:860:de01:1100::2	19	9271.32
iperf.comneonext.de	Germany	could not find host		
ikoula.testdebit.info	France	2a00:c70:1:213:246:63:45:2	30	9261.87
st2.nn.ertelecom.ru	Russia	91.144.184.232	25	6414.87
iperf.biznetnetworks.com	Indonesia	117.102.109.186	15	4442.74
iperf.scottlinux.com	USA	45.33.39.39	30	9923.91
speedtest.serverius.net	Netherlands	178.21.16.76	18	8818.70
iperf.volia.net	Ukraine	77.120.3.236	30	7450.24
Add: speed.myloc.de	Germany	37.157.253.246	30	8850.68



Note: IP geolocations are queried from db-ip.com, and distance between cities are measured byhttps://www.freemaptools.com/how-far-is-it between.htm

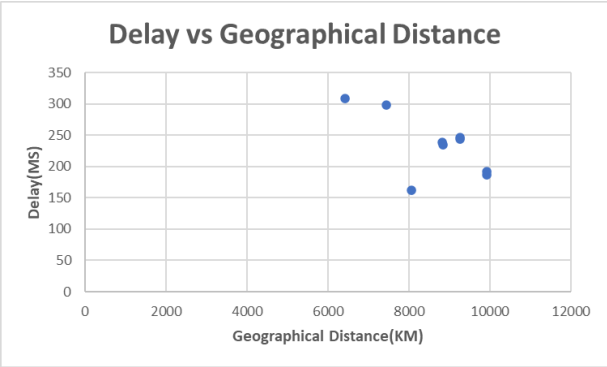
The number of hops is the number of routers that travel from the source to the destination. As can be seen from the chart, there is a certain correlation between geographical distance and hops. Generally, the greater the geographical distance, the more hop counts, but it is not completely correlated, because in the process of routing selection, the optimal route will constantly change according to the actual network conditions.

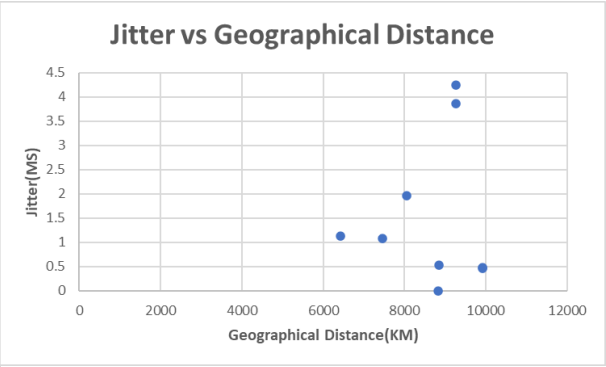
3 Measuring delay and jitter

3.1 Measure the round-trip delay

Make three delay measurements (run this command 3 times - not 1 command gathering 9-10 rows of ICMP responses) of each host and find the average round-trip delay and jitter by calculating the standard deviation manually or by using the standard deviation reported by your command output, for all the hosts used in Section 2. For each of the above hosts, plot the average round-trip delay versus the approximate physical geographical distance to the server. Do the same with the jitter (i.e. jitter vs geo distance).

Host	Delay	Jitter	Distance(km)	Time(ms)											
cis.unimelb.edu.au	161.55	1.97	8055.19	163	161	162	163	159	162	162	162	164	157	162	packet loss
iperf.he.net	187.30	0.48	9923.91	187	187	187	187	188	188	187	188	187	187	packet loss	
bouygues.testdebit.info	246.00	3.86	9271.32	248	249	249	246	250	249	246	241	240	244	240	250
iperf.comneonext.de	Could not find host														
ikoula.testdebit.info	243.30	4.24	9261.87	239	239	248	241	248	240	242	250	246	240	248	239
st2.nn.ertelecom.ru	308.80	1.14	6414.87	308	309	310	308	308	308	310	310	307	310	310	311
iperf.biznetnetworks.com	Destination host unreachable														
iperf.scottlinux.com	192.00	0.47	9923.91	191	192	192	193	192	192	192	192	192	192	191	191
speedtest.serverius.net	238.00	0.00	8818.70	238	238	238	238	238	238	238	238	packet loss			
iperf.volia.net	298.08	1.08	7450.24	298	299	297	297	298	298	298	298	298	297	298	301
Add: speed.myloc.de	234.44	0.53	8850.68	235	235	235	234	234	234	234	234	235	packet loss		





3.2 Correlation between delay and jitter

From the two plots above, do you observe any correlation between delay and jitter as a function of distance? Why or Why not? Explain your results comparatively with reference to the network environment in which you were collecting your results (this includes metrics like your download/ upload speed, users sharing the network, load on network through other apps, etc) and how does your networking environment influence your results obtained (examples required)?

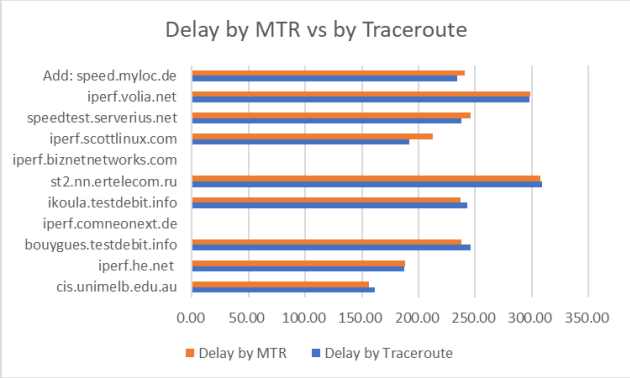
Delay refers to the time used for network transmission in the transmission medium, that is, the time from when a message enters the network to when it leaves the network. Jitter refers to the short-term deviation of a network signal from its ideal time position at a particular moment, and describes the degree of change in delay.

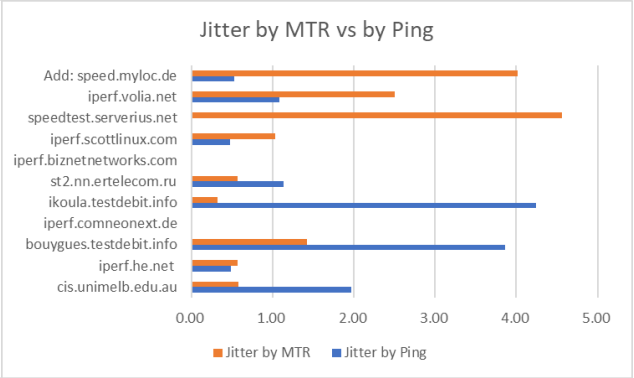
In order to control the variables as much as possible, I used the same computer, the same wireless network, and the same VPN account (FortiClient, provided by Unimelb) in the test, all of which were tested at night.

From the above two graphs, there is no positive correlation between delay and geographic distance. On the contrary, in many cases, the greater the geographic distance, the lower the latency. I think the delay may be affected by many factors, such as the condition of the communication line during the test and whether the server is in a high load state. The jitter and geographic distance also did not have a significant correlation. There were two cases where the jitter value was extremely large, which may be related to the unstable communication quality caused by the use of VPN.

3.3 MTR results

Collect MTR results for all hosts mentioned in Section 2 and compare the number of hops and the standard deviation (overall) reported by it with the results obtained from traceroute and ping? Do you observe any differences? Why or why not?





Host	Delay by Traceroute	Delay by MTR	Jitter by Ping	Jitter by MTR
cis.unimelb.edu.au	161.55	156.17	1.97	0.58
iperf.he.net	187.30	188.10	0.48	0.57
bouygues.testdebit.info	246.00	237.75	3.86	1.42
iperf.comneonext.de	Could not find host			
ikoula.testdebit.info	243.30	236.90	4.24	0.32
st2.nn.ertelecom.ru	308.80	307.90	1.14	0.57
iperf.biznetnetworks.com	Destination host unreachable			
iperf.scottlinux.com	192.00	212.80	0.47	1.03
speedtest.serverius.net	238.00	245.75	0.00	4.56
iperf.volia.net	298.08	298.50	1.08	2.50
Add: speed.myloc.de	234.44	241.11	0.53	4.01

MTR can dynamically obtain routing information, which is constantly updated, so that the results can be more reliable. Traceroute, on the other hand, updates the data slowly and requires multiple probes manually if the data needs to be updated.

According to the collected data and statistical chart, the delay collected by MTR and Traceroute are similar, but the Jitter collected by them is quite different. Maybe the delay is fixed and has nothing to do with the collection method. However, due to the real-time changes of network performance, different measurement tools produce different results.

4 Measuring the bandwidth-delay product

4.1 Measuring the bandwidth

What does the bandwidth-delay product tell us about the data transmission capability of networks? Collect three set of measurements (run this command 3 times) measuring the bandwidth of the public iperf hosts in Section 2 and find the mean bandwidth for each host.

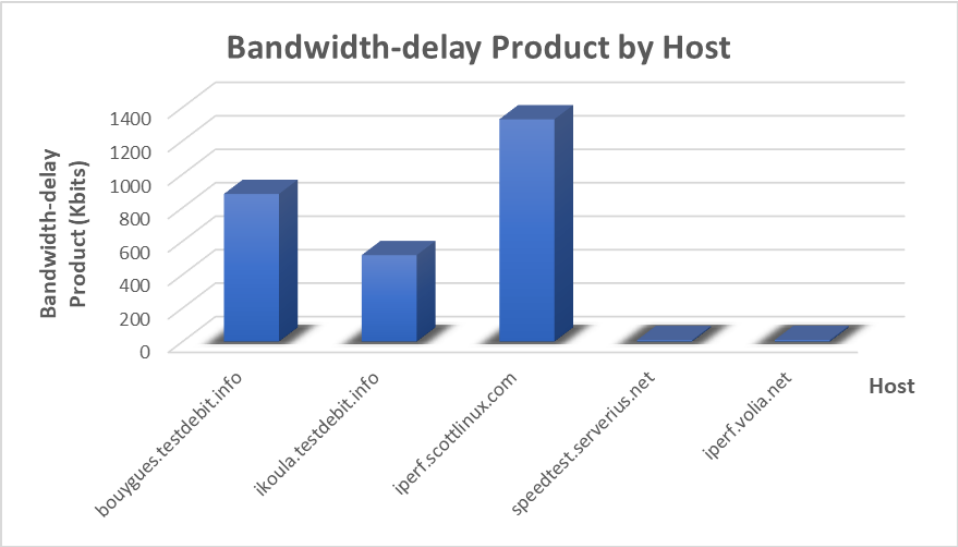
Bandwidth delay product is a network performance metric that measures the product of data link capacity (bits per second) and round-trip communication delay (units of seconds). The result is a total amount of data in bits, equivalent to the maximum amount of data on the network line at any given time -- data that has been sent but not yet acknowledged.

Host	Mean Bandwidth (Mbits/sec)	Test Results		
iperf.he.net	Connection timed out			
bouygues.testdebit.info	3.59	1.81	7.28	1.67
iperf.comneonext.de	error: Name or service not known			
ikoula.testdebit.info	2.12	2.07	2.33	1.97
st2.nn.ertelecom.ru	Connection refused			
iperf.biznetnetworks.com	Connection timed out			
iperf.scottlinux.com	6.92	7.55	6.19	7.02
speedtest.serverius.net	0.04	0.03	0.04	0.04
iperf.volia.net	0.03	0.03	0.03	0.03
Add: speed.myloc.de	Connection refused			

4.2 Calculate the bandwidth-delay product

Take the mean bandwidth and calculate the bandwidth-delay product in kilobits. You may use the mean round-trip delay time from your ping experiments to use as the delay time. Plot a bar chart for each host showing your results. You may wish to use a logarithmic scale, if appropriate. Explain your results making a comparative analysis with reference to your networking environment in which you performed your measurements. How do your results reflect upon your actual internet link speed and how does your network environment influence your results obtained (provide examples)? Are there outliers in your data? If yes, point out the outliers and explain why they are marked as outliers in your data?

Host	Mean Bandwidth (Kbits/sec)	Delay(MS)	Bandwidth-delay Product (Kbits)
iperf.he.net	Connection timed out		
bouygues.testdebit.info	3586.67	246.00	882.32
iperf.comneonext.de	error: Name or service not known		
ikoula.testdebit.info	2123.33	243.30	516.61
st2.nn.ertelecom.ru	Connection refused		
iperf.biznetnetworks.com	Connection timed out		
iperf.scottlinux.com	6920.00	192.00	1328.64
speedtest.serverius.net	36.80	238.00	8.76
iperf.volia.net	32.23	298.08	9.61
Add: speed.myloc.de	Connection refused		

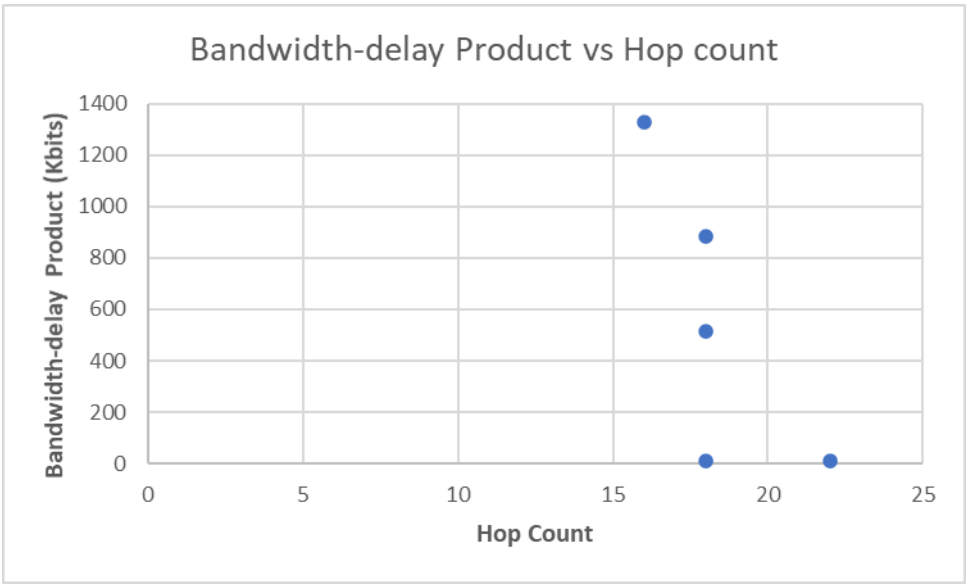


According to the statistical results, the speed of connecting to the first three servers was fast, with the bandwidth-delay product exceeding 500 kbits, while the speed of connecting to the last two servers was very slow, which should have caused network congestion at that time. My network environment shouldn't have had a big impact, because I test them on the same laptop, in the same wireless network, and at about the same time.

The last two data are outliers because the mean bandwidth of some of the public iperf hosts I have tested is roughly between 1 and 5 Mbits/sec. Only these two servers' mean bandwidths are unusually small.

4.3 Bandwidth-delay product versus the hop count

Plot the bandwidth-delay product versus the hop count. Do you observe any correlation?



As can be seen from the chart, there is a negative correlation between bandwidth-delay product and hop count. The larger the bandwidth-delay product, the smaller the hop count.

4.4 Variables

When running your tests for bandwidth, delay, and jitter, were there any variables which may have affected the accuracy or reliability of your results? How might you improve upon these (explain your rationale with examples from your experience)?

Yes.

- Factors that may affect the results include laptop performance, test time, wireless network speed, and the use of VPNs that creates more complex network connections.
- In order to improve the accuracy and reliability of the data, we should try to use the same computer, connect to the same wireless network, and conduct the test at the same time.

Appendix.

2.2 Screenshots of the hop count result

Sorry, I didn't know how to adjust the display language in English at that time. If switch back to the English display now, the data collected will also change.

```
C:\WINDOWS\system32>tracert -d -w 1 2001:470:0:236::2

通过最多 30 个跃点跟踪到 2001:470:0:236::2 的路由

  1     1 ms     1 ms     1 ms  2409:8a1e:340e:6e9d:7965:fdfe:b153:5bf3
  2     4 ms     3 ms     3 ms  2409:801e:f0:1::29d
  3     7 ms     8 ms     5 ms  2409:801e:f0:1::29c
  4     4 ms     4 ms     4 ms  2409:8080:0:2:203:275::
  5     3 ms     4 ms     4 ms  2409:8080:0:1:203:2c1:0:1
  6     6 ms     4 ms     5 ms  2409:8080:0:1:2c1:2f1:1:1
  7     *      181 ms   182 ms  2409:8080:0:4:2f1:291:0:1
  8   234 ms     *      238 ms  2402:4f00:2000:100::20d
  9   232 ms     *      234 ms  2402:4f00:2000:100::f6
 10   222 ms   221 ms     *     2001:7f8::1b1b:0:1
 11     *        *        *     请求超时。
 12     *        *        *     请求超时。
 13     *      255 ms     *     2001:470:0:410::2
 14   267 ms     *      267 ms  2001:470:0:440::1
 15   266 ms     *      277 ms  2001:470:0:20a::1
 16   273 ms     *      273 ms  2001:470:0:296::2
 17   283 ms     *      290 ms  2001:470:0:535::1
 18   285 ms     *      285 ms  2001:470:0:437::2
 19   274 ms     *      274 ms  2001:470:0:236::2

跟踪完成。
```

```
C:\WINDOWS\system32>tracert -d -w 1 bouygues.testdebit.info

通过最多 30 个跃点跟踪
到 bouygues.testdebit.info [89.84.1.186] 的路由:

  1    12 ms    12 ms    12 ms  10.0.1.248
  2    40 ms    40 ms    39 ms  192.168.2.1
  3     *        *        *     请求超时。
  4    42 ms    40 ms    41 ms  10.36.56.73
  5    40 ms    40 ms    42 ms  10.36.58.113
  6    40 ms    40 ms    41 ms  10.36.51.177
  7    42 ms    40 ms    40 ms  47.246.116.58
  8    40 ms    41 ms    40 ms  47.246.115.102
  9    40 ms    41 ms     *     63.218.175.101
 10    41 ms    40 ms    41 ms  154.54.140.65
 11    41 ms    41 ms    40 ms  154.54.88.49
 12     *      296 ms     *     154.54.81.37
 13   291 ms     *      291 ms  130.117.50.165
 14   285 ms     *      284 ms  130.117.1.46
 15   284 ms     *      284 ms  149.14.121.234
 16   282 ms     *      281 ms  62.34.2.57
 17   285 ms     *        *     212.194.171.68
 18   285 ms     *      285 ms  89.89.101.141
 19   285 ms     *      285 ms  89.84.1.186

跟踪完成。
```

```
C:\WINDOWS\system32>tracert -d -w 1 iperf.comneonext.de
无法解析目标系统名称 iperf.comneonext.de。
```

```
C:\WINDOWS\system32>tracert -d -w 1 ikoula.testdebit.info

通过最多 30 个跃点跟踪
到 ikoula.testdebit.info [213.246.63.45] 的路由:

  1    12 ms    13 ms    12 ms  10.0.1.248
  2     *       40 ms    40 ms  192.168.2.1
  3     *        *        *     请求超时。
  4    41 ms    40 ms    41 ms  10.36.60.5
  5    41 ms    41 ms    41 ms  10.36.62.73
  6    40 ms    40 ms    40 ms  10.36.51.153
  7    44 ms    40 ms    39 ms  47.246.116.54
  8    41 ms     *       41 ms  47.246.115.102
  9    75 ms    81 ms    74 ms  36.255.56.8
 10    75 ms    75 ms    77 ms  184.105.222.102
 11     *      212 ms   211 ms  184.105.65.14
 12   220 ms     *      219 ms  184.105.81.29
 13   222 ms   222 ms     *     184.104.205.18
 14   226 ms   221 ms     *     213.246.50.193
 15   223 ms   228 ms     *     213.246.50.182
 16   224 ms   222 ms     *     213.246.63.45
 17   223 ms   223 ms     *     213.246.63.45
 18   223 ms   223 ms     *     213.246.63.45
 19   222 ms   223 ms     *     213.246.63.45
 20   225 ms   223 ms     *     213.246.63.45
 21   223 ms   223 ms     *     213.246.63.45
 22   225 ms   224 ms     *     213.246.63.45
 23   223 ms   223 ms     *     213.246.63.45
 24   224 ms   224 ms     *     213.246.63.45
 25   223 ms   223 ms     *     213.246.63.45
 26   223 ms   224 ms     *     213.246.63.45
 27   231 ms   223 ms     *     213.246.63.45
 28   222 ms   222 ms     *     213.246.63.45
 29   223 ms   223 ms     *     213.246.63.45
 30   223 ms   223 ms     *     213.246.63.45

跟踪完成。
```

```
C:\WINDOWS\system32>tracert -d -w 1 st2.nn.ertelecom.ru

通过最多 30 个跃点跟踪
到 st2.nn.ertelecom.ru [91.144.184.232] 的路由:

  1    13 ms    13 ms    12 ms  10.0.1.248
  2    40 ms    45 ms    39 ms  192.168.2.1
  3     *        *        *     请求超时。
  4    41 ms    40 ms    41 ms  10.36.60.37
  5    47 ms    41 ms    43 ms  10.36.62.93
  6    41 ms    40 ms    41 ms  10.36.51.169
  7    41 ms    43 ms     *     47.246.116.58
  8    41 ms    44 ms    40 ms  47.246.115.102
  9    40 ms    42 ms    40 ms  63.218.175.101
 10   199 ms     *      198 ms  63.218.178.58
 11   192 ms   193 ms     *     213.248.104.84
 12   191 ms   190 ms     *     62.115.125.160
 13   246 ms   247 ms   246 ms  62.115.119.228
 14   335 ms     *      336 ms  62.115.113.21
 15   340 ms     *      339 ms  80.91.249.11
 16   321 ms     *      325 ms  213.155.130.101
 17   311 ms     *      310 ms  62.115.123.179
 18   325 ms     *      325 ms  62.115.123.194
 19     *        *        *     请求超时。
 20   322 ms     *      323 ms  62.115.133.234
 21   324 ms     *      325 ms  62.115.116.233
 22   336 ms     *      338 ms  62.115.12.110
 23   327 ms     *      331 ms  109.194.232.26
 24   346 ms     *      346 ms  109.194.232.25
 25   334 ms     *      334 ms  91.144.184.232

跟踪完成。
```

```
C:\WINDOWS\system32>tracert -d -w 1 st2.nn.ertelecom.ru

通过最多 30 个跃点跟踪
到 st2.nn.ertelecom.ru [91.144.184.232] 的路由:

  1    13 ms    13 ms    12 ms  10.0.1.248
  2    40 ms    45 ms    39 ms  192.168.2.1
  3     *        *        *     请求超时。
  4    41 ms    40 ms    41 ms  10.36.60.37
  5    47 ms    41 ms    43 ms  10.36.62.93
  6    41 ms    40 ms    41 ms  10.36.51.169
  7    41 ms    43 ms     *     47.246.116.58
  8    41 ms    44 ms    40 ms  47.246.115.102
  9    40 ms    42 ms    40 ms  63.218.175.101
 10   199 ms     *      198 ms  63.218.178.58
 11   192 ms   193 ms     *     213.248.104.84
 12   191 ms   190 ms     *     62.115.125.160
 13   246 ms   247 ms   246 ms  62.115.119.228
 14   335 ms     *      336 ms  62.115.113.21
 15   340 ms     *      339 ms  80.91.249.11
 16   321 ms     *      325 ms  213.155.130.101
 17   311 ms     *      310 ms  62.115.123.179
 18   325 ms     *      325 ms  62.115.123.194
 19     *        *        *     请求超时。
 20   322 ms     *      323 ms  62.115.133.234
 21   324 ms     *      325 ms  62.115.116.233
 22   336 ms     *      338 ms  62.115.12.110
 23   327 ms     *      331 ms  109.194.232.26
 24   346 ms     *      346 ms  109.194.232.25
 25   334 ms     *      334 ms  91.144.184.232

跟踪完成。
```

```
C:\WINDOWS\system32>tracert -d -w 1 iperf.biznetnetworks.com

通过最多 30 个跃点跟踪
到 iperf.biznetnetworks.com [117.102.109.186] 的路由:

  1    12 ms    13 ms    12 ms  10.0.1.248
  2    39 ms    40 ms    39 ms  192.168.2.1
  3     *        *        *     请求超时。
  4    40 ms    41 ms    40 ms  10.36.56.125
  5    46 ms    41 ms    42 ms  10.36.58.133
  6    42 ms    42 ms    41 ms  10.36.51.169
  7    41 ms    41 ms    41 ms  47.246.116.66
  8     *       41 ms    42 ms  116.251.86.198
  9    89 ms    86 ms    86 ms  47.246.116.253
 10     *        *        *     请求超时。
 11     *        *        *     请求超时。
 12     *        *        *     请求超时。
 13    91 ms    95 ms    89 ms  218.100.36.91
 14    90 ms    90 ms     *     117.102.109.186
 15    91 ms    90 ms    90 ms  117.102.109.186

跟踪完成。
```

```
C:\WINDOWS\system32>tracert -d -w 1 iperf.scottlinux.com

通过最多 30 个跃点跟踪
到 iperf.scottlinux.com [45.33.39.39] 的路由:

  1    14 ms    13 ms    13 ms  10.0.1.248
  2    40 ms    40 ms    44 ms  192.168.2.1
  3     *        *        *     请求超时。
  4    40 ms    40 ms    40 ms  10.36.56.165
  5    41 ms    40 ms    42 ms  10.36.58.121
  6    39 ms    40 ms    39 ms  10.36.51.153
  7    41 ms    42 ms    40 ms  47.246.116.62
  8    42 ms     *       53 ms  116.251.86.194
  9    42 ms    42 ms    41 ms  203.131.242.229
 10    44 ms    43 ms    43 ms  129.250.6.99
 11    82 ms    82 ms     *     129.250.2.50
 12   194 ms   197 ms     *     129.250.5.78
 13   195 ms   186 ms     *     129.250.6.119
 14   192 ms   192 ms     *     192.80.17.170
 15   190 ms   193 ms     *     173.230.159.65
 16   195 ms   200 ms     *     45.33.39.39
 17   202 ms   194 ms     *     45.33.39.39
 18   195 ms   194 ms     *     45.33.39.39
 19   195 ms   194 ms     *     45.33.39.39
 20   195 ms   194 ms     *     45.33.39.39
 21   206 ms   194 ms     *     45.33.39.39
 22   195 ms   195 ms     *     45.33.39.39
 23   207 ms   195 ms     *     45.33.39.39
 24   195 ms   194 ms     *     45.33.39.39
 25   194 ms   195 ms     *     45.33.39.39
 26   197 ms   194 ms     *     45.33.39.39
 27   196 ms   195 ms     *     45.33.39.39
 28   196 ms   195 ms     *     45.33.39.39
 29   197 ms   194 ms     *     45.33.39.39
 30   195 ms   195 ms     *     45.33.39.39

跟踪完成。
```

```
C:\WINDOWS\system32>tracert -d -w 1 speedtest.serverius.net

通过最多 30 个跃点跟踪
到 speedtest.serverius.net [178.21.16.76] 的路由:

  1    12 ms    13 ms    12 ms  10.0.1.248
  2    39 ms    38 ms    39 ms  192.168.2.1
  3     *        *        *     请求超时。
  4    41 ms    42 ms    41 ms  10.36.60.65
  5    47 ms    42 ms    42 ms  10.36.62.85
  6    41 ms    41 ms    41 ms  10.36.51.161
  7    40 ms    45 ms    40 ms  47.246.116.66
  8     *       40 ms    40 ms  116.251.86.198
  9    41 ms    42 ms    41 ms  63.216.84.145
 10    41 ms    40 ms    41 ms  63.218.174.245
 11    41 ms    42 ms    42 ms  154.54.140.65
 12    42 ms     *       42 ms  154.54.88.49
 13   271 ms     *      268 ms  154.54.1.117
 14   275 ms     *      275 ms  130.117.49.153
 15   288 ms     *      449 ms  130.117.2.141
 16   287 ms     *      287 ms  130.117.1.10
 17   278 ms     *      278 ms  149.11.39.186
 18   278 ms     *      278 ms  178.21.16.76

跟踪完成。
```

```
C:\WINDOWS\system32>tracert -d -w 1 iperf.volia.net

通过最多 30 个跃点跟踪
到 speedtest.volia.net [77.120.3.236] 的路由:

  1    12 ms    12 ms    13 ms  10.0.1.248
  2    40 ms    39 ms    38 ms  192.168.2.1
  3     *        *        *     请求超时。
  4    43 ms    41 ms    42 ms  10.36.56.85
  5    45 ms    42 ms    40 ms  10.36.58.141
  6    42 ms    39 ms    42 ms  10.36.51.145
  7    41 ms    52 ms    53 ms  47.246.116.62
  8     *       42 ms    41 ms  116.251.86.198
  9    43 ms    47 ms    44 ms  203.131.242.185
 10    44 ms    43 ms    49 ms  129.250.6.93
 11    92 ms    84 ms     *     129.250.2.50
 12   190 ms   198 ms     *     129.250.5.78
 13   187 ms   189 ms     *     129.250.6.119
 14     *        *        *     请求超时。
 15   198 ms   199 ms     *     154.54.43.9
 16   217 ms   218 ms     *     154.54.44.138
 17   234 ms   234 ms     *     154.54.41.146
 18   232 ms   230 ms     *     154.54.5.90
 19   238 ms   238 ms   237 ms  154.54.42.166
 20   257 ms     *      254 ms  154.54.6.222
 21   251 ms     *      252 ms  154.54.31.226
 22   266 ms     *      264 ms  154.54.41.206
 23   346 ms     *      345 ms  154.54.44.161
 24   344 ms     *      345 ms  154.54.77.245
 25   344 ms     *      345 ms  130.117.0.122
 26   349 ms     *      351 ms  154.54.36.54
 27   357 ms     *      357 ms  154.54.58.6
 28   357 ms     *      357 ms  154.54.59.85
 29   375 ms     *      387 ms  154.54.58.246
 30   370 ms     *      370 ms  149.6.190.250

跟踪完成。
```

```
C:\WINDOWS\system32>tracert -d -w 1 speed.myloc.de

通过最多 30 个跃点跟踪
到 speedtest.myloc.de [37.157.253.246] 的路由:

  1    12 ms    12 ms    12 ms  10.0.1.248
  2    39 ms    39 ms    42 ms  192.168.2.1
  3     *        *        *     请求超时。
  4    43 ms    40 ms    41 ms  10.36.56.81
  5    39 ms    39 ms    39 ms  10.36.58.105
  6    42 ms    43 ms    40 ms  10.36.51.153
  7    40 ms    40 ms     *     47.246.116.54
  8    48 ms    40 ms    40 ms  47.246.115.110
  9    44 ms    43 ms    46 ms  203.131.242.185
 10    41 ms    40 ms    41 ms  4.68.75.93
 11     *        *        *     请求超时。
 12   220 ms   219 ms     *     212.162.19.26
 13   234 ms   236 ms   237 ms  62.141.47.9
 14   223 ms   224 ms     *     37.157.253.246
 15   222 ms   221 ms     *     37.157.253.246
 16   223 ms   224 ms     *     37.157.253.246
 17   221 ms   222 ms     *     37.157.253.246
 18   222 ms   223 ms     *     37.157.253.246
 19   223 ms   223 ms     *     37.157.253.246
 20   225 ms   222 ms     *     37.157.253.246
 21   225 ms   223 ms     *     37.157.253.246
 22   223 ms   223 ms     *     37.157.253.246
 23   223 ms   223 ms     *     37.157.253.246
 24   224 ms   225 ms     *     37.157.253.246
 25   222 ms   225 ms     *     37.157.253.246
 26   222 ms   224 ms     *     37.157.253.246
 27   222 ms   222 ms     *     37.157.253.246
 28   225 ms   225 ms     *     37.157.253.246
 29   223 ms   222 ms     *     37.157.253.246
 30   223 ms   223 ms     *     37.157.253.246

跟踪完成。
```

3.1 Measure the round-trip delay

```
C:\WINDOWS\system32>ping cis.unimelb.edu.au

Pinging cis.unimelb.edu.au [128.250.59.35] with 32 bytes of data:
Reply from 128.250.59.35: bytes=32 time=163ms TTL=40
Reply from 128.250.59.35: bytes=32 time=161ms TTL=40
Reply from 128.250.59.35: bytes=32 time=162ms TTL=40
Reply from 128.250.59.35: bytes=32 time=163ms TTL=40

Ping statistics for 128.250.59.35:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 161ms, Maximum = 163ms, Average = 162ms

C:\WINDOWS\system32>ping cis.unimelb.edu.au

Pinging cis.unimelb.edu.au [128.250.59.35] with 32 bytes of data:
Reply from 128.250.59.35: bytes=32 time=159ms TTL=40
Reply from 128.250.59.35: bytes=32 time=162ms TTL=40
Reply from 128.250.59.35: bytes=32 time=162ms TTL=40
Reply from 128.250.59.35: bytes=32 time=162ms TTL=40

Ping statistics for 128.250.59.35:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 159ms, Maximum = 162ms, Average = 161ms

C:\WINDOWS\system32>ping cis.unimelb.edu.au

Pinging cis.unimelb.edu.au [128.250.59.35] with 32 bytes of data:
Reply from 128.250.59.35: bytes=32 time=164ms TTL=40
Reply from 128.250.59.35: bytes=32 time=157ms TTL=40
Request timed out.
Reply from 128.250.59.35: bytes=32 time=162ms TTL=40

Ping statistics for 128.250.59.35:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 157ms, Maximum = 164ms, Average = 161ms
```

```
C:\WINDOWS\system32>ping iperf.he.net

Pinging 1500.mtu.he.net [2001:470:0:236::2] with 32 bytes of data:
Request timed out.
Reply from 2001:470:0:236::2: time=187ms
Request timed out.
Reply from 2001:470:0:236::2: time=187ms

Ping statistics for 2001:470:0:236::2:
    Packets: Sent = 4, Received = 2, Lost = 2 (50% loss),
Approximate round trip times in milli-seconds:
    Minimum = 187ms, Maximum = 187ms, Average = 187ms

C:\WINDOWS\system32>ping iperf.he.net

Pinging 1500.mtu.he.net [2001:470:0:236::2] with 32 bytes of data:
Reply from 2001:470:0:236::2: time=187ms
Reply from 2001:470:0:236::2: time=187ms
Reply from 2001:470:0:236::2: time=188ms
Reply from 2001:470:0:236::2: time=188ms

Ping statistics for 2001:470:0:236::2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 187ms, Maximum = 188ms, Average = 187ms

C:\WINDOWS\system32>ping iperf.he.net

Pinging 1500.mtu.he.net [2001:470:0:236::2] with 32 bytes of data:
Reply from 2001:470:0:236::2: time=187ms
Reply from 2001:470:0:236::2: time=188ms
Reply from 2001:470:0:236::2: time=187ms
Reply from 2001:470:0:236::2: time=187ms

Ping statistics for 2001:470:0:236::2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 187ms, Maximum = 188ms, Average = 187ms
```

```
C:\WINDOWS\system32>ping bouygues.testdebit.info

Pinging bouygues.testdebit.info [2001:860:de01:1100::2] with 32 bytes of data:
Reply from 2001:860:de01:1100::2: time=248ms
Reply from 2001:860:de01:1100::2: time=249ms
Reply from 2001:860:de01:1100::2: time=249ms
Reply from 2001:860:de01:1100::2: time=246ms

Ping statistics for 2001:860:de01:1100::2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 246ms, Maximum = 249ms, Average = 248ms

C:\WINDOWS\system32>ping bouygues.testdebit.info

Pinging bouygues.testdebit.info [2001:860:de01:1100::2] with 32 bytes of data:
Reply from 2001:860:de01:1100::2: time=250ms
Reply from 2001:860:de01:1100::2: time=249ms
Reply from 2001:860:de01:1100::2: time=246ms
Reply from 2001:860:de01:1100::2: time=241ms

Ping statistics for 2001:860:de01:1100::2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 241ms, Maximum = 250ms, Average = 246ms

C:\WINDOWS\system32>ping bouygues.testdebit.info

Pinging bouygues.testdebit.info [2001:860:de01:1100::2] with 32 bytes of data:
Reply from 2001:860:de01:1100::2: time=240ms
Reply from 2001:860:de01:1100::2: time=244ms
Reply from 2001:860:de01:1100::2: time=240ms
Reply from 2001:860:de01:1100::2: time=250ms

Ping statistics for 2001:860:de01:1100::2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 240ms, Maximum = 250ms, Average = 243ms
```

```
C:\WINDOWS\system32>ping ikoula.testdebit.info

Pinging ikoula.testdebit.info [2a00:c70:1:213:246:63:45:2] with 32 bytes of data:
Reply from 2a00:c70:1:213:246:63:45:2: time=239ms
Reply from 2a00:c70:1:213:246:63:45:2: time=239ms
Reply from 2a00:c70:1:213:246:63:45:2: time=248ms
Reply from 2a00:c70:1:213:246:63:45:2: time=241ms

Ping statistics for 2a00:c70:1:213:246:63:45:2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 239ms, Maximum = 248ms, Average = 241ms

C:\WINDOWS\system32>ping ikoula.testdebit.info

Pinging ikoula.testdebit.info [2a00:c70:1:213:246:63:45:2] with 32 bytes of data:
Reply from 2a00:c70:1:213:246:63:45:2: time=248ms
Reply from 2a00:c70:1:213:246:63:45:2: time=240ms
Reply from 2a00:c70:1:213:246:63:45:2: time=242ms
Reply from 2a00:c70:1:213:246:63:45:2: time=250ms

Ping statistics for 2a00:c70:1:213:246:63:45:2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 240ms, Maximum = 250ms, Average = 245ms

C:\WINDOWS\system32>ping ikoula.testdebit.info

Pinging ikoula.testdebit.info [2a00:c70:1:213:246:63:45:2] with 32 bytes of data:
Reply from 2a00:c70:1:213:246:63:45:2: time=246ms
Reply from 2a00:c70:1:213:246:63:45:2: time=240ms
Reply from 2a00:c70:1:213:246:63:45:2: time=248ms
Reply from 2a00:c70:1:213:246:63:45:2: time=239ms

Ping statistics for 2a00:c70:1:213:246:63:45:2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 239ms, Maximum = 248ms, Average = 243ms
```

```
C:\WINDOWS\system32>ping st2.nn.ertelecom.ru

Pinging st2.nn.ertelecom.ru [91.144.184.232] with 32 bytes of data:
Reply from 91.144.184.232: bytes=32 time=308ms TTL=50
Reply from 91.144.184.232: bytes=32 time=309ms TTL=50
Reply from 91.144.184.232: bytes=32 time=310ms TTL=50
Reply from 91.144.184.232: bytes=32 time=308ms TTL=50

Ping statistics for 91.144.184.232:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 308ms, Maximum = 310ms, Average = 308ms

C:\WINDOWS\system32>ping st2.nn.ertelecom.ru

Pinging st2.nn.ertelecom.ru [91.144.184.232] with 32 bytes of data:
Reply from 91.144.184.232: bytes=32 time=308ms TTL=50
Reply from 91.144.184.232: bytes=32 time=308ms TTL=50
Reply from 91.144.184.232: bytes=32 time=310ms TTL=50
Reply from 91.144.184.232: bytes=32 time=310ms TTL=50

Ping statistics for 91.144.184.232:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 308ms, Maximum = 310ms, Average = 309ms

C:\WINDOWS\system32>ping st2.nn.ertelecom.ru

Pinging st2.nn.ertelecom.ru [91.144.184.232] with 32 bytes of data:
Reply from 91.144.184.232: bytes=32 time=307ms TTL=50
Reply from 91.144.184.232: bytes=32 time=310ms TTL=50
Reply from 91.144.184.232: bytes=32 time=310ms TTL=50
Reply from 91.144.184.232: bytes=32 time=311ms TTL=50

Ping statistics for 91.144.184.232:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 307ms, Maximum = 311ms, Average = 309ms
```

```
C:\WINDOWS\system32>ping iperf.biznetnetworks.com

Pinging iperf.biznetnetworks.com [2404:8000:70:d4::2] with 32 bytes of data:
Request timed out.
Request timed out.
Request timed out.
Destination host unreachable.

Ping statistics for 2404:8000:70:d4::2:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

C:\WINDOWS\system32>
C:\WINDOWS\system32>ping iperf.biznetnetworks.com

Pinging iperf.biznetnetworks.com [2404:8000:70:d4::2] with 32 bytes of data:
Request timed out.
Destination host unreachable.
Request timed out.
Request timed out.

Ping statistics for 2404:8000:70:d4::2:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

C:\WINDOWS\system32>ping iperf.biznetnetworks.com

Pinging iperf.biznetnetworks.com [2404:8000:70:d4::2] with 32 bytes of data:
Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 2404:8000:70:d4::2:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

```
C:\WINDOWS\system32>ping iperf.scottlinux.com

Pinging iperf.scottlinux.com [2600:3c01::f03c:91ff:fed5:ed33] with 32 bytes of data:
Reply from 2600:3c01::f03c:91ff:fed5:ed33: time=191ms
Reply from 2600:3c01::f03c:91ff:fed5:ed33: time=192ms
Reply from 2600:3c01::f03c:91ff:fed5:ed33: time=192ms
Reply from 2600:3c01::f03c:91ff:fed5:ed33: time=193ms

Ping statistics for 2600:3c01::f03c:91ff:fed5:ed33:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 191ms, Maximum = 193ms, Average = 192ms

C:\WINDOWS\system32>ping iperf.scottlinux.com

Pinging iperf.scottlinux.com [2600:3c01::f03c:91ff:fed5:ed33] with 32 bytes of data:
Reply from 2600:3c01::f03c:91ff:fed5:ed33: time=192ms
Reply from 2600:3c01::f03c:91ff:fed5:ed33: time=192ms
Reply from 2600:3c01::f03c:91ff:fed5:ed33: time=192ms
Reply from 2600:3c01::f03c:91ff:fed5:ed33: time=192ms

Ping statistics for 2600:3c01::f03c:91ff:fed5:ed33:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 192ms, Maximum = 192ms, Average = 192ms

C:\WINDOWS\system32>ping iperf.scottlinux.com

Pinging iperf.scottlinux.com [2600:3c01::f03c:91ff:fed5:ed33] with 32 bytes of data:
Reply from 2600:3c01::f03c:91ff:fed5:ed33: time=192ms
Reply from 2600:3c01::f03c:91ff:fed5:ed33: time=192ms
Reply from 2600:3c01::f03c:91ff:fed5:ed33: time=191ms
Reply from 2600:3c01::f03c:91ff:fed5:ed33: time=191ms

Ping statistics for 2600:3c01::f03c:91ff:fed5:ed33:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 191ms, Maximum = 192ms, Average = 191ms
```

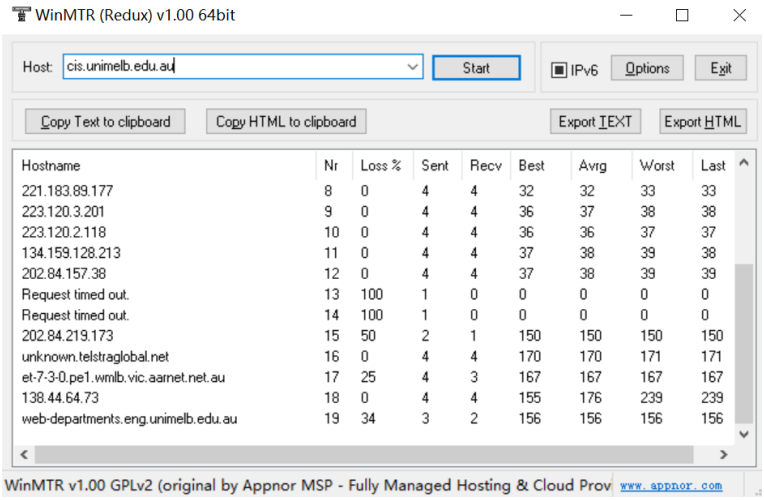
```
C:\WINDOWS\system32>ping speedtest.serverius.net

Pinging speedtest.serverius.net [2a00:1ca8:33::2] with 32 bytes of data:
Reply from 2a00:1ca8:33::2: time=238ms
Reply from 2a00:1ca8:33::2: time=238ms
Reply from 2a00:1ca8:33::2: time=238ms
Request timed out.

Ping statistics for 2a00:1ca8:33::2:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 238ms, Maximum = 238ms, Average = 238ms

C:\WINDOWS\system32>
C:\WINDOWS\system32>ping speedtest.serverius.net

Pinging speedtest.serverius.net [2a00:1ca8:33::2] with 32 bytes of data:
Reply from 2a00:1ca8:33::2: time=238ms
Request timed out.
Reply from 2a00:1ca8:33::2: time=238ms
Reply from 2a00:1ca8:33::2: time=238ms

Ping statistics for 2a00:1ca8:33::2:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 238ms, Maximum = 238ms, Average = 238ms

C:\WINDOWS\system32>
C:\WINDOWS\system32>ping speedtest.serverius.net

Pinging speedtest.serverius.net [2a00:1ca8:33::2] with 32 bytes of data:
Request timed out.
Reply from 2a00:1ca8:33::2: time=238ms
Reply from 2a00:1ca8:33::2: time=238ms
Request timed out.

Ping statistics for 2a00:1ca8:33::2:
    Packets: Sent = 4, Received = 2, Lost = 2 (50% loss),
Approximate round trip times in milli-seconds:
    Minimum = 238ms, Maximum = 238ms, Average = 238ms
```

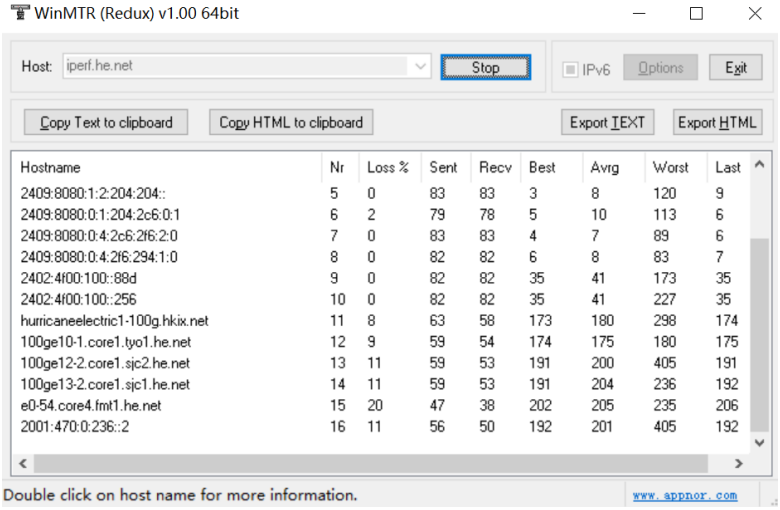
```
C:\WINDOWS\system32>ping iperf.volia.net

Pinging speedtest.volia.net [77.120.3.236] with 32 bytes of data:
Reply from 77.120.3.236: bytes=32 time=298ms TTL=50
Reply from 77.120.3.236: bytes=32 time=299ms TTL=50
Reply from 77.120.3.236: bytes=32 time=297ms TTL=50
Reply from 77.120.3.236: bytes=32 time=297ms TTL=50

Ping statistics for 77.120.3.236:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 297ms, Maximum = 299ms, Average = 297ms

C:\WINDOWS\system32>
C:\WINDOWS\system32>ping iperf.volia.net

Pinging speedtest.volia.net [77.120.3.236] with 32 bytes of data:
Reply from 77.120.3.236: bytes=32 time=298ms TTL=50
Reply from 77.120.3.236: bytes=32 time=298ms TTL=50
Reply from 77.120.3.236: bytes=32 time=298ms TTL=50
Reply from 77.120.3.236: bytes=32 time=298ms TTL=50

Ping statistics for 77.120.3.236:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 298ms, Maximum = 298ms, Average = 298ms

C:\WINDOWS\system32>ping iperf.volia.net

Pinging speedtest.volia.net [77.120.3.236] with 32 bytes of data:
Reply from 77.120.3.236: bytes=32 time=298ms TTL=50
Reply from 77.120.3.236: bytes=32 time=297ms TTL=50
Reply from 77.120.3.236: bytes=32 time=298ms TTL=50
Reply from 77.120.3.236: bytes=32 time=301ms TTL=50

Ping statistics for 77.120.3.236:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 297ms, Maximum = 301ms, Average = 298ms
```

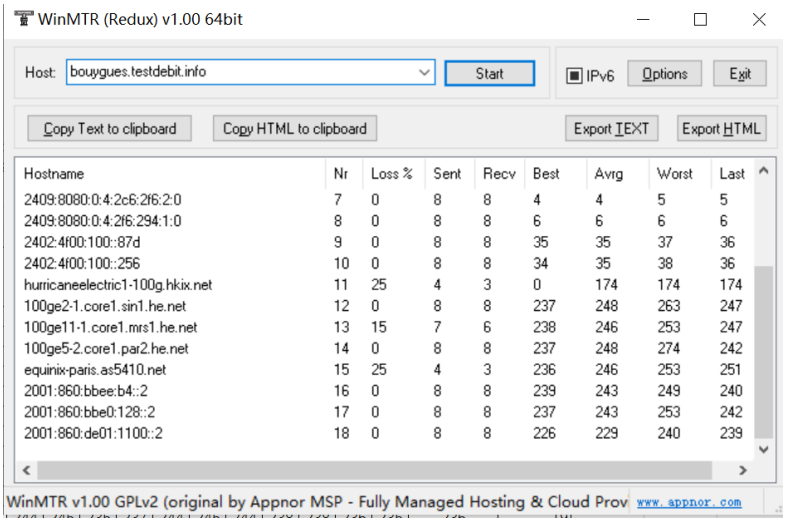
```
C:\WINDOWS\system32>ping speed.myloc.de

Pinging speedtest.myloc.de [2001:4ba0:ffe0:ffff::2] with 32 bytes of data:
Request timed out.
Reply from 2001:4ba0:ffe0:ffff::2: time=235ms
Reply from 2001:4ba0:ffe0:ffff::2: time=235ms
Reply from 2001:4ba0:ffe0:ffff::2: time=235ms

Ping statistics for 2001:4ba0:ffe0:ffff::2:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 235ms, Maximum = 235ms, Average = 235ms

C:\WINDOWS\system32>ping speed.myloc.de

Pinging speedtest.myloc.de [2001:4ba0:ffe0:ffff::2] with 32 bytes of data:
Reply from 2001:4ba0:ffe0:ffff::2: time=234ms
Reply from 2001:4ba0:ffe0:ffff::2: time=234ms
Reply from 2001:4ba0:ffe0:ffff::2: time=234ms
Reply from 2001:4ba0:ffe0:ffff::2: time=234ms

Ping statistics for 2001:4ba0:ffe0:ffff::2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 234ms, Maximum = 234ms, Average = 234ms

C:\WINDOWS\system32>ping speed.myloc.de

Pinging speedtest.myloc.de [2001:4ba0:ffe0:ffff::2] with 32 bytes of data:
Request timed out.
Reply from 2001:4ba0:ffe0:ffff::2: time=234ms
Request timed out.
Reply from 2001:4ba0:ffe0:ffff::2: time=235ms

Ping statistics for 2001:4ba0:ffe0:ffff::2:
    Packets: Sent = 4, Received = 2, Lost = 2 (50% loss),
Approximate round trip times in milli-seconds:
    Minimum = 234ms, Maximum = 235ms, Average = 234ms
```

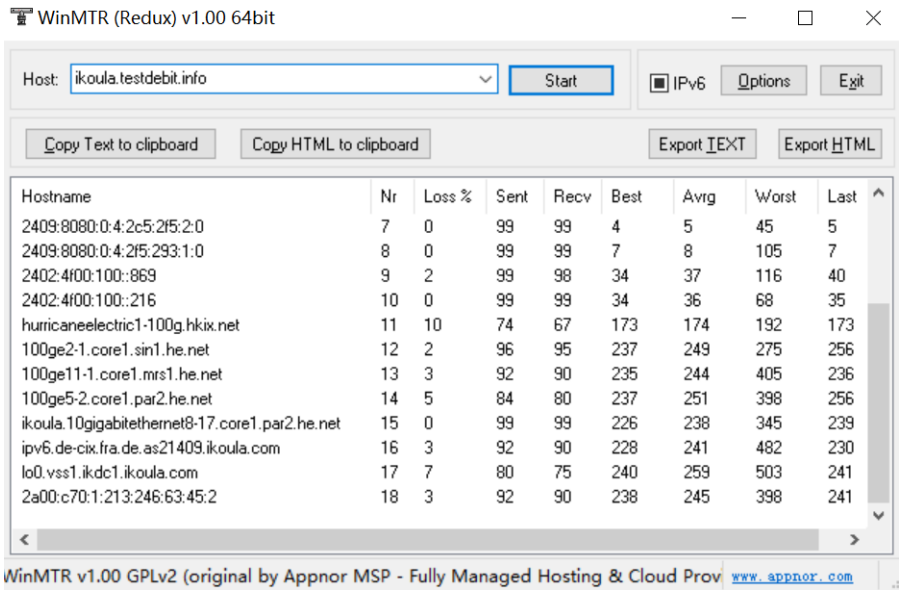
3.3 MTR results

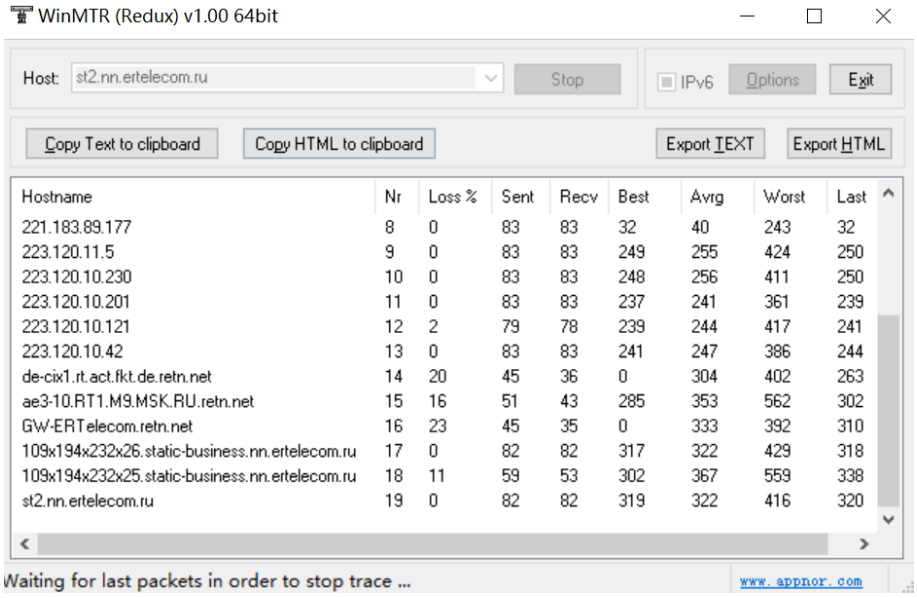
- Since MTR of Win10 does not directly display standard deviation, I took the Last value of 12 consecutive jumps as a sample and calculated the standard deviation by myself.
- One problem is that I forgot to take MTR results screenshot when drawing the statistical chart. When I realized and tested again the next night, although hop counts did not change, there were some differences with the delay value.

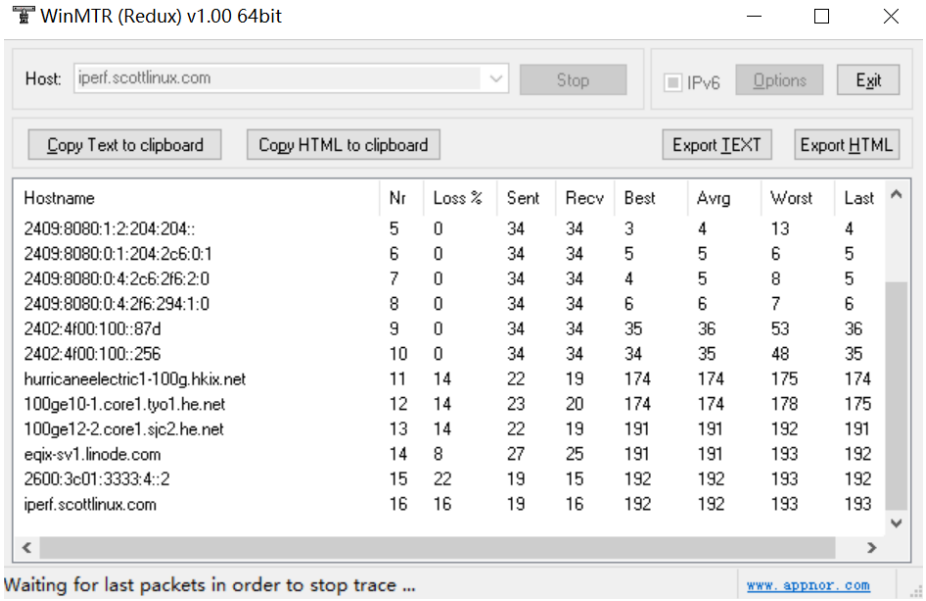


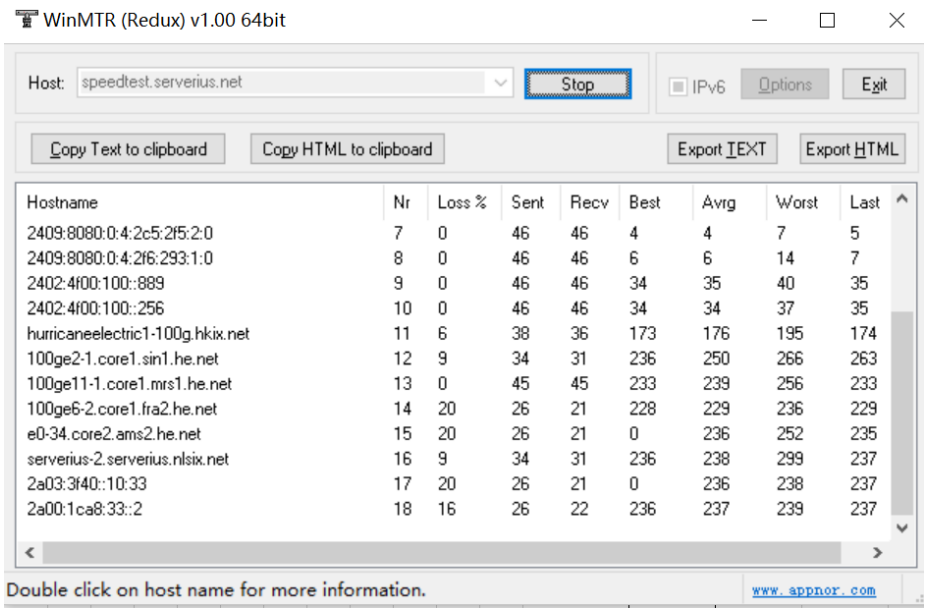


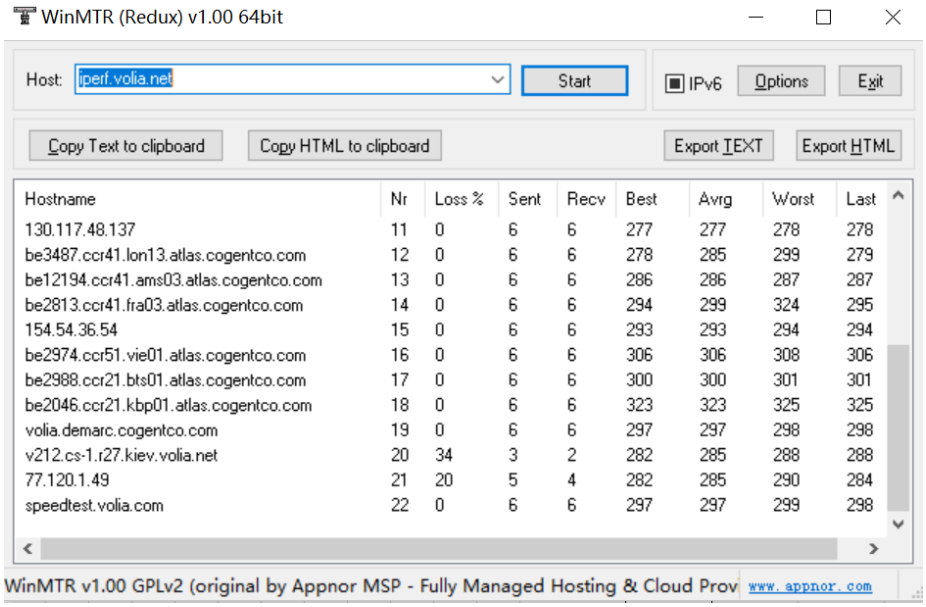


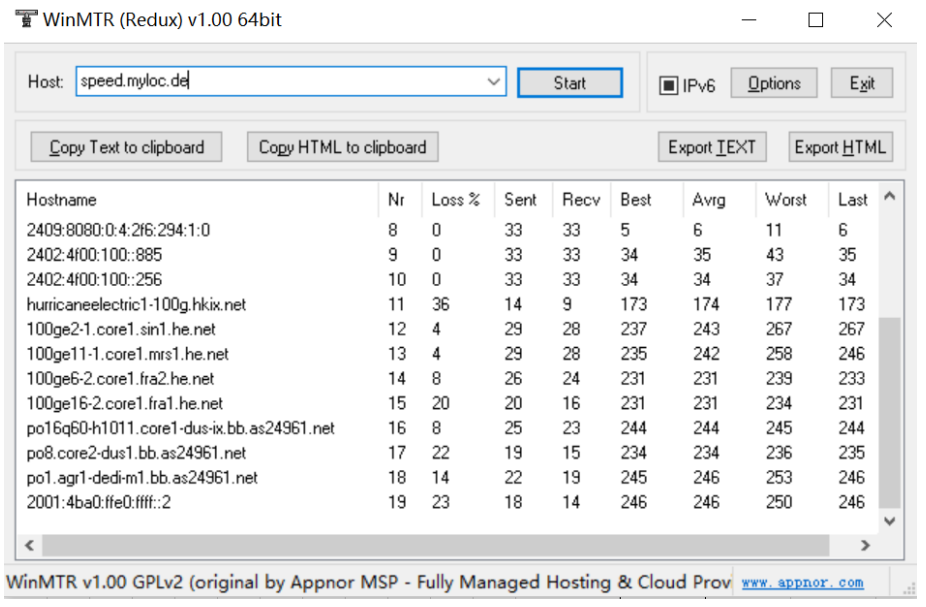

WinMTR (Redux) v1.00 64bit
Host: ikoula.testdebit.info
Start
IPv6
Options
Exit
Copy Text to clipboard
Copy HTML to clipboard
Export TEXT
Export HTML
Hostname Nr Loss % Sent Recv Best Avrg Worst Last
2409:8080:0:4:2c5:2f5:2:0 7 0 99 99 4 5 45 5
2409:8080:0:4:2f5:293:1:0 8 0 99 99 7 8 105 7
2402:4f00:100::869 9 2 99 98 34 37 116 40
2402:4f00:100::216 10 0 99 99 34 36 68 35
hurricaneelectric1-100g.hkix.net 11 10 74 67 173 174 192 173
100ge2-1.core1.sin1.he.net 12 2 96 95 237 249 275 256
100ge11-1.core1.mrs1.he.net 13 3 92 90 235 244 405 236
100ge5-2.core1.par2.he.net 14 5 84 80 237 251 398 256
ikoula.10gigabitethernet8-17.core1.par2.he.net 15 0 99 99 226 238 345 239
ipv6.de-cix.fra.de.as21409.ikoula.com 16 3 92 90 228 241 482 230
lo0.vss1.ikdc1.ikoula.com 17 7 80 75 240 259 503 241
2a00:c70:1:213:246:63:45:2 18 3 92 90 238 245 398 241
WinMTR v1.00 GPLv2 (original by Appnor MSP - Fully Managed Hosting & Cloud Prov
www.appnor.com


WinMTR (Redux) v1.00 64bit
Host: st2.nn.ertelecom.ru
Stop
IPv6
Options
Exit
Copy Text to clipboard
Copy HTML to clipboard
Export TEXT
Export HTML
Hostname Nr Loss % Sent Recv Best Avrg Worst Last
221.183.89.177 8 0 83 83 32 40 243 32
223.120.11.5 9 0 83 83 249 255 424 250
223.120.10.230 10 0 83 83 248 256 411 250
223.120.10.201 11 0 83 83 237 241 361 239
223.120.10.121 12 2 79 78 239 244 417 241
223.120.10.42 13 0 83 83 241 247 386 244
de-cix1.rt.act.fkt.de.retn.net 14 20 45 36 0 304 402 263
ae3-10.RT1.M9.MSK.RU.retn.net 15 16 51 43 285 353 562 302
GW-ERTelecom.retn.net 16 23 45 35 0 333 392 310
109x194x232x26.static-business.nn.ertelecom.ru 17 0 82 82 317 322 429 318
109x194x232x25.static-business.nn.ertelecom.ru 18 11 59 53 302 367 559 338
st2.nn.ertelecom.ru 19 0 82 82 319 322 416 320
Waiting for last packets in order to stop trace ...
www.appnor.com


WinMTR (Redux) v1.00 64bit
Host: iperf.scottlinux.com
Stop
IPv6
Options
Exit
Copy Text to clipboard
Copy HTML to clipboard
Export TEXT
Export HTML
Hostname Nr Loss % Sent Recv Best Avrg Worst Last
2409:8080:1:2:204:204:: 5 0 34 34 3 4 13 4
2409:8080:0:1:204:2c6:0:1 6 0 34 34 5 5 6 5
2409:8080:0:4:2c6:2f6:2:0 7 0 34 34 4 5 8 5
2409:8080:0:4:2f6:294:1:0 8 0 34 34 6 6 7 6
2402:4f00:100::87d 9 0 34 34 35 36 53 36
2402:4f00:100::256 10 0 34 34 34 35 48 35
hurricaneelectric1-100g.hkix.net 11 14 22 19 174 174 175 174
100ge10-1.core1.tyo1.he.net 12 14 23 20 174 174 178 175
100ge12-2.core1.sjc2.he.net 13 14 22 19 191 191 192 191
eqix-sv1.linode.com 14 8 27 25 191 191 193 192
2600:3c01:3333:4::2 15 22 19 15 192 192 193 192
iperf.scottlinux.com 16 16 19 16 192 192 193 193
Waiting for last packets in order to stop trace ...
www.appnor.com


WinMTR (Redux) v1.00 64bit
Host: speedtest.serverius.net
Stop
IPv6
Options
Exit
Copy Text to clipboard
Copy HTML to clipboard
Export TEXT
Export HTML
Hostname Nr Loss % Sent Recv Best Avrg Worst Last
2409:8080:0:4:2c5:2f5:2:0 7 0 46 46 4 4 7 5
2409:8080:0:4:2f6:293:1:0 8 0 46 46 6 6 14 7
2402:4f00:100::889 9 0 46 46 34 35 40 35
2402:4f00:100::256 10 0 46 46 34 34 37 35
hurricaneelectric1-100g.hkix.net 11 6 38 36 173 176 195 174
100ge2-1.core1.sin1.he.net 12 9 34 31 236 250 266 263
100ge11-1.core1.mrs1.he.net 13 0 45 45 233 239 256 233
100ge6-2.core1.fra2.he.net 14 20 26 21 228 229 236 229
e0-34.core2.ams2.he.net 15 20 26 21 0 236 252 235
serverius-2.serverius.nlsix.net 16 9 34 31 236 238 299 237
2a03:3f40::10:33 17 20 26 21 0 236 238 237
2a00:1ca8:33::2 18 16 26 22 236 237 239 237
Double click on host name for more information.
www.appnor.com


WinMTR (Redux) v1.00 64bit
Host: iperf.volia.net
Start
IPv6
Options
Exit
Copy Text to clipboard
Copy HTML to clipboard
Export TEXT
Export HTML
Hostname Nr Loss % Sent Recv Best Avrg Worst Last
130.117.48.137 11 0 6 6 277 277 278 278
be3487.ccr41.lon13.atlas.cogentco.com 12 0 6 6 278 285 299 279
be12194.ccr41.ams03.atlas.cogentco.com 13 0 6 6 286 286 287 287
be2813.ccr41.fra03.atlas.cogentco.com 14 0 6 6 294 299 324 295
154.54.36.54 15 0 6 6 293 293 294 294
be2974.ccr51.vie01.atlas.cogentco.com 16 0 6 6 306 306 308 306
be2988.ccr21.bts01.atlas.cogentco.com 17 0 6 6 300 300 301 301
be2046.ccr21.kbp01.atlas.cogentco.com 18 0 6 6 323 323 325 325
volia.demarc.cogentco.com 19 0 6 6 297 297 298 298
v212.cs-1.r27.kiev.volia.net 20 34 3 2 282 285 288 288
77.120.1.49 21 20 5 4 282 285 290 284
speedtest.volia.com 22 0 6 6 297 297 299 298
WinMTR v1.00 GPLv2 (original by Appnor MSP - Fully Managed Hosting & Cloud Prov
www.appnor.com


WinMTR (Redux) v1.00 64bit
Host: speed.myloc.de
Start
IPv6
Options
Exit
Copy Text to clipboard
Copy HTML to clipboard
Export TEXT
Export HTML
Hostname Nr Loss % Sent Recv Best Avrg Worst Last
2409:8080:0:4:2f6:294:1:0 8 0 33 33 5 6 11 6
2402:4f00:100::885 9 0 33 33 34 35 43 35
2402:4f00:100::256 10 0 33 33 34 34 37 34
hurricaneelectric1-100g.hkix.net 11 36 14 9 173 174 177 173
100ge2-1.core1.sin1.he.net 12 4 29 28 237 243 267 267
100ge11-1.core1.mrs1.he.net 13 4 29 28 235 242 258 246
100ge6-2.core1.fra2.he.net 14 8 26 24 231 231 239 233
100ge16-2.core1.fra1.he.net 15 20 20 16 231 231 234 231
po16q60-h1011.core1-dus-ix.bb.as24961.net 16 8 25 23 244 244 245 244
po8.core2-dus1.bb.as24961.net 17 22 19 15 234 234 236 235
po1.agr1-dedi-m1.bb.as24961.net 18 14 22 19 245 246 253 246
2001:4ba0:ffe0:ffff::2 19 23 18 14 246 246 250 246
WinMTR v1.00 GPLv2 (original by Appnor MSP - Fully Managed Hosting & Cloud Prov
www.appnor.com

4.1 Measuring the bandwidth

```
E:\墨大选课\1-COMP90007  IT\作业\iperf-2.0.9-win64>iperf -c bouygues.testdebit.info
------------------------------------------------------------
Client connecting to bouygues.testdebit.info, TCP port 5001
TCP window size:  208 KByte (default)
------------------------------------------------------------
[  3] local 10.0.0.182 port 6988 connected with 89.84.1.186 port 5001
write failed: Broken pipe
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0- 1.2 sec   256 KBytes  1.81 Mbits/sec

E:\墨大选课\1-COMP90007  IT\作业\iperf-2.0.9-win64>iperf -c bouygues.testdebit.info
------------------------------------------------------------
Client connecting to bouygues.testdebit.info, TCP port 5001
TCP window size:  208 KByte (default)
------------------------------------------------------------
[  3] local 10.0.0.182 port 6991 connected with 89.84.1.186 port 5001
write failed: Connection reset by peer
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0- 0.3 sec   256 KBytes  7.28 Mbits/sec

E:\墨大选课\1-COMP90007  IT\作业\iperf-2.0.9-win64>iperf -c bouygues.testdebit.info
------------------------------------------------------------
Client connecting to bouygues.testdebit.info, TCP port 5001
TCP window size:  208 KByte (default)
------------------------------------------------------------
[  3] local 10.0.0.182 port 6992 connected with 89.84.1.186 port 5001
write failed: Broken pipe
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0- 1.3 sec   256 KBytes  1.67 Mbits/sec
```

```
E:\墨大选课\1-COMP90007  IT\作业\iperf-2.0.9-win64>iperf -c ikoula.testdebit.info
------------------------------------------------------------
Client connecting to ikoula.testdebit.info, TCP port 5001
TCP window size:  208 KByte (default)
------------------------------------------------------------
[  3] local 10.0.0.182 port 6883 connected with 213.246.63.45 port 5001
write failed: Broken pipe
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0- 1.0 sec   256 KBytes  2.07 Mbits/sec

E:\墨大选课\1-COMP90007  IT\作业\iperf-2.0.9-win64>iperf -c ikoula.testdebit.info
------------------------------------------------------------
Client connecting to ikoula.testdebit.info, TCP port 5001
TCP window size:  208 KByte (default)
------------------------------------------------------------
[  3] local 10.0.0.182 port 6889 connected with 213.246.63.45 port 5001
write failed: Broken pipe
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0- 0.9 sec   256 KBytes  2.33 Mbits/sec

E:\墨大选课\1-COMP90007  IT\作业\iperf-2.0.9-win64>iperf -c ikoula.testdebit.info
------------------------------------------------------------
Client connecting to ikoula.testdebit.info, TCP port 5001
TCP window size:  208 KByte (default)
------------------------------------------------------------
[  3] local 10.0.0.182 port 6893 connected with 213.246.63.45 port 5001
write failed: Broken pipe
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0- 1.1 sec   256 KBytes  1.97 Mbits/sec
```

```
E:\墨大选课\1-COMP90007  IT\作业\iperf-3.1.3-win64>iperf3 -c iperf.scottlinux.com
Connecting to host iperf.scottlinux.com, port 5201
[  4] local 2409:8a1e:34e0:7890:24e9:eef7:7e6a:e8e9 port 4162 connected to 2600:3c01::f03c:91ff:fed5:ed33 port 5201
[ ID] Interval           Transfer     Bandwidth
[  4]   0.00-1.01   sec   256 KBytes  2.07 Mbits/sec
[  4]   1.01-2.01   sec  1.00 MBytes  8.39 Mbits/sec
[  4]   2.01-3.01   sec  1.12 MBytes  9.43 Mbits/sec
[  4]   3.01-4.01   sec  1.00 MBytes  8.38 Mbits/sec
[  4]   4.01-5.01   sec  1.00 MBytes  8.41 Mbits/sec
[  4]   5.01-6.01   sec  1.00 MBytes  8.39 Mbits/sec
[  4]   6.01-7.00   sec   896 KBytes  7.39 Mbits/sec
[  4]   7.00-8.00   sec  1.00 MBytes  8.43 Mbits/sec
[  4]   8.00-9.02   sec   896 KBytes  7.23 Mbits/sec
[  4]   9.02-10.00  sec   896 KBytes  7.44 Mbits/sec
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bandwidth
[  4]   0.00-10.00  sec  9.00 MBytes  7.55 Mbits/sec                  sender
[  4]   0.00-10.00  sec  9.00 MBytes  7.55 Mbits/sec                  receiver

iperf Done.
```

```
E:\墨大选课\1-COMP90007  IT\作业\iperf-3.1.3-win64>iperf3 -c iperf.scottlinux.com
Connecting to host iperf.scottlinux.com, port 5201
[  4] local 2409:8a1e:34e0:7890:24e9:eef7:7e6a:e8e9 port 4142 connected to 2600:3c01::f03c:91ff:fed5:ed33 port 5201
[ ID] Interval           Transfer     Bandwidth
[  4]   0.00-1.00   sec   256 KBytes  2.10 Mbits/sec
[  4]   1.00-2.01   sec   640 KBytes  5.18 Mbits/sec
[  4]   2.01-3.00   sec  1.00 MBytes  8.47 Mbits/sec
[  4]   3.00-4.00   sec   896 KBytes  7.35 Mbits/sec
[  4]   4.00-5.01   sec  1.25 MBytes  10.4 Mbits/sec
[  4]   5.01-6.02   sec   768 KBytes  6.27 Mbits/sec
[  4]   6.02-7.01   sec  1.00 MBytes  8.40 Mbits/sec
[  4]   7.01-8.00   sec   768 KBytes  6.36 Mbits/sec
[  4]   8.00-9.00   sec   768 KBytes  6.30 Mbits/sec
[  4]   9.00-10.00  sec   128 KBytes  1.05 Mbits/sec
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bandwidth
[  4]   0.00-10.00  sec  7.38 MBytes  6.19 Mbits/sec                  sender
[  4]   0.00-10.00  sec  7.38 MBytes  6.19 Mbits/sec                  receiver

iperf Done.
```

```
E:\墨大选课\1-COMP90007  IT\作业\iperf-3.1.3-win64>iperf3 -c iperf.scottlinux.com
Connecting to host iperf.scottlinux.com, port 5201
[  4] local 2409:8a1e:34e0:7890:24e9:eef7:7e6a:e8e9 port 4131 connected to 2600:3c01::f03c:91ff:fed5:ed33 port 5201
[ ID] Interval           Transfer     Bandwidth
[  4]   0.00-1.00   sec   256 KBytes  2.10 Mbits/sec
[  4]   1.00-2.01   sec   512 KBytes  4.14 Mbits/sec
[  4]   2.01-3.00   sec   896 KBytes  7.44 Mbits/sec
[  4]   3.00-4.01   sec   896 KBytes  7.24 Mbits/sec
[  4]   4.01-5.01   sec  1.12 MBytes  9.44 Mbits/sec
[  4]   5.01-6.01   sec  1.00 MBytes  8.42 Mbits/sec
[  4]   6.01-7.01   sec  1.00 MBytes  8.40 Mbits/sec
[  4]   7.01-8.01   sec  1.00 MBytes  8.39 Mbits/sec
[  4]   8.01-9.01   sec  1.00 MBytes  8.37 Mbits/sec
[  4]   9.01-10.01  sec   768 KBytes  6.28 Mbits/sec
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bandwidth
[  4]   0.00-10.01  sec  8.38 MBytes  7.02 Mbits/sec                  sender
[  4]   0.00-10.01  sec  8.38 MBytes  7.02 Mbits/sec                  receiver

iperf Done.
```

```
E:\墨大选课\1-COMP90007  IT\作业\iperf-2.0.9-win64>iperf -c speedtest.serverius.net -p 5002
------------------------------------------------------------
Client connecting to speedtest.serverius.net, TCP port 5002
TCP window size:  208 KByte (default)
------------------------------------------------------------
[  3] local 10.0.0.182 port 6204 connected with 178.21.16.76 port 5002
write failed: Connection reset by peer
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0-62.5 sec   256 KBytes  33.6 Kbits/sec

E:\墨大选课\1-COMP90007  IT\作业\iperf-2.0.9-win64>
E:\墨大选课\1-COMP90007  IT\作业\iperf-2.0.9-win64>iperf -c speedtest.serverius.net -p 5002
------------------------------------------------------------
Client connecting to speedtest.serverius.net, TCP port 5002
TCP window size:  208 KByte (default)
------------------------------------------------------------
[  3] local 10.0.0.182 port 6241 connected with 178.21.16.76 port 5002
write failed: Connection reset by peer
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0-53.1 sec   256 KBytes  39.5 Kbits/sec

E:\墨大选课\1-COMP90007  IT\作业\iperf-2.0.9-win64>iperf -c speedtest.serverius.net -p 5002
------------------------------------------------------------
Client connecting to speedtest.serverius.net, TCP port 5002
TCP window size:  208 KByte (default)
------------------------------------------------------------
[  3] local 10.0.0.182 port 6296 connected with 178.21.16.76 port 5002
write failed: Connection reset by peer
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0-56.3 sec   256 KBytes  37.3 Kbits/sec
```

```
E:\墨大选课\1-COMP90007  IT\作业\iperf-2.0.9-win64>iperf -c iperf.volia.net
------------------------------------------------------------
Client connecting to iperf.volia.net, TCP port 5001
TCP window size:  208 KByte (default)
------------------------------------------------------------
[  3] local 10.0.0.182 port 6502 connected with 77.120.3.236 port 5001
write failed: Connection reset by peer
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0-62.9 sec   256 KBytes  33.4 Kbits/sec

E:\墨大选课\1-COMP90007  IT\作业\iperf-2.0.9-win64>iperf -c iperf.volia.net
------------------------------------------------------------
Client connecting to iperf.volia.net, TCP port 5001
TCP window size:  208 KByte (default)
------------------------------------------------------------
[  3] local 10.0.0.182 port 6529 connected with 77.120.3.236 port 5001
write failed: Connection reset by peer
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0-73.8 sec   256 KBytes  28.4 Kbits/sec

E:\墨大选课\1-COMP90007  IT\作业\iperf-2.0.9-win64>iperf -c iperf.volia.net
------------------------------------------------------------
Client connecting to iperf.volia.net, TCP port 5001
TCP window size:  208 KByte (default)
------------------------------------------------------------
[  3] local 10.0.0.182 port 6571 connected with 77.120.3.236 port 5001
write failed: Connection reset by peer
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0-60.1 sec   256 KBytes  34.9 Kbits/sec
```