COMP90007 Internet Technologies

Project 1 – Network Analysis

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Section 2

Ans 2.1

-n means not to map IP addresses to host names when displaying them ("Trace Route Guide for Windows, MAC and Linux", 2020). The importance is, if without -n, it will display the long host names which is not necessary and helpful to measure the hop count. Also, it will waste time mapping IP addresses to host names.

-w1 means to set the time as 1.0 sec to wait for a response to a probe("Trace Route Guide for Windows, MAC and Linux", 2020). The importance is, without -w1, it will set the time as the default value 5.0 sec, which would be too long to wait and unnecessary.

Ans 2.2

I chose 6 servers from the given list and 4 other public iperf servers. The client (the VPS I used) is located in Singapore. All of their relevant information and results are demonstrated in Table 1 and Figure 1. The locations of the tested servers are obtained at https://db-ip.com/. The distances between the client and servers are obtained at www.freemaptools.com/how-far-is-it-between.htm. The hop counts are observed by running *traceroute* command for each server.

Table 1. Results of hop count

Host	Country	City	Distance	Hop Count
bouygues.testdebit.info	France	Clichy-sous-Bois	10721.021	25
ikoula.testdebit.info	France	Paris	10736.088	11
st2.nn.ertelecom.ru	Russia	Nizhny Novgorod	8084.683	16
iperf.biznetnetworks.com	Indonesia	Jakarta	893.389	7
speedtest.serverius.net	Netherlands	Dronten	10439.498	15
iperf.volia.net	Ukraine	Lviv	9169.026	28
iperf.jp.milou.icu	Japan	Tokyo	5322.404	13
iperf.sg.milou.icu	Singapore	Singapore	1.313	2
iperf.hk.milou.site	China	Hongkong	2585.659	6
iperf.us.milou.icu	US	California	13635.957	14

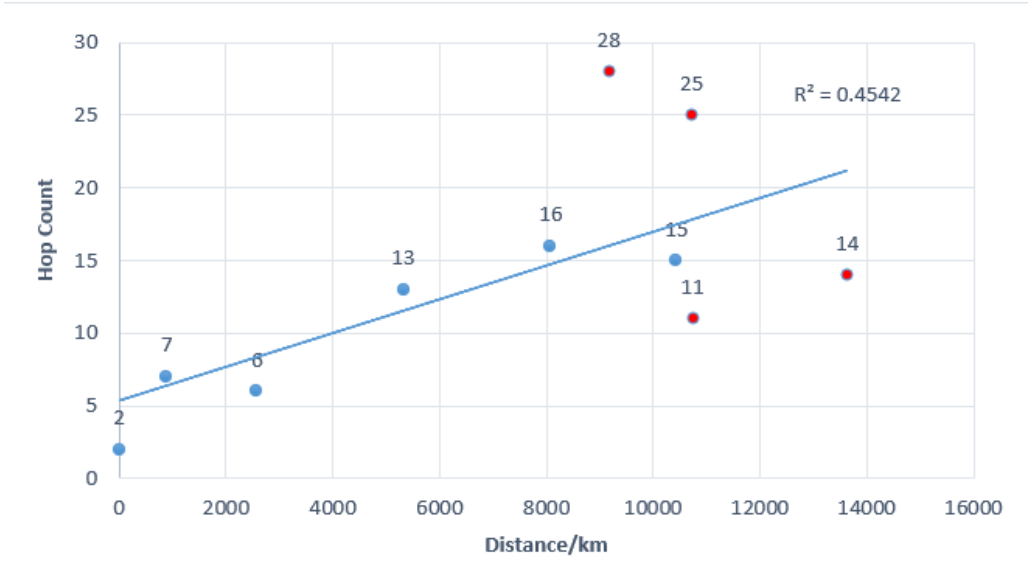


Figure 1. correlation analysis between Hop Count and geographical distance

From Table 1 and Figure 1, we can see there seems to be a positive correlation between the physical distance and the hop count. But this correlation is not obvious ($R^2 = 0.4542$) due to several outliers that have occurred (shown as the red spots in Figure 1). My explanation for this is hop count is the number of routers or other intermediate devices on the path between the source and the destination that data are transmitted through (PETERSON, 2020). Hence, the number of intermediate devices tends to be larger with a longer distance. But it is also affected by other factors, such as how advanced the network construction in the server's country is, and whether the transmission mostly goes through submarine cables or land cables. For instance, the geographical distance between Singapore and Netherlands is almost the same to that between Singapore and Ukraine, while the hop counts to these two destinations are around double in number. This is because the network construction in Netherlands is more advanced than that in Ukraine, and the ISPs in Netherlands have more international peers.

Section 3

Ans 3.1

I wrote and run a script (attached in the Appendix Section3), within which I run the *ping* command 3 times for each server. The results of average round-trip delay and jitter, as well as other relevant information and statistics are demonstrated below in Table 2, Figure2 and Figure 3.

Table 2. Results of RTD measurement

Host	Distance (km)	RTD1(ms)	RTD2(ms)	RTD3(ms)	Avg RTD(ms)	mdev1(ms	mdev2(ms	mdev3(ms	Jitter(ms)
bouygues.testdebit.info	10721.021	237.235	237.156	236.941	237.111	0.602	0.610	0.399	0.546
ikoula.testdebit.info	10736.088	150.080	149.733	149.774	149.862	0.508	0.040	0.062	0.296
st2.nn.ertelecom.ru	8084.683	278.001	278.028	278.096	278.042	0.431	0.430	0.032	0.352
iperf.biznetnetworks.com	893.389	14.078	13.788	13.741	13.869	0.39	0.137	0.038	0.240
speedtest.serverius.net	10439.498	156.650	157.123	157.047	156.940	1.062	1.082	0.726	0.971
iperf.volia.net	9169.026	279.173	278.831	278.777	278.927	0.592	0.048	0.030	0.343
iperf.jp.milou.icu	5322.404	72.309	73.974	72.036	72.773	0.521	2.021	0.312	1.218
iperf.sg.milou.icu	1.313	1.100	0.460	0.467	0.676	0.802	0.064	0.049	0.465
iperf.hk.milou.site	2585.659	34.659	34.346	34.353	34.453	0.418	0.218	0.215	0.299
iperf.us.milou.icu	13635.957	170.551	170.185	170.119	170.285	0.597	0.478	0.347	0.485

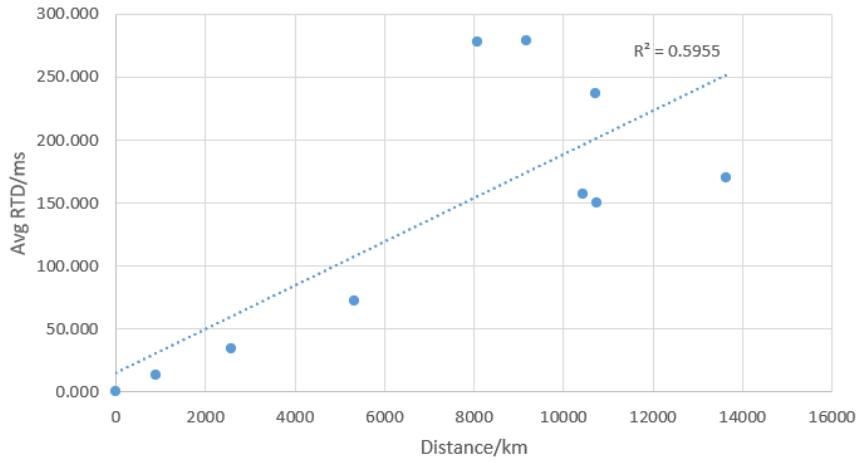


Figure 2. correlation analysis between RTD and geographical distance

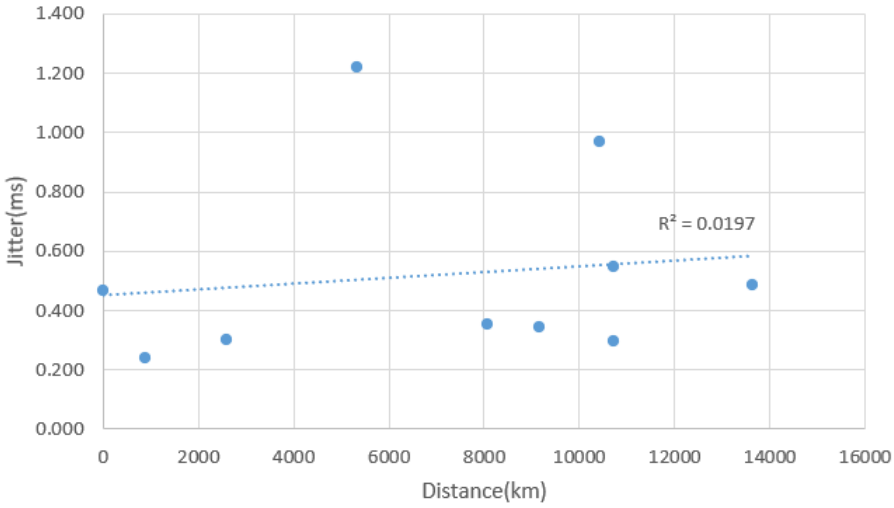


Figure 3. correlation analysis between Jitter and geographical distance

Ans 3.2

According to Figure 2, we can see RTD has a not-quite-strong positive correlation with geographical distance, with $R^2 = 0.5955$. The Average RTD tends to increase when the distance between the client and the server increases. Theoretically, this correlation can be explained as longer distance usually (but not necessarily) means more hop counts and longer propagation delay. There are also a few outliers like 'bouygues.testdebit.info' and 'iperf.volia.net'. These may be because the route from the ISP of the client to the ISP of the servers is worse than standard international BGP route.

According to Figure 3, we can see there is no obvious correlation between network jitter and geographical distance, with $R^2 = 0.0197$. The jitter does not change much as the distance changes. This could be explained as the client (the VPS I used) is from the tier 1 Singapore data centre, which has stable connection to most of areas

around the world. Besides, the routers and network hardware provided by the data centre are also reliable and hence it is less prone to have high jitter.

Section 4

Ans 4.1

The bandwidth-delay product is the maximum amount of data on the network circuit at given RTD time ("RFC 1072 - TCP extensions for long-delay paths", 2020). It refers to the amount of data on the transmission path that are sent but not yet acknowledged. The bandwidth-delay product can tell congestion window size, which determines the maximum numbers of packets can be sent simultaneously. Generally, a larger bandwidth-delay product means larger congestion window, namely, higher throughput ("Background Information", 2020).

I wrote and run a script (attached in the Appendix Section4), within which I run the *iperf* and *iperf3* commands 3 times for each server. When a server turned out having both the result of *iperf2* and *iperf3*, I chose to use the result of *iperf2* as the bandwidth value since it is generally more reliable. The results of average round-trip delay and jitter, as well as other relevant information and statistics are demonstrated below in Table 3.

Table 3. Results of bandwidth measurement

Host	Bandwidth1(Mb/s)	Bandwidth2(Mb/s)	Bandwidth3(Mb/s)	Avg Bandwidth(Mb/s)
bouygues.testdebit.info	5.23	5.08	5.04	5.117
ikoula.testdebit.info	8.1	8.32	8.2	8.207
st2.nn.ertelecom.ru	57.9	62.3	61.2	60.467
iperf.biznetnetworks.com	1.4	1.58	1.48	1.487
speedtest.serverius.net	0.101	0.101	0.101	0.101
iperf.volia.net	0.103	0.102	0.102	0.102
iperf.jp.milou.icu	94.2	84.8	91.1	90.033
iperf.sg.milou.icu	1980	1980	2000	1986.667
iperf.hk.milou.site	225	193	98.5	172.167
iperf.us.milou.icu	110	96.4	108	104.800

Ans 4.2

I calculated the bandwidth-delay product using the formula “bandwidth-delay product = average round-trip delay × average bandwidth”. In addition, I converted the results of the bandwidth-delay product into a logarithmic scale. These results are demonstrated below in Table 4, Figure 4 and Figure 5.

Table 4. Calculation of bandwidth-delay product

Host	Avg RTD(ms)	Avg Bandwidth(Mb/s)	bandwidth-delay product(kbits)	log(bandwidth-delay product)/log kbit
bouygues.testdebit.info	237.1106667	5.117	1213.216	3.084
ikoula.testdebit.info	149.8623333	8.207	1229.870	3.090
st2.nn.ertelecom.ru	278.0416667	60.467	16812.253	4.226
iperf.biznetnetworks.com	13.869	1.487	20.619	1.314
speedtest.serverius.net	156.94	0.101	15.851	1.200
iperf.volia.net	278.927	0.102	28.544	1.456
iperf.jp.milou.icu	72.773	90.033	6551.996	3.816
iperf.sg.milou.icu	0.675666667	1986.667	1342.324	3.128
iperf.hk.milou.site	34.45266667	172.167	5931.601	3.773
iperf.us.milou.icu	170.285	104.800	17845.868	4.252

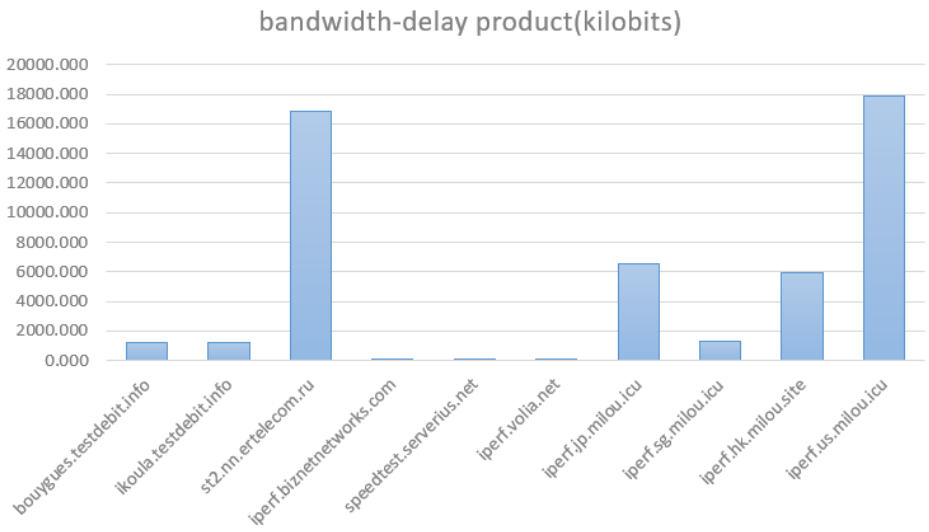


Figure 4. Bandwidth-delay product

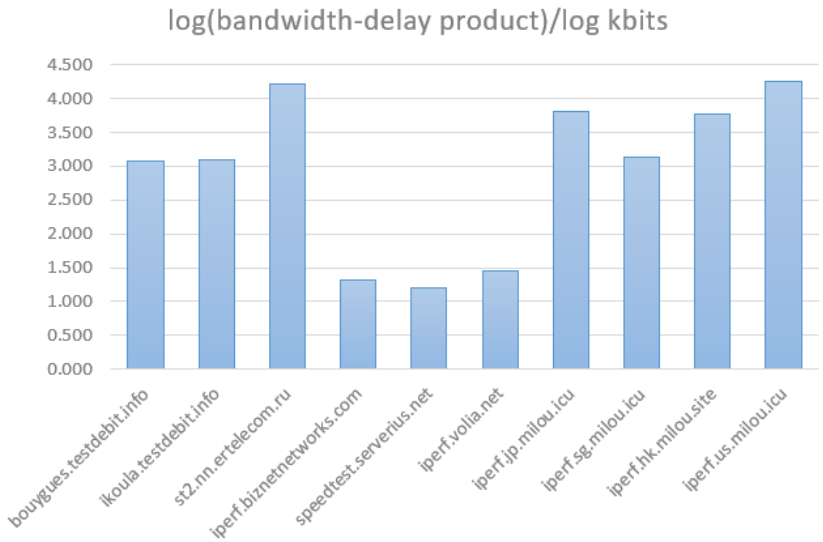


Figure 5. Bandwidth-delay product in a logarithmic scale

The bandwidth-delay product in logarithmic scale can, to some degree, roughly reflect the capacity of the actual Internet upload speed from the client to the servers, which is relatively good in most cases in this test.

The VPS I used is from Tier1 host provider, Digital Ocean. Digital Ocean provides my VPS with high enough bandwidth and a stable network environment, which helps me to get relatively reliable results.

According to Figure 5, we can find that the value of log_{10}(bandwidth-delay product) is quite stable lying between 3000kb and 4500kb. Only a few outliers:

1. iperf.biznetnetworks.com (Indonesia)

This site was pre-tested by iperf3 with 1.5Gbps bandwidth but in formal test there is only 1.487Mbps. One possible reason is that the formal test time was 8 p.m. Saturday, the peak time. Most of the server's bandwidth could get occupied by other clients.

2. speedtest.serverius.net (Netherlands) and iperf.volia.net (Ukraine)

These two servers are quite far from Singapore. Many hop counts (16 and 28) need be experienced before packets arrive the server. Long propagation delay time makes gaps in the data flow, which could become bottleneck and limit the performance of overall available bandwidth (Medhi & Ramasamy, n.d.).

Ans 4.3

I plotted the bandwidth-delay product versus the hop count. The statistics and the plot are shown in Table 5 and Figure 6.

Table 5. Results of bandwidth measurement

Host	Hop Count	bandwidth-delay product(kilobits)
bouygues.testdebit.info	25	1213.216244
ikoula.testdebit.info	11	1229.870216
st2.nn.ertelecom.ru	16	16812.25278
iperf.biznetnetworks.com	7	20.61858
speedtest.serverius.net	15	15.85094
iperf.volia.net	28	28.54352967
iperf.jp.milou.icu	13	6551.995767
iperf.sg.milou.icu	2	1342.324444
iperf.hk.milou.site	6	5931.600778
iperf.us.milou.icu	14	17845.868

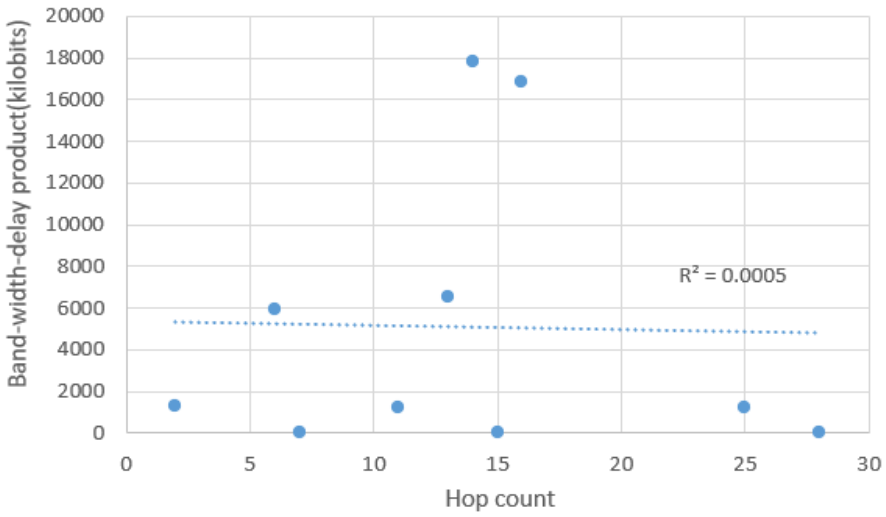


Figure 6. Bandwidth-delay product in a logarithmic scale

According to Figure 5, no obvious correlation is found between hop count and bandwidth-delay product (with $R^2 = 0.0005$).

Ans 4.4

Since the client I used, namely, the source host is from Tier1 host provider (Digital Ocean), the routers and network hardware are reliable. The data centre is located in Singapore, which has many Tier1 international ISP peers such as Ntt, Cogent, Vodafone. Thus, the network connection is less prone to be affected by many variables. There is only one obvious difference between my iperf3 pre-test and formal test on iperf.biznetnetworks.com. In the pre-test, iperf3 returned a result of approximately 835Mbps bandwidth at 12 a.m., as shown below in Figure 7. However, in the formal test iperf3 only returned 1.487Mbp at 8p.m. A reasonable explanation of this difference is most of the download bandwidth of the server could be occupied by other clients at that peak time. Thus, if we

wish to obtain an unbiased bandwidth value that could reflect the overall bandwidth performance between the client and the server, possible improvement could be to run the test at multiple times during a day and comprehensively analyse the results, for example, use the average value.

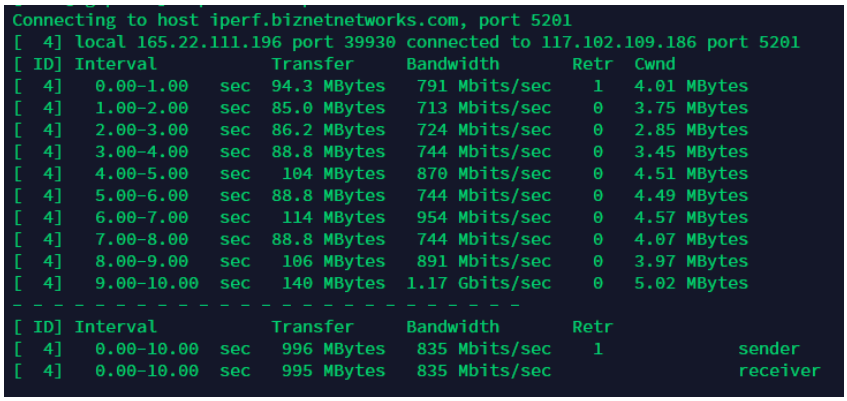


Figure 7. pre-test of bandwidth measurement on iperf.biznetnetworks.com

References

Trace Route Guide for Windows, MAC and Linux. (2020). Retrieved 22 September 2020, from https://www.noip.com/support/knowledgebase/trace-route-guide/

PETERSON, L. (2020). COMPUTER NETWORKS. [Place of publication not identified]: MORGAN KAUFMANN.

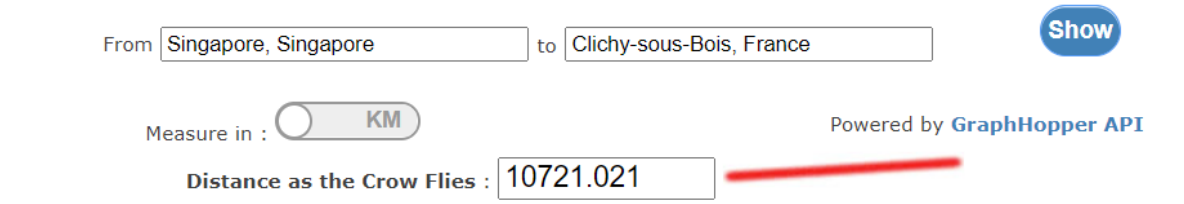
RFC 1072 - TCP extensions for long-delay paths. (2020). Retrieved 21 September 2020, from https://tools.ietf.org/html/rfc1072

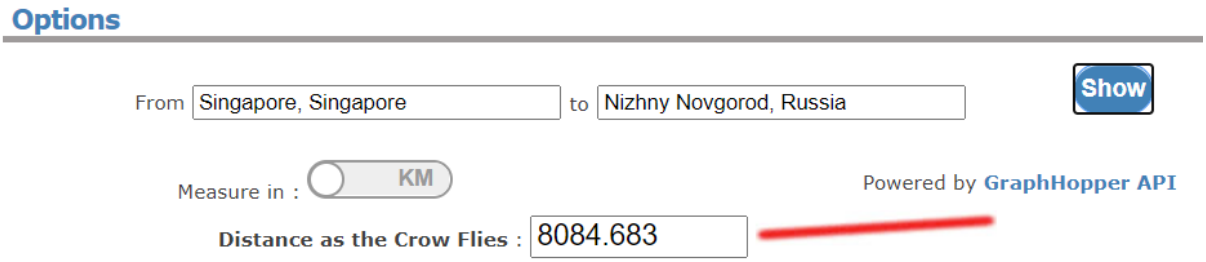
Background Information. (2020). Retrieved 21 September 2020, from https://fasterdata.es.net/host-tuning/background/

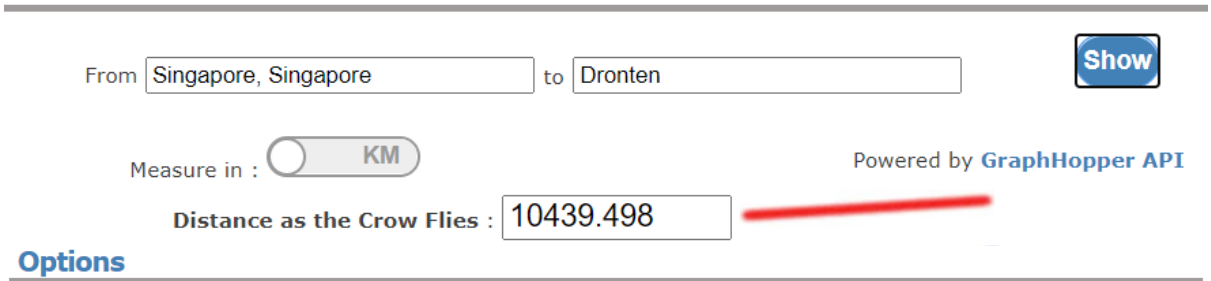
Medhi, D., & Ramasamy, K. Network Routing, 2nd Edition.

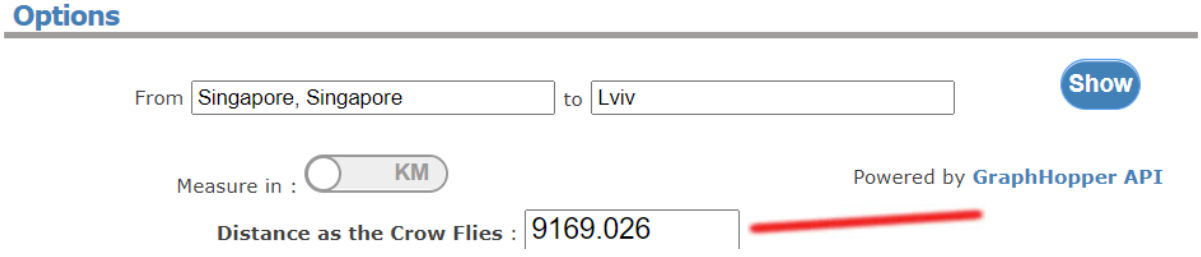
Appendix

Section 2









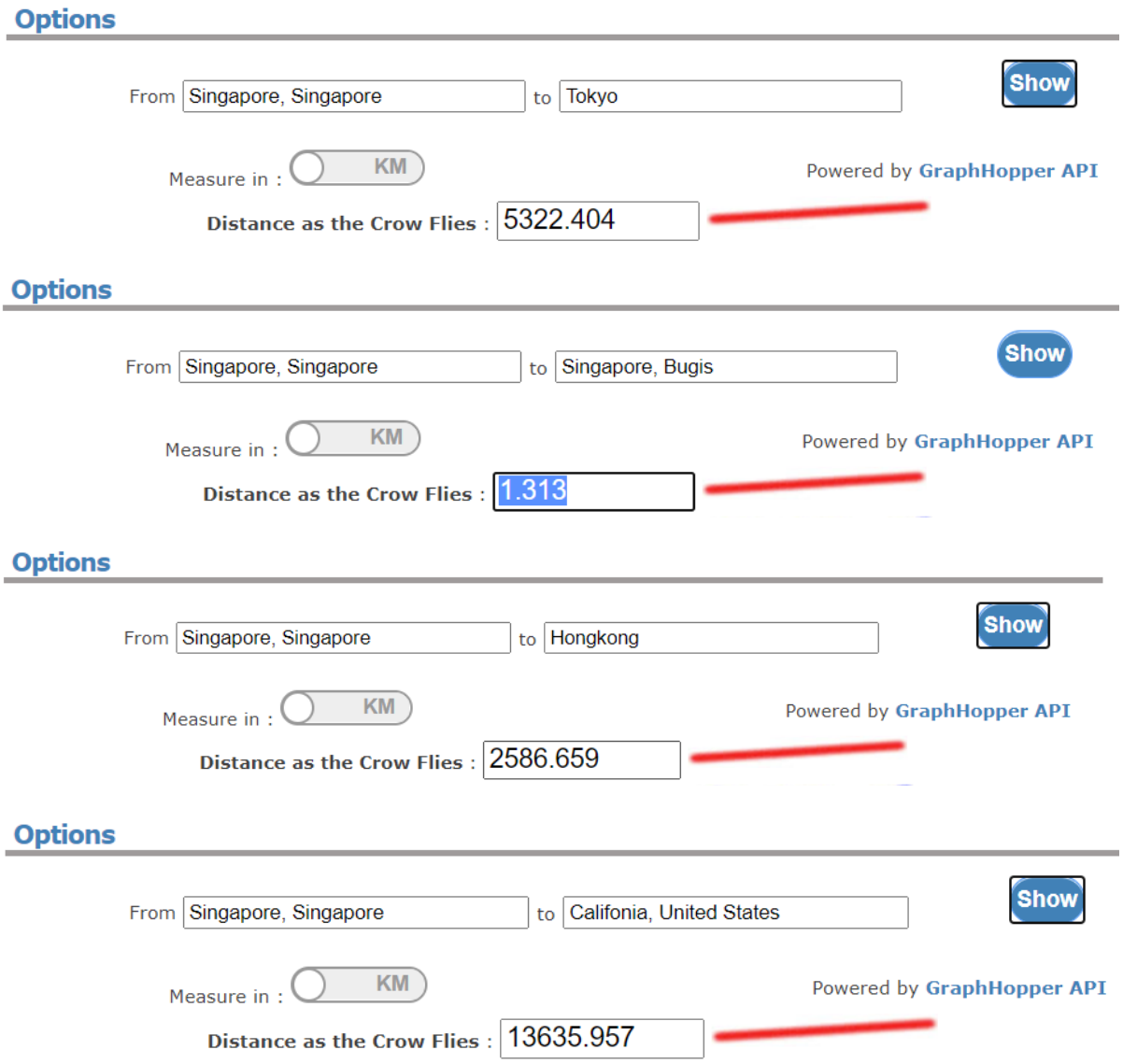


Figure S2-1. Physical distance from the client to different servers

```
#!/bin/bash

touch route.txt
while read i; do
        echo "-----------------" >> route.txt
        echo "route to ${i}" >> route.txt
        traceroute -nw 1 ${i} >> route.txt
        echo "-----------------" >> route.txt
done < hosts.txt
traceroute.sh (END)
```

Figure S2-2. Shell script to run *traceroute*

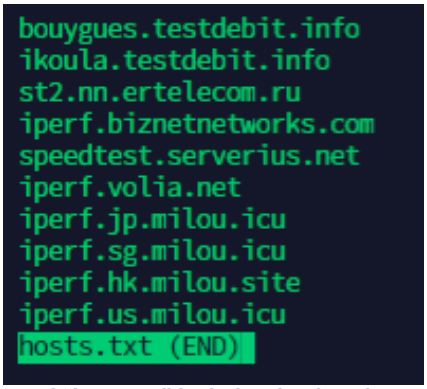


Figure S2-3. file named “hosts.txt” includes the domain names of the servers

```
route to bouygues.testdebit.info
traceroute to bouygues.testdebit.info (89.84.1.222), 30 hops max, 60 byte packets
 1  178.128.48.253  2.934 ms 178.128.48.254  2.245 ms  2.225 ms
 2  138.197.251.46  7.621 ms 138.197.251.34  2.142 ms 138.197.251.182  1.539 ms
 3  138.197.251.173  1.402 ms 138.197.251.37  1.397 ms 138.197.251.175  1.393 ms
 4  138.197.245.8  1.318 ms 138.197.245.14  1.288 ms 138.197.245.4  1.331 ms
 5  116.51.17.193  1.783 ms  1.743 ms 116.51.17.165  1.703 ms
 6  129.250.2.123  181.175 ms  180.657 ms 129.250.2.93  167.998 ms
 7  129.250.3.83  2.597 ms 129.250.3.131  6.054 ms 129.250.3.101  1.445 ms
 8  129.250.2.67  65.374 ms  65.382 ms  65.526 ms
 9  129.250.2.176  173.702 ms 129.250.3.193  178.223 ms  184.250 ms
10  129.250.3.17  177.271 ms  172.669 ms  172.286 ms
11  154.54.9.29  173.216 ms  168.092 ms  180.228 ms
12  154.54.25.149  183.130 ms  171.077 ms 154.54.42.101  173.371 ms
13  154.54.45.161  179.590 ms  194.873 ms  182.621 ms
14  154.54.42.78  202.740 ms  198.306 ms  195.394 ms
15  154.54.29.221  207.841 ms  210.640 ms 154.54.30.161  208.177 ms
16  154.54.28.69  231.173 ms  235.591 ms 154.54.28.129  232.883 ms
17  154.54.24.221  235.090 ms  238.046 ms 154.54.7.157  236.115 ms
18  154.54.85.246  257.130 ms 154.54.85.242  260.185 ms 154.54.85.246  252.954 ms
19  154.54.61.114  254.955 ms  250.041 ms 154.54.61.118  263.173 ms
20  138.117.1.46  244.030 ms  253.218 ms  247.176 ms
21  * * *
22  62.34.2.57  243.955 ms  231.163 ms  226.900 ms
23  212.194.171.68  243.917 ms  232.173 ms  236.435 ms
24  89.89.101.141  232.290 ms  242.123 ms  228.390 ms
25  89.84.1.222  235.633 ms  227.738 ms  228.364 ms
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route to ikoula.testdebit.info
traceroute to ikoula.testdebit.info (213.246.63.45), 30 hops max, 60 byte packets
 1  178.128.48.254  2.828 ms  3.365 ms  3.385 ms
 2  138.197.251.170  2.141 ms 138.197.251.46  2.204 ms 138.197.251.32  2.863 ms
 3  138.197.251.185  1.620 ms 138.197.251.163  1.552 ms 138.197.251.185  1.547 ms
 4  138.197.245.8  2.203 ms 138.197.245.14  2.179 ms  2.148 ms
 5  * * *
 6  184.105.65.14  154.177 ms  152.740 ms  147.617 ms
 7  184.105.81.29  147.686 ms  147.668 ms  147.886 ms
 8  184.104.205.18  148.344 ms  148.489 ms  147.089 ms
 9  213.246.50.193  151.953 ms  151.785 ms  151.202 ms
10  * 213.246.50.182  151.073 ms *
11  213.246.63.45  150.927 ms  148.054 ms  148.037 ms
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route to st2.nn.ertelecom.ru
traceroute to st2.nn.ertelecom.ru (91.144.184.232), 30 hops max, 60 byte packets
 1  178.128.48.254  1.093 ms  1.044 ms 178.128.48.253  2.794 ms
 2  138.197.251.32  0.968 ms 138.197.251.182  4.137 ms 138.197.251.46  15.107 ms
 3  138.197.251.175  1.267 ms 138.197.251.185  23.832 ms 138.197.251.39  0.798 ms
 4  138.197.245.2  6.634 ms 138.197.245.8  2.504 ms 138.197.245.0  6.590 ms
 5  116.51.17.193  1.049 ms  1.017 ms 116.51.17.165  6.867 ms
 6  129.250.2.123  181.052 ms  180.835 ms 129.250.2.241  183.377 ms
 7  129.250.3.101  1.014 ms 129.250.3.131  1.003 ms 129.250.3.83  1.087 ms
 8  129.250.2.243  68.025 ms  66.992 ms  66.955 ms
 9  129.250.2.176  169.379 ms 129.250.3.193  183.239 ms  184.162 ms
10  129.250.3.17  177.578 ms 129.250.3.238  180.204 ms 129.250.3.17  177.285 ms
11  213.248.103.170  178.860 ms  183.423 ms  178.111 ms
12  62.115.114.87  228.796 ms  231.264 ms  228.180 ms
13  62.115.141.245  270.111 ms  266.101 ms  270.389 ms
14  213.155.134.51  276.978 ms  273.583 ms *
15  * * 62.115.139.168  275.577 ms
16  62.115.116.233  279.703 ms  277.682 ms 80.91.249.11  281.014 ms
```

```
17  62.115.123.178  285.577 ms 213.155.130.101  267.899 ms 62.115.12.110  278.427 ms
18  62.115.139.168  277.046 ms  277.113 ms  282.775 ms
19  * 62.115.116.233  284.719 ms  278.742 ms
20  91.144.184.232  275.980 ms  278.067 ms 62.115.12.110  279.314 ms
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route to iperf.biznetnetworks.com
traceroute to iperf.biznetnetworks.com (117.102.109.186), 30 hops max, 60 byte packets
 1  178.128.48.253  1.425 ms  1.404 ms 178.128.48.254  1.344 ms
 2  138.197.251.44  2.117 ms 138.197.251.46  1.288 ms 138.197.251.170  1.241 ms
 3  138.197.251.173  1.198 ms 138.197.251.37  1.157 ms 138.197.251.175  1.146 ms
 4  27.111.228.9  4.983 ms  4.973 ms  4.975 ms
 5  202.169.59.182  17.522 ms  17.515 ms  17.485 ms
 6  182.253.99.106  15.203 ms  14.303 ms  14.399 ms
 7  117.102.109.186  13.885 ms !X  13.896 ms !X  13.850 ms !X
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route to speedtest.serverius.net
traceroute to speedtest.serverius.net (178.21.16.76), 30 hops max, 60 byte packets
 1  178.128.48.253  1.142 ms  1.083 ms 178.128.48.254  1.048 ms
 2  138.197.251.170  1.406 ms 138.197.251.34  4.451 ms 138.197.251.46  1.020 ms
 3  138.197.251.39  0.855 ms  0.809 ms 138.197.251.187  0.595 ms
 4  138.197.245.4  0.934 ms 138.197.245.8  1.031 ms 138.197.245.0  0.846 ms
 5  120.29.214.49  0.868 ms  0.835 ms 120.29.214.141  0.972 ms
 6  * * *
 7  * * *
 8  80.231.217.2  150.343 ms  150.217 ms  150.098 ms
 9  * * *
10  195.219.156.135  151.922 ms  162.896 ms 195.219.156.132  152.144 ms
11  5.23.30.17  152.730 ms  152.291 ms  153.903 ms
12  80.231.65.2  156.013 ms  157.827 ms  157.691 ms
13  87.245.234.102  169.174 ms 87.245.232.44  166.874 ms  166.824 ms
14  87.245.236.181  162.361 ms 87.245.246.61  155.668 ms 87.245.246.51  160.100 ms
15  185.8.179.33  162.050 ms  158.169 ms  160.582 ms
16  * * *
17  * * *
18  * * *
19  * * *
20  * * *
21  * * *
22  * * *
23  * * *
24  * * *
25  * * *
26  * * *
27  * * *
28  * * *
29  * * *
30  * * *
------------------
------------------
route to iperf.volia.net
traceroute to iperf.volia.net (77.120.3.236), 30 hops max, 60 byte packets
 1  178.128.48.253  1.540 ms 178.128.48.254  2.848 ms  1.451 ms
 2  138.197.251.168  1.432 ms 138.197.251.182  1.405 ms 138.197.251.34  5.898 ms
 3  138.197.251.173  1.351 ms 138.197.251.37  1.322 ms 138.197.251.161  1.309 ms
 4  138.197.245.6  1.378 ms 138.197.245.4  1.506 ms 138.197.245.6  1.481 ms
 5  116.51.17.165  2.433 ms 116.51.17.193  7.712 ms 116.51.17.165  2.418 ms
 6  129.250.2.123  181.612 ms  180.546 ms 129.250.2.93  167.798 ms
 7  129.250.3.91  1.206 ms 129.250.3.131  1.188 ms 129.250.3.91  1.267 ms
 8  129.250.2.67  65.110 ms 129.250.2.243  65.693 ms  67.410 ms
 9  129.250.2.176  169.594 ms 129.250.3.193  184.556 ms 129.250.2.176  169.073 ms
10  129.250.3.17  177.690 ms 129.250.3.238  173.306 ms  165.583 ms
```

```
11  154.54.9.29  180.296 ms  165.526 ms  168.005 ms
12  154.54.42.101  170.910 ms  175.772 ms 154.54.25.149  183.966 ms
13  154.54.45.161  187.979 ms 154.54.44.85  184.729 ms 154.54.45.161  192.887 ms
14  154.54.42.66  191.102 ms 154.54.42.78  194.204 ms 154.54.42.66  196.713 ms
15  154.54.30.161  213.545 ms 154.54.29.221  218.801 ms 154.54.30.161  213.110 ms
16  154.54.28.129  242.618 ms  227.974 ms  229.515 ms
17  154.54.7.157  230.808 ms  235.919 ms  234.694 ms
18  154.54.40.109  224.548 ms 154.54.40.105  227.920 ms 154.54.40.109  233.563 ms
19  154.54.30.186  253.649 ms  241.307 ms  241.170 ms
20  154.54.56.94  231.456 ms * *
21  154.54.38.210  245.269 ms  280.041 ms  283.710 ms
22  130.117.51.105  292.932 ms 154.54.59.62  262.378 ms 154.54.36.254  276.533 ms
23  154.54.59.98  257.842 ms 154.54.59.181  269.565 ms 130.117.51.57  285.589 ms
24  154.54.58.246  283.166 ms 154.54.60.206  279.920 ms 154.54.58.246  284.616 ms
25  149.6.190.250  274.547 ms 149.6.190.26  276.696 ms  274.502 ms
26  77.120.1.125  274.810 ms 77.120.1.123  284.269 ms  274.718 ms
27  77.120.1.49  274.750 ms  292.918 ms  278.943 ms
28  77.120.3.236  274.280 ms  274.602 ms 77.120.1.49  277.415 ms
----------------
----------------
route to iperf.jp.milou.icu
traceroute to iperf.jp.milou.icu (202.212.86.234), 30 hops max, 60 byte packets
 1  178.128.48.254  1.075 ms 178.128.48.253  1.026 ms 178.128.48.254  1.020 ms
 2  138.197.251.34  1.288 ms 138.197.251.44  1.440 ms 138.197.251.168  1.228 ms
 3  138.197.251.37  1.042 ms 138.197.251.175  0.982 ms 138.197.251.37  0.971 ms
 4  138.197.245.14  1.419 ms 138.197.245.12  1.382 ms 138.197.245.8  1.341 ms
 5  210.176.138.132  1.487 ms 210.176.138.134  1.667 ms 210.176.138.132  1.643 ms
 6  202.84.224.189  3.517 ms  3.918 ms  3.850 ms
 7  202.84.141.206  72.401 ms  72.370 ms  72.336 ms
 8  202.47.216.210  71.872 ms  71.820 ms  71.782 ms
 9  210.171.224.38  75.425 ms  75.373 ms  75.955 ms
10  * * *
11  202.239.114.14  75.307 ms 202.239.114.18  72.249 ms 202.239.114.14  75.170 ms
12  202.239.82.50  75.060 ms  75.067 ms  75.222 ms
13  202.212.86.234  71.942 ms  71.666 ms  71.653 ms
----------------
----------------
route to iperf.sg.milou.icu
traceroute to iperf.sg.milou.icu (165.22.50.237), 30 hops max, 60 byte packets
 1  178.128.48.253  1.039 ms 178.128.48.254  0.823 ms  2.800 ms
 2  165.22.50.237  1.624 ms  1.500 ms  1.482 ms
----------------
----------------
route to iperf.hk.milou.site
traceroute to iperf.hk.milou.site (103.53.199.62), 30 hops max, 60 byte packets
 1  178.128.48.253  1.749 ms  1.684 ms 178.128.48.254  4.239 ms
 2  138.197.251.168  1.597 ms 138.197.251.44  2.677 ms 138.197.251.34  1.523 ms
 3  138.197.251.175  3.100 ms 138.197.251.187  1.464 ms 138.197.251.163  3.092 ms
 4  27.111.228.86  1.636 ms  1.660 ms  2.403 ms
 5  * * *
 6  103.53.199.62  35.349 ms  34.608 ms *
----------------
----------------
route to iperf.us.milou.icu
traceroute to iperf.us.milou.icu (173.82.154.77), 30 hops max, 60 byte packets
 1  178.128.48.253  1.162 ms  1.067 ms  1.158 ms
 2  138.197.251.46  3.717 ms 138.197.251.180  6.917 ms 138.197.251.168  1.308 ms
 3  138.197.251.175  0.782 ms 138.197.251.185  0.838 ms 138.197.251.173  3.986 ms
 4  138.197.245.6  1.161 ms 138.197.245.4  1.128 ms 138.197.245.0  1.088 ms
 5  116.51.17.165  1.883 ms  1.902 ms  1.871 ms
```

```
 6  129.250.2.93  169.481 ms 129.250.2.241  186.283 ms 129.250.2.93  168.819 ms
 7  129.250.3.101  1.484 ms 129.250.3.83  1.433 ms 129.250.3.131  1.396 ms
 8  129.250.2.243  67.057 ms 129.250.2.67  67.057 ms  67.035 ms
 9  129.250.3.193  194.166 ms 129.250.2.176  180.581 ms 129.250.3.193  191.287 ms
10  129.250.3.123  165.970 ms  165.814 ms 129.250.4.107  180.909 ms
11  129.250.2.116  166.142 ms  171.065 ms 129.250.2.104  166.271 ms
12  129.250.205.122  168.602 ms  168.704 ms  173.656 ms
13  208.64.231.5  190.908 ms  271.506 ms  272.037 ms
14  173.82.154.77  175.018 ms  173.466 ms  173.356 ms
-----------------
(END)
```

Figure S2-4. Results for *traceroute* after running the script

Section 3

```
#!/bin/bash

touch ping.txt
while read i; do
        echo "-----------------" >> ping.txt
        echo "ping ${i}" >> ping.txt
        ping -c 3 ${i} >> ping.txt
        ping -c 3 ${i} >> ping.txt
        ping -c 3 ${i} >> ping.txt
        echo "-----------------" >> ping.txt
done < hosts.txt
ping.sh (END)
```

Figure S3-1. Shell script to run *ping*

```
-----------------
ping bouygues.testdebit.info
PING bouygues.testdebit.info (89.84.1.222) 56(84) bytes of data.
64 bytes from 89.84.1.222 (89.84.1.222): icmp_seq=1 ttl=50 time=237 ms
64 bytes from 89.84.1.222 (89.84.1.222): icmp_seq=2 ttl=50 time=236 ms
64 bytes from 89.84.1.222 (89.84.1.222): icmp_seq=3 ttl=50 time=236 ms

--- bouygues.testdebit.info ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2003ms
rtt min/avg/max/mdev = 236.877/237.235/237.874/0.602 ms
PING bouygues.testdebit.info (89.84.1.222) 56(84) bytes of data.
64 bytes from 89.84.1.222 (89.84.1.222): icmp_seq=1 ttl=50 time=237 ms
64 bytes from 89.84.1.222 (89.84.1.222): icmp_seq=2 ttl=50 time=236 ms
64 bytes from 89.84.1.222 (89.84.1.222): icmp_seq=3 ttl=50 time=236 ms

--- bouygues.testdebit.info ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2002ms
rtt min/avg/max/mdev = 236.983/237.156/237.492/0.610 ms
PING bouygues.testdebit.info (89.84.1.222) 56(84) bytes of data.
64 bytes from 89.84.1.222 (89.84.1.222): icmp_seq=1 ttl=50 time=236 ms
64 bytes from 89.84.1.222 (89.84.1.222): icmp_seq=2 ttl=50 time=237 ms
64 bytes from 89.84.1.222 (89.84.1.222): icmp_seq=3 ttl=50 time=236 ms

--- bouygues.testdebit.info ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2002ms
rtt min/avg/max/mdev = 236.894/236.941/237.000/0.399 ms
-----------------
-----------------
ping ikoula.testdebit.info
PING ikoula.testdebit.info (213.246.63.45) 56(84) bytes of data.
64 bytes from ik063045.ikexpress.com (213.246.63.45): icmp_seq=1 ttl=54 time=150 ms
64 bytes from ik063045.ikexpress.com (213.246.63.45): icmp_seq=2 ttl=54 time=149 ms
64 bytes from ik063045.ikexpress.com (213.246.63.45): icmp_seq=3 ttl=54 time=149 ms

--- ikoula.testdebit.info ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2004ms
rtt min/avg/max/mdev = 149.734/150.080/150.637/0.508 ms
PING ikoula.testdebit.info (213.246.63.45) 56(84) bytes of data.
64 bytes from ik063045.ikexpress.com (213.246.63.45): icmp_seq=1 ttl=54 time=149 ms
64 bytes from ik063045.ikexpress.com (213.246.63.45): icmp_seq=2 ttl=54 time=149 ms
64 bytes from ik063045.ikexpress.com (213.246.63.45): icmp_seq=3 ttl=54 time=149 ms

--- ikoula.testdebit.info ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2004ms
rtt min/avg/max/mdev = 149.677/149.733/149.772/0.040 ms
PING ikoula.testdebit.info (213.246.63.45) 56(84) bytes of data.
64 bytes from ik063045.ikexpress.com (213.246.63.45): icmp_seq=1 ttl=54 time=149 ms
64 bytes from ik063045.ikexpress.com (213.246.63.45): icmp_seq=2 ttl=54 time=149 ms
64 bytes from ik063045.ikexpress.com (213.246.63.45): icmp_seq=3 ttl=54 time=149 ms

--- ikoula.testdebit.info ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2001ms
rtt min/avg/max/mdev = 149.705/149.774/149.856/0.062 ms
-----------------
-----------------
```

```
ping st2.nn.ertelecom.ru
PING st2.nn.ertelecom.ru (91.144.184.232) 56(84) bytes of data.
64 bytes from st2.nn.ertelecom.ru (91.144.184.232): icmp_seq=1 ttl=51 time=278 ms
64 bytes from st2.nn.ertelecom.ru (91.144.184.232): icmp_seq=2 ttl=51 time=278 ms
64 bytes from st2.nn.ertelecom.ru (91.144.184.232): icmp_seq=3 ttl=51 time=277 ms

--- st2.nn.ertelecom.ru ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2001ms
rtt min/avg/max/mdev = 277.970/278.001/278.022/0.431 ms
PING st2.nn.ertelecom.ru (91.144.184.232) 56(84) bytes of data.
64 bytes from st2.nn.ertelecom.ru (91.144.184.232): icmp_seq=1 ttl=51 time=278 ms
64 bytes from st2.nn.ertelecom.ru (91.144.184.232): icmp_seq=2 ttl=51 time=278 ms
64 bytes from st2.nn.ertelecom.ru (91.144.184.232): icmp_seq=3 ttl=51 time=278 ms

--- st2.nn.ertelecom.ru ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2002ms
rtt min/avg/max/mdev = 278.007/278.028/278.051/0.430 ms
PING st2.nn.ertelecom.ru (91.144.184.232) 56(84) bytes of data.
64 bytes from st2.nn.ertelecom.ru (91.144.184.232): icmp_seq=1 ttl=51 time=278 ms
64 bytes from st2.nn.ertelecom.ru (91.144.184.232): icmp_seq=2 ttl=51 time=278 ms
64 bytes from st2.nn.ertelecom.ru (91.144.184.232): icmp_seq=3 ttl=51 time=278 ms

--- st2.nn.ertelecom.ru ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2002ms
rtt min/avg/max/mdev = 278.050/278.096/278.120/0.032 ms
-----------------
-----------------
ping iperf.biznetnetworks.com
PING iperf.biznetnetworks.com (117.102.109.186) 56(84) bytes of data.
64 bytes from 117.102.109.186 (117.102.109.186): icmp_seq=1 ttl=58 time=14.6 ms
64 bytes from 117.102.109.186 (117.102.109.186): icmp_seq=2 ttl=58 time=13.8 ms
64 bytes from 117.102.109.186 (117.102.109.186): icmp_seq=3 ttl=58 time=13.7 ms

--- iperf.biznetnetworks.com ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2003ms
rtt min/avg/max/mdev = 13.797/14.078/14.613/0.390 ms
PING iperf.biznetnetworks.com (117.102.109.186) 56(84) bytes of data.
64 bytes from 117.102.109.186 (117.102.109.186): icmp_seq=1 ttl=58 time=13.7 ms
64 bytes from 117.102.109.186 (117.102.109.186): icmp_seq=2 ttl=58 time=13.8 ms
64 bytes from 117.102.109.186 (117.102.109.186): icmp_seq=3 ttl=58 time=13.7 ms

--- iperf.biznetnetworks.com ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2003ms
rtt min/avg/max/mdev = 13.762/13.788/13.814/0.137 ms
PING iperf.biznetnetworks.com (117.102.109.186) 56(84) bytes of data.
64 bytes from 117.102.109.186 (117.102.109.186): icmp_seq=1 ttl=58 time=13.6 ms
64 bytes from 117.102.109.186 (117.102.109.186): icmp_seq=2 ttl=58 time=13.7 ms
64 bytes from 117.102.109.186 (117.102.109.186): icmp_seq=3 ttl=58 time=13.7 ms

--- iperf.biznetnetworks.com ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2011ms
rtt min/avg/max/mdev = 13.690/13.741/13.783/0.038 ms
-----------------
-----------------
```

```
ping speedtest.serverius.net
PING speedtest.serverius.net (178.21.16.76) 56(84) bytes of data.
64 bytes from speedtest.serverius.net (178.21.16.76): icmp_seq=1 ttl=51 time=157 ms
64 bytes from speedtest.serverius.net (178.21.16.76): icmp_seq=2 ttl=51 time=155 ms
64 bytes from speedtest.serverius.net (178.21.16.76): icmp_seq=3 ttl=51 time=157 ms

--- speedtest.serverius.net ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2000ms
rtt min/avg/max/mdev = 155.200/156.650/157.714/1.062 ms
PING speedtest.serverius.net (178.21.16.76) 56(84) bytes of data.
64 bytes from speedtest.serverius.net (178.21.16.76): icmp_seq=1 ttl=51 time=157 ms
64 bytes from speedtest.serverius.net (178.21.16.76): icmp_seq=2 ttl=51 time=158 ms
64 bytes from speedtest.serverius.net (178.21.16.76): icmp_seq=3 ttl=51 time=155 ms

--- speedtest.serverius.net ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2001ms
rtt min/avg/max/mdev = 155.886/157.123/158.286/1.082 ms
PING speedtest.serverius.net (178.21.16.76) 56(84) bytes of data.
64 bytes from speedtest.serverius.net (178.21.16.76): icmp_seq=1 ttl=51 time=157 ms
64 bytes from speedtest.serverius.net (178.21.16.76): icmp_seq=2 ttl=51 time=156 ms
64 bytes from speedtest.serverius.net (178.21.16.76): icmp_seq=3 ttl=51 time=157 ms

--- speedtest.serverius.net ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2003ms
rtt min/avg/max/mdev = 156.184/157.047/157.755/0.726 ms
-----------------
-----------------
ping iperf.volia.net
PING speedtest.volia.net (77.120.3.236) 56(84) bytes of data.
64 bytes from speedtest.volia.com (77.120.3.236): icmp_seq=1 ttl=48 time=280 ms
64 bytes from speedtest.volia.com (77.120.3.236): icmp_seq=2 ttl=48 time=278 ms
64 bytes from speedtest.volia.com (77.120.3.236): icmp_seq=3 ttl=48 time=278 ms

--- speedtest.volia.net ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2008ms
rtt min/avg/max/mdev = 278.731/279.173/280.011/0.592 ms
PING speedtest.volia.net (77.120.3.236) 56(84) bytes of data.
64 bytes from speedtest.volia.com (77.120.3.236): icmp_seq=1 ttl=48 time=278 ms
64 bytes from speedtest.volia.com (77.120.3.236): icmp_seq=2 ttl=48 time=278 ms
64 bytes from speedtest.volia.com (77.120.3.236): icmp_seq=3 ttl=48 time=278 ms

--- speedtest.volia.net ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2007ms
rtt min/avg/max/mdev = 278.796/278.831/278.899/0.048 ms
PING speedtest.volia.net (77.120.3.236) 56(84) bytes of data.
64 bytes from speedtest.volia.com (77.120.3.236): icmp_seq=1 ttl=48 time=278 ms
64 bytes from speedtest.volia.com (77.120.3.236): icmp_seq=2 ttl=48 time=278 ms
64 bytes from speedtest.volia.com (77.120.3.236): icmp_seq=3 ttl=48 time=278 ms

--- speedtest.volia.net ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2007ms
rtt min/avg/max/mdev = 278.735/278.777/278.808/0.030 ms
-----------------
-----------------
```

```
----------------
ping iperf.sg.milou.icu
PING iperf.sg.milou.icu (165.22.50.237) 56(84) bytes of data.
64 bytes from 165.22.50.237 (165.22.50.237): icmp_seq=1 ttl=63 time=2.23 ms
64 bytes from 165.22.50.237 (165.22.50.237): icmp_seq=2 ttl=63 time=0.554 ms
64 bytes from 165.22.50.237 (165.22.50.237): icmp_seq=3 ttl=63 time=0.513 ms

--- iperf.sg.milou.icu ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2065ms
rtt min/avg/max/mdev = 0.513/1.100/2.234/0.802 ms
PING iperf.sg.milou.icu (165.22.50.237) 56(84) bytes of data.
64 bytes from 165.22.50.237 (165.22.50.237): icmp_seq=1 ttl=63 time=0.377 ms
64 bytes from 165.22.50.237 (165.22.50.237): icmp_seq=2 ttl=63 time=0.469 ms
64 bytes from 165.22.50.237 (165.22.50.237): icmp_seq=3 ttl=63 time=0.534 ms

--- iperf.sg.milou.icu ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2043ms
rtt min/avg/max/mdev = 0.377/0.460/0.534/0.064 ms
PING iperf.sg.milou.icu (165.22.50.237) 56(84) bytes of data.
64 bytes from 165.22.50.237 (165.22.50.237): icmp_seq=1 ttl=63 time=0.408 ms
64 bytes from 165.22.50.237 (165.22.50.237): icmp_seq=2 ttl=63 time=0.501 ms
64 bytes from 165.22.50.237 (165.22.50.237): icmp_seq=3 ttl=63 time=0.494 ms

--- iperf.sg.milou.icu ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2042ms
rtt min/avg/max/mdev = 0.408/0.467/0.501/0.049 ms
----------------
----------------
ping iperf.hk.milou.site
PING iperf.hk.milou.site (103.53.199.62) 56(84) bytes of data.
64 bytes from 103.53.199.62 (103.53.199.62): icmp_seq=1 ttl=58 time=35.2 ms
64 bytes from 103.53.199.62 (103.53.199.62): icmp_seq=2 ttl=58 time=34.4 ms
64 bytes from 103.53.199.62 (103.53.199.62): icmp_seq=3 ttl=58 time=34.3 ms

--- iperf.hk.milou.site ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2003ms
rtt min/avg/max/mdev = 34.300/34.659/35.246/0.418 ms
PING iperf.hk.milou.site (103.53.199.62) 56(84) bytes of data.
64 bytes from 103.53.199.62 (103.53.199.62): icmp_seq=1 ttl=58 time=34.3 ms
64 bytes from 103.53.199.62 (103.53.199.62): icmp_seq=2 ttl=58 time=34.2 ms
64 bytes from 103.53.199.62 (103.53.199.62): icmp_seq=3 ttl=58 time=34.3 ms

--- iperf.hk.milou.site ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2002ms
rtt min/avg/max/mdev = 34.290/34.346/34.399/0.218 ms
PING iperf.hk.milou.site (103.53.199.62) 56(84) bytes of data.
64 bytes from 103.53.199.62 (103.53.199.62): icmp_seq=1 ttl=58 time=34.3 ms
64 bytes from 103.53.199.62 (103.53.199.62): icmp_seq=2 ttl=58 time=34.3 ms
64 bytes from 103.53.199.62 (103.53.199.62): icmp_seq=3 ttl=58 time=34.3 ms

--- iperf.hk.milou.site ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2003ms
rtt min/avg/max/mdev = 34.321/34.353/34.389/0.215 ms
----------------
----------------
```

```
ping iperf.jp.milou.icu
PING iperf.jp.milou.icu (202.212.86.234) 56(84) bytes of data.
64 bytes from iperf.jp.milou.icu (202.212.86.234): icmp_seq=1 ttl=52 time=72.9 ms
64 bytes from iperf.jp.milou.icu (202.212.86.234): icmp_seq=2 ttl=52 time=72.0 ms
64 bytes from iperf.jp.milou.icu (202.212.86.234): icmp_seq=3 ttl=52 time=71.9 ms

--- iperf.jp.milou.icu ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2002ms
rtt min/avg/max/mdev = 71.908/72.309/72.973/0.521 ms
PING iperf.jp.milou.icu (202.212.86.234) 56(84) bytes of data.
64 bytes from iperf.jp.milou.icu (202.212.86.234): icmp_seq=1 ttl=52 time=72.0 ms
64 bytes from iperf.jp.milou.icu (202.212.86.234): icmp_seq=2 ttl=52 time=76.7 ms
64 bytes from iperf.jp.milou.icu (202.212.86.234): icmp_seq=3 ttl=52 time=73.1 ms

--- iperf.jp.milou.icu ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2003ms
rtt min/avg/max/mdev = 72.039/73.974/76.724/2.021 ms
PING iperf.jp.milou.icu (202.212.86.234) 56(84) bytes of data.
64 bytes from iperf.jp.milou.icu (202.212.86.234): icmp_seq=1 ttl=52 time=71.9 ms
64 bytes from iperf.jp.milou.icu (202.212.86.234): icmp_seq=2 ttl=52 time=72.0 ms
64 bytes from iperf.jp.milou.icu (202.212.86.234): icmp_seq=3 ttl=52 time=72.0 ms

--- iperf.jp.milou.icu ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2002ms
rtt min/avg/max/mdev = 71.989/72.036/72.076/0.312 ms
------------------

ping iperf.us.milou.icu
PING iperf.us.milou.icu (173.82.154.77) 56(84) bytes of data.
64 bytes from top24.topdlinha.com (173.82.154.77): icmp_seq=1 ttl=51 time=171 ms
64 bytes from top24.topdlinha.com (173.82.154.77): icmp_seq=2 ttl=51 time=170 ms
64 bytes from top24.topdlinha.com (173.82.154.77): icmp_seq=3 ttl=51 time=170 ms

--- iperf.us.milou.icu ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2002ms
rtt min/avg/max/mdev = 170.126/170.551/171.396/0.597 ms
PING iperf.us.milou.icu (173.82.154.77) 56(84) bytes of data.
64 bytes from top24.topdlinha.com (173.82.154.77): icmp_seq=1 ttl=51 time=170 ms
64 bytes from top24.topdlinha.com (173.82.154.77): icmp_seq=2 ttl=51 time=170 ms
64 bytes from top24.topdlinha.com (173.82.154.77): icmp_seq=3 ttl=51 time=170 ms

--- iperf.us.milou.icu ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2002ms
rtt min/avg/max/mdev = 170.121/170.185/170.233/0.478 ms
PING iperf.us.milou.icu (173.82.154.77) 56(84) bytes of data.
64 bytes from top24.topdlinha.com (173.82.154.77): icmp_seq=1 ttl=51 time=170 ms
64 bytes from top24.topdlinha.com (173.82.154.77): icmp_seq=2 ttl=51 time=170 ms
64 bytes from top24.topdlinha.com (173.82.154.77): icmp_seq=3 ttl=51 time=170 ms

--- iperf.us.milou.icu ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2001ms
rtt min/avg/max/mdev = 170.031/170.119/170.234/0.347 ms
------------------
(END)
```

Figure S3-2. Results for *ping* after running the script

Host	Distance (km)	RTD1(ms)	RTD2(ms)	RTD3(ms)	Avg RTD(ms)	mdev1(ms	mdev2(ms	mdev3(ms	Jitter(ms)
bouygues.testdebit.info	10721.021	237.235	237.156	236.941	237.111	0.602	0.610	0.399	0.546
ikoula.testdebit.info	10736.088	150.080	149.733	149.774	149.862	0.508	0.040	0.062	0.296
st2.nn.ertelecom.ru	8084.683	278.001	278.028	278.096	278.042	0.431	0.430	0.032	0.352
iperf.biznetnetworks.com	893.389	14.078	13.788	13.741	13.869	0.39	0.137	0.038	0.240
speedtest.serverius.net	10439.498	156.650	157.123	157.047	156.940	1.062	1.082	0.726	0.971
iperf.volia.net	9169.026	279.173	278.831	278.777	278.927	0.592	0.048	0.030	0.343
iperf.jp.milou.icu	5322.404	72.309	73.974	72.036	72.773	0.521	2.021	0.312	1.218
iperf.sg.milou.icu	1.313	1.100	0.460	0.467	0.676	0.802	0.064	0.049	0.465
iperf.hk.milou.site	2585.659	34.659	34.346	34.353	34.453	0.418	0.218	0.215	0.299
iperf.us.milou.icu	13635.957	170.551	170.185	170.119	170.285	0.597	0.478	0.347	0.485

Figure S3-3. Calculation for *ping* results

Here, the formula used in Excel is:
Avg RTD = 1/3(RTD1 + RTD2 +RTD3)
Jitter = =SQRT[(mdev1^2 + mdev2^2 + mdev3^2)/3]

Section 4

```
#!/bin/bash

touch iperf.txt
while read i; do
        echo "--------------------------" >> iperf.txt
        echo "--------------------------" >> iperf.txt
        echo "iperf3 test to ${i}" >> iperf.txt
        iperf3 -c ${i}  >> iperf.txt
        iperf3 -c ${i}  >> iperf.txt
        iperf3 -c ${i}  >> iperf.txt
        echo "--------------------------" >> iperf.txt
        echo "iperf test to ${i}" >> iperf.txt
        iperf -c ${i}  >> iperf.txt
        iperf -c ${i}  >> iperf.txt
        iperf -c ${i}  >> iperf.txt
done < hosts.txt
(END)
```

Figure S4-1. Shell script to run *iperf* and *iperf3*

```
iperf3 test to bouygues.testdebit.info
iperf3: error - unable to receive control message: Connection reset by peer
iperf3: error - unable to receive control message: Connection reset by peer
iperf3: error - unable to receive control message: Connection reset by peer
-------------------------
iperf test to bouygues.testdebit.info
------------------------------------------------------------
Client connecting to bouygues.testdebit.info, TCP port 5001
TCP window size:  128 KByte (default)
------------------------------------------------------------
[  3] local 178.128.52.192 port 54500 connected with 89.84.1.222 port 5001
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0- 0.2 sec   158 KBytes  5.23 Mbits/sec
------------------------------------------------------------
Client connecting to bouygues.testdebit.info, TCP port 5001
TCP window size:  128 KByte (default)
------------------------------------------------------------
[  3] local 178.128.52.192 port 54502 connected with 89.84.1.222 port 5001
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0- 0.3 sec   158 KBytes  5.08 Mbits/sec
------------------------------------------------------------
Client connecting to bouygues.testdebit.info, TCP port 5001
TCP window size:  128 KByte (default)
------------------------------------------------------------
[  3] local 178.128.52.192 port 54504 connected with 89.84.1.222 port 5001
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0- 0.3 sec   158 KBytes  5.04 Mbits/sec
-------------------------
-------------------------
iperf3 test to ikoula.testdebit.info
iperf3: error - control socket has closed unexpectedly
iperf3: error - control socket has closed unexpectedly
iperf3: error - control socket has closed unexpectedly
-------------------------
iperf test to ikoula.testdebit.info
------------------------------------------------------------
Client connecting to ikoula.testdebit.info, TCP port 5001
TCP window size:  128 KByte (default)
------------------------------------------------------------
[  3] local 178.128.52.192 port 57318 connected with 213.246.63.45 port 5001
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0- 0.2 sec   158 KBytes  8.10 Mbits/sec
------------------------------------------------------------
Client connecting to ikoula.testdebit.info, TCP port 5001
TCP window size:  128 KByte (default)
------------------------------------------------------------
[  3] local 178.128.52.192 port 57320 connected with 213.246.63.45 port 5001
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0- 0.2 sec   158 KBytes  8.32 Mbits/sec
------------------------------------------------------------
Client connecting to ikoula.testdebit.info, TCP port 5001
TCP window size:  128 KByte (default)
------------------------------------------------------------
[  3] local 178.128.52.192 port 57322 connected with 213.246.63.45 port 5001
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0- 0.2 sec   158 KBytes  8.20 Mbits/sec
```

```
iperf3 test to st2.nn.ertelecom.ru
Connecting to host st2.nn.ertelecom.ru, port 5201
[  4] local 178.128.52.192 port 34494 connected to 91.144.184.232 port 5201
[ ID] Interval           Transfer     Bandwidth       Retr  Cwnd
[  4]   0.00-1.00   sec   489 KBytes  4.01 Mbits/sec    0   55.1 KBytes
[  4]   1.00-2.00   sec  3.18 MBytes  26.7 Mbits/sec    0    475 KBytes
[  4]   2.00-3.00   sec  3.75 MBytes  31.4 Mbits/sec    0   4.93 MBytes
[  4]   3.00-4.00   sec  11.2 MBytes  94.6 Mbits/sec    0   8.76 MBytes
[  4]   4.00-5.00   sec  8.75 MBytes  73.4 Mbits/sec    0   8.76 MBytes
[  4]   5.00-6.00   sec  11.2 MBytes  94.2 Mbits/sec    0   8.76 MBytes
[  4]   6.00-7.00   sec  10.0 MBytes  84.1 Mbits/sec    0   8.76 MBytes
[  4]   7.00-8.01   sec  10.0 MBytes  83.3 Mbits/sec    0   8.76 MBytes
[  4]   8.01-9.00   sec  10.0 MBytes  84.5 Mbits/sec    0   8.76 MBytes
[  4]   9.00-10.00  sec  10.0 MBytes  83.9 Mbits/sec    0   8.76 MBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bandwidth       Retr
[  4]   0.00-10.00  sec  78.7 MBytes  66.0 Mbits/sec    0             sender
[  4]   0.00-10.00  sec  78.4 MBytes  65.8 Mbits/sec                  receiver

iperf Done.
Connecting to host st2.nn.ertelecom.ru, port 5201
[  4] local 178.128.52.192 port 34498 connected to 91.144.184.232 port 5201
[ ID] Interval           Transfer     Bandwidth       Retr  Cwnd
[  4]   0.00-1.00   sec   489 KBytes  4.01 Mbits/sec    0   58.0 KBytes
[  4]   1.00-2.00   sec  3.18 MBytes  26.7 Mbits/sec    0    510 KBytes
[  4]   2.00-3.00   sec  5.00 MBytes  42.0 Mbits/sec    0   5.65 MBytes
[  4]   3.00-4.00   sec  11.2 MBytes  93.9 Mbits/sec    0   8.76 MBytes
[  4]   4.00-5.00   sec  10.0 MBytes  84.3 Mbits/sec    0   8.76 MBytes
[  4]   5.00-6.00   sec  10.0 MBytes  83.9 Mbits/sec    0   8.76 MBytes
[  4]   6.00-7.00   sec  10.0 MBytes  83.9 Mbits/sec    0   8.76 MBytes
[  4]   7.00-8.00   sec  10.0 MBytes  83.9 Mbits/sec    0   8.76 MBytes
[  4]   8.00-9.00   sec  11.2 MBytes  94.4 Mbits/sec    0   8.76 MBytes
[  4]   9.00-10.00  sec  10.0 MBytes  83.9 Mbits/sec    0   8.76 MBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bandwidth       Retr
[  4]   0.00-10.00  sec  81.2 MBytes  68.1 Mbits/sec    0             sender
[  4]   0.00-10.00  sec  81.2 MBytes  68.1 Mbits/sec                  receiver

iperf Done.
Connecting to host st2.nn.ertelecom.ru, port 5201
[  4] local 178.128.52.192 port 34502 connected to 91.144.184.232 port 5201
[ ID] Interval           Transfer     Bandwidth       Retr  Cwnd
[  4]   0.00-1.00   sec   489 KBytes  4.01 Mbits/sec    0   58.0 KBytes
[  4]   1.00-2.00   sec  3.18 MBytes  26.7 Mbits/sec    0    505 KBytes
[  4]   2.00-3.00   sec  5.00 MBytes  41.9 Mbits/sec    0   5.08 MBytes
[  4]   3.00-4.00   sec  8.75 MBytes  73.4 Mbits/sec    0   8.77 MBytes
[  4]   4.00-5.00   sec  11.2 MBytes  94.4 Mbits/sec    0   8.77 MBytes
[  4]   5.00-6.00   sec  10.0 MBytes  83.9 Mbits/sec    0   8.77 MBytes
[  4]   6.00-7.00   sec  11.2 MBytes  94.4 Mbits/sec    0   8.77 MBytes
[  4]   7.00-8.00   sec  10.0 MBytes  83.9 Mbits/sec    0   8.77 MBytes
[  4]   8.00-9.00   sec  10.0 MBytes  83.9 Mbits/sec    0   8.77 MBytes
[  4]   9.00-10.00  sec  10.0 MBytes  83.9 Mbits/sec    0   8.77 MBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bandwidth       Retr
[  4]   0.00-10.00  sec  79.9 MBytes  67.0 Mbits/sec    0             sender
[  4]   0.00-10.00  sec  79.9 MBytes  67.0 Mbits/sec                  receiver

iperf Done.
```

```
-------------------------
iperf test to st2.nn.ertelecom.ru
------------------------------------------------------------
Client connecting to st2.nn.ertelecom.ru, TCP port 5001
TCP window size:  128 KByte (default)
------------------------------------------------------------
[  3] local 178.128.52.192 port 47080 connected with 91.144.184.232 port 5001
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0-10.1 sec  69.9 MBytes  57.9 Mbits/sec
------------------------------------------------------------
Client connecting to st2.nn.ertelecom.ru, TCP port 5001
TCP window size:  128 KByte (default)
------------------------------------------------------------
[  3] local 178.128.52.192 port 47082 connected with 91.144.184.232 port 5001
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0-10.1 sec  75.2 MBytes  62.3 Mbits/sec
------------------------------------------------------------
Client connecting to st2.nn.ertelecom.ru, TCP port 5001
TCP window size:  128 KByte (default)
------------------------------------------------------------
[  3] local 178.128.52.192 port 47090 connected with 91.144.184.232 port 5001
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0-10.1 sec  73.8 MBytes  61.2 Mbits/sec
-------------------------
-------------------------
```

```
iperf3 test to iperf.biznetnetworks.com
Connecting to host iperf.biznetnetworks.com, port 5201
[  4] local 178.128.52.192 port 44678 connected to 117.102.109.186 port 5201
[ ID] Interval           Transfer     Bandwidth       Retr  Cwnd
[  4]   0.00-1.00   sec   162 MBytes  1.35 Gbits/sec    1   8.90 MBytes
[  4]   1.00-2.01   sec   168 MBytes  1.39 Gbits/sec    0   8.90 MBytes
[  4]   2.01-3.00   sec   151 MBytes  1.27 Gbits/sec    0   6.56 MBytes
[  4]   3.00-4.01   sec   148 MBytes  1.23 Gbits/sec    0   8.42 MBytes
[  4]   4.01-5.00   sec   149 MBytes  1.25 Gbits/sec    0   6.54 MBytes
[  4]   5.00-6.00   sec   148 MBytes  1.24 Gbits/sec    0   6.61 MBytes
[  4]   6.00-7.00   sec   169 MBytes  1.42 Gbits/sec    0   6.69 MBytes
[  4]   7.00-8.00   sec   191 MBytes  1.60 Gbits/sec    0   6.65 MBytes
[  4]   8.00-9.00   sec   188 MBytes  1.57 Gbits/sec    0   7.42 MBytes
[  4]   9.00-10.00  sec   194 MBytes  1.63 Gbits/sec    0   6.47 MBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bandwidth       Retr
[  4]   0.00-10.00  sec  1.63 GBytes  1.40 Gbits/sec    1             sender
[  4]   0.00-10.00  sec  1.63 GBytes  1.40 Gbits/sec                  receiver

iperf Done.
Connecting to host iperf.biznetnetworks.com, port 5201
[  4] local 178.128.52.192 port 44682 connected to 117.102.109.186 port 5201
[ ID] Interval           Transfer     Bandwidth       Retr  Cwnd
[  4]   0.00-1.00   sec   174 MBytes  1.46 Gbits/sec    2   8.83 MBytes
[  4]   1.00-2.00   sec   201 MBytes  1.69 Gbits/sec    1   8.84 MBytes
[  4]   2.00-3.00   sec   189 MBytes  1.58 Gbits/sec    0   6.95 MBytes
[  4]   3.00-4.00   sec   192 MBytes  1.61 Gbits/sec    0   6.44 MBytes
[  4]   4.00-5.00   sec   185 MBytes  1.55 Gbits/sec    0   7.95 MBytes
[  4]   5.00-6.00   sec   178 MBytes  1.49 Gbits/sec    0   6.96 MBytes
[  4]   6.00-7.00   sec   189 MBytes  1.58 Gbits/sec    0   7.19 MBytes
[  4]   7.00-8.00   sec   190 MBytes  1.59 Gbits/sec    0   6.40 MBytes
[  4]   8.00-9.00   sec   184 MBytes  1.54 Gbits/sec    0   7.05 MBytes
[  4]   9.00-10.00  sec   186 MBytes  1.56 Gbits/sec    0   6.43 MBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bandwidth       Retr
[  4]   0.00-10.00  sec  1.82 GBytes  1.57 Gbits/sec    3             sender
[  4]   0.00-10.00  sec  1.82 GBytes  1.57 Gbits/sec                  receiver

iperf Done.
Connecting to host iperf.biznetnetworks.com, port 5201
[  4] local 178.128.52.192 port 44686 connected to 117.102.109.186 port 5201
[ ID] Interval           Transfer     Bandwidth       Retr  Cwnd
[  4]   0.00-1.00   sec   152 MBytes  1.27 Gbits/sec    3   7.64 MBytes
[  4]   1.00-2.00   sec   141 MBytes  1.18 Gbits/sec    0   6.25 MBytes
[  4]   2.00-3.00   sec   179 MBytes  1.50 Gbits/sec    0   6.98 MBytes
[  4]   3.00-4.00   sec   182 MBytes  1.53 Gbits/sec    0   8.25 MBytes
[  4]   4.00-5.00   sec   166 MBytes  1.39 Gbits/sec    0   6.02 MBytes
[  4]   5.00-6.00   sec   186 MBytes  1.56 Gbits/sec    0   6.23 MBytes
[  4]   6.00-7.00   sec   188 MBytes  1.57 Gbits/sec    0   6.14 MBytes
[  4]   7.00-8.00   sec   189 MBytes  1.58 Gbits/sec    0   6.36 MBytes
[  4]   8.00-9.00   sec   188 MBytes  1.57 Gbits/sec    0   6.19 MBytes
[  4]   9.00-10.00  sec   195 MBytes  1.63 Gbits/sec    0   6.52 MBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bandwidth       Retr
[  4]   0.00-10.00  sec  1.72 GBytes  1.48 Gbits/sec    3             sender
[  4]   0.00-10.00  sec  1.72 GBytes  1.48 Gbits/sec                  receiver

iperf Done.
```

```
iperf3 test to speedtest.serverius.net
iperf3: error - unable to connect to server: Connection timed out
iperf3: error - unable to connect to server: Connection timed out
iperf3: error - unable to connect to server: Connection timed out
-------------------------
iperf test to speedtest.serverius.net
------------------------------------------------------------
Client connecting to speedtest.serverius.net, TCP port 5001
TCP window size:  128 KByte (default)
------------------------------------------------------------
[  3] local 178.128.52.192 port 50526 connected with 178.21.16.76 port 5001
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0-10.6 sec   130 KBytes   101 Kbits/sec
------------------------------------------------------------
Client connecting to speedtest.serverius.net, TCP port 5001
TCP window size:  128 KByte (default)
------------------------------------------------------------
[  3] local 178.128.52.192 port 50528 connected with 178.21.16.76 port 5001
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0-10.5 sec   130 KBytes   101 Kbits/sec
------------------------------------------------------------
Client connecting to speedtest.serverius.net, TCP port 5001
TCP window size:  128 KByte (default)
------------------------------------------------------------
[  3] local 178.128.52.192 port 50534 connected with 178.21.16.76 port 5001
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0-10.5 sec   130 KBytes   101 Kbits/sec
-------------------------
-------------------------
-------------------------
iperf3 test to iperf.volia.net
iperf3: error - unable to receive control message: Connection reset by peer
iperf3: error - unable to receive control message: Connection reset by peer
iperf3: error - unable to receive control message: Connection reset by peer
-------------------------
iperf test to iperf.volia.net
------------------------------------------------------------
Client connecting to iperf.volia.net, TCP port 5001
TCP window size:  128 KByte (default)
------------------------------------------------------------
[  3] local 178.128.52.192 port 49346 connected with 77.120.3.236 port 5001
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0-10.4 sec   130 KBytes   103 Kbits/sec
------------------------------------------------------------
Client connecting to iperf.volia.net, TCP port 5001
TCP window size:  128 KByte (default)
------------------------------------------------------------
[  3] local 178.128.52.192 port 49348 connected with 77.120.3.236 port 5001
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0-10.4 sec   130 KBytes   102 Kbits/sec
------------------------------------------------------------
Client connecting to iperf.volia.net, TCP port 5001
TCP window size:  128 KByte (default)
------------------------------------------------------------
[  3] local 178.128.52.192 port 49354 connected with 77.120.3.236 port 5001
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0-10.4 sec   130 KBytes   102 Kbits/sec
-------------------------
-------------------------
```

```
-------------------------
-------------------------
iperf3 test to iperf.jp.milou.icu
Connecting to host iperf.jp.milou.icu, port 5201
[  4] local 178.128.52.192 port 37522 connected to 202.212.86.234 port 5201
[ ID] Interval           Transfer     Bandwidth       Retr  Cwnd
[  4]   0.00-1.00   sec  7.35 MBytes  61.6 Mbits/sec  864   1.93 MBytes
[  4]   1.00-2.00   sec  12.5 MBytes   105 Mbits/sec  688   1.80 MBytes
[  4]   2.00-3.00   sec  11.2 MBytes  94.4 Mbits/sec    0   1.73 MBytes
[  4]   3.00-4.00   sec  11.2 MBytes  94.4 Mbits/sec    0   1.82 MBytes
[  4]   4.00-5.00   sec  12.5 MBytes   105 Mbits/sec    0   1.82 MBytes
[  4]   5.00-6.00   sec  11.2 MBytes  94.4 Mbits/sec   13   1.79 MBytes
[  4]   6.00-7.00   sec  11.2 MBytes  94.4 Mbits/sec    2   1.79 MBytes
[  4]   7.00-8.00   sec  12.5 MBytes   105 Mbits/sec    0   1.73 MBytes
[  4]   8.00-9.00   sec  11.2 MBytes  94.4 Mbits/sec    0   1.78 MBytes
[  4]   9.00-10.00  sec  11.2 MBytes  94.4 Mbits/sec    0   1.78 MBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bandwidth       Retr
[  4]   0.00-10.00  sec   112 MBytes  94.2 Mbits/sec  1567             sender
[  4]   0.00-10.00  sec   110 MBytes  92.3 Mbits/sec                  receiver

iperf Done.
Connecting to host iperf.jp.milou.icu, port 5201
[  4] local 178.128.52.192 port 37546 connected to 202.212.86.234 port 5201
[ ID] Interval           Transfer     Bandwidth       Retr  Cwnd
[  4]   0.00-1.00   sec  7.35 MBytes  61.6 Mbits/sec  746   1.84 MBytes
[  4]   1.00-2.00   sec  11.2 MBytes  94.4 Mbits/sec  245   1.65 MBytes
[  4]   2.00-3.00   sec  10.0 MBytes  83.9 Mbits/sec    0   1.63 MBytes
[  4]   3.00-4.00   sec  10.0 MBytes  83.8 Mbits/sec    0   1.69 MBytes
[  4]   4.00-5.00   sec  10.0 MBytes  84.0 Mbits/sec  197   1.65 MBytes
[  4]   5.00-6.00   sec  11.2 MBytes  94.4 Mbits/sec    2   1.64 MBytes
[  4]   6.00-7.00   sec  10.0 MBytes  83.9 Mbits/sec    0   1.68 MBytes
[  4]   7.00-8.00   sec  10.0 MBytes  83.9 Mbits/sec    1   1.67 MBytes
[  4]   8.00-9.00   sec  11.2 MBytes  94.4 Mbits/sec    0   1.72 MBytes
[  4]   9.00-10.00  sec  10.0 MBytes  83.8 Mbits/sec    0   1.76 MBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bandwidth       Retr
[  4]   0.00-10.00  sec   101 MBytes  84.8 Mbits/sec  1191             sender
[  4]   0.00-10.00  sec  99.0 MBytes  83.1 Mbits/sec                  receiver

iperf Done.
Connecting to host iperf.jp.milou.icu, port 5201
[  4] local 178.128.52.192 port 37562 connected to 202.212.86.234 port 5201
[ ID] Interval           Transfer     Bandwidth       Retr  Cwnd
[  4]   0.00-1.00   sec  7.35 MBytes  61.6 Mbits/sec  579   1.67 MBytes
[  4]   1.00-2.00   sec  11.2 MBytes  94.4 Mbits/sec  360   1.78 MBytes
[  4]   2.00-3.00   sec  11.2 MBytes  94.4 Mbits/sec    0   1.79 MBytes
[  4]   3.00-4.00   sec  11.2 MBytes  94.4 Mbits/sec   72   1.07 MBytes
[  4]   4.00-5.00   sec  11.2 MBytes  94.4 Mbits/sec    0   1.76 MBytes
[  4]   5.00-6.00   sec  11.2 MBytes  94.4 Mbits/sec  296   1.80 MBytes
[  4]   6.00-7.00   sec  11.2 MBytes  94.4 Mbits/sec    0   1.79 MBytes
[  4]   7.00-8.00   sec  10.0 MBytes  83.9 Mbits/sec   15   1.20 MBytes
[  4]   8.00-9.00   sec  12.5 MBytes   105 Mbits/sec    0   1.72 MBytes
[  4]   9.00-10.00  sec  11.2 MBytes  94.4 Mbits/sec    0   1.71 MBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bandwidth       Retr
[  4]   0.00-10.00  sec   109 MBytes  91.1 Mbits/sec  1322             sender
[  4]   0.00-10.00  sec   106 MBytes  89.1 Mbits/sec                  receiver

iperf Done.
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iperf3 test to iperf.sg.milou.icu
Connecting to host iperf.sg.milou.icu, port 5201
[  4] local 178.128.52.192 port 33894 connected to 165.22.50.237 port 5201
[ ID] Interval           Transfer     Bandwidth       Retr  Cwnd
[  4]   0.00-1.00   sec   265 MBytes  2.23 Gbits/sec  31762    127 KBytes
[  4]   1.00-2.00   sec   239 MBytes  2.00 Gbits/sec  36218    277 KBytes
[  4]   2.00-3.00   sec   238 MBytes  1.99 Gbits/sec  40443    242 KBytes
[  4]   3.00-4.00   sec   239 MBytes  2.00 Gbits/sec  46289    345 KBytes
[  4]   4.00-5.00   sec   238 MBytes  1.99 Gbits/sec  39987    308 KBytes
[  4]   5.00-6.00   sec   239 MBytes  2.00 Gbits/sec  43450    276 KBytes
[  4]   6.00-7.00   sec   239 MBytes  2.00 Gbits/sec  38078    334 KBytes
[  4]   7.00-8.00   sec   211 MBytes  1.77 Gbits/sec  25941    373 KBytes
[  4]   8.00-9.00   sec   239 MBytes  2.00 Gbits/sec  28904    277 KBytes
[  4]   9.00-10.00  sec   214 MBytes  1.79 Gbits/sec  26599    298 KBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bandwidth       Retr
[  4]   0.00-10.00  sec  2.30 GBytes  1.98 Gbits/sec  357671             sender
[  4]   0.00-10.00  sec  2.30 GBytes  1.98 Gbits/sec                  receiver

iperf Done.
Connecting to host iperf.sg.milou.icu, port 5201
[  4] local 178.128.52.192 port 33898 connected to 165.22.50.237 port 5201
[ ID] Interval           Transfer     Bandwidth       Retr  Cwnd
[  4]   0.00-1.00   sec   265 MBytes  2.22 Gbits/sec  37574    272 KBytes
[  4]   1.00-2.00   sec   239 MBytes  2.00 Gbits/sec  42987    764 KBytes
[  4]   2.00-3.00   sec   214 MBytes  1.79 Gbits/sec  27354    318 KBytes
[  4]   3.00-4.00   sec   238 MBytes  2.00 Gbits/sec  43014    127 KBytes
[  4]   4.00-5.00   sec   212 MBytes  1.78 Gbits/sec  28929    349 KBytes
[  4]   5.00-6.00   sec   238 MBytes  1.99 Gbits/sec  43951    281 KBytes
[  4]   6.00-7.01   sec   240 MBytes  2.00 Gbits/sec  38728    296 KBytes
[  4]   7.01-8.01   sec   238 MBytes  2.00 Gbits/sec  36118    280 KBytes
[  4]   8.01-9.00   sec   236 MBytes  1.99 Gbits/sec  40016    290 KBytes
[  4]   9.00-10.00  sec   240 MBytes  2.01 Gbits/sec  33977    317 KBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bandwidth       Retr
[  4]   0.00-10.00  sec  2.30 GBytes  1.98 Gbits/sec  372648             sender
[  4]   0.00-10.00  sec  2.30 GBytes  1.98 Gbits/sec                  receiver

iperf Done.
Connecting to host iperf.sg.milou.icu, port 5201
[  4] local 178.128.52.192 port 33912 connected to 165.22.50.237 port 5201
[ ID] Interval           Transfer     Bandwidth       Retr  Cwnd
[  4]   0.00-1.00   sec   259 MBytes  2.17 Gbits/sec  29605    450 KBytes
[  4]   1.00-2.01   sec   240 MBytes  2.00 Gbits/sec  38330    636 KBytes
[  4]   2.01-3.00   sec   238 MBytes  2.00 Gbits/sec  37196    286 KBytes
[  4]   3.00-4.00   sec   239 MBytes  2.00 Gbits/sec  30427    310 KBytes
[  4]   4.00-5.00   sec   212 MBytes  1.78 Gbits/sec  30657    239 KBytes
[  4]   5.00-6.00   sec   235 MBytes  1.97 Gbits/sec  33793    436 KBytes
[  4]   6.00-7.00   sec   242 MBytes  2.03 Gbits/sec  36746    303 KBytes
[  4]   7.00-8.00   sec   238 MBytes  1.99 Gbits/sec  36131    191 KBytes
[  4]   8.00-9.00   sec   235 MBytes  1.97 Gbits/sec  38436    563 KBytes
[  4]   9.00-10.01  sec   242 MBytes  2.02 Gbits/sec  30791    311 KBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bandwidth       Retr
[  4]   0.00-10.01  sec  2.32 GBytes  2.00 Gbits/sec  342112             sender
[  4]   0.00-10.01  sec  2.32 GBytes  1.99 Gbits/sec                  receiver

iperf Done.
-------------------------
```

```
Connecting to host iperf.hk.milou.site, port 5201
[  4] local 178.128.52.192 port 43154 connected to 103.53.199.62 port 5201
[ ID] Interval           Transfer     Bandwidth       Retr  Cwnd
[  4]   0.00-1.00   sec  23.6 MBytes   198 Mbits/sec  961   4.53 MBytes
[  4]   1.00-2.00   sec  28.8 MBytes   241 Mbits/sec  529   3.36 MBytes
[  4]   2.00-3.00   sec  27.5 MBytes   231 Mbits/sec    4   3.30 MBytes
[  4]   3.00-4.00   sec  27.5 MBytes   231 Mbits/sec    7   3.53 MBytes
[  4]   4.00-5.00   sec  27.5 MBytes   231 Mbits/sec    0   3.50 MBytes
[  4]   5.00-6.00   sec  27.5 MBytes   231 Mbits/sec    0   3.37 MBytes
[  4]   6.00-7.00   sec  27.5 MBytes   231 Mbits/sec    0   3.43 MBytes
[  4]   7.00-8.00   sec  27.5 MBytes   231 Mbits/sec   55   3.60 MBytes
[  4]   8.00-9.00   sec  27.5 MBytes   231 Mbits/sec    1   3.26 MBytes
[  4]   9.00-10.00  sec  23.8 MBytes   199 Mbits/sec  260   3.14 MBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bandwidth       Retr
[  4]   0.00-10.00  sec   269 MBytes   225 Mbits/sec  1817             sender
[  4]   0.00-10.00  sec   268 MBytes   225 Mbits/sec                  receiver

iperf Done.
iperf3: error - unable to receive control message: Connection reset by peer
Connecting to host iperf.hk.milou.site, port 5201
[  4] local 178.128.52.192 port 43170 connected to 103.53.199.62 port 5201
[ ID] Interval           Transfer     Bandwidth       Retr  Cwnd
[  4]   0.00-1.00   sec  16.8 MBytes   141 Mbits/sec  100   4.97 MBytes
[  4]   1.00-2.00   sec  26.2 MBytes   220 Mbits/sec  1392   2.55 MBytes
[  4]   2.00-3.00   sec  27.5 MBytes   231 Mbits/sec   63   2.92 MBytes
[  4]   3.00-4.00   sec  13.8 MBytes   115 Mbits/sec  808   2.14 MBytes
[  4]   4.00-5.00   sec  16.2 MBytes   136 Mbits/sec  180   1.24 MBytes
[  4]   5.00-6.00   sec  20.0 MBytes   168 Mbits/sec    3   3.33 MBytes
[  4]   6.00-7.00   sec  27.5 MBytes   231 Mbits/sec  297   3.21 MBytes
[  4]   7.00-8.00   sec  27.5 MBytes   231 Mbits/sec   21   1.98 MBytes
[  4]   8.00-9.00   sec  27.5 MBytes   231 Mbits/sec   12   2.98 MBytes
[  4]   9.00-10.00  sec  27.5 MBytes   231 Mbits/sec    0   2.85 MBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bandwidth       Retr
[  4]   0.00-10.00  sec   231 MBytes   193 Mbits/sec  2876             sender
[  4]   0.00-10.00  sec   230 MBytes   193 Mbits/sec                  receiver

iperf Done.
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iperf test to iperf.hk.milou.site
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iperf3 test to iperf.us.milou.icu
Connecting to host iperf.us.milou.icu, port 5201
[  4] local 178.128.52.192 port 42146 connected to 173.82.154.77 port 5201
[ ID] Interval           Transfer     Bandwidth       Retr  Cwnd
[  4]   0.00-1.00   sec  1.67 MBytes  14.0 Mbits/sec    0    188 KBytes
[  4]   1.00-2.00   sec  8.24 MBytes  69.1 Mbits/sec    0   7.37 MBytes
[  4]   2.00-3.00   sec  17.5 MBytes   147 Mbits/sec    0   8.80 MBytes
[  4]   3.00-4.00   sec  12.5 MBytes   105 Mbits/sec   54   8.80 MBytes
[  4]   4.00-5.00   sec  13.8 MBytes   115 Mbits/sec  202   2.60 MBytes
[  4]   5.00-6.00   sec  15.0 MBytes   126 Mbits/sec    0   7.72 MBytes
[  4]   6.00-7.00   sec  13.8 MBytes   115 Mbits/sec    0   7.73 MBytes
[  4]   7.00-8.00   sec  12.5 MBytes   105 Mbits/sec   10   2.48 MBytes
[  4]   8.00-9.00   sec  10.0 MBytes  83.9 Mbits/sec    0   4.35 MBytes
[  4]   9.00-10.00  sec  12.5 MBytes   105 Mbits/sec    0   6.29 MBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bandwidth       Retr
[  4]   0.00-10.00  sec   117 MBytes  98.5 Mbits/sec  266             sender
[  4]   0.00-10.00  sec   117 MBytes  97.9 Mbits/sec                  receiver

iperf Done.
```

```
[root@centos-s-1vcpu-2gb-sgp1-01 ~]# iperf3 -c iperf.us.milou.icu
Connecting to host iperf.us.milou.icu, port 5201
[  4] local 178.128.52.192 port 42486 connected to 173.82.154.77 port 5201
[ ID] Interval           Transfer     Bandwidth       Retr  Cwnd
[  4]   0.00-1.00   sec  1.67 MBytes  14.0 Mbits/sec    0    219 KBytes
[  4]   1.00-2.00   sec  10.7 MBytes  90.0 Mbits/sec    0   8.68 MBytes
[  4]   2.00-3.00   sec  13.8 MBytes   115 Mbits/sec  196   8.79 MBytes
[  4]   3.00-4.00   sec  17.5 MBytes   147 Mbits/sec    0   8.79 MBytes
[  4]   4.00-5.00   sec  17.5 MBytes   147 Mbits/sec    0   8.79 MBytes
[  4]   5.00-6.00   sec  12.5 MBytes   105 Mbits/sec   10   7.84 MBytes
[  4]   6.00-7.00   sec  15.0 MBytes   126 Mbits/sec    0   7.83 MBytes
[  4]   7.00-8.00   sec  16.2 MBytes   136 Mbits/sec    0   7.83 MBytes
[  4]   8.00-9.00   sec  13.8 MBytes   115 Mbits/sec    0   6.47 MBytes
[  4]   9.00-10.00  sec  12.5 MBytes   105 Mbits/sec    2   3.29 MBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bandwidth       Retr
[  4]   0.00-10.00  sec   131 MBytes   110 Mbits/sec  208             sender
[  4]   0.00-10.00  sec   130 MBytes   109 Mbits/sec                  receiver

iperf Done.
[root@centos-s-1vcpu-2gb-sgp1-01 ~]# iperf3 -c iperf.us.milou.icu
Connecting to host iperf.us.milou.icu, port 5201
[  4] local 178.128.52.192 port 42498 connected to 173.82.154.77 port 5201
[ ID] Interval           Transfer     Bandwidth       Retr  Cwnd
[  4]   0.00-1.00   sec  1.11 MBytes  9.32 Mbits/sec    0    163 KBytes
[  4]   1.00-2.00   sec  7.55 MBytes  63.3 Mbits/sec    0   5.81 MBytes
[  4]   2.00-3.00   sec  15.0 MBytes   126 Mbits/sec    0   8.79 MBytes
[  4]   3.00-4.00   sec  12.5 MBytes   105 Mbits/sec    3   8.79 MBytes
[  4]   4.00-5.00   sec  15.0 MBytes   126 Mbits/sec    0   8.79 MBytes
[  4]   5.00-6.00   sec  13.8 MBytes   115 Mbits/sec   18   8.79 MBytes
[  4]   6.00-7.00   sec  12.5 MBytes   105 Mbits/sec    0   7.66 MBytes
[  4]   7.00-8.00   sec  12.5 MBytes   105 Mbits/sec    0   7.66 MBytes
[  4]   8.00-9.00   sec  12.5 MBytes   105 Mbits/sec    0   7.64 MBytes
[  4]   9.00-10.00  sec  12.5 MBytes   105 Mbits/sec    0   6.46 MBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bandwidth       Retr
[  4]   0.00-10.00  sec   115 MBytes  96.4 Mbits/sec   21             sender
[  4]   0.00-10.00  sec   115 MBytes  96.2 Mbits/sec                  receiver

iperf Done.
[root@centos-s-1vcpu-2gb-sgp1-01 ~]# iperf3 -c iperf.us.milou.icu
Connecting to host iperf.us.milou.icu, port 5201
[  4] local 178.128.52.192 port 42522 connected to 173.82.154.77 port 5201
[ ID] Interval           Transfer     Bandwidth       Retr  Cwnd
[  4]   0.00-1.00   sec  1.67 MBytes  14.0 Mbits/sec    0    180 KBytes
[  4]   1.00-2.00   sec  8.24 MBytes  69.1 Mbits/sec    0   7.05 MBytes
[  4]   2.00-3.00   sec  16.2 MBytes   136 Mbits/sec    0   8.84 MBytes
[  4]   3.00-4.00   sec  13.8 MBytes   115 Mbits/sec    7   8.84 MBytes
[  4]   4.00-5.00   sec  16.2 MBytes   136 Mbits/sec    0   8.84 MBytes
[  4]   5.00-6.00   sec  16.2 MBytes   136 Mbits/sec    0   8.84 MBytes
[  4]   6.00-7.00   sec  15.0 MBytes   126 Mbits/sec    0   8.84 MBytes
[  4]   7.00-8.00   sec  13.8 MBytes   115 Mbits/sec   23   7.73 MBytes
[  4]   8.00-9.00   sec  13.8 MBytes   115 Mbits/sec    0   7.73 MBytes
[  4]   9.00-10.00  sec  13.8 MBytes   115 Mbits/sec    6   2.41 MBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bandwidth       Retr
[  4]   0.00-10.00  sec   129 MBytes   108 Mbits/sec   36             sender
[  4]   0.00-10.00  sec   129 MBytes   108 Mbits/sec                  receiver

iperf Done.
```

Figure S4-2. Results for *iperf* and *iperf3* after running the script

Host	Bandwidth1(Mb/s)	Bandwidth2(Mb/s)	Bandwidth3(Mb/s)	Avg Bandwidth(Mb/s)
bouygues.testdebit.info	5.23	5.08	5.04	5.117
ikoula.testdebit.info	8.1	8.32	8.2	8.207
st2.nn.ertelecom.ru	57.9	62.3	61.2	60.467
iperf.biznetnetworks.com	1.4	1.58	1.48	1.487
speedtest.serverius.net	0.101	0.101	0.101	0.101
iperf.volia.net	0.103	0.102	0.102	0.102
iperf.jp.milou.icu	94.2	84.8	91.1	90.033
iperf.sg.milou.icu	1980	1980	2000	1986.667
iperf.hk.milou.site	225	193	98.5	172.167
iperf.us.milou.icu	110	96.4	108	104.800

Host	Avg RTD(ms)	Avg Bandwidth(Mb/s)	bandwidth-delay product(kbits)	log(bandwidth-delay product)/log kbit
bouygues.testdebit.info	237.1106667	5.117	1213.216	3.084
ikoula.testdebit.info	149.8623333	8.207	1229.870	3.090
st2.nn.ertelecom.ru	278.0416667	60.467	16812.253	4.226
iperf.biznetnetworks.com	13.869	1.487	20.619	1.314
speedtest.serverius.net	156.94	0.101	15.851	1.200
iperf.volia.net	278.927	0.102	28.544	1.456
iperf.jp.milou.icu	72.773	90.033	6551.996	3.816
iperf.sg.milou.icu	0.675666667	1986.667	1342.324	3.128
iperf.hk.milou.site	34.45266667	172.167	5931.601	3.773
iperf.us.milou.icu	170.285	104.800	17845.868	4.252

Figure S4-3. Calculations for average bandwidth, bandwidth-delay product, log(bandwidth-delay product)

Here, the formula used in Excel is:
Avg bandwidth = 1/3(Bandwidth1 + Bandwidth2 + Bandwidth3)
Bandwith-delay product = Avg bandwidth * Avg RTD
log(Bandwith-delay product) = $\log_{10}$(Bandwith-delay product)