


```
>>nmcli device show | grep GATEWAY
```

```
>>IP4.GATEWAY 172.30.72.1
```

```
>>ping 172.30.72.1
```

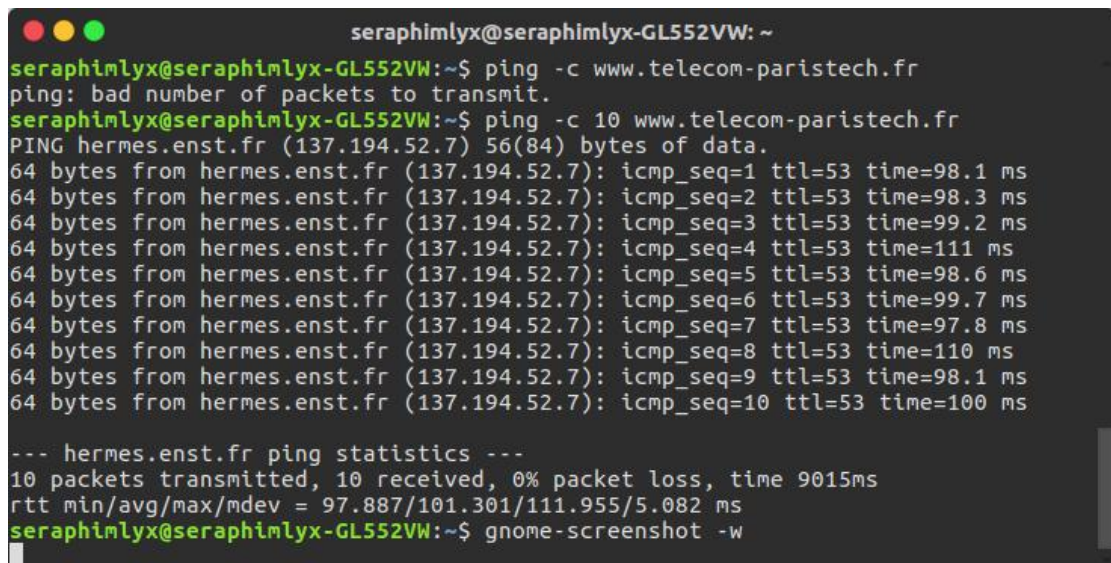
```
>>nmcli device show | grep DNS
```

```
>>IP4.DNS[1]: 129.100.74.79
```

```
>>ping 129.100.74.79
```

b) Ping `www.telecom-paristech.fr` . What is the IP address of the computer you pinged (2 Points)? What are the minimum (2 Points), average (2 Points) and maximum (2 Points) round trip times?

Answer:

A terminal window with a dark background and light text. The prompt is 'seraphimlyx@seraphimlyx-GL552VW: ~'. The user enters 'ping -c www.telecom-paristech.fr' and gets 'ping: bad number of packets to transmit.'. Then they enter 'ping -c 10 www.telecom-paristech.fr' and get a detailed output. The output shows 10 successful ping requests to 'hermes.enst.fr' (IP 137.194.52.7) with varying round trip times. At the bottom, it shows statistics: 10 packets transmitted, 10 received, 0% packet loss, time 9015ms. The minimum RTT is 97.887ms, average is 101.301ms, and maximum is 111.955ms. The user then enters 'gnome-screenshot -w'.

IP Address-137.194.52.7

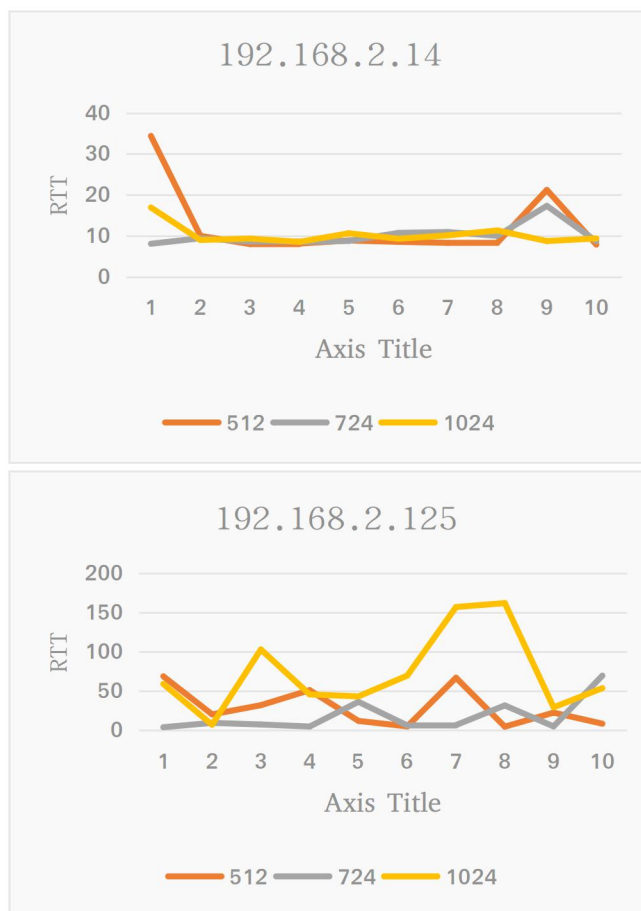
Min-97.887ms

Avg-101.301ms

Max-111.955ms

c) Use ping to measure Round Trip Time (RTT) for 10 messages of size 512, 724, 1024, and 4072 bytes. Use the "-f" configuration switch to make sure that the message is not fragmented. Graph the message size versus RTT for:

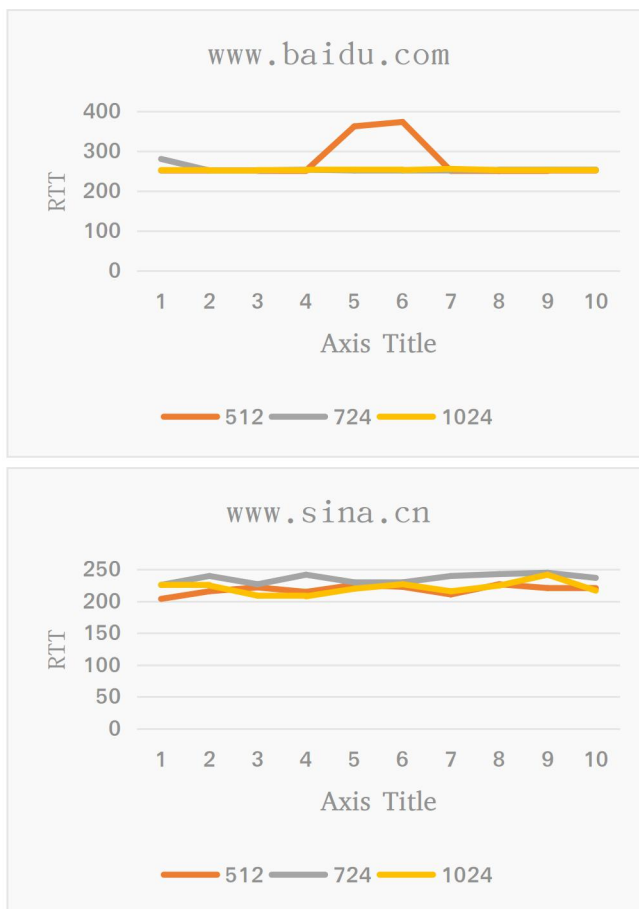
i) Two hosts on a LAN (two workstations in the lab or in your house)



Answer:

	192.168.2.125		192.168.2.14	
	Average	Standard Deviation	Average	Standard Deviation
512	29.31	23.49	12.340	8.297
724	18.25	20.44	10.101	2.602
1024	73.24	49.51	10.314	2.357
4012	N/A	N/A	N/A	N/A

ii) Two nodes on a WAN (for instance, your workstation and a host in China)



	www.baidu.com		www.sina.cn	
	Average	Standard Deviation	Average	Standard Deviation
512	275.50	46.62	219.02	6.81
724	256.05	8.418	236.23	6.68
1024	253.79	1.275	221.99	9.482
4012	N/A	N/A	N/A	N/A

Analyze your results. Calculate the average and standard deviation for every destination.(4 Points) Discuss the effects of distance, message size, and their relationship with bandwidth and latency. (3 Points)

Answer:

Because of MTU = 1500, sending unfragmented data with 4072 bytes is restricted.

The distance will significantly affect the latency of the data transmission, which is called propagation delay. The equation of the propagation delay is $d_{prop} = d(\text{distance})/s(\text{speed})$. According to the data above, the delay to the Chinese hosts are much larger than that of the LAN hosts because of the distance.

The transmission delay can be described by $d_{trans} = L(\text{packet length})/R(\text{rate})$. We could see that the larger the packets or the smaller the bandwidth is, the bigger the transmission delay will be.

d) Use the `tracert` utility on your workstation to find the route to a host:

i) In Toronto: How many hops did it take to reach the destination host?

(3 Points) How many ISPs did you traverse? (3 Points)

Answer:

Typing traceroute <https://www.utoronto.ca/> in the Terminal

The result is the picture below

```
seraphimlyx@seraphimlyx-GL552VW: ~
seraphimlyx@seraphimlyx-GL552VW:~$ gnome-screenshot -w
seraphimlyx@seraphimlyx-GL552VW:~$ traceroute www.utoronto.ca
traceroute to www.utoronto.ca (52.85.184.117), 30 hops max, 60 byte packets
 1 mynetwork (192.168.2.1)  2.334 ms  6.667 ms  8.130 ms
 2 10.11.3.17 (10.11.3.17)  86.586 ms  88.153 ms  88.182 ms
 3 10.178.206.30 (10.178.206.30)  17.900 ms  20.049 ms  21.049 ms
 4 10.178.206.31 (10.178.206.31)  23.794 ms  23.809 ms  23.800 ms
 5 64.230.112.106 (64.230.112.106)  44.264 ms  44.280 ms  64.230.112.104 (64.230
.112.104)  50.141 ms
 6 tcore3-toronto47_hundredgige2-8-0-1.net.bell.ca (64.230.50.240)  44.255 ms
34.158 ms hundredgige2-8-0-1.net.bell.ca (64.230.50.242)  43.912 ms
 7 tcore4-chicagocp_hundredgige0-4-0-0.net.bell.ca (64.230.79.157)  33.992 ms
33.855 ms 41.594 ms
 8 bx6-chicagodt_0-6-0-0.net.bell.ca (64.230.79.85)  36.049 ms bx6-chicagodt_0-
7-0-0.net.bell.ca (64.230.79.87)  37.728 ms 43.138 ms
 9 verio-peering.net.bell.ca (64.230.186.218)  95.680 ms 80.514 ms 80.486 ms
10 ae-2.r05.chcgil09.us.bb.gin.ntt.net (129.250.5.95)  166.658 ms ae-9.r06.chcg
il09.us.bb.gin.ntt.net (129.250.4.217)  167.196 ms 167.084 ms
11 ae-5.r20.chcgil09.us.bb.gin.ntt.net (129.250.3.5)  85.913 ms ae-0.r20.chcgil
09.us.bb.gin.ntt.net (129.250.2.191)  85.904 ms 80.541 ms
12 ae-0.r25.nycmny01.us.bb.gin.ntt.net (129.250.2.167)  87.130 ms 91.319 ms 9
3.635 ms
13 ae-9.r24.frnkge08.de.bb.gin.ntt.net (129.250.2.5)  167.460 ms 168.936 ms 1
65.742 ms
14 ae-1.r02.frnkge03.de.bb.gin.ntt.net (129.250.4.163)  166.933 ms 166.071 ms
ae-13.r03.frnkge03.de.bb.gin.ntt.net (129.250.6.207)  165.701 ms
15 212.119.27.170 (212.119.27.170)  161.226 ms 212.119.27.174 (212.119.27.174)
164.168 ms 165.898 ms
16 54.239.107.162 (54.239.107.162)  186.927 ms 54.239.107.30 (54.239.107.30)  1
81.124 ms 181.135 ms
17 54.239.107.149 (54.239.107.149)  180.637 ms 54.239.107.17 (54.239.107.17)  1
80.405 ms 54.239.107.127 (54.239.107.127)  178.387 ms
18 54.239.4.219 (54.239.4.219)  181.975 ms 182.223 ms 177.853 ms
19 54.239.4.79 (54.239.4.79)  163.220 ms 162.038 ms 162.350 ms
20 * * *
21 * * *
22 * * *
23 * server-52-85-184-117.fra2.r.cloudfront.net (52.85.184.117)  173.400 ms 17
4.163 ms
seraphimlyx@seraphimlyx-GL552VW:~$ gnome-screenshot -w
```

We could see in the way to the <https://www.utoronto.ca/>, there are **23** hops for our request to go through as well as **4** ISPs are shown in the picture.

ii) In China: How many hops did it take to reach the destination host? (3 Points) How many ISPs did you traverse? (3 Points)

```
seraphimlyx@seraphimlyx-GL552VW: ~
seraphimlyx@seraphimlyx-GL552VW:~$ traceroute www.baidu.com
traceroute to www.baidu.com (103.235.46.39), 30 hops max, 60 byte packets
 1 mynetwork (192.168.2.1)  2.117 ms  3.292 ms  3.283 ms
 2 10.11.3.17 (10.11.3.17)  31.185 ms  31.168 ms  31.149 ms
 3 10.178.206.30 (10.178.206.30)  9.515 ms  9.503 ms  9.484 ms
 4 10.178.206.31 (10.178.206.31)  9.482 ms  9.475 ms  10.518 ms
 5 64.230.112.106 (64.230.112.106)  17.605 ms  64.230.112.104 (64.230.112.104)
16.368 ms  16.363 ms
 6 tcore3-toronto12_hundredgige2-8-0-1.net.bell.ca (64.230.50.238)  21.151 ms
16.330 ms hundredgige2-8-0-1.net.bell.ca (64.230.50.242)  14.013 ms
 7 tcore4-torontoxn_hundredgige0-5-0-0.net.bell.ca (64.230.50.13)  20.032 ms  2
0.035 ms tcore3-torontoxn_hundredgige0-5-0-0.net.bell.ca (64.230.50.5)  10.229 m
s
 8 bx1-torontoxn_et4-0-0.net.bell.ca (64.230.97.159)  10.203 ms  10.194 ms  10.
183 ms
 9 ix-xe-5-0-1-0.tcore2.TNK-Toronto.as6453.net (63.243.172.25)  11.681 ms  9.05
2 ms  9.056 ms
10 if-ae-8-2.tcore1.CT8-Chicago.as6453.net (66.110.48.2)  251.816 ms  249.958 m
s  249.970 ms
11 if-ae-29-2.tcore2.SQN-San-Jose.as6453.net (64.86.21.104)  253.297 ms  253.29
8 ms  253.300 ms
12 * * *
13 if-ae-18-2.tcore2.SV1-Santa-Clara.as6453.net (63.243.205.131)  248.974 ms  2
52.188 ms *
14 if-et-5-2.hcore1.KV8-Chiba.as6453.net (209.58.86.143)  178.914 ms  177.825 m
s  176.443 ms
15 if-ae-21-2.tcore1.TV2-Tokyo.as6453.net (120.29.217.66)  249.404 ms  248.572
ms  250.912 ms
16 if-ae-31-2.tcore2.SVW-Singapore.as6453.net (180.87.15.40)  249.830 ms  247.7
20 ms  248.153 ms
17 * if-ae-20-2.tcore1.SVQ-Singapore.as6453.net (180.87.96.21)  247.717 ms  251
.128 ms
18 120.29.215.238 (120.29.215.238)  251.103 ms  251.051 ms  253.182 ms
19 45.113.192.16 (45.113.192.16)  253.259 ms  257.509 ms  255.217 ms
20 103.235.45.28 (103.235.45.28)  260.563 ms  260.413 ms  264.588 ms
21 * * *
22 * * *
23 * * *
24 * * ^C
seraphimlyx@seraphimlyx-GL552VW:~$ gnome-screenshot -w
```

Answer: As we see, by using the command traceroute www.baidu.com to trace the request to the Chinese server, the terminal shows that **20** hops with **3** ISPs are needed to go by before the packets get to the destination.

The output of the command “traceroute” contains 6 columns.

The first one means the number of the hops.

The second and third one mean the ISP and its IP address respectively. If it is a LAN, the second column will show a IP address the same as the third column.

The forth to sixth column means the delay from one router to another.

When the ‘*’ comes out, it means that the router does not response to the probes. This is led by the lost of the probes or the not replying of the router.

e) Use the trace route utilities at the site

www.traceroute.org to find the routes between a host in Europe and a host in South America.

i) In 50 words, explain how tracert discovers a path to a remote host. (2 Points)

The traceroute uses TTL values. Starting from 1 for the first packet, the TTL values increase from packet to packet. When the packets reach the router, the TTL values decrease by 1 and send an ICMP error message to source when there is TTL value reach 0. Hence, the traceroute uses the error message to build a path until the destination is reached.

ii) Trace the route again between these two hosts after at least an hour.

Provide reasons why the two routes could differ. (3 Points)

Answer: The result of the trace is as picture below. These are the routes traced from Brazil to German. The hops 5 and 6 is in America between Brazil and German.

tracert from 200.145.255.41 (ping.unesp.br) to 5.35.241.151 (www.han.de) for 174.93.26.33 - Google Chrome

tracert from 200.145.255.41 (ping.unesp.br) to 5.35.241.151 (www.han.de) for 174.93.26.33

CGI script maintainer: [Les Cottrell](#), SLAC. Script version 6.52, 6/24/2015, Les Cottrell.

To perform a traceroute/ping/tracert function from ping.unesp.br to the target, enter the desired target [host domain](#) (e.g. www.yahoo.com) or [Internet address](#) (e.g. 137.138.28.228) in the box below. Note the function is performed for the target's resolved Internet address.


Enter target name or address: then push 'Enter' key.

Lookup: [domain name](#) | [Locating a Host](#) | [visual traceroute](#) | [Find AS's between hosts](#) | [Find AS of a host](#) | [contacting someone](#)

Please note that traceroutes can appear similar to port scans. If you see a suspected port scan alert, for example from your firewall, with a series of ports in the range 33434 - 33465, coming from ping.unesp.br it is probably a reverse traceroute from our web based reverse traceroute server. Please do NOT report this to us, it will almost certainly be a waste of both of our times. For more on this see [Traceroute security issues](#).

Looks like a web URL, I will try and extract the target.

```
Executing exec(tracert -m 30 -q 3 5.35.241.151 140)
tracert to 5.35.241.151 (5.35.241.151), 30 hops max, 140 byte packets
 1 gw-pinger.unesp.br (200.145.255.42) 0.556 ms 0.653 ms 0.756 ms
 2 dc-bf.net.unesp.br (200.145.255.45) 0.600 ms 0.718 ms 0.826 ms
 3 asr-rt.net.unesp.br (200.145.0.254) 1.367 ms 1.419 ms 1.506 ms
 4 200.136.41.45.ansp.br (200.136.41.45) 7.704 ms 7.807 ms 7.914 ms
 5 198.32.252.141 (198.32.252.141) 130.483 ms 130.589 ms 130.616 ms
 6 xe0-0-2-541.miamil5.mia.seabone.net (195.22.199.209) 130.622 ms 130.723 ms 130.767 ms
 7 mai-b1-link.telcel.net (80.239.193.161) 130.976 ms 132.404 ms 131.370 ms
 8 ash-bb3-link.telcel.net (62.115.119.230) 155.701 ms ash-bb3-link.telcel.net (62.115.141.115) 155.546 ms ash-bb3-link.telcel.net (62.115.137.172) 155.800 ms
 9 ffm-b1-link.telcel.net (80.91.246.59) 249.374 ms 249.395 ms ffm-bb3-link.telcel.net (62.115.141.109) 247.266 ms
10 ffm-b1-link.telcel.net (62.115.121.3) 254.588 ms ffm-b1-link.telcel.net (62.115.141.237) 250.162 ms ffm-b1-link.telcel.net (62.115.121.11) 255.194 ms
11 ae2-cr-nunki.sxb1.core.heg.com (62.115.144.9) 249.160 ms 254.895 ms 249.315 ms
12 ae0-v100.sr-sol.sxb1.mass.systems (87.230.114.18) 249.343 ms 254.568 ms 249.050 ms
13 * * *
14 haldir.han.de (5.35.241.151) 249.544 ms 249.653 ms 249.991 ms
tracert -m 30 -q 3 5.35.241.151 140 took 7secs. Total time=8secs. user=www.data
```

traceroute from 200.145.255.41 (ping.unesp.br) to 5.35.241.151 (www.han.de) for 174.93.26.33

CGI script maintainer: [Les Cottrell/ SLAC](#). Script version 6.52, 6/24/2015, Les Cottrell.
[Download perl source code.](#)

To perform a traceroute/ping/tracepath function from ping.unesp.br to the target, enter the desired target [host domain](#) (e.g. www.yahoo.com) or [Internet address](#) (e.g. 137.138.28.228) in the box below. Note the function is performed for the target's resolved Internet address.

Enter target name or address: then push 'Enter' key.

Lookup: [domain name](#) | [Locating a Host](#) | [visual traceroute](#) | [Find AS's between hosts](#) | [Find AS of a host](#) | [contacting someone](#)

Please note that traceroutes can appear similar to port scans. If you see a suspected port scan alert, for example from your firewall, with a series of ports in the range 33 coming from ping.unesp.br it is probably a reverse traceroute from our web based reverse traceroute server. Please do NOT report this to us, it will almost certainly be a waste of our times. For more on this see [Traceroute security issues](#).

Looks like a web URL, I will try and extract the target.

```

Executing exec(traceroute -m 30 -q 3 5.35.241.151 140)
traceroute to 5.35.241.151 (5.35.241.151), 30 hops max, 140 byte packets
 1 gw=pinger.unesp.br (200.145.255.42) 0.539 ms 0.715 ms 0.804 ms
 2 dc-bf.net.unesp.br (200.145.255.45) 41.111 ms 41.250 ms 41.311 ms
 3 asrrt.net.unesp.br (200.145.0.254) 1.419 ms 1.549 ms 1.623 ms
 4 200-136-41-45.ansp.br (200.136.41.45) 12.419 ms 12.610 ms 12.710 ms
 5 198.32.252.141 (198.32.252.141) 127.050 ms 127.204 ms 127.245 ms
 6 re0-0-2-541.miamil5.mia.seabone.net (195.22.199.209) 127.266 ms 127.061 ms 127.084 ms
 7 mei-b1-link.telcel.net (80.239.193.161) 127.403 ms 127.496 ms 127.608 ms
 8 ash-bb4-link.telcel.net (62.115.141.123) 151.760 ms ash-bb4-link.telcel.net (62.115.136.204) 152.889 ms ash-bb3-link.telcel.net (62.115.141.115) 152.031 ms
 9 ffm-bb3-link.telcel.net (62.115.141.109) 242.912 ms 243.072 ms 243.491 ms
10 ffm-b1-link.telcel.net (62.115.116.162) 246.711 ms ffm-b1-link.telcel.net (62.115.116.160) 245.678 ms ffm-b1-link.telcel.net (62.115.121.11) 252.976 ms
11 ae2-cr-munk1.sxbl.core.heg.com (62.115.144.9) 247.169 ms 247.180 ms 247.624 ms
12 ae0-v100.sr-sol.sxbl.mass.systems (87.230.114.18) 245.069 ms 245.182 ms 247.104 ms
13 * * *
14 haldir.han.de (5.35.241.151) 247.542 ms 246.207 ms 251.755 ms
traceroute -m 30 -q 3 5.35.241.151 140 took 9secs. Total time=9secs. user=www-data

```

The difference of the routes may be caused by the stuck or the no response of the routers on the path. From one router to another, if there is a heavy congestion or no response on the path, then the router will calculate another better way to transmit the data, which is so-called “load-balance”.

f) Briefly discuss why ping would not necessarily provide an accurate estimate of the round trip time for packets exchanged by two hosts on the Internet?

Answer: Ping relies on the ICMP protocol to test the reachability.

However, because of the “load-balance” of the router, the destination you ping will not necessarily go on the same path, which affect the accuracy of the RTT. Besides, QoS(Quality of Service) will also affect the consistency of the the ICMP replies.

g) List at least three other such utilities and briefly describe their use. (9 Points; 3 Points for each utility)

In Linux:

1.ifconfig: 'Ifconfig' is used to set the network interface and get their information.

2.nslookup: 'nslookup' command is used to check the IP address and its domain name it associates.

3.nmap: 'nmap' can allow user to scan the IP address of all the hosts connected in a specific range of IP area.