COMP3331 Lab 1

Exercise 1: nslookup

Use the nslookup command from the "Tools of the Trade" and answer the following questions:

1. Which is the IP address of the website www.koala.com.au? In your opinion, what is the reason of having several IP addresses as an output?
2. Find out the name of the IP address 127.0.0.1. What is special about this IP address?

Answer:

1.

```
z5223796@vx5:/tmp_amd/kamen/export/kamen/4/z5223796/Desktop/comp3331$ nslookup www.koala.
com.au
Server:         129.94.242.45
Address:        129.94.242.45#53

Non-authoritative answer:
Name:   www.koala.com.au
Address: 172.67.219.46
Name:   www.koala.com.au
Address: 104.18.60.21
Name:   www.koala.com.au
Address: 104.18.61.21
```

As the image, the IP address of the www.koala.com.au is 172.67.219.46, 104.18.60.21, 104,18,61,21.

Some website will have several IP addresses due to high availability.Several IP addresses can be load balancing and performace better based on the users location,ISP,etc.

2.

```
z5223796@vx5:/tmp_amd/kamen/export/kamen/4/z5223796/Desktop/comp3331$ nslookup 127.0.0.1
Server:         129.94.242.45
Address:        129.94.242.45#53

1.0.0.127.in-addr.arpa  name = localhost.
```

Localhost. This IP address is a loopback address. Everything that send to 127.0.0.1 will send the machine itself without any external network transmissions. Can access the local website host on the local machine without the physical network interface. Ping 127.0.0.1 to test the TCP/IP work.

Exercise 2: Use ping to test host reachability

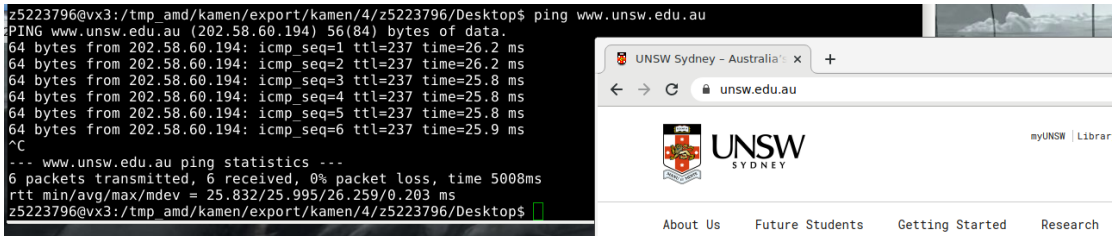
Are the following hosts reachable from your machine by using ping:

- www.unsw.edu.au
- www.getfittest.com.au
- www.mit.edu
- www.intel.com.au
- www.tpg.com.au
- www.hola.hp
- www.amazon.com
- www.tsinghua.edu.cn
- www.kremlin.ru
- 8.8.8.8

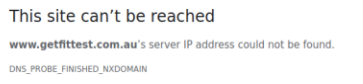
If you observe that some hosts are not reachable, then can you explain why? Check if the addresses unreachable by the ping command are reachable from the Web browser.

Answer:

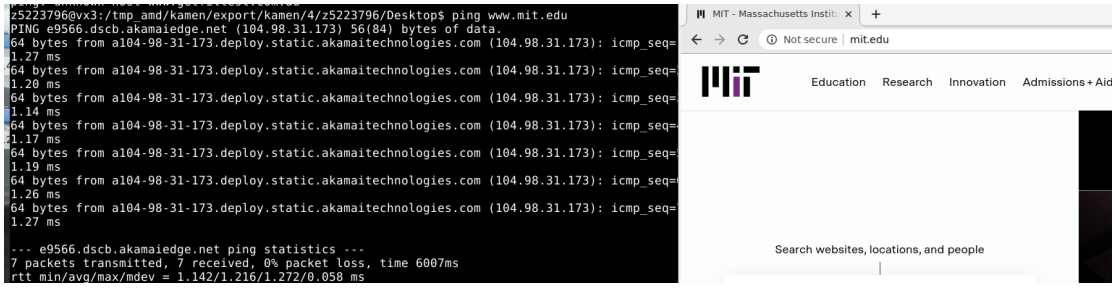
www.unsw.edu.au Can be reachable on ping and website.



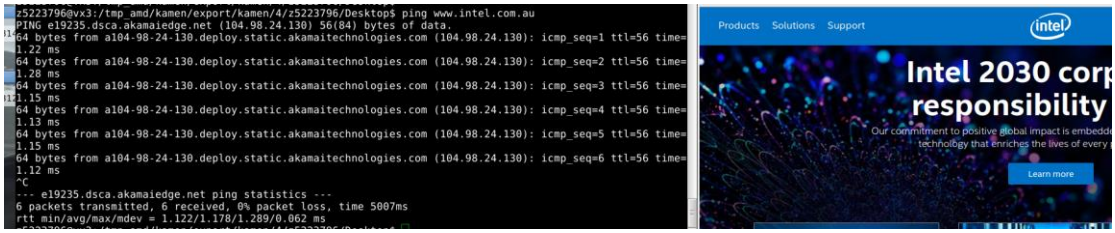
www.getfittest.com.au Not reachable on ping and website. Unknown host. Does not exist.



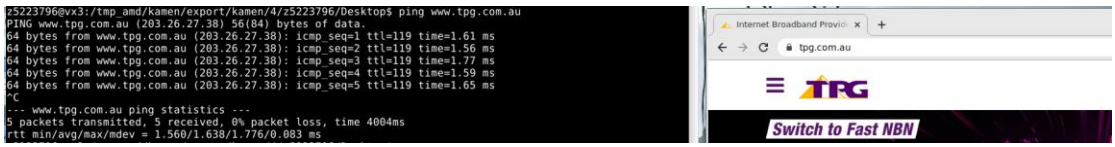
www.mit.edu Can be reachable on ping and website.



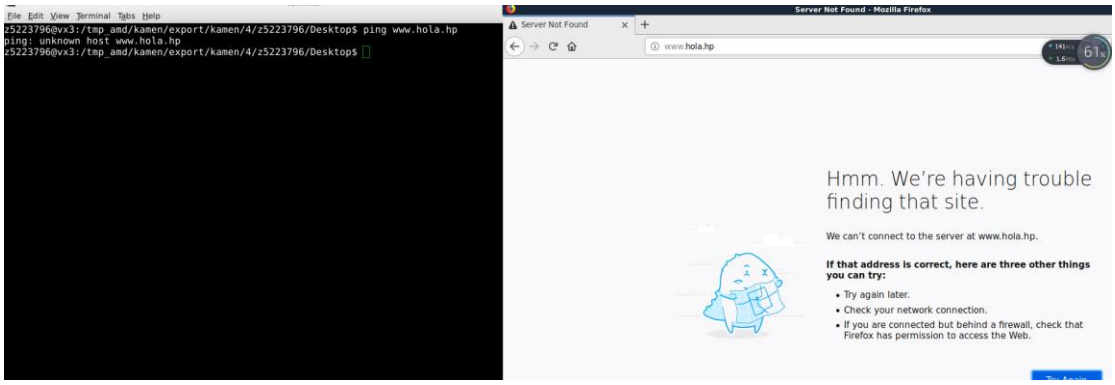
www.intel.com.au Can be reachable on ping and website.



www.tpg.com.au Can be reachable on ping and website.

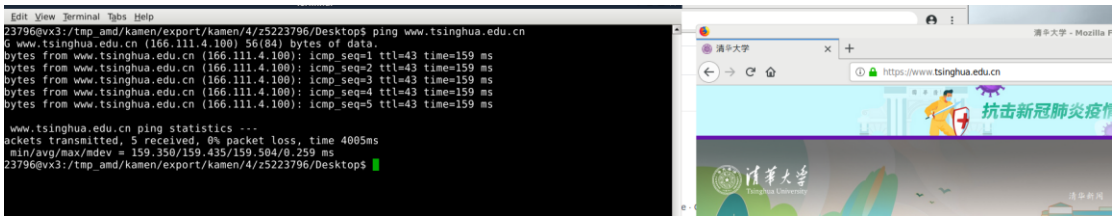


www.hola.hp Not reachable on ping and website. Unknown host. Does not exist.

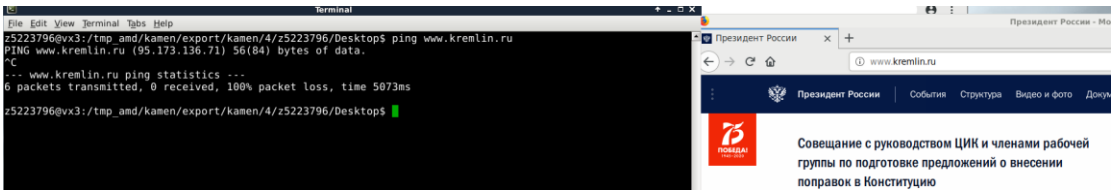


www.amazon.com Can be reachable on ping and website.

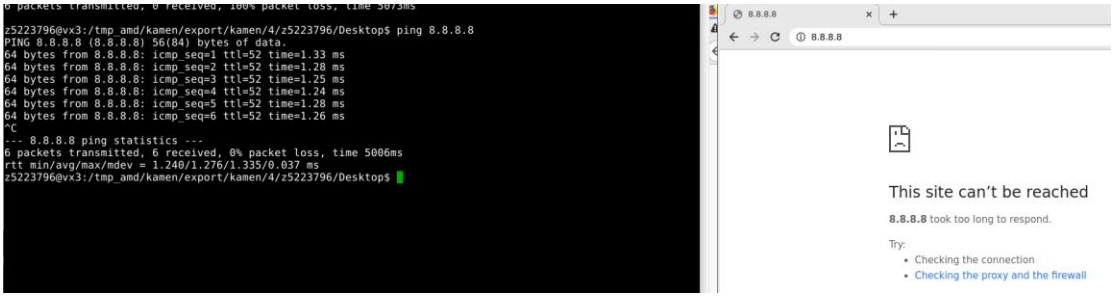
www.tsinghua.edu.cn Can be reachable on ping and website.



www.kremlin.ru Not reachable on ping, But reachable on web browser. Some website blocks the ping for security.



8.8.8.8 Can be reachable on ping but not on browser. It is google DNS server.

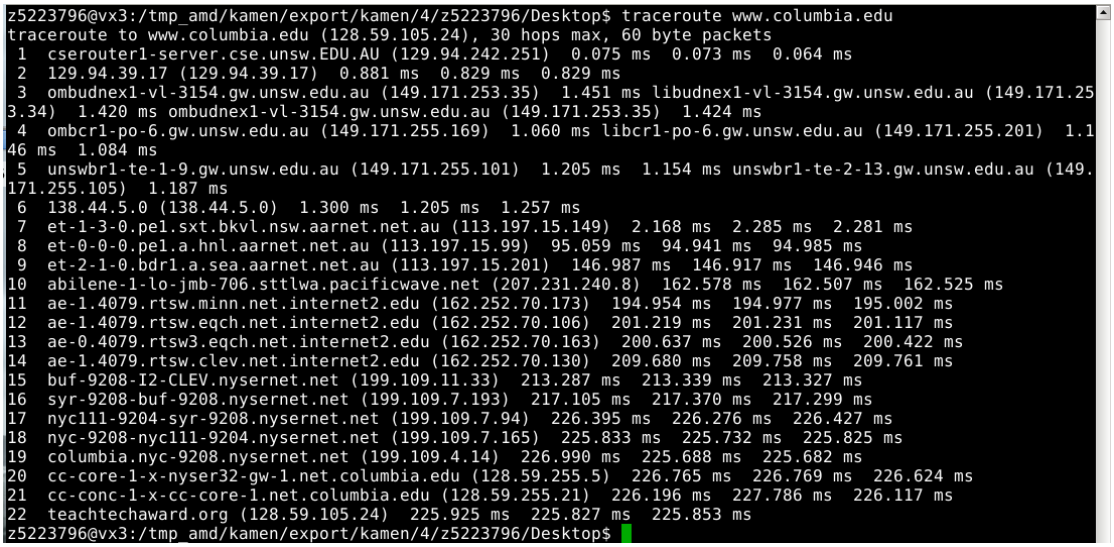


Exercise 3: Use traceroute to understand network topology

Note: Include all traceroute outputs in your report.

1. Run traceroute on your machine to www.columbia.edu . How many routers are there between your workstation and www.columbia.edu ? How many routers along the path are part of the UNSW network? Between which two routers do packets cross the Pacific Ocean? Hint: compare the round trip times from your machine to the routers using ping.

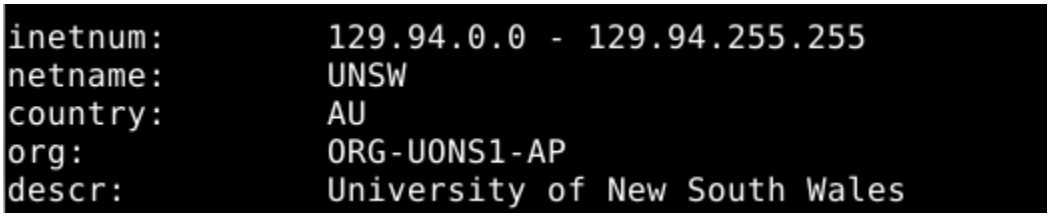
Answer:



```
z5223796@vx3:/tmp_amd/kamen/export/kamen/4/z5223796/Desktop$ traceroute www.columbia.edu
traceroute to www.columbia.edu (128.59.105.24), 30 hops max, 60 byte packets
 1  cserouter1-server.cse.unsw.EDU.AU (129.94.242.251)  0.075 ms  0.073 ms  0.064 ms
 2  129.94.39.17 (129.94.39.17)  0.881 ms  0.829 ms  0.829 ms
 3  ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35)  1.451 ms libudnex1-vl-3154.gw.unsw.edu.au (149.171.25
3.34)  1.420 ms ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35)  1.424 ms
 4  ombcr1-po-6.gw.unsw.edu.au (149.171.255.169)  1.060 ms libcr1-po-6.gw.unsw.edu.au (149.171.255.201)  1.1
46 ms  1.084 ms
 5  unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101)  1.205 ms  1.154 ms unswbr1-te-2-13.gw.unsw.edu.au (149.
171.255.105)  1.187 ms
 6  138.44.5.0 (138.44.5.0)  1.300 ms  1.205 ms  1.257 ms
 7  et-1-3-0.pe1.sxt.bkvl.nsw.aarnet.net.au (113.197.15.149)  2.168 ms  2.285 ms  2.281 ms
 8  et-0-0-0.pe1.a.hnl.aarnet.net.au (113.197.15.99)  95.059 ms  94.941 ms  94.985 ms
 9  et-2-1-0.bdr1.a.sea.aarnet.net.au (113.197.15.201)  146.987 ms  146.917 ms  146.946 ms
10  abilene-1-lo-jmb-706.sttlwa.pacificwave.net (207.231.240.8)  162.578 ms  162.507 ms  162.525 ms
11  ae-1.4079.rtsw.minn.net.internet2.edu (162.252.70.173)  194.954 ms  194.977 ms  195.002 ms
12  ae-1.4079.rtsw.eqch.net.internet2.edu (162.252.70.106)  201.219 ms  201.231 ms  201.117 ms
13  ae-0.4079.rtsw3.eqch.net.internet2.edu (162.252.70.163)  200.637 ms  200.526 ms  200.422 ms
14  ae-1.4079.rtsw.clev.net.internet2.edu (162.252.70.130)  209.680 ms  209.758 ms  209.761 ms
15  buf-9208-I2-CLEV.nysernet.net (199.109.11.33)  213.287 ms  213.339 ms  213.327 ms
16  syr-9208-buf-9208.nysernet.net (199.109.7.193)  217.105 ms  217.370 ms  217.299 ms
17  nyc111-9204-syr-9208.nysernet.net (199.109.7.94)  226.395 ms  226.276 ms  226.427 ms
18  nyc-9208-nyc111-9204.nysernet.net (199.109.7.165)  225.833 ms  225.732 ms  225.825 ms
19  columbia.nyc-9208.nysernet.net (199.109.4.14)  226.990 ms  225.688 ms  225.682 ms
20  cc-core-1-x-nyser32-gw-1.net.columbia.edu (128.59.255.5)  226.765 ms  226.769 ms  226.624 ms
21  cc-conc-1-x-cc-core-1.net.columbia.edu (128.59.255.21)  226.196 ms  227.786 ms  226.117 ms
22  teachtechaward.org (128.59.105.24)  225.925 ms  225.827 ms  225.853 ms
z5223796@vx3:/tmp_amd/kamen/export/kamen/4/z5223796/Desktop$
```

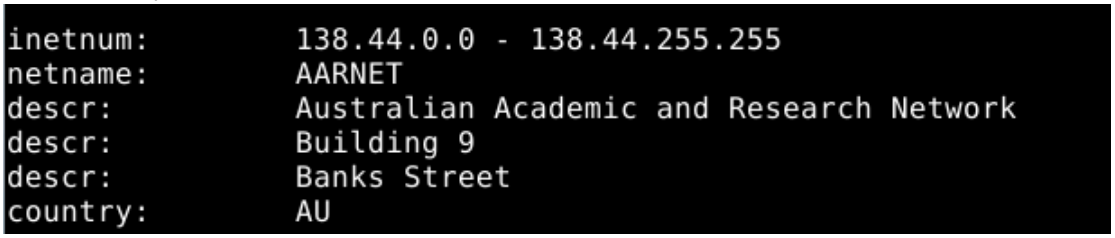
There are 21 routers between the CSE VLAB and www.columbia.edu.

The first five routers are part of the UNSW network. We can find the net name to determine the 1,3,4,5. As for 2, I try whois command found that is part of UNSW.



```
inetnum:        129.94.0.0 - 129.94.255.255
netname:        UNSW
country:        AU
org:            ORG-UONS1-AP
descr:          University of New South Wales
```

And 6th is part of aarnet.



```
inetnum:        138.44.0.0 - 138.44.255.255
netname:        AARNET
descr:          Australian Academic and Research Network
descr:          Building 9
descr:          Banks Street
country:        AU
```

There is a big increase on ping between 7th and 11th hops. I use ping to compare the round trip times.

7th:

```
z5223796@vx4:/tmp_amd/kamen/export/kamen/4/z5223796/Desktop$ ping 113.197.15.149
PING 113.197.15.149 (113.197.15.149) 56(84) bytes of data.
64 bytes from 113.197.15.149: icmp_seq=1 ttl=58 time=2.37 ms
64 bytes from 113.197.15.149: icmp_seq=2 ttl=58 time=2.20 ms
64 bytes from 113.197.15.149: icmp_seq=3 ttl=58 time=2.15 ms
64 bytes from 113.197.15.149: icmp_seq=4 ttl=58 time=2.16 ms
^C
--- 113.197.15.149 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3004ms
```

8th:

```
z5223796@vx4:/tmp_amd/kamen/export/kamen/4/z5223796/Desktop$ ping 113.197.15.99
PING 113.197.15.99 (113.197.15.99) 56(84) bytes of data.
64 bytes from 113.197.15.99: icmp_seq=1 ttl=57 time=95.0 ms
64 bytes from 113.197.15.99: icmp_seq=2 ttl=57 time=94.9 ms
64 bytes from 113.197.15.99: icmp_seq=3 ttl=57 time=94.9 ms
64 bytes from 113.197.15.99: icmp_seq=4 ttl=57 time=94.8 ms
^C
--- 113.197.15.99 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3003ms
rtt min/avg/max/mdev = 94.864/94.936/95.003/0.223 ms
```

9th:

```
z5223796@vx4:/tmp_amd/kamen/export/kamen/4/z5223796/Desktop$ ping 113.197.15.201
PING 113.197.15.201 (113.197.15.201) 56(84) bytes of data.
64 bytes from 113.197.15.201: icmp_seq=1 ttl=56 time=147 ms
64 bytes from 113.197.15.201: icmp_seq=2 ttl=56 time=146 ms
64 bytes from 113.197.15.201: icmp_seq=3 ttl=56 time=146 ms
64 bytes from 113.197.15.201: icmp_seq=4 ttl=56 time=146 ms
^C
--- 113.197.15.201 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3003ms
rtt min/avg/max/mdev = 146.869/146.948/147.027/0.472 ms
```

10th:

```
z5223796@vx4:/tmp_amd/kamen/export/kamen/4/z5223796/Desktop$ ping 207.231.240.8
PING 207.231.240.8 (207.231.240.8) 56(84) bytes of data.
64 bytes from 207.231.240.8: icmp_seq=1 ttl=55 time=147 ms
64 bytes from 207.231.240.8: icmp_seq=2 ttl=55 time=147 ms
64 bytes from 207.231.240.8: icmp_seq=3 ttl=55 time=147 ms
64 bytes from 207.231.240.8: icmp_seq=4 ttl=55 time=147 ms
^C
--- 207.231.240.8 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3003ms
```

So, we can found that 7th- 8th and 8th - 9th is the router cross the pacific ocean. 8th is the middle route for transiting.

2. Run traceroute from your machine to the following destinations:
(i) www.ucla.edu (ii) www.u-tokyo.ac.jp and (iii) www.lancaster.ac.uk . At which router do the paths from your machine to these three destinations diverge? Find out further details about this router. (HINT: You can find out more about a router by running the Whois command: Whois router-IP-address). Is the number of hops on each path proportional the physical distance? HINT: You can find out the geographical location of a server using the following tool - http://www.yougetsignal.com/tools/network-location/

Answer:

```
z5223796@vx4:/tmp_amd/kamen/export/kamen/4/z5223796/Desktop$ traceroute  www.ucla.edu
traceroute to www.ucla.edu (164.67.228.152), 30 hops max, 60 byte packets
 1  cserouter1-server.cse.unsw.EDU.AU (129.94.242.251)  0.101 ms  0.071 ms  0.046 ms
 2  129.94.39.17 (129.94.39.17)  0.900 ms  0.883 ms  0.852 ms
 3  libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34)  1.407 ms  1.917 ms  1.883 ms
 4  ombcr1-po-6.gw.unsw.edu.au (149.171.255.169)  1.194 ms ombcr1-po-5.gw.unsw.edu.au (149.
171.255.197)  1.109 ms  1.106 ms
 5  unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  19.149 ms  19.140 ms unswbr1-te-1-9.g
w.unsw.edu.au (149.171.255.101)  19.159 ms
 6  138.44.5.0 (138.44.5.0)  1.258 ms  1.297 ms  1.244 ms
 7  et-1-3-0.pe1.sxt.bkvl.nsw.aarnet.net.au (113.197.15.149)  2.295 ms  2.226 ms  2.161 ms
 8  et-0-0-0.pe1.a.hnl.aarnet.net.au (113.197.15.99)  95.112 ms  95.110 ms  95.049 ms
 9  et-2-1-0.bdr1.a.sea.aarnet.net.au (113.197.15.201)  147.583 ms  147.546 ms  147.496 ms
10  cenichpr-1-is-jmb-778.snvaca.pacificwave.net (207.231.245.129)  164.195 ms  164.183 ms
 163.740 ms
11  hpr-lax-hpr3--svl-hpr3-100ge.cenic.net (137.164.25.73)  160.085 ms  160.053 ms  160.845
 ms
12  * * *
13  bd11f1.anderson--cr001.anderson.ucla.net (169.232.4.6)  161.182 ms bd11f1.anderson--cr0
0f2.csb1.ucla.net (169.232.4.4)  161.093 ms bd11f1.anderson--cr001.anderson.ucla.net (169.2
32.4.6)  161.259 ms
14  cr00f1.anderson--rtr11f4.mathsci.ucla.net (169.232.8.185)  161.552 ms cr00f2.csb1--rtr1
1f4.mathsci.ucla.net (169.232.8.181)  160.820 ms cr00f1.anderson--rtr11f4.mathsci.ucla.net
(169.232.8.185)  161.164 ms
15  * * *
16  * * *
17  * * *
18  * * *
19  * * *
20  * * *
21  * * *
22  * * *
23  * * *
24  * * *
25  * * *
26  * * *
27  * * *
28  * * *
29  * * *
30  * * *
z5223796@vx4:/tmp_amd/kamen/export/kamen/4/z5223796/Desktop$
```

```
z5223796@vx4:/tmp_amd/kamen/export/kamen/4/z5223796/Desktop$ traceroute www.u-tokyo.ac.jp
traceroute to www.u-tokyo.ac.jp (210.152.243.234), 30 hops max, 60 byte packets
 1  cserouter1-server.cse.unsw.EDU.AU (129.94.242.251)  0.075 ms  0.055 ms  0.071 ms
 2  129.94.39.17 (129.94.39.17)  0.911 ms  0.861 ms  0.863 ms
 3  ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35)  1.510 ms  1.498 ms libudnex1-vl-3154.gw.unsw.edu.au (149.1
71.253.34)  7.825 ms
 4  ombcr1-po-5.gw.unsw.edu.au (149.171.255.197)  1.067 ms  1.097 ms libcr1-po-5.gw.unsw.edu.au (149.171.255.165)
  1.052 ms
 5  unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  12.349 ms unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101)
12.372 ms unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  12.348 ms
 6  138.44.5.0 (138.44.5.0)  1.268 ms  1.310 ms  1.288 ms
 7  et-0-3-0.pe1.bkvl.nsw.aarnet.net.au (113.197.15.147)  1.671 ms  1.716 ms  1.705 ms
 8  ge-4_0_0.bb1.a.pao.aarnet.net.au (202.158.194.177)  154.980 ms  155.462 ms  155.454 ms
 9  paloalto0.iij.net (198.32.176.24)  156.475 ms  156.463 ms  156.527 ms
10  osk004bb00.IIJ.Net (58.138.88.185)  286.920 ms osk004bb01.IIJ.Net (58.138.88.189)  269.317 ms osk004bb00.IIJ.
Net (58.138.88.185)  286.902 ms
11  osk004ip57.IIJ.Net (58.138.106.166)  278.155 ms  277.959 ms osk004ip57.IIJ.Net (58.138.106.162)  286.911 ms
12  210.130.135.130 (210.130.135.130)  269.592 ms  271.464 ms  271.440 ms
13  124.83.228.58 (124.83.228.58)  286.989 ms  278.213 ms  287.057 ms
14  124.83.252.178 (124.83.252.178)  293.029 ms  292.988 ms  284.214 ms
15  158.205.134.26 (158.205.134.26)  284.053 ms  292.913 ms  284.164 ms
16  158.205.121.46 (158.205.121.46)  275.677 ms  275.404 ms  284.350 ms
17  * * *
18  * * *
19  * * *
20  * * *
21  * * *
22  * * *
23  * * *
24  * * *
25  * * *
26  * * *
27  * * *
28  * * *
29  * * *
30  * * *
```

```
z5223796@vx4:/tmp_amd/kamen/export/kamen/4/z5223796/Desktop$ traceroute www.lancaster.ac.uk
traceroute to www.lancaster.ac.uk (148.88.65.80), 30 hops max, 60 byte packets
 1  cserouter1-server.cse.unsw.EDU.AU (129.94.242.251)  0.121 ms  0.055 ms  0.050 ms
 2  129.94.39.17 (129.94.39.17)  0.860 ms  0.846 ms  0.815 ms
 3  libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34)  1.470 ms  1.466 ms ombudnex1-vl-3154.gw.unsw.edu.au (149.1
71.253.35)  1.353 ms
 4  ombcr1-po-6.gw.unsw.edu.au (149.171.255.169)  1.075 ms libcr1-po-6.gw.unsw.edu.au (149.171.255.201)  3.331 ms
 libcr1-po-5.gw.unsw.edu.au (149.171.255.165)  3.321 ms
 5  unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101)  1.123 ms unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  1
.158 ms  1.175 ms
 6  138.44.5.0 (138.44.5.0)  1.211 ms  1.307 ms  1.356 ms
 7  et-1-1-0.pe1.rsby.nsw.aarnet.net.au (113.197.15.12)  1.593 ms  1.602 ms  1.639 ms
 8  xe-1-1-0.pe1.eskp.nsw.aarnet.net.au (113.197.15.199)  2.751 ms  2.748 ms  2.726 ms
 9  et-0-3-0.pe1.prka.sa.aarnet.net.au (113.197.15.42)  19.976 ms  20.000 ms  20.036 ms
10  et-0-3-0.pe1.knsg.wa.aarnet.net.au (113.197.15.45)  45.940 ms  45.935 ms  45.995 ms
11  et-2-1-2.bdr2.sing.sin.aarnet.net.au (113.197.15.247)  91.760 ms  91.698 ms  91.749 ms
12  ae1.bdr1.sing.sin.aarnet.net.au (113.197.15.234)  115.273 ms  115.180 ms  113.854 ms
13  138.44.226.7 (138.44.226.7)  259.218 ms  259.115 ms  259.009 ms
14  janet-gw.mx1.lon.uk.geant.net (62.40.124.198)  259.416 ms  259.312 ms  259.292 ms
15  ae29.londpg-sbr2.ja.net (146.97.33.2)  259.728 ms  259.673 ms  259.655 ms
16  ae31.erdiss-sbr2.ja.net (146.97.33.22)  268.932 ms  263.462 ms  263.439 ms
17  ae29.manckh-sbr2.ja.net (146.97.33.42)  265.254 ms  265.214 ms  265.204 ms
18  ae24.lanclu-rbr1.ja.net (146.97.38.58)  267.601 ms  267.616 ms  267.598 ms
19  lancaster-university.ja.net (194.81.46.2)  336.932 ms  336.415 ms  315.000 ms
20  is-border01.bfw01.rtr.lancs.ac.uk (148.88.253.202)  268.100 ms  268.038 ms  268.076 ms
21  bfw01.iss-servers.is-core01.rtr.lancs.ac.uk (148.88.250.98)  274.770 ms  269.923 ms  269.746 ms
22  * * *
23  www.lancs.ac.uk (148.88.65.80)  267.847 ms !X  267.858 ms !X  267.862 ms !X
```

The first 6 hops are same. The 7th becomes different. So, the 7th router start diverging.

Those three path 7th hops all belong to aarnet. (113.197.15.149,113.197.15.147, 113.197.15.12)

```
% Information related to '113.197.15.0 - 113.197.15.255'

% Abuse contact for '113.197.15.0 - 113.197.15.255' is 'abuse@aarnet.edu.au'

inetnum:        113.197.15.0 - 113.197.15.255
netname:        IIPC
descr:          Customer Connection Network
country:        AU
admin-c:        ANOC-AP
tech-c:         ANOC-AP
status:         ASSIGNED NON-PORTABLE
remarks:        AARNet customer network
mnt-by:         MAINT-AARNET-AP
mnt-lower:      MAINT-AARNET-AP
mnt-routes:     MAINT-AARNET-AP
mnt-irt:        IRT-AARNET-AU
last-modified:  2011-10-20T08:36:39Z
source:         APNIC
```

www.ucla.edu

approximate geophysical location

network information

IP Address
164.67.228.152
Base Domain
ucla.edu
Country
United States
Region
CA
City
Los Angeles
Latitude
33.7866
Longitude
-118.2987
Area Code
310
Postal Code
90095
Distance from Last (as the crow flies)
7499.0 miles
Source
MaxMind

locate a network

Remote Address 164.67.228.152 Locate
Use Current IP

www.u-tokyo.ac.jp

approximate geophysical location

network information

IP Address
210.152.243.234
Base Domain
idcfcloud.com
Country
Japan
Region
Unknown
City
Unknown
Latitude
36
Longitude
138
Area Code
Unknown
Postal Code
Unknown
Distance from Last (as the crow flies)
4908.7 miles
Source
MaxMind

locate a network

Remote Address 210.152.243.234 Locate
Use Current IP

www.lancaster.ac.uk

approximate geophysical location

network information

IP Address
148.88.65.80
Base Domain
ac.uk
Country
United Kingdom
Region
H2
City
Lancaster
Latitude
54.0667
Longitude
-2.8333
Area Code
Unknown
Postal Code
Unknown
Distance from Last (as the crow flies)
10569.8 miles
Source
MaxMind

locate a network

Remote Address 148.88.65.80 Locate
Use Current IP

From the distance, we found that Japan is closer to Sydney compare to the Los Angeles. But the path to Los Angeles takes 13 hops. To japan takes 16 hops. Thus, the number of hops on each path is not connect with the physical distance.

3. Several servers distributed around the world provide a web interface from which you can perform a traceroute to any other host in the Internet. Here are two examples: (i) http://www.speedtest.com.sg/tr.php and (ii) https://www.telstra.net/cgi-bin/trace . Run traceroute from both these servers towards your machine and in the reverse direction (i.e. From your machine to these servers). You may also try other traceroute servers from the list at www.traceroute.org . What are the IP addresses of the two servers that you have chosen. Does the reverse path go through the same routers as the forward path? If you observe common routers between the forward and the reverse path, do you also observe the same IP addresses? Why or why not?

Answer:

IP of CSE is 129.94.242.117 IP of speedtest is 202.150.221.170

From CSE to speedtest:

```
z5223796@vx4:/tmp_amd/kamen/export/kamen/4/z5223796/Desktop$ traceroute www.speedtest.com.sg
traceroute to www.speedtest.com.sg (202.150.221.170), 30 hops max, 60 byte packets
 1  cserouter1-server.cse.unsw.EDU.AU (129.94.242.251)  0.113 ms  0.087 ms  0.068 ms
 2  129.94.39.17 (129.94.39.17)  0.839 ms  0.832 ms  0.801 ms
 3  ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35)  1.249 ms libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34)
  1.326 ms  1.432 ms
 4  libcr1-po-5.gw.unsw.edu.au (149.171.255.165)  1.096 ms libcr1-po-6.gw.unsw.edu.au (149.171.255.201)  1.156 ms
  1.064 ms
 5  unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101)  1.277 ms unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  1
.179 ms  1.185 ms
 6  138.44.5.0 (138.44.5.0)  1.754 ms  1.367 ms  1.309 ms
 7  et-0-3-0.pe1.alxd.nsw.aarnet.net.au (113.197.15.153)  1.645 ms  1.823 ms  1.874 ms
 8  xe-0-2-7.bdr1.a.lax.aarnet.net.au (202.158.194.173)  147.746 ms  147.665 ms  147.640 ms
 9  singtel.as7473.any2ix.coresite.com (206.72.210.63)  147.709 ms  147.613 ms  147.700 ms
10  203.208.171.117 (203.208.171.117)  147.938 ms  147.954 ms 203.208.173.81 (203.208.173.81)  321.026 ms
11  203.208.177.110 (203.208.177.110)  328.344 ms  319.949 ms  328.322 ms
12  * 203.208.182.253 (203.208.182.253)  323.366 ms *
13  203.208.182.253 (203.208.182.253)  322.174 ms 202-150-221-170.rev.ne.com.sg (202.150.221.170)  214.179 ms  20
8.945 ms
```

From speedtest to CSE:

```
Traceroute Result:
traceroute to 129.94.242.117 (129.94.242.117), 30 hops max, 60 byte packets
 1  ge2-8.r01.sin01.ne.com.sg (202.150.221.169)  0.138 ms  0.143 ms  0.148 ms
 2  10.11.34.146 (10.11.34.146)  0.404 ms  0.481 ms  0.554 ms
 3  aarnet.sgix.sg (103.16.102.67)  207.746 ms  207.811 ms  207.790 ms
 4  et-7-1-0.pe1.brwy.nsw.aarnet.net.au (113.197.15.13)  207.618 ms et-5-1-0.pe1.brwy.nsw.aarnet.net.au (113.197.15.5)  211.066 ms et-7-1-0.pe1.brwy.nsw.aarnet.net.au (113.197.15.13)  207.630 ms
 5  138.44.5.1 (138.44.5.1)  203.759 ms  204.056 ms  204.070 ms
 6  ombcr1-te-1-5.gw.unsw.edu.au (149.171.255.106)  208.136 ms  207.766 ms  207.818 ms
 7  libudnex1-po-2.gw.unsw.edu.au (149.171.255.198)  211.690 ms  211.299 ms  211.756 ms
 8  ufw1-ae-1-3154.gw.unsw.edu.au (149.171.253.36)  208.499 ms  208.429 ms  208.416 ms
 9  129.94.39.23 (129.94.39.23)  208.853 ms  208.888 ms  208.478 ms
10  * * *
11  * * *
12  * * *
13  * * *
14  * * *
15  * * *
16  * * *
17  * * *
18  * * *
19  * * *
20  * * *
21  * * *
22  * * *
23  * * *
24  * * *
25  * * *
26  * * *
27  * * *
28  * * *
29  * * *
30  * * *
Traceroute Completed.
```

IP of Telstra is 203.50.5.178

From CSE to Telstra:

```
z5223796@vx4:/tmp_amd/kamen/export/kamen/4/z5223796/Desktop$ traceroute www.telstra.net
traceroute to www.telstra.net (203.50.5.178), 30 hops max, 60 byte packets
 1  cserouter1-server.cse.unsw.EDU.AU (129.94.242.251)  0.137 ms  0.106 ms  0.083 ms
 2  129.94.39.17 (129.94.39.17)  0.923 ms  0.881 ms  0.842 ms
 3  libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34)  1.444 ms  1.726 ms  1.527 ms
 4  libcr1-po-5.gw.unsw.edu.au (149.171.255.165)  1.158 ms libcr1-po-6.gw.unsw.edu.au (149.171.255.201)  1.133 ms libcr1-po-
5.gw.unsw.edu.au (149.171.255.165)  1.126 ms
 5  unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101)  1.173 ms  1.170 ms unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  1.
225 ms
 6  138.44.5.0 (138.44.5.0)  3.648 ms  2.958 ms  2.952 ms
 7  et-1-1-0.pe1.rsby.nsw.aarnet.net.au (113.197.15.12)  1.522 ms  1.625 ms  1.632 ms
 8  xe-0-0-3.bdr1.rsby.nsw.aarnet.net.au (113.197.15.31)  1.624 ms  1.505 ms  1.499 ms
 9  HundredGigE0-1-0-4.ken-edge903.sydney.telstra.net (139.130.0.77)  2.405 ms  2.234 ms  2.440 ms
10  bundle-ether2.chw-edge903.sydney.telstra.net (203.50.11.175)  4.761 ms  2.366 ms bundle-ether17.ken-core10.sydney.telstr
a.net (203.50.11.172)  2.894 ms
11  bundle-ether17.chw-core10.sydney.telstra.net (203.50.11.176)  3.562 ms bundle-ether10.win-core10.melbourne.telstra.net (
203.50.11.123)  13.878 ms bundle-ether17.chw-core10.sydney.telstra.net (203.50.11.176)  3.397 ms
12  203.50.6.40 (203.50.6.40)  13.383 ms bundle-ether8.exi-core10.melbourne.telstra.net (203.50.11.125)  15.034 ms  14.990 m
s
13  bundle-ether2.exi-ncprouter101.melbourne.telstra.net (203.50.11.209)  13.232 ms  13.231 ms  13.300 ms
14  www.telstra.net (203.50.5.178)  12.896 ms  12.867 ms  12.482 ms
```

From Telstra to CSE:

```
 1  gigabitethernet3-3.exi2.melbourne.telstra.net (203.50.77.53)  0.575 ms  0.211 ms  0.244 ms
 2  bundle-ether3-100.win-core10.melbourne.telstra.net (203.50.80.129)  1.118 ms  1.613 ms  2.120 ms
 3  bundle-ether12.ken-core10.sydney.telstra.net (203.50.11.122)  12.384 ms  11.742 ms  12.228 ms
 4  bundle-ether1.ken-edge903.sydney.telstra.net (203.50.11.173)  12.344 ms  12.365 ms  12.101 ms
 5  aar3533567.lnk.telstra.net (139.130.0.78)  11.724 ms  11.609 ms  11.846 ms
 6  et-7-1-0.pe1.brwy.nsw.aarnet.net.au (113.197.15.13)  11.869 ms  11.948 ms  11.858 ms
 7  138.44.5.1 (138.44.5.1)  12.102 ms  12.083 ms  12.100 ms
 8  libcr1-te-1-5.gw.unsw.edu.au (149.171.255.102)  12.101 ms  12.117 ms  12.102 ms
 9  ombudnex1-po-1.gw.unsw.edu.au (149.171.255.202)  12.346 ms
10  ufw1-ae-1-3154.gw.unsw.edu.au (149.171.253.36)  12.721 ms  12.847 ms  12.609 ms
11  129.94.39.23 (129.94.39.23)  12.860 ms  12.969 ms  12.868 ms
```

IP of speedtest is 202.150.221.170, IP of Telstra is 203.50.5.178.

From above, the direct and reverse path pass through some same router (although name is different), but not all. Like from CSE to speedtest it passes through 202.158.194.173, but from speedtest to CSE not pass through any router with 202.158.194.xxx, same as 10.11.34.146, 206.72.210.63, etc.

But in Telstra and CSE, forward and reverse path will pass through same router again with different IP. It is for load balance and avoid conflict to allocate a different interface. That's the reason why IP address is different.

To be noticed, there is a special router 138.44.5.x, both speedtest and Telstra pass through it. The direct and reverse path both pass this router with different IP. It may be a router connect UNSW intranet and AAR network.

Exercise 4: Use ping to gain insights into network performance

Note: Include all graphs in your report. You need to run the scripts (runping.sh and plot.sh) when you are physically using a lab machine or connected to a CSE server/lab machine using VLAB / VNC client. You need to ensure gnuplot and ps2pdf are available on your system if you are planning to do this exercise on your own machine.

We now use the ping utility to investigate network delay and its implications on network performance. In particular, we will analyze the dependency of packet size and delay.

There is a shell script, runping.sh , provided that you can use instead of running many pings with different packet sizes by hand. After downloading this script on your machine make sure you can execute it. If not, you will have to execute the following command in the command line: *chmod u+x runping.sh* . To run the ping traces you may use the runping.sh script as follows: ./runping.sh www.abc.net (or whatever other destination you want to ping). It will automatically run ping for different packet sizes and with 50 ping packets per size. Note, since a ping is sent once per second, this script will take a few minutes to finish. Basically, this script only executes the commands:

```
$ ping -s 22 -c 50 -i 1 www.abc.net > www.abc.net-p50

...

$ ping -s 1472 -c 50 -i 1 www.abc.net > www.abc.net-p1500
```

and writes the output of the pings to the corresponding files.

Use this script for the following destinations:

(i) www.uq.edu.au (ii) www.dlsu.edu.ph and (iii) www.tu-berlin.de

In other words, execute the following commands

```
$ ./runping.sh www.uq.edu.au

$ ./runping.sh www.dlsu.edu.ph

$ ./runping.sh www.tu-berlin.de
```

In case you notice one of the hosts above is not responsive, select the following alternate destinations: (i) within Australia (www.flinders.edu.au , www.unsw.edu.au) (ii) Asia (www.upm.edu.my , upd.edu.ph) (iii) Europe (www.aau.dk , www.uio.no)

Note that all delay values reported are in milliseconds (ms) and reflect the round trip time (RTT) between your host and the destinations.

When the runping.sh script is finished for all destinations, you can plot the results using another provided script, plot.sh , as follows:

```
$ ./plot.sh www.uq.edu.au-p*

$ ./plot.sh www.dlsu.edu.ph-p*

$ ./plot.sh www.tu-berlin.de-p*
```

If you cannot execute plot.sh, then fix the permissions by executing the following command in the command line:

```
$ chmod u+x plot.sh
```

The script plot.sh will produce the following files: destination_delay.pdf, destination_scatter.pdf, and destination_avg.txt for each of the destinations (e.g., for www.uq.edu.au we have *www.uq.edu.au_delay.pdf* , *www.uq.edu.au_scatter.pdf* and *www.uq.edu.au_avg.txt*).

The graph *destination_delay.pdf* shows how delay varies over time (different colours correspond to different packet sizes), and *destination_scatter.pdf* shows delay vs. packet size as a scatter plot. *destination_avg.txt* contains the average (2nd column) and minimum (3rd column) delay values corresponding to each packet size (1st column).

1. For each of these locations find the (approximate) physical distance from UNSW using Google Maps and compute the shortest possible time T for a packet to reach that location from UNSW. You should assume that the packet moves (i.e. propagates) at the

speed of light, 3 x 10 8 m/s. Note that the shortest possible time will simply be the distance divided by the propagation speed. Plot a graph where the x-axis represents the distance to each city (i.e. Brisbane, Manila and Berlin), and the y-axis represents the ratio between the minimum delay (i.e. RTT) as measured by the ping program (select the values for 50 byte packets) and the shortest possible time T to reach that city from UNSW. (Note that the y-values are no smaller than 2 since it takes at least 2*T time for any packet to reach the destination from UNSW and get back). Can you think of at least two reasons why the y-axis values that you plot are greater than 2?

Answer:

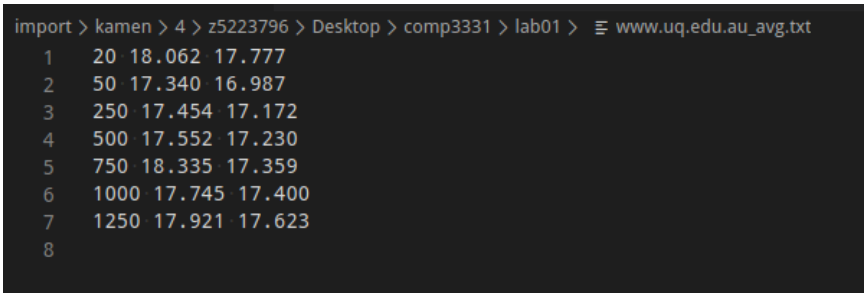
Speed of light : 3 x 10^8 m/s = 3 x 10^5 km/s

For www.uq.edu.au IP address is 130.102.184.3. (Brisbane)

Physical distance from UNSW (Approximate):732.39 km

Shortest possible time- T: 732.39km ÷(3 x 10^5km/s) $\approx 2.44ms$

The minimum RTT (for 50byte packets) from www.uq.edu.au_avg.txt:16.987ms

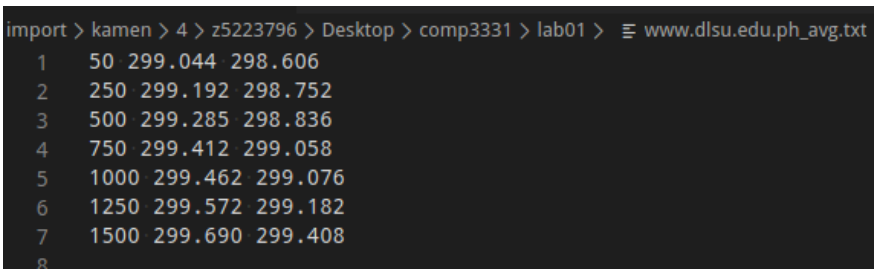


For www.dlsu.edu.ph IP address is 103.231.241.180. (Manila)

Physical distance from UNSW (Approximate): 6261.82 km

Shortest possible time- T: 6261.82km÷(3 x 10^5km/s) $\approx 20.87ms$

The minimum RTT (for 50byte packets) from www.dlsu.edu.ph_avg.txt:298.606ms



For www.tu-berlin.de IP address is 130.149.7.201. (Berlin)

Physical distance from UNSW (Approximate):16095.32 km

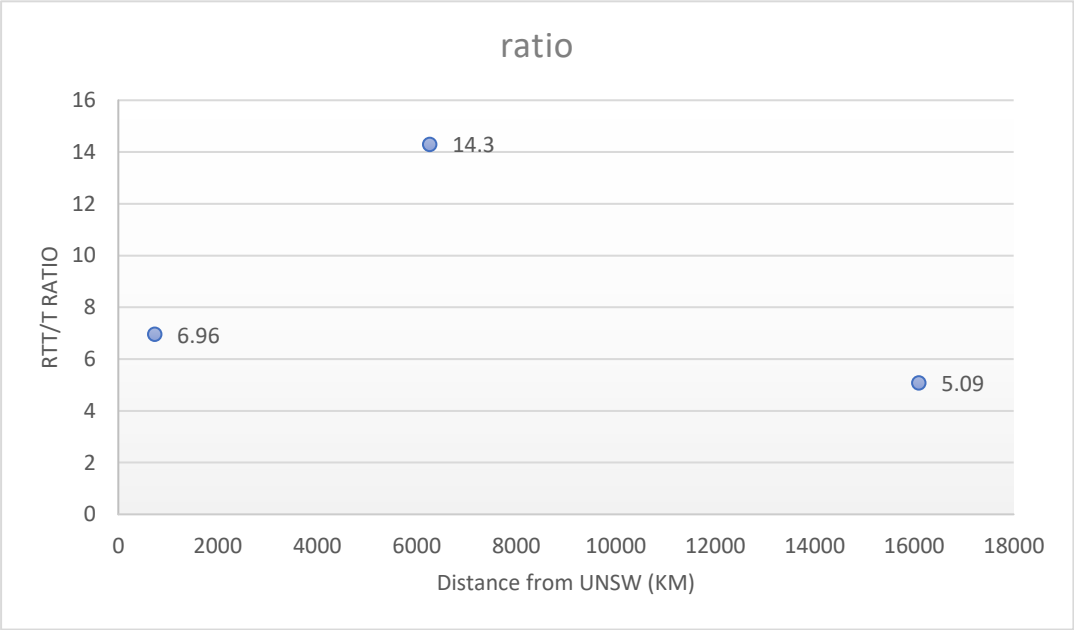
Shortest possible time- T: 16095.32km÷(3 x 10^5km/s) $\approx 53.65ms$

The minimum RTT (for 50byte packets) from www.tu-berlin.de_avg.txt:273.205ms

```
import > kamen > 4 > z5223796 > Desktop > comp3331 > lab01 > ≡ www.tu-berlin.de_avg.txt
1   50 273.377 273.205
2   250 273.450 273.307
3   500 273.526 273.404
4   750 273.627 273.517
5   1000 273.717 273.560
6   1250 273.786 273.662
7   1500 273.889 273.748
8
```

The ratios of minimum RTT to the T.

Brisbane: 6.96 Manila: 14.30 Berlin: 5.09



The reason that ratio is always > 2.

The transmission speed does not actually reach the speed of light.

There going have delay of transmission, propagation, queuing and processing during transmission.

Different ISP may lead to different path which not necessary to pass through make extra time to the destination.

The packet travel the cables cannot be placed exactly same as the physical distance(flight distance) due to the terrain politics and other reason. (NOT DIRECTLY)

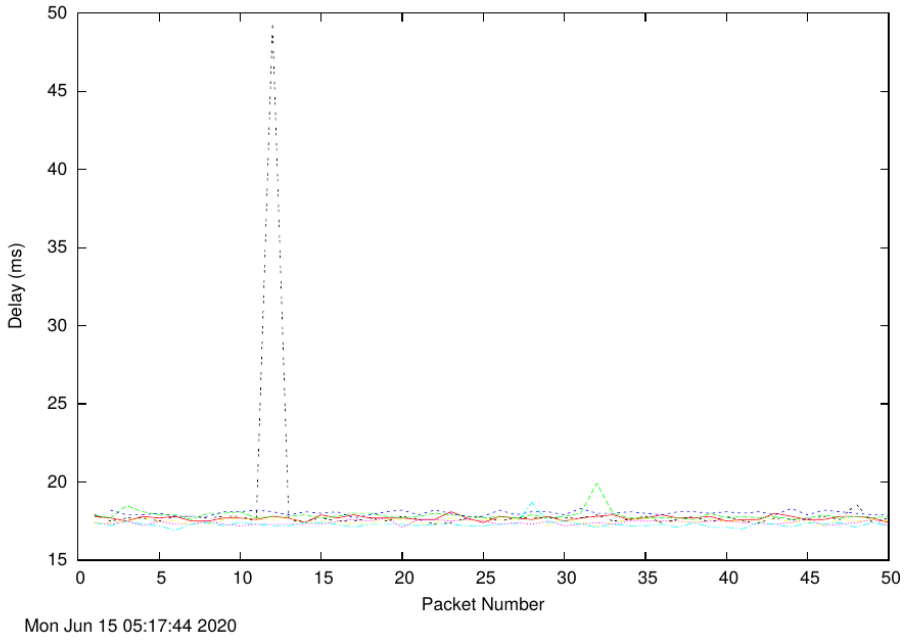
The RRT is the time from source to destination and back so at least at 2 * T.

2. Is the delay to the destinations constant or does it vary over time? Explain why.

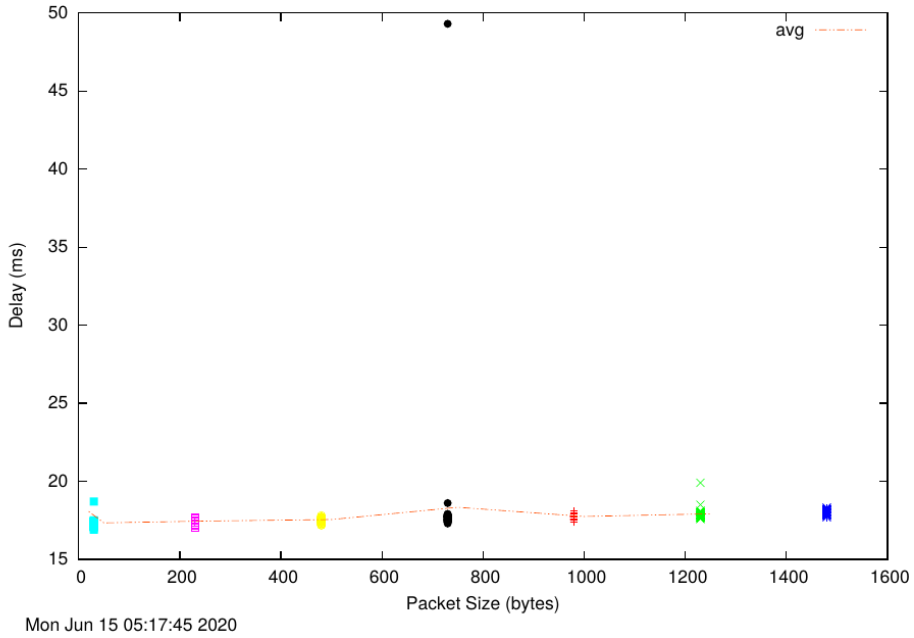
Answer:

www.uq.edu.au

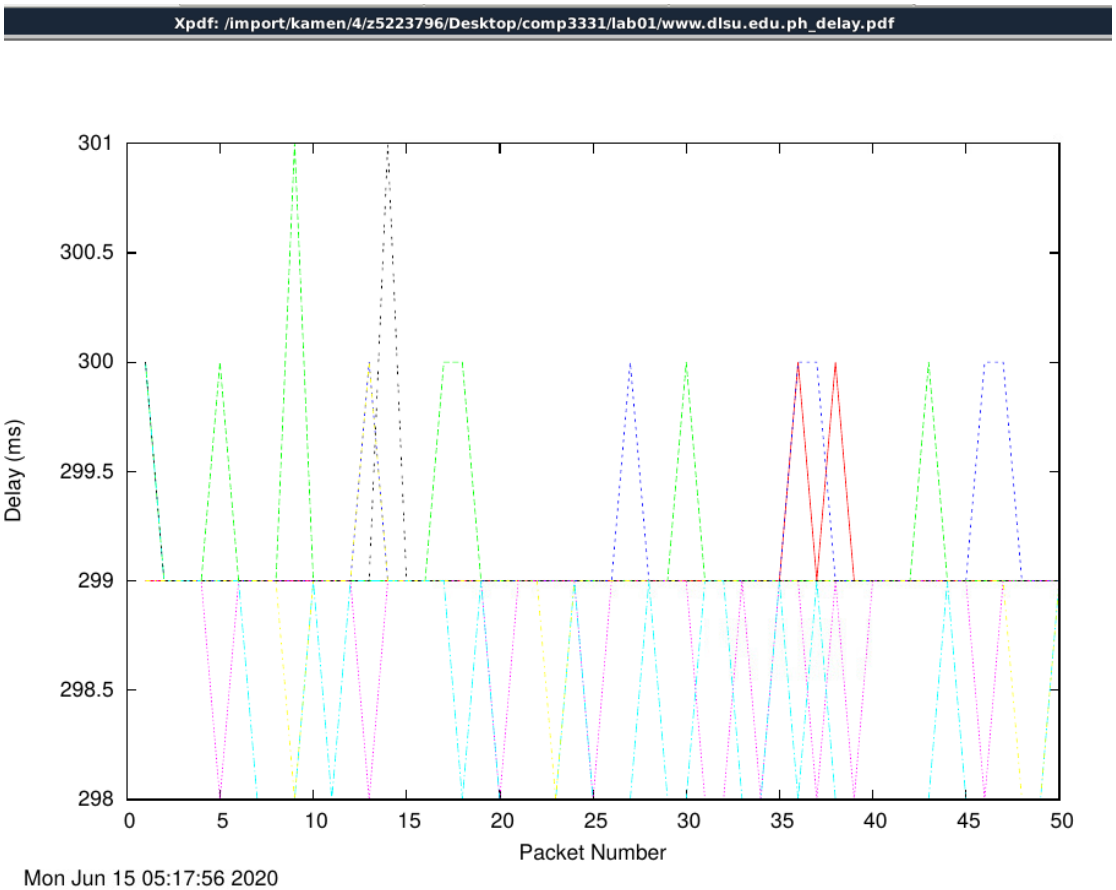
Xpdf: /import/kamen/4/z5223796/Desktop/comp3331/lab01/www.uq.edu.au_delay.pdf

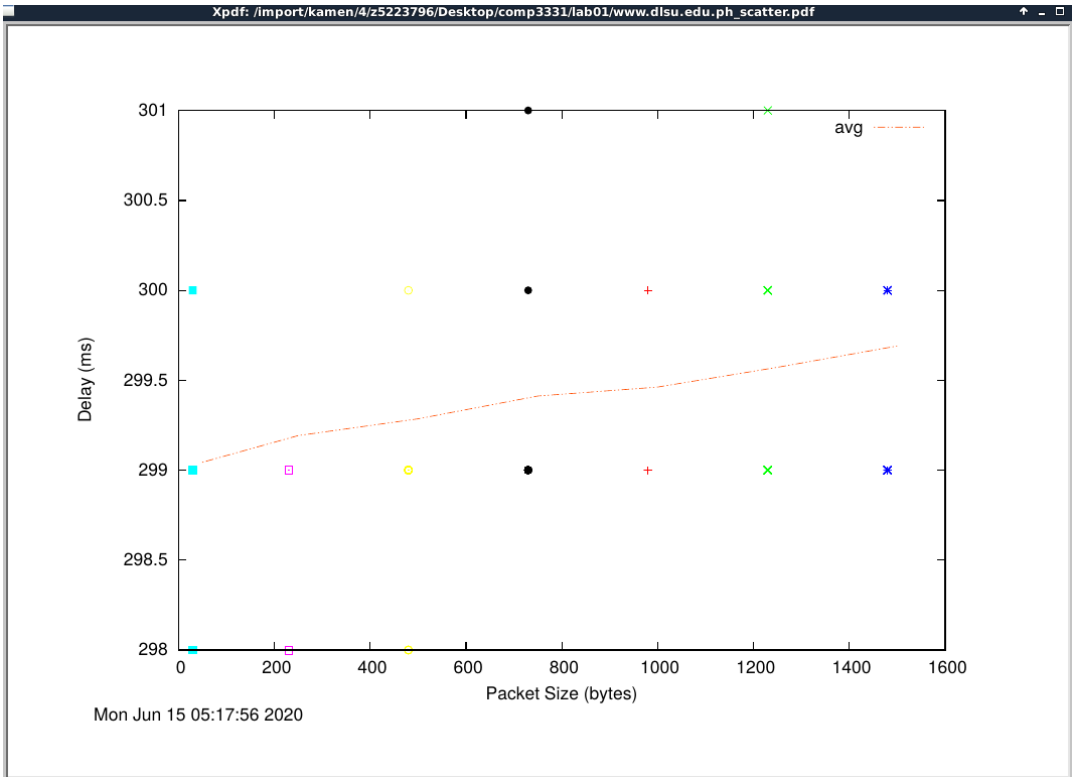


Xpdf: /import/kamen/4/z5223796/Desktop/comp3331/lab01/www.uq.edu.au_scatter.pdf

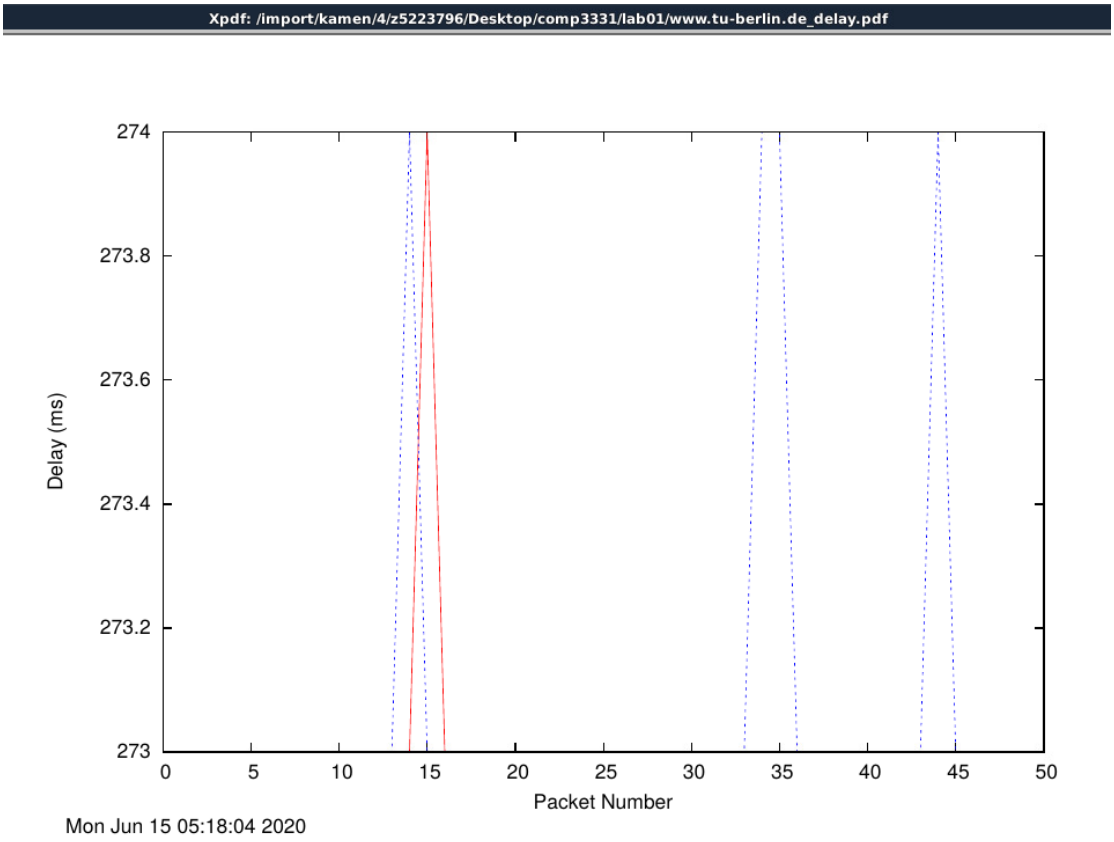


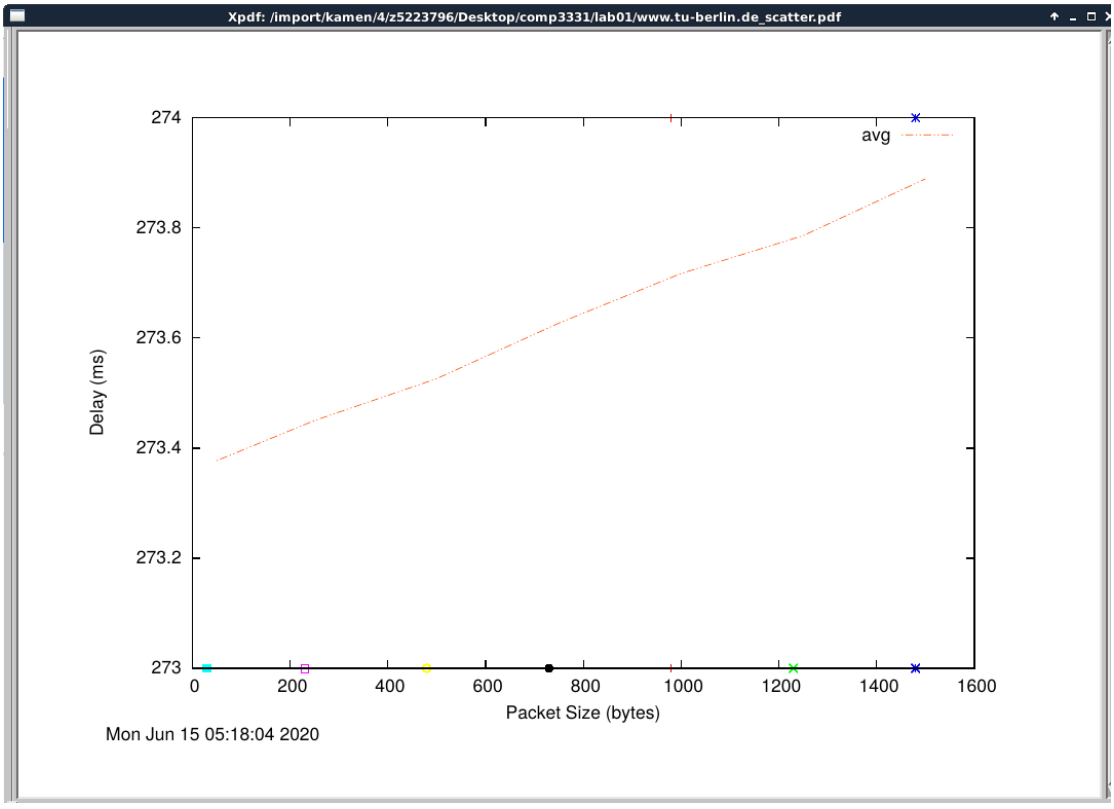
www.dlsu.edu.ph





www.tu-berlin.de

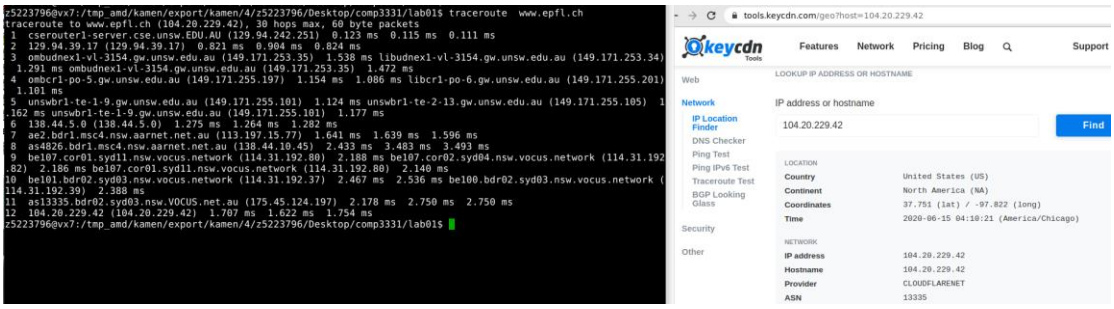




It clear to see that the delay to destination is NOT constant, The reason cause that may are propagation delay and queuing delay. And different time will have different queuing delay for different router due to network's traffic.

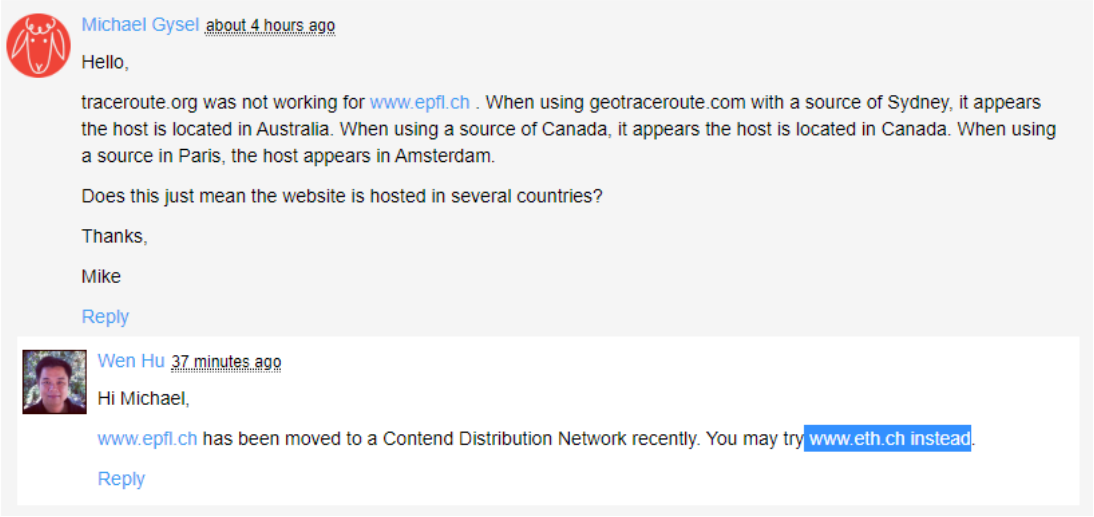
3. Explore where the website for www.epfl.ch is hosted. Is it in Switzerland?

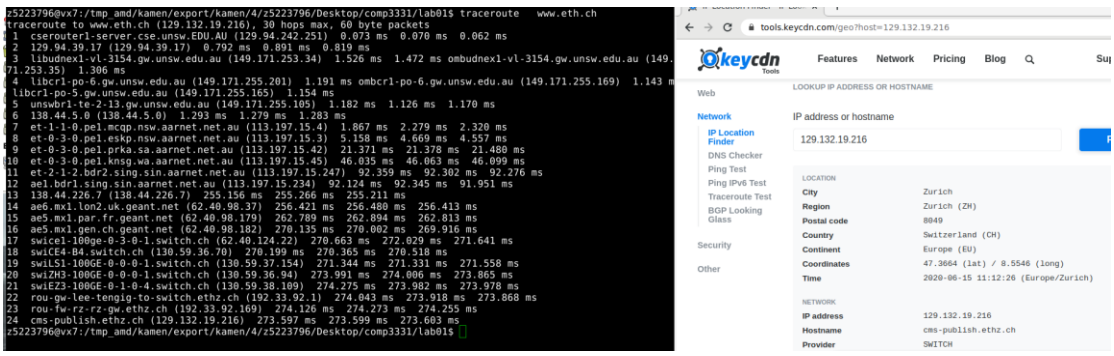
Answer:



For www.epfl.ch is not in Switzerland.

For www.eth.ch instead is in Switzerland.





4. The measured delay (i.e., the delay you can see in the graphs) is composed of propagation delay, transmission delay, processing delay and queuing delay. Which of these delays depend on the packet size and which do not?

Answer:

Transmission delay and Processing delay.

Transmission delay depends on **packet size.**

Processing delay can depend on packet size but less than transmission delay. It will check bit error.

Propagation delay depend on the physical transmission mode.

Queuing delay depend on how many packets in the queue.