Exercise 1

1. 172.67.219.46 or 104.18.60.21 or 104.18.61.21

Reasons:

Due to security reason and also there might be different server with different IP that can work for different places to provide better service to local users.

2.it is local host. All computer used this address as their own local ip but it does not let computer to communicate with other device using this address

Exercise 2

www.unsw.edu.au : reachable by ping

www.getfittest.com.au : not reachable by ping and browser (the website does not exist)

www.mit.edu :reachable by ping

www.intel.com.au : reachable by ping

www.tpg.com.au : reachable by ping

www.hola.hp : not reachable by ping and browser (the website does not exist)

www.amazon.com :reachable by ping

www.tsinghua.edu.cn : reachable by ping

www.kremlin.ru : not reachable by ping but reachable by browser (the website blocked us from pinging)

8.8.8.8(Google DNS) : reachable by ping

Exercise 3

1. How many routers are there between your workstation and www.columbia.edu ?
   ➔ 20 routers between my workstation and www.columbia.edu.

   How many routers along the path are part of the UNSW network?

   →5 routers along the path are part of the UNSW network.

   Between which two routers do packets cross the Pacific Ocean?

   →The two routers that packets cross the Pacific Ocean are between

7th and 9th router .Because the time to connect the host in row 8 jumps to 90+ms and the time need to connect the host in row 9 needs 140+ms

```
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)  0.101 ms  0.082 ms  0.085 ms
 2  129.94.39.17 (129.94.39.17)  0.859 ms  0.818 ms  0.851 ms
 3  libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34)  1.299 ms ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35)  4.403 ms  4.400 ms
 4  ombcr1-po-5.gw.unsw.edu.au (149.171.255.197)  1.138 ms libcr1-po-6.gw.unsw.edu.au (149.171.255.201)  1.080 ms ombcr1-po-6.gw.unsw.edu.au
(149.171.255.169)  1.135 ms
 5  unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  1.147 ms  1.186 ms unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101)  1.194 ms
 6  138.44.5.0 (138.44.5.0)  1.250 ms  1.244 ms  1.264 ms
 7  et-1-3-0.pe1.sxt.bkvl.nsw.aarnet.net.au (113.197.15.149)  2.217 ms  2.509 ms  2.507 ms
 8  et-0-0-0.pe1.a.hnl.aarnet.net.au (113.197.15.99)  95.121 ms  95.089 ms  95.088 ms
 9  et-2-1-0.bdr1.a.sea.aarnet.net.au (113.197.15.201)  146.985 ms  146.985 ms  146.972 ms
10  abilene-1-lo-jmb-706.sttlwa.pacificwave.net (207.231.240.8)  160.649 ms  160.662 ms  160.668 ms
11  ae-1.4079.rtsw.minn.net.internet2.edu (162.252.70.173)  193.885 ms  193.887 ms  193.943 ms
12  ae-1.4079.rtsw.eqch.net.internet2.edu (162.252.70.106)  200.240 ms  200.243 ms  200.233 ms
13  ae-0.4079.rtsw3.eqch.net.internet2.edu (162.252.70.163)  201.050 ms  212.740 ms  210.814 ms
14  ae-1.4079.rtsw.clev.net.internet2.edu (162.252.70.130)  209.035 ms  209.064 ms  210.240 ms
15  buf-9208-I2-CLEV.nysernet.net (199.109.11.33)  214.271 ms  214.121 ms  214.068 ms
16  syr-9208-buf-9208.nysernet.net (199.109.7.193)  216.456 ms  216.525 ms  216.511 ms
17  nyc111-9204-syr-9208.nysernet.net (199.109.7.94)  225.547 ms  225.589 ms  225.575 ms
18  nyc-9208-nyc111-9204.nysernet.net (199.109.7.165)  226.467 ms  226.665 ms  226.650 ms
19  columbia.nyc-9208.nysernet.net (199.109.4.14)  226.482 ms  226.409 ms  226.472 ms
20  cc-core-1-x-nyser32-gw-1.net.columbia.edu (128.59.255.5)  225.965 ms  225.992 ms  226.049 ms
21  cc-conc-1-x-cc-core-1.net.columbia.edu (128.59.255.21)  246.817 ms  244.792 ms  226.818 ms
22  vii.org (128.59.105.24)  226.642 ms  226.594 ms  226.799 ms
```

2. At which router do the paths from your machine to these three destinations diverge?

→The paths from my machine to these three destinations diverge at 198.32.176.24 (8th router)

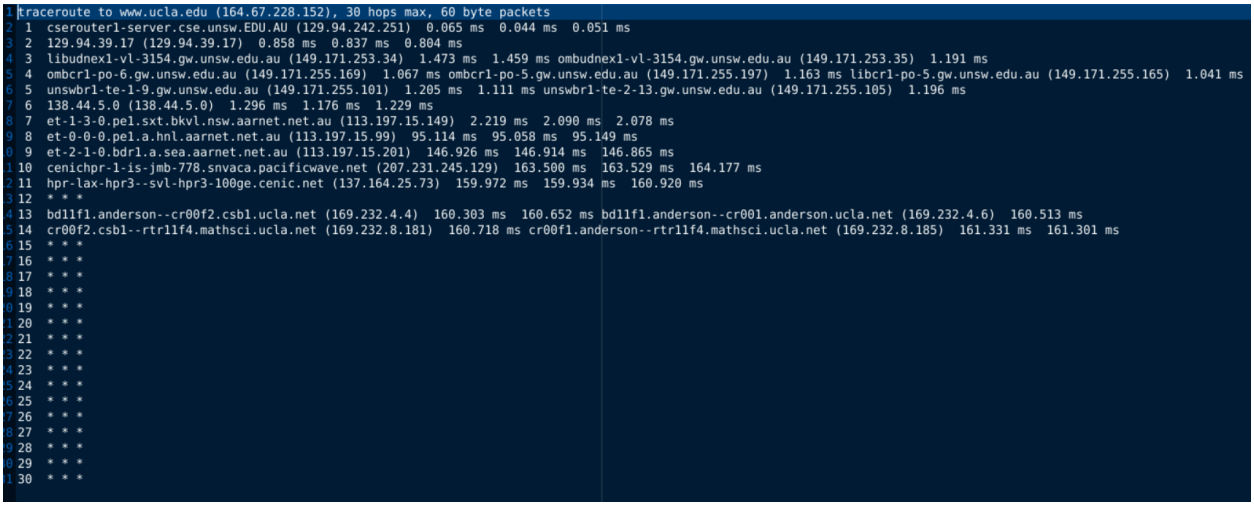
Find out further details about this router

→The router is in Red Wood City of United States.

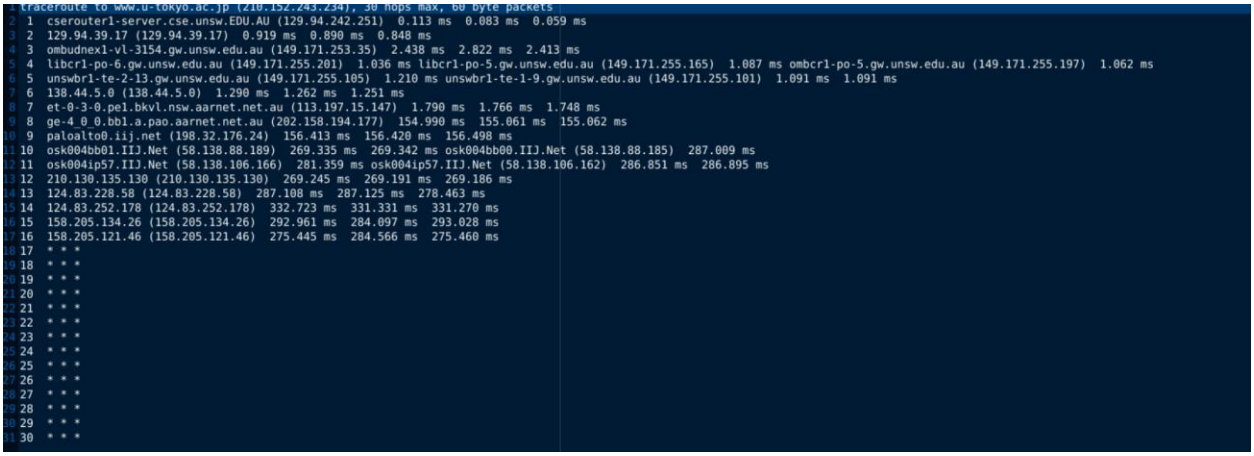
Is the number of hops on each path proportional the physical distance?

→The number of hops on each path is not proportional to physical distance. Because the traceroute to UTokyo in Japan took more hops than to Lancaster,UK. Japan is nearer to UNSW compared to UK.

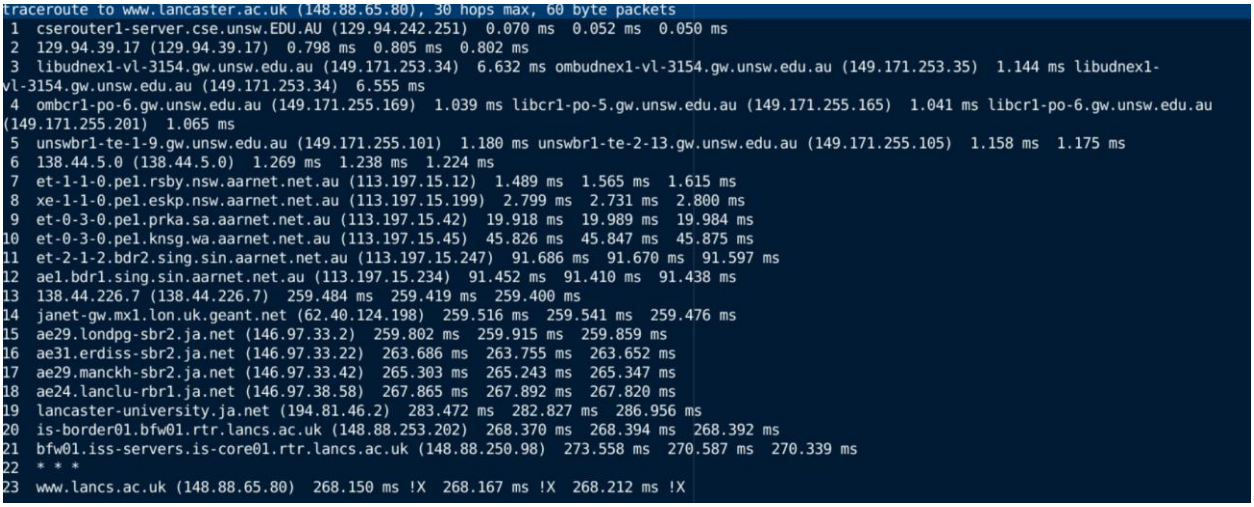
ucla traceroute output



utokyo traceroute output



Lancaster traceroute output



```
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)  0.070 ms  0.052 ms  0.050 ms
 2  129.94.39.17 (129.94.39.17)  0.798 ms  0.805 ms  0.802 ms
 3  libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34)  6.632 ms ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35)  1.144 ms libudnex1-
vl-3154.gw.unsw.edu.au (149.171.253.34)  6.555 ms
 4  ombcr1-po-6.gw.unsw.edu.au (149.171.255.169)  1.039 ms libcr1-po-5.gw.unsw.edu.au (149.171.255.165)  1.041 ms libcr1-po-6.gw.unsw.edu.au
(149.171.255.201)  1.065 ms
 5  unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101)  1.180 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)  1.269 ms  1.238 ms  1.224 ms
 7  et-1-1-0.pe1.rsby.nsw.aarnet.net.au (113.197.15.12)  1.489 ms  1.565 ms  1.615 ms
 8  xe-1-1-0.pe1.eskp.nsw.aarnet.net.au (113.197.15.199)  2.799 ms  2.731 ms  2.800 ms
 9  et-0-3-0.pe1.prka.sa.aarnet.net.au (113.197.15.42)  19.918 ms  19.989 ms  19.984 ms
10  et-0-3-0.pe1.knsg.wa.aarnet.net.au (113.197.15.45)  45.826 ms  45.847 ms  45.875 ms
11  et-2-1-2.bdr2.sing.sin.aarnet.net.au (113.197.15.247)  91.686 ms  91.670 ms  91.597 ms
12  ae1.bdr1.sing.sin.aarnet.net.au (113.197.15.234)  91.452 ms  91.410 ms  91.438 ms
13  138.44.226.7 (138.44.226.7)  259.484 ms  259.419 ms  259.400 ms
14  janet-gw.mx1.lon.uk.geant.net (62.40.124.198)  259.516 ms  259.541 ms  259.476 ms
15  ae29.londpg-sbr2.ja.net (146.97.33.2)  259.802 ms  259.915 ms  259.859 ms
16  ae31.erdiss-sbr2.ja.net (146.97.33.22)  263.686 ms  263.755 ms  263.652 ms
17  ae29.manckh-sbr2.ja.net (146.97.33.42)  265.303 ms  265.243 ms  265.347 ms
18  ae24.lanclu-rbr1.ja.net (146.97.38.58)  267.865 ms  267.892 ms  267.820 ms
19  lancaster-university.ja.net (194.81.46.2)  283.472 ms  282.827 ms  286.956 ms
20  is-border01.bfw01.rtr.lancs.ac.uk (148.88.253.202)  268.370 ms  268.394 ms  268.392 ms
21  bfw01.iss-servers.is-core01.rtr.lancs.ac.uk (148.88.250.98)  273.558 ms  270.587 ms  270.339 ms
22  * * *
23  www.lancs.ac.uk (148.88.65.80)  268.150 ms !X  268.167 ms !X  268.212 ms !X
```

3. What are the IP addresses of the two servers that you have chosen?

→www.speedtest.com.sg = 202.150.221.170

→www.telstra.net = 203.50.5.178

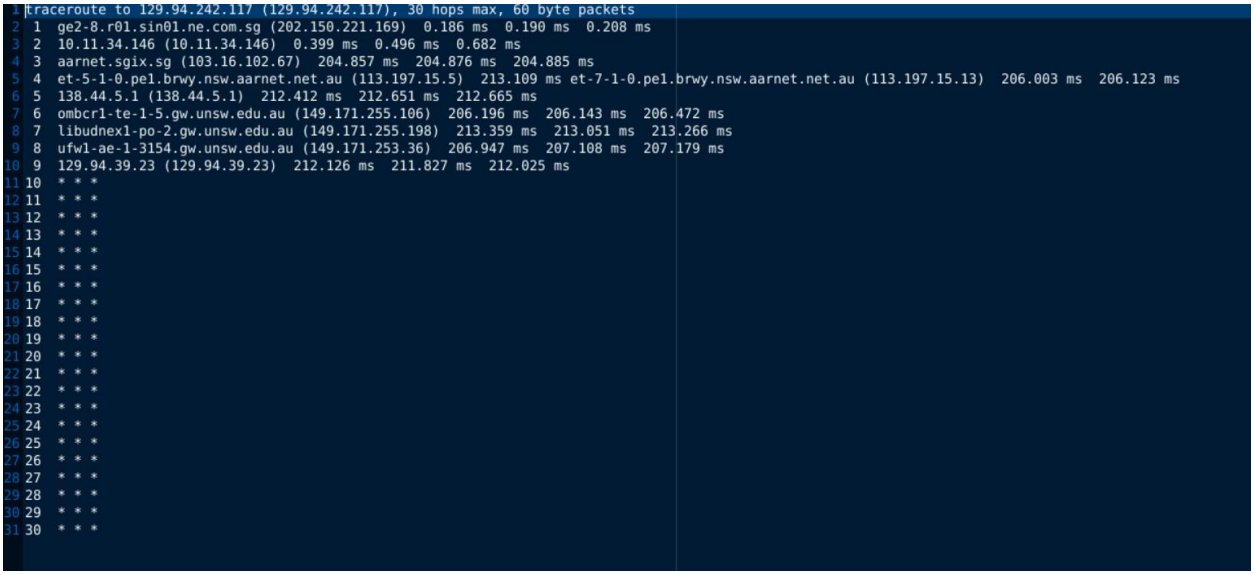
Does the reverse path go through the same routers as the forward path?

→The reverse path does not go through the same router 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?

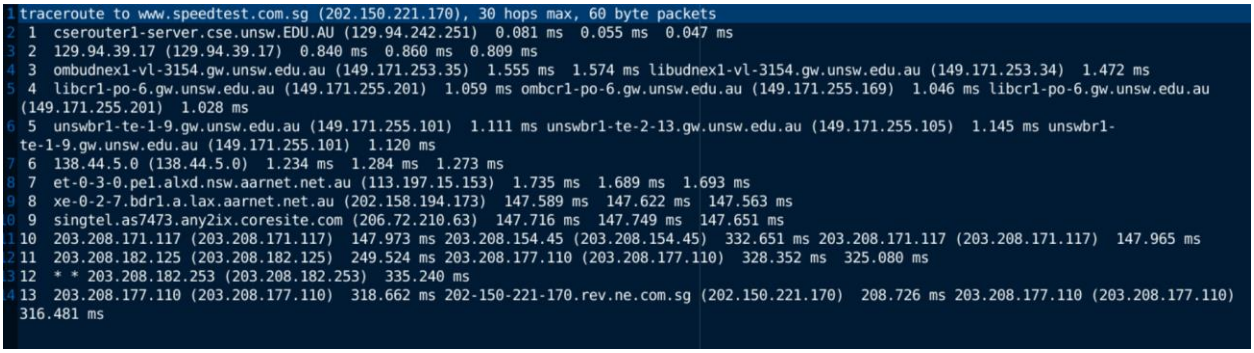
→There are common route between the two paths, but in different IP address, this is because the packet will always be send to the most optimized path

Speedtest to machine traceroute output



```
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)  0.186 ms  0.190 ms  0.208 ms
 2  10.11.34.146 (10.11.34.146)  0.399 ms  0.496 ms  0.682 ms
 3  aarnet.sgix.sg (103.16.102.67)  204.857 ms  204.876 ms  204.885 ms
 4  et-5-1-0.pe1.brwy.nsw.aarnet.net.au (113.197.15.5)  213.109 ms et-7-1-0.pe1.brwy.nsw.aarnet.net.au (113.197.15.13)  206.003 ms  206.123 ms
 5  138.44.5.1 (138.44.5.1)  212.412 ms  212.651 ms  212.665 ms
 6  ombcr1-te-1-5.gw.unsw.edu.au (149.171.255.106)  206.196 ms  206.143 ms  206.472 ms
 7  libudnex1-po-2.gw.unsw.edu.au (149.171.255.198)  213.359 ms  213.051 ms  213.266 ms
 8  ufw1-ae-1-3154.gw.unsw.edu.au (149.171.253.36)  206.947 ms  207.108 ms  207.179 ms
 9  129.94.39.23 (129.94.39.23)  212.126 ms  211.827 ms  212.025 ms
10  * * *
11  * * *
12  * * *
13  * * *
14  * * *
15  * * *
16  * * *
17  * * *
18  * * *
19  * * *
20  * * *
21  * * *
22  * * *
23  * * *
24  * * *
25  * * *
26  * * *
27  * * *
28  * * *
29  * * *
30  * * *
```

Machine to speedtest traceroute output



```
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)  0.081 ms  0.055 ms  0.047 ms
 2  129.94.39.17 (129.94.39.17)  0.840 ms  0.860 ms  0.809 ms
 3  ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35)  1.555 ms  1.574 ms libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34)  1.472 ms
 4  libcr1-po-6.gw.unsw.edu.au (149.171.255.201)  1.059 ms ombcr1-po-6.gw.unsw.edu.au (149.171.255.169)  1.046 ms libcr1-po-6.gw.unsw.edu.au
(149.171.255.201)  1.028 ms
 5  unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101)  1.111 ms unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  1.145 ms unswbr1-
te-1-9.gw.unsw.edu.au (149.171.255.101)  1.120 ms
 6  138.44.5.0 (138.44.5.0)  1.234 ms  1.284 ms  1.273 ms
 7  et-0-3-0.pe1.alxd.nsw.aarnet.net.au (113.197.15.153)  1.735 ms  1.689 ms  1.693 ms
 8  xe-0-2-7.bdr1.a.lax.aarnet.net.au (202.158.194.173)  147.589 ms  147.622 ms  147.563 ms
 9  singtel.as7473.any2ix.coresite.com (206.72.210.63)  147.716 ms  147.749 ms  147.651 ms
10  203.208.171.117 (203.208.171.117)  147.973 ms 203.208.154.45 (203.208.154.45)  332.651 ms 203.208.171.117 (203.208.171.117)  147.965 ms
11  203.208.182.125 (203.208.182.125)  249.524 ms 203.208.177.110 (203.208.177.110)  328.352 ms  325.080 ms
12  * * 203.208.182.253 (203.208.182.253)  335.240 ms
13  203.208.177.110 (203.208.177.110)  318.662 ms 202-150-221-170.rev.ne.com.sg (202.150.221.170)  208.726 ms 203.208.177.110 (203.208.177.110)
316.481 ms
```

Telstra to machine traceroute output

```
 1  gigabitethernet3-3.exi2.melbourne.telstra.net (203.50.77.53)  0.385 ms  0.203 ms  0.243 ms
 2  bundle-ether3-100.win-core10.melbourne.telstra.net (203.50.80.129)  2.489 ms  1.353 ms  2.243 ms
 3  bundle-ether12.ken-core10.sydney.telstra.net (203.50.11.122)  13.860 ms  12.472 ms  12.859 ms
 4  bundle-ether1.ken-edge903.sydney.telstra.net (203.50.11.173)  12.360 ms  12.098 ms  14.609 ms
 5  aar3533567.lnk.telstra.net (139.130.0.78)  11.860 ms  11.599 ms  11.610 ms
 6  et-7-1-0.pe1.brwy.nsw.aarnet.net.au (113.197.15.13)  11.736 ms  11.724 ms  11.736 ms
 7  138.44.5.1 (138.44.5.1)  11.984 ms  11.977 ms  11.986 ms
 8  libcr1-te-1-5.gw.unsw.edu.au (149.171.255.102)  12.109 ms  11.970 ms  11.987 ms
 9  libudnex1-po-1.gw.unsw.edu.au (149.171.255.166)  12.358 ms  12.473 ms  12.360 ms
10  ufw1-ae-1-3154.gw.unsw.edu.au (149.171.253.36)  12.736 ms  12.724 ms  12.735 ms
11  129.94.39.23 (129.94.39.23)  12.859 ms  12.852 ms  12.859 ms
```

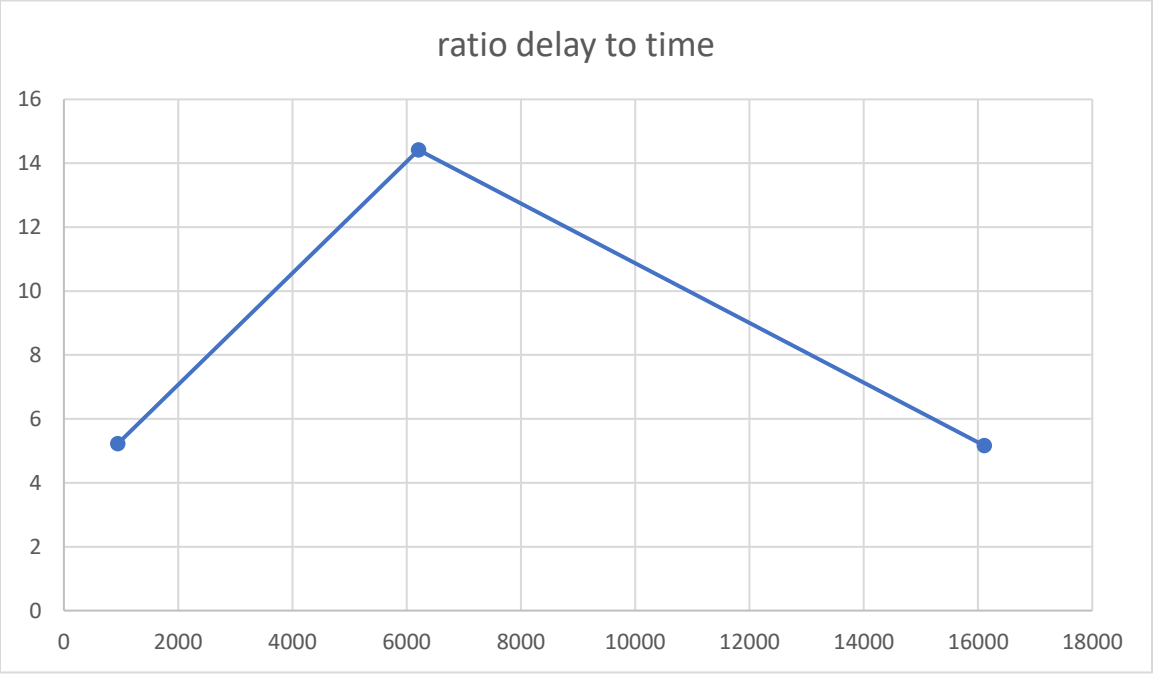
Machine to Telstra traceroute output

```
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)  0.072 ms  0.049 ms  0.046 ms
 2  129.94.39.17 (129.94.39.17)  0.882 ms  0.871 ms  0.851 ms
 3  ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35)  1.449 ms libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34)  1.679 ms  1.617 ms
 4  libcr1-po-5.gw.unsw.edu.au (149.171.255.165)  1.163 ms libcr1-po-6.gw.unsw.edu.au (149.171.255.201)  1.153 ms libcr1-po-5.gw.unsw.edu.au
(149.171.255.165)  1.157 ms
 5  unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  1.186 ms  1.175 ms  1.172 ms
 6  138.44.5.0 (138.44.5.0)  1.264 ms  1.281 ms  1.223 ms
 7  et-1-1-0.pe1.rsby.nsw.aarnet.net.au (113.197.15.12)  1.565 ms  1.531 ms  1.544 ms
 8  xe-0-0-3.bdr1.rsby.nsw.aarnet.net.au (113.197.15.31)  1.577 ms  1.479 ms  1.449 ms
 9  HundredGigE0-1-0-4.ken-edge903.sydney.telstra.net (139.130.0.77)  2.340 ms  2.311 ms  2.275 ms
10  bundle-ether2.chw-edge903.sydney.telstra.net (203.50.11.175)  2.187 ms  2.278 ms  2.230 ms
11  bundle-ether10.win-core10.melbourne.telstra.net (203.50.11.123)  14.810 ms  14.787 ms  13.292 ms
12  203.50.6.40 (203.50.6.40)  15.681 ms bundle-ether8.exi-core10.melbourne.telstra.net (203.50.11.125)  14.430 ms  15.170 ms
13  bundle-ether2.exi-ncprouter101.melbourne.telstra.net (203.50.11.209)  13.405 ms  13.267 ms  13.289 ms
14  www.telstra.net (203.50.5.178)  12.695 ms  13.934 ms  12.544 ms
```

Exercise 4

1. compute the shortest possible time T for a packet to reach that location from UNSW

Destination	Shortest time/s	RTT(50 byte packet)	RTT/T
www.uq.edu.au	0.00314	16.401	5.223
www.dlsu.edu.ph	0.0207	298.420	14.416
www.tu-berlin.de	0.0537	277.233	5.163



Can you think of at least two reasons why the y-axis values that you plot are greater than 2?

→ Round Trip Time is counting the time it takes for a packet to travel from source to destination and back to source. T is the shortest time to reach destination from source , so RTT would be at least twice as big as T. There is also other end to end delay causing the y-axis to be greater than 2.

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

→It vary over time. Because delay depend on location of specific pair of communication endpoints and it will also vary due to external factor such as temperature.

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

→No www.epfl.ch is not hosted in Switzerland. It is hosted at San Francisco in US.

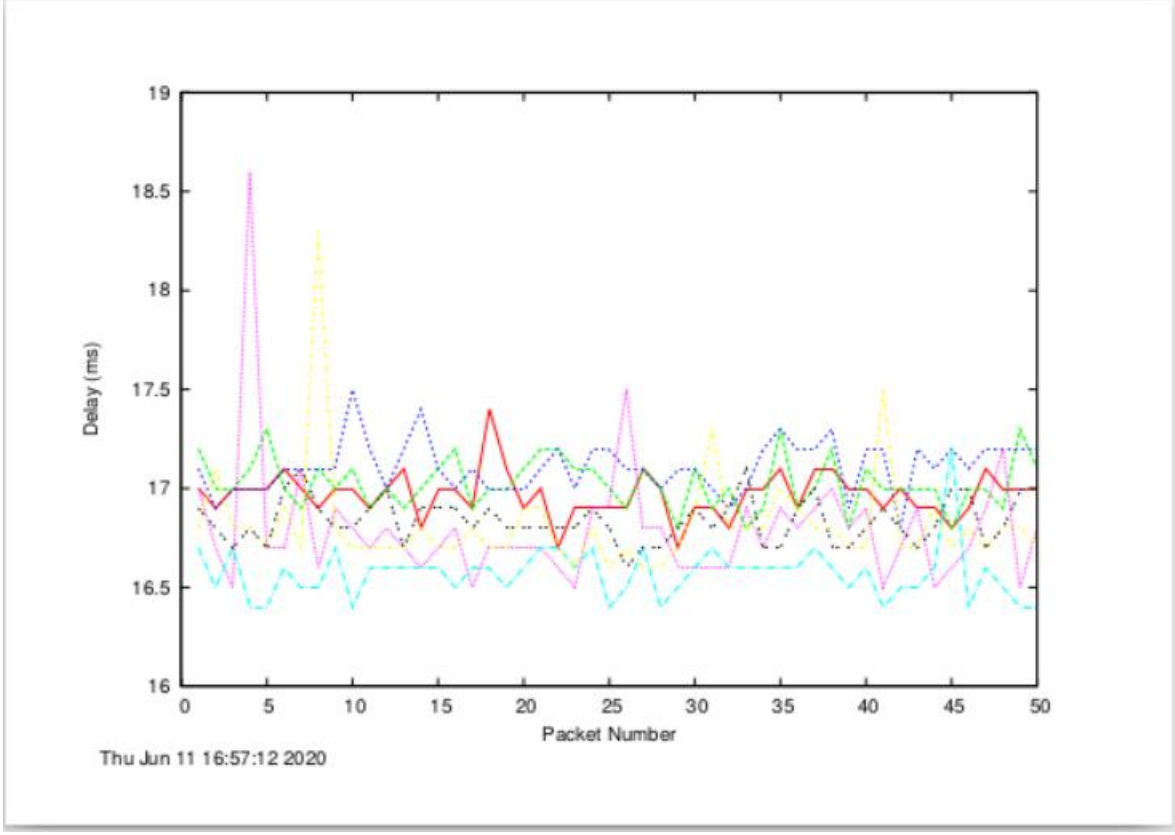
```
OrgName:        Cloudflare, Inc.
OrgId:          CLOUD14
Address:        101 Townsend Street
City:           San Francisco
StateProv:      CA
PostalCode:     94107
Country:        US
RegDate:        2010-07-09
Updated:        2019-09-25
Ref:            https://rdap.arin.net/registry/entity/CLOUD14
```

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?

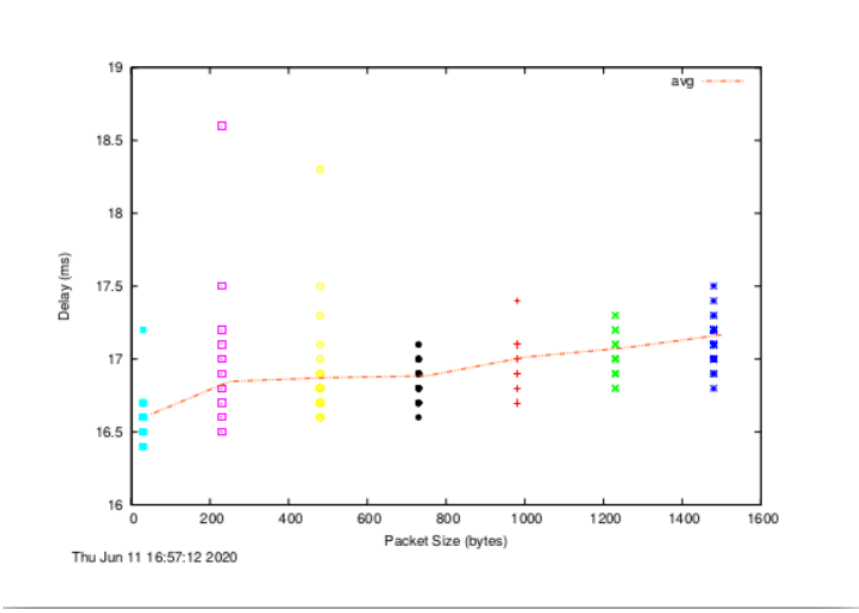
→transmission delay is affected by packet size

→Propagation delay , queuing delay and processing delay is not affected by packet size

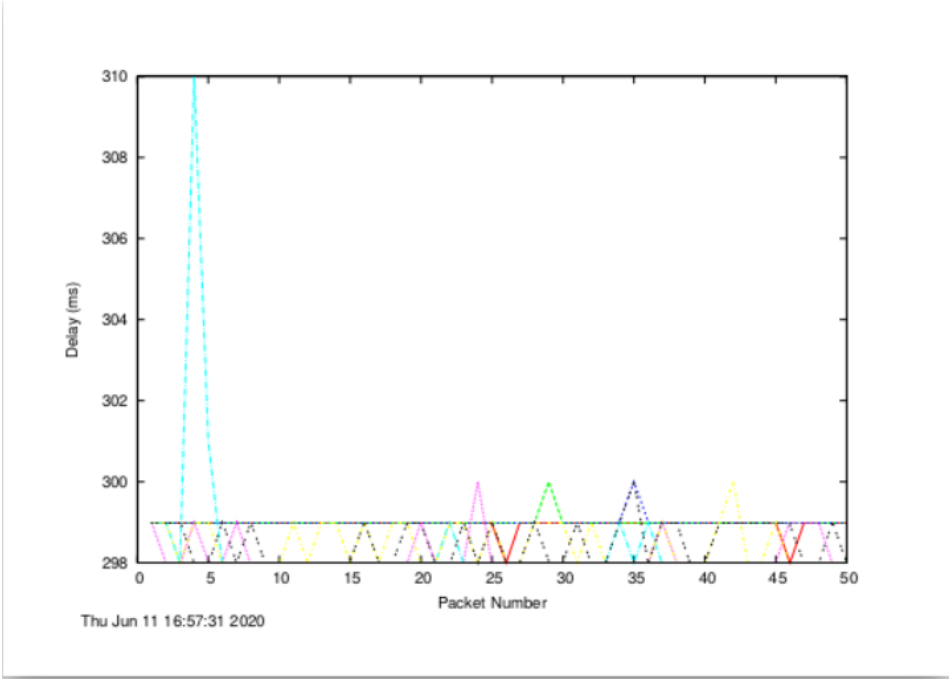
Uq_delay.pdf



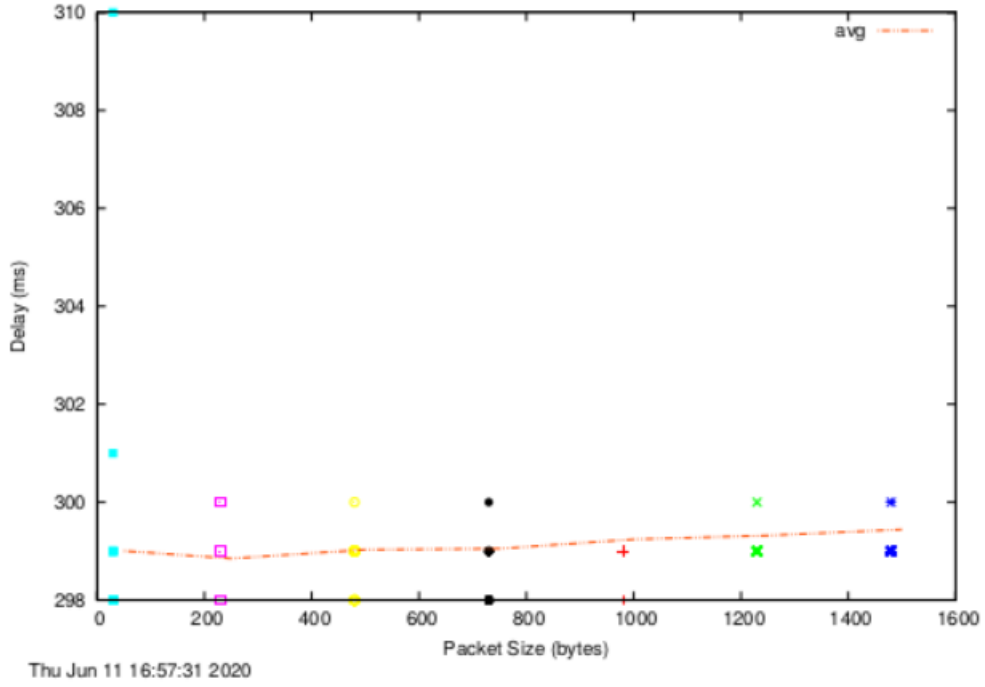
Uq_scatter.pdf



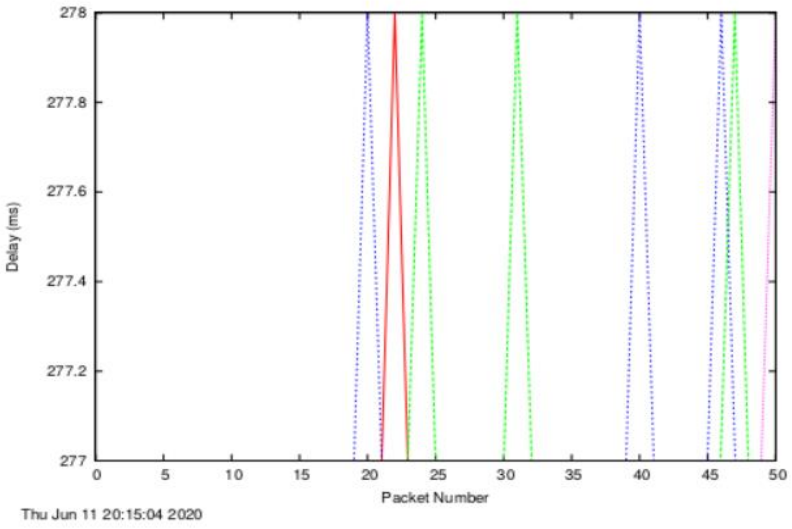
Dlsu_delay.pdf



Dlsu_scatter.pdf



Berlin_delay.txt



Berlin_scatter.pdf