Exercise 1:
1. IP address: 104.18.60.21/ 104.18.61.21/ 172.67.219.46

```
z5235242@vx5:/tmp_amd/reed/export/reed/5/z5235242/Desktop$ nslookup www.koala.co
m.au
Server:         129.94.242.45
Address:        129.94.242.45#53

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

z5235242@vx5:/tmp_amd/reed/export/reed/5/z5235242/Desktop$ 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.
```

Having several IP addresses could help the searchers to choose the IP address they prefer to use. And it could be also related to load balancing.

2.
Name: localhost
Special: it refers to 'this computer' itself.

Exercise 2:
www.unsw.edu.au:reachable
www.getfittest.com.au: unknown host, neither reachable from the Web browser. Because it's not a legitimate website.
www.mit.edu:reachable
www.intel.com.au:reachable
www.tpg.com.au:reachable
www.hola.hp: unknown host, neither reachable from the Web browser. Because the host link is unknown and DNS could not be found.
www.amazon.com reachable
www.tsinghua.edu.cn reachable
www.kremlin.ru unreachable, packets transmitted while nothing received. But reachable from the Web browser. Because it disables ICMP.
8.8.8.8 reachable

Exercise 3:
1.

```
z5235242@vx5:/tmp_amd/reed/export/reed/5/z5235242/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)  0.084 ms  0.058 ms  0.055 ms
 2  129.94.39.17 (129.94.39.17)  0.840 ms  0.791 ms  0.831 ms
 3  libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34)  1.365 ms ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35)  1.607 ms  1.563 ms
 4  libcr1-po-6.gw.unsw.edu.au (149.171.255.201)  1.051 ms libcr1-po-5.gw.unsw.edu.au (149.171.255.165)  1.070 ms ombcr1-po-5.gw.unsw.edu.au (149.171.255.197)  1.075 ms
 5  unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101)  27.519 ms  27.522 ms unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  27.509 ms
 6  138.44.5.0 (138.44.5.0)  1.302 ms  1.316 ms  1.264 ms
 7  et-1-3-0.pe1.sxt.bkvl.nsw.aarnet.net.au (113.197.15.149)  2.241 ms  2.244 ms  2.258 ms
 8  et-0-0-0.pe1.a.hnl.aarnet.net.au (113.197.15.99)  95.150 ms  95.209 ms  95.136 ms
 9  et-2-1-0.bdr1.a.sea.aarnet.net.au (113.197.15.201)  146.953 ms  146.875 ms  146.901 ms
10  abilene-1-lo-jmb-706.sttlwa.pacificwave.net (207.231.240.8)  147.062 ms  147.026 ms  147.037 ms
11  ae-1.4079.rtsw.minn.net.internet2.edu (162.252.70.173)  179.628 ms  179.576 ms  179.617 ms
12  ae-1.4079.rtsw.eqch.net.internet2.edu (162.252.70.106)  187.474 ms  189.953 ms  189.941 ms
13  ae-0.4079.rtsw3.eqch.net.internet2.edu (162.252.70.163)  191.084 ms  189.891 ms  189.840 ms
14  ae-1.4079.rtsw.clev.net.internet2.edu (162.252.70.130)  196.065 ms  196.281 ms  196.111 ms
15  buf-9208-I2-CLEV.nysernet.net (199.109.11.33)  200.446 ms  200.418 ms  200.372 ms
16  syr-9208-buf-9208.nysernet.net (199.109.7.193)  203.597 ms  203.897 ms  203.541 ms
17  nyc111-9204-syr-9208.nysernet.net (199.109.7.94)  212.756 ms  247.748 ms  220.730 ms
18  nyc-9208-nyc111-9204.nysernet.net (199.109.7.165)  219.248 ms  213.024 ms  221.745 ms
19  columbia.nyc-9208.nysernet.net (199.109.4.14)  212.828 ms  212.867 ms  212.956 ms
20  cc-core-1-x-nyser32-gw-1.net.columbia.edu (128.59.255.5)  213.302 ms  213.200 ms  213.343 ms
21  cc-conc-1-x-cc-core-1.net.columbia.edu (128.59.255.21)  213.403 ms  213.239 ms  213.328 ms
22  exeas.org (128.59.105.24)  213.094 ms  213.224 ms  213.091 ms
z5235242@vx5:/tmp_amd/reed/export/reed/5/z5235242/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=2.27 ms
64 bytes from 113.197.15.149: icmp_seq=2 ttl=58 time=1.91 ms
64 bytes from 113.197.15.149: icmp_seq=3 ttl=58 time=2.10 ms
^C
--- 113.197.15.149 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2000ms
rtt min/avg/max/mdev = 1.912/2.098/2.275/0.148 ms
z5235242@vx5:/tmp_amd/reed/export/reed/5/z5235242/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=94.9 ms
64 bytes from 113.197.15.99: icmp_seq=2 ttl=57 time=94.9 ms
^C
--- 113.197.15.99 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1000ms
rtt min/avg/max/mdev = 94.936/94.937/94.939/0.308 ms
z5235242@vx5:/tmp_amd/reed/export/reed/5/z5235242/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=146 ms
64 bytes from 113.197.15.201: icmp_seq=2 ttl=56 time=146 ms
^C
--- 113.197.15.201 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1000ms
rtt min/avg/max/mdev = 146.930/146.939/146.948/0.009 ms
z5235242@vx5:/tmp_amd/reed/export/reed/5/z5235242/Desktop$
```

There are 21 routers between my workstation and www.columbia.edu.
The first 5 are part of the UNSW network.
Packets cross the Pacific Ocean between 7 and 9.(NSW to Honolulu to Seattle)

2.

```
z5235242@vx5:/tmp_amd/reed/export/reed/5/z5235242/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)  0.096 ms  0.082 ms  0.068 ms
 2  129.94.39.17 (129.94.39.17)  0.814 ms  0.844 ms  0.794 ms
 3  libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34)  1.202 ms ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35)  1.547 ms  1.551 ms
 4  ombcr1-po-6.gw.unsw.edu.au (149.171.255.169)  1.365 ms libcr1-po-5.gw.unsw.edu.au (149.171.255.165)  1.101 ms  1.133 ms
 5  unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  1.329 ms  1.235 ms  1.316 ms
 6  138.44.5.0 (138.44.5.0)  1.434 ms  1.361 ms  1.307 ms
 7  et-1-1-0.pe1.rsby.nsw.aarnet.net.au (113.197.15.12)  1.893 ms  7.937 ms  7.933 ms
 8  xe-1-1-0.pe1.eskp.nsw.aarnet.net.au (113.197.15.199)  2.884 ms  2.916 ms  3.008 ms
 9  et-0-3-0.pe1.prka.sa.aarnet.net.au (113.197.15.42)  20.506 ms  20.367 ms  20.319 ms
10  et-0-3-0.pe1.knsg.wa.aarnet.net.au (113.197.15.45)  48.678 ms  48.677 ms  48.755 ms
11  et-2-1-2.bdr2.sing.sin.aarnet.net.au (113.197.15.247)  92.027 ms  92.028 ms  91.846 ms
12  ae1.bdr1.sing.sin.aarnet.net.au (113.197.15.234)  91.806 ms  92.097 ms  91.844 ms
13  138.44.226.7 (138.44.226.7)  258.776 ms  258.689 ms  259.173 ms
14  janet-gw.mx1.lon.uk.geant.net (62.40.124.198)  259.244 ms  259.241 ms  259.142 ms
15  ae29.londpg-sbr2.ja.net (146.97.33.2)  259.263 ms  259.402 ms  259.404 ms
16  ae31.erdiss-sbr2.ja.net (146.97.33.22)  263.360 ms  263.439 ms  265.146 ms
17  ae29.manckh-sbr2.ja.net (146.97.33.42)  265.372 ms  265.393 ms  265.447 ms
18  ae24.lanclu-rbr1.ja.net (146.97.38.58)  267.226 ms  267.271 ms  267.263 ms
19  lancaster-university.ja.net (194.81.46.2)  286.363 ms  285.986 ms  285.351 ms
20  is-border01.bfw01.rtr.lancs.ac.uk (148.88.253.202)  267.991 ms  267.913 ms  268.048 ms
21  bfw01.iss-servers.is-core01.rtr.lancs.ac.uk (148.88.250.98)  272.950 ms  270.036 ms  270.052 ms
22  * * *
23  www.lancs.ac.uk (148.88.65.80)  267.723 ms !X  268.019 ms !X  267.933 ms !X
```

```
z5235242@vx5:/tmp_amd/reed/export/reed/5/z5235242/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)  0.084 ms  0.067 ms  0.053 ms
 2  129.94.39.17 (129.94.39.17)  0.915 ms  0.863 ms  0.815 ms
 3  ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35)  1.918 ms  1.366 ms  1.832 ms
 4  ombcr1-po-6.gw.unsw.edu.au (149.171.255.169)  1.132 ms ombcr1-po-5.gw.unsw.edu.au (149.171.255.197)  1.088 ms libcr1-po-5.gw.unsw.edu.au (149.171.255.165)  1.091 ms
 5  unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101)  1.103 ms unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  1.184 ms  1.189 ms
 6  138.44.5.0 (138.44.5.0)  1.286 ms  1.547 ms  1.532 ms
 7  et-1-3-0.pe1.sxt.bkvl.nsw.aarnet.net.au (113.197.15.149)  2.261 ms  2.174 ms  2.122 ms
 8  et-0-0-0.pe1.a.hnl.aarnet.net.au (113.197.15.99)  95.222 ms  95.184 ms  95.265 ms
 9  et-2-1-0.bdr1.a.sea.aarnet.net.au (113.197.15.201)  146.939 ms  146.936 ms  146.933 ms
10  cenichpr-1-is-jmb-778.snvaca.pacificwave.net (207.231.245.129)  164.216 ms  164.172 ms  163.393 ms
11  hpr-lax-hpr3--svl-hpr3-100ge.cenic.net (137.164.25.73)  160.648 ms  159.990 ms  159.819 ms
12  * * *
13  bd11f1.anderson--cr00f2.csb1.ucla.net (169.232.4.4)  160.513 ms  160.574 ms  161.228 ms
14  cr00f1.anderson--rtr11f4.mathsci.ucla.net (169.232.8.185)  161.481 ms  161.367 ms  161.165 ms
15  * * *
16  * * *
17  * * *
18  * * *
19  * * *
20  * * *
21  * * *
22  * * *
23  * * *
24  * * *
25  * * *
26  * * *
27  * * *
28  * * *
29  * * *
30
```

```
z5235242@vx5:/tmp_amd/reed/export/reed/5/z5235242/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)  0.079 ms  0.055 ms  0.054 ms
 2  129.94.39.17 (129.94.39.17)  0.817 ms  0.857 ms  0.858 ms
 3  libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34)  1.580 ms ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35)  9.943 ms libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34)  1.563 ms
 4  libcr1-po-6.gw.unsw.edu.au (149.171.255.201)  1.126 ms ombcr1-po-6.gw.unsw.edu.au (149.171.255.169)  1.086 ms libcr1-po-6.gw.unsw.edu.au (149.171.255.201)  1.108 ms
 5  unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101)  1.133 ms  1.158 ms  1.165 ms
 6  138.44.5.0 (138.44.5.0)  1.381 ms  1.185 ms  1.220 ms
 7  et-0-3-0.pe1.bkvl.nsw.aarnet.net.au (113.197.15.147)  1.738 ms  1.655 ms  1.802 ms
 8  ge-4_0_0.bb1.a.pao.aarnet.net.au (202.158.194.177)  155.057 ms  155.066 ms  155.043 ms
 9  paloalto0.iij.net (198.32.176.24)  156.501 ms  156.499 ms  156.537 ms
10  osk004bb00.IIJ.Net (58.138.88.185)  286.940 ms  287.112 ms osk004bb01.IIJ.Net (58.138.88.189)  269.258 ms
11  osk004ip57.IIJ.Net (58.138.106.166)  269.150 ms  269.236 ms  269.130 ms
12  210.130.135.130 (210.130.135.130)  287.085 ms  286.872 ms  278.059 ms
13  124.83.228.58 (124.83.228.58)  286.958 ms  356.399 ms  356.382 ms
14  124.83.252.178 (124.83.252.178)  293.063 ms  292.931 ms  284.682 ms
15  158.205.134.26 (158.205.134.26)  292.953 ms  293.004 ms  284.062 ms
16  158.205.121.46 (158.205.121.46)  292.980 ms  284.297 ms  284.155 ms
17  * * *
18  * * *
19  * * *
20  * * *
21  * * *
22  * * *
23  * * *
24  * * *
25  * * *
26  * * *
27  * * *
28  * * *
29  * * *
30  * * *
```

Diverge at the 6th router 138.44.5.0.
Details:

```
z5235242@vx5:/tmp_amd/reed/export/reed/5/z5235242/Desktop$ whois 138.44.5.0

#
# ARIN WHOIS data and services are subject to the Terms of Use
# available at: https://www.arin.net/resources/registry/whois/tou/
#
# If you see inaccuracies in the results, please report at
# https://www.arin.net/resources/registry/whois/inaccuracy_reporting/
#
# Copyright 1997-2020, American Registry for Internet Numbers, Ltd.
#


NetRange:       138.44.0.0 - 138.44.255.255
CIDR:           138.44.0.0/16
NetName:        APNIC-ERX-138-44-0-0
NetHandle:      NET-138-44-0-0-1
Parent:         NET138 (NET-138-0-0-0-0)
NetType:        Early Registrations, Transferred to APNIC
OriginAS:
Organization:   Asia Pacific Network Information Centre (APNIC)
RegDate:        2003-12-11
Updated:        2009-10-08
Comment:        This IP address range is not registered in the ARIN database.
Comment:        This range was transferred to the APNIC Whois Database as
Comment:        part of the ERX (Early Registration Transfer) project.
Comment:        For details, refer to the APNIC Whois Database via
Comment:        WHOIS.APNIC.NET or http://wq.apnic.net/apnic-bin/whois.pl
Comment:
Comment:        ** IMPORTANT NOTE: APNIC is the Regional Internet Registry
Comment:        for the Asia Pacific region.  APNIC does not operate networks
Comment:        using this IP address range and is not able to investigate
Comment:        spam or abuse reports relating to these addresses.  For more
Comment:        help, refer to http://www.apnic.net/apnic-info/whois_search2/abu
se-and-spamming
Ref:            https://rdap.arin.net/registry/ip/138.44.0.0
```

The numbers of hops on each path is not proportional the physical distance. It only reflect the number of relay stations.
(Physical distance LancasterUniversity>UCLA>U-Tokyo ,
but numbers of hops UCLA = U-Tokyo > LancasterUniversity)
3.
http://www.speedtest.com.sg
IP:202.150.221.170
Run traceroute from its server:

```
traceroute to 129.94.242.118 (129.94.242.118), 30 hops max, 60 byte packets
 1  ge2-8.r01.sin01.ne.com.sg (202.150.221.169)  0.164 ms  0.184 ms  0.205 ms
 2  10.11.34.146 (10.11.34.146)  0.405 ms  0.505 ms  0.586 ms
 3  aarnet.sgix.sg (103.16.102.67)  207.542 ms  207.521 ms  207.545 ms
 4  et-7-1-0.pe1.brwy.nsw.aarnet.net.au (113.197.15.13)  207.636 ms  207.647 ms  207.655 ms
 5  138.44.5.1 (138.44.5.1)  204.002 ms  203.785 ms  203.818 ms
 6  libcr1-te-1-5.gw.unsw.edu.au (149.171.255.102)  296.596 ms  294.757 ms  293.028 ms
 7  libudnex1-po-1.gw.unsw.edu.au (149.171.255.166)  202.542 ms ombudnex1-po-1.gw.unsw.edu.au (149.171.255.202)  211.667 m
 8  ufw1-ae-1-3154.gw.unsw.edu.au (149.171.253.36)  208.381 ms  208.740 ms  208.764 ms
 9  129.94.39.23 (129.94.39.23)  208.718 ms  208.468 ms  208.437 ms
10  * * *
11  * * *
12  * * *
13  * * *
14  * * *
15  * * *
16  * * *
17  * * *
18  * * *
19  * * *
20  * * *
21  * * *
22  * * *
23  * * *
24  * * *
25  * * *
26  * * *
27  * * *
28  * * *
29  * * *
30  * * *
```

In the reverse direction:

```
z5235242@vx7:/tmp_amd/reed/export/reed/5/z5235242/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)  0.084 ms  0.067 ms  0.050 ms
 2  129.94.39.17 (129.94.39.17)  0.912 ms  0.916 ms  0.851 ms
 3  libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34)  1.887 ms  1.836 ms  1.872 ms
 4  ombcr1-po-6.gw.unsw.edu.au (149.171.255.169)  1.107 ms  1.133 ms libcr1-po-5.gw.unsw.edu.au (149.171.255.165)  1.088 ms
 5  unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  1.154 ms  1.175 ms  1.198 ms
 6  138.44.5.0 (138.44.5.0)  1.326 ms  1.324 ms  1.259 ms
 7  et-0-3-0.pe1.alxd.nsw.aarnet.net.au (113.197.15.153)  1.695 ms  1.637 ms  1.750 ms
 8  xe-0-2-7.bdr1.a.lax.aarnet.net.au (202.158.194.173)  147.661 ms  147.597 ms  147.608 ms
 9  singtel.as7473.any2ix.coresite.com (206.72.210.63)  147.977 ms  147.948 ms  160.955 ms
10  203.208.173.81 (203.208.173.81)  320.996 ms 203.208.171.117 (203.208.171.117)  148.384 ms  148.391 ms
11  203.208.171.85 (203.208.171.85)  243.020 ms 203.208.151.233 (203.208.151.233)  249.031 ms 203.208.177.110 (203.208.177.110)  328.393 ms
12  * * *
13  203.208.177.110 (203.208.177.110)  330.153 ms 202-150-221-170.rev.ne.com.sg (202.150.221.170)  200.081 ms  204.596 ms
```

http://www.telstra.net
IP:203.50.5.178
Run traceroute from its server:

```
 1  gigabitethernet3-3.exi2.melbourne.telstra.net (203.50.77.53)  0.363 ms  0.212 ms  0.246 ms
 2  bundle-ether3-100.win-core10.melbourne.telstra.net (203.50.80.129)  2.495 ms  1.736 ms  2.245 ms
 3  bundle-ether12.ken-core10.sydney.telstra.net (203.50.11.122)  14.008 ms  12.487 ms  12.732 ms
 4  bundle-ether1.ken-edge903.sydney.telstra.net (203.50.11.173)  12.224 ms  12.113 ms  12.106 ms
 5  aar3533567.lnk.telstra.net (139.130.0.78)  11.598 ms  11.617 ms  11.603 ms
 6  et-7-1-0.pe1.brwy.nsw.aarnet.net.au (113.197.15.13)  11.848 ms  12.616 ms  11.834 ms
 7  138.44.5.1 (138.44.5.1)  12.104 ms  12.473 ms  11.984 ms
 8  ombcr1-te-1-5.gw.unsw.edu.au (149.171.255.106)  12.112 ms  11.972 ms  11.988 ms
 9  libudnex1-po-2.gw.unsw.edu.au (149.171.255.198)  12.483 ms  12.348 ms  12.359 ms
10  ufw1-ae-1-3154.gw.unsw.edu.au (149.171.253.36)  12.735 ms  12.724 ms  12.735 ms
11  129.94.39.23 (129.94.39.23)  12.985 ms  12.851 ms  12.859 ms
```

In the reverse direction:

```
z5235242@vx7:/tmp_amd/reed/export/reed/5/z5235242/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)  0.086 ms  0.067 ms  0.083 ms
 2  129.94.39.17 (129.94.39.17)  0.898 ms  0.853 ms  0.887 ms
 3  libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34)  1.331 ms ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35)  1.574 ms  1.594 ms
 4  ombcr1-po-5.gw.unsw.edu.au (149.171.255.197)  1.158 ms ombcr1-po-6.gw.unsw.edu.au (149.171.255.169)  1.128 ms libcr1-po-6.gw.unsw.edu.au (149.171.255.201)  1.139 ms
 5  unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  1.130 ms  1.176 ms  1.118 ms
 6  138.44.5.0 (138.44.5.0)  1.278 ms  1.221 ms  1.219 ms
 7  et-1-1-0.pe1.rsby.nsw.aarnet.net.au (113.197.15.12)  1.609 ms  1.830 ms  1.643 ms
 8  xe-0-0-3.bdr1.rsby.nsw.aarnet.net.au (113.197.15.31)  1.693 ms  1.667 ms  1.626 ms
 9  HundredGigE0-1-0-4.ken-edge903.sydney.telstra.net (139.130.0.77)  2.235 ms  2.248 ms  2.186 ms
10  bundle-ether17.ken-core10.sydney.telstra.net (203.50.11.172)  3.462 ms bundle-ether2.chw-edge903.sydney.telstra.net (203.50.11.175)  2.385 ms  2.265 ms
11  bundle-ether17.chw-core10.sydney.telstra.net (203.50.11.176)  2.956 ms  3.542 ms  3.115 ms
12  203.50.6.40 (203.50.6.40)  13.979 ms bundle-ether8.exi-core10.melbourne.telstra.net (203.50.11.125)  13.140 ms 203.50.6.40 (203.50.6.40)  13.964 ms
13  bundle-ether2.exi-ncprouter101.melbourne.telstra.net (203.50.11.209)  13.229 ms  15.423 ms  15.384 ms
14  www.telstra.net (203.50.5.178)  12.672 ms  12.613 ms  12.718 ms
z5235242@vx7:/tmp_amd/reed/export/reed/5/z5235242/Desktop$
```
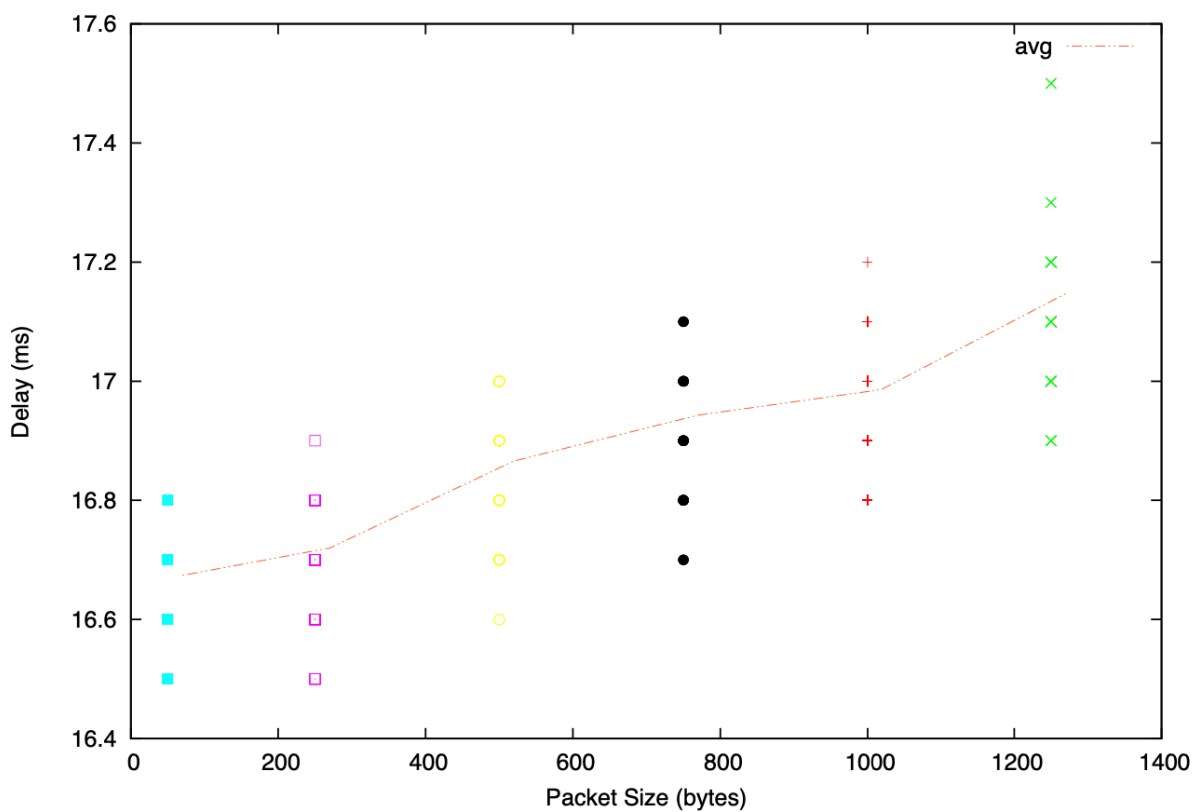
The reserve path does not go through the same routers as the forward path. There is no same IP addresses can be found. This is because it is an asymmetric path. Distribution mechanism of links decides which router jump to or sometime considering the load congestion, distributing different paths. This may also related to load balancing.
Except for telstra. 138.44.5.0 and 138.44.5.1 may refer to a same router.
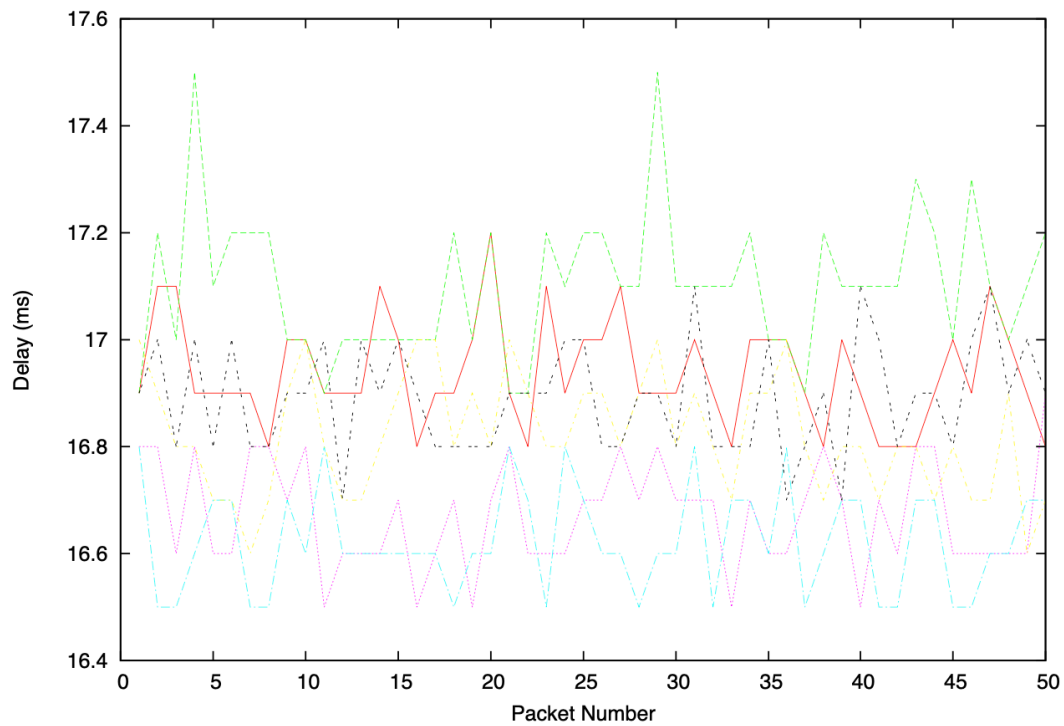
Exercise 4

```
www.uq.edu.au_avg.txt

70 16.674 16.529
270 16.720 16.566
520 16.866 16.682
770 16.943 16.777
1020 16.986 16.823
1270 17.147 16.973
```

```
70 299.242 298.743
270 299.292 298.852
520 299.239 298.923
770 299.339 299.094
1020 299.539 299.133
1270 299.775 299.355
```

```
70 277.170 277.050
270 277.227 277.104
520 277.335 277.212
770 277.425 277.300
1020 277.498 277.391
1270 277.583 277.481
```
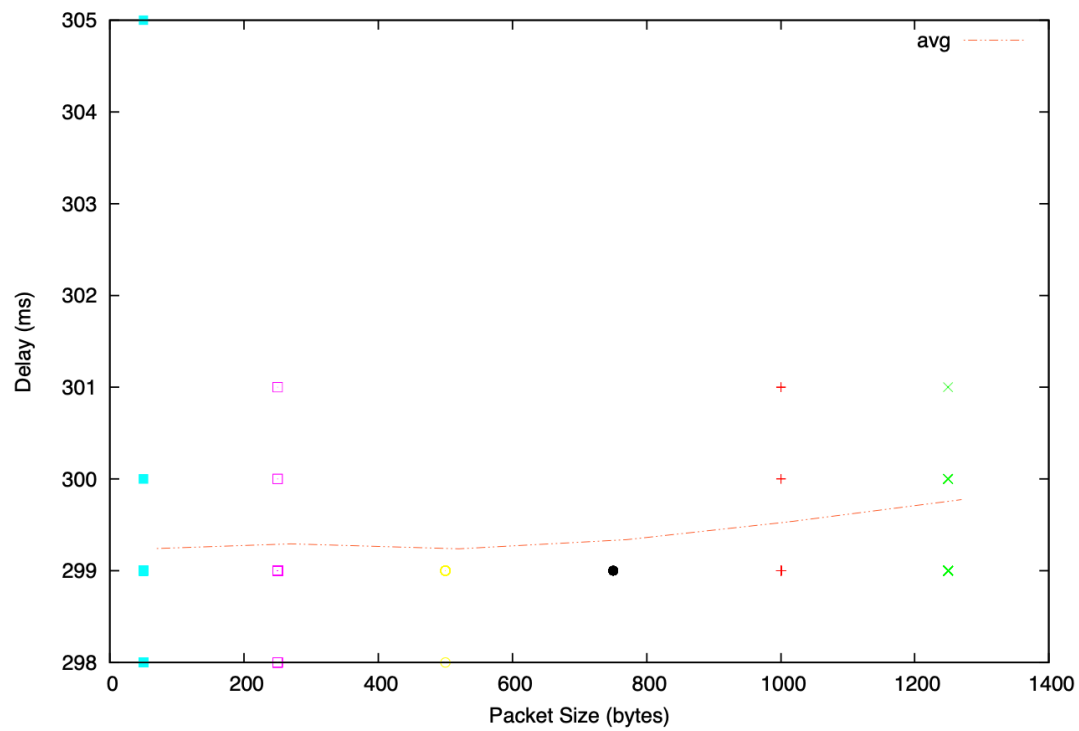

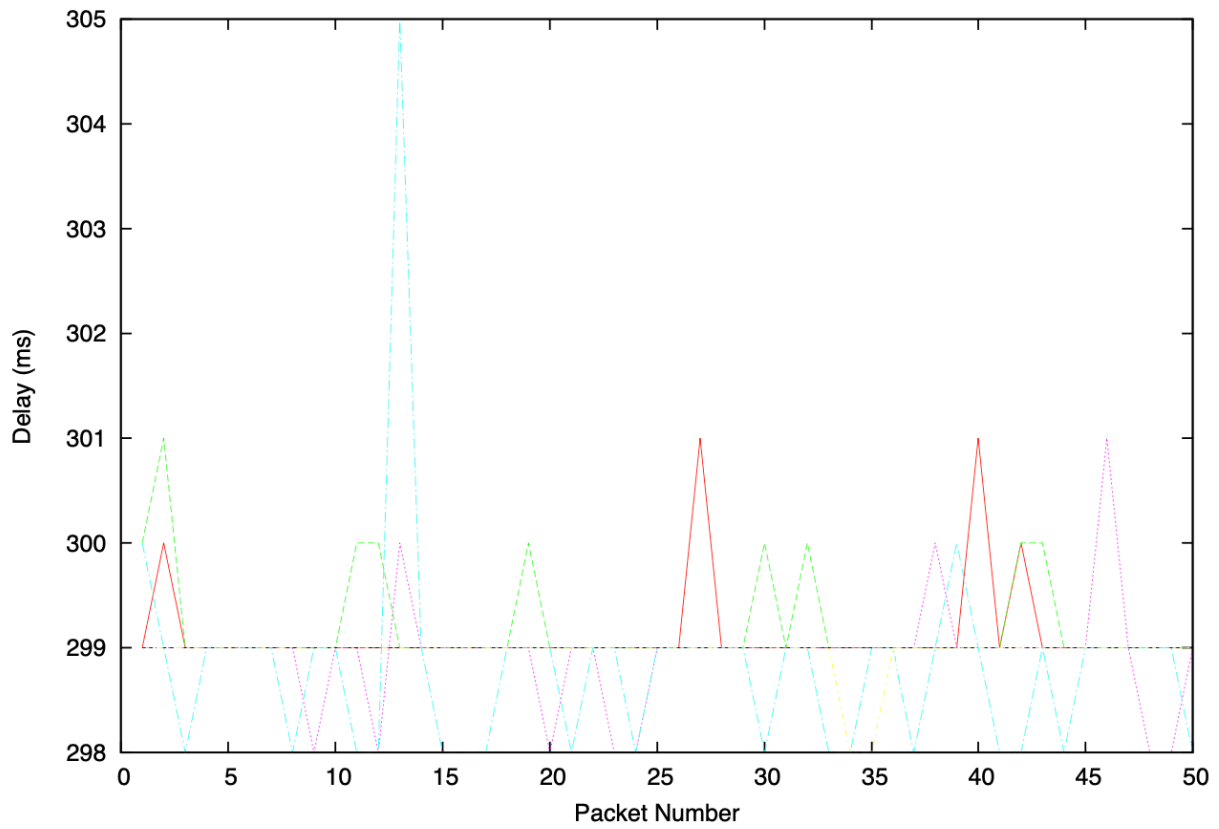Sat Jun 13 03:39:04 2020

www.uq.edu.au_scatter

Delay (ms)

17.6
17.4
17.2
17
16.8
16.6
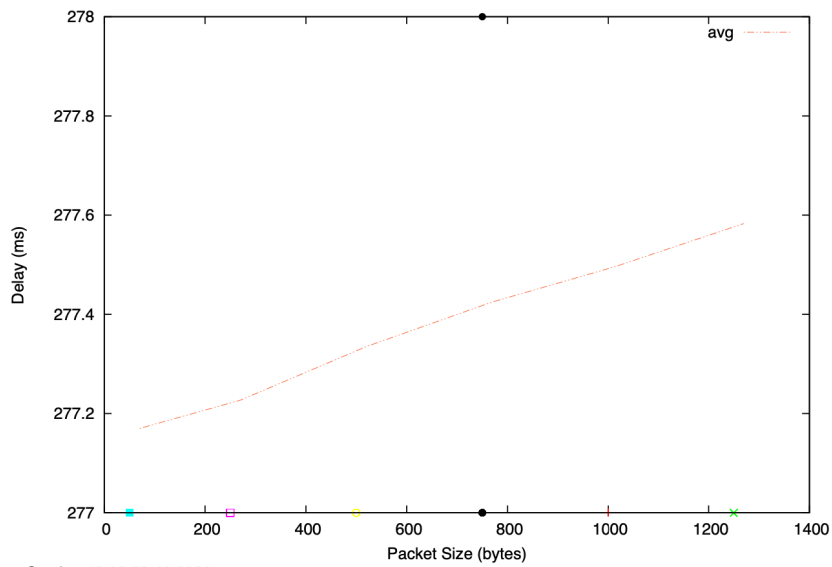16.4

Packet Number

Sat Jun 13 03:39:04 2020

www.uq.edu.au_delay

Delay (ms)

305
304
303
302
301
300
299
298

Packet Size (bytes)

avg

Sat Jun 13 03:51:51 2020

www.disu.edu.ph_scatter

305

304

303

302

301

Delay (ms)

300

299

298

0   5   10   15   20   25   30   35   40   45   50

Packet Number

Sat Jun 13 03:51:51 2020

www.dlsu.edu.ph_delay

278

277.8

277.6

Delay (ms)

277.4

277.2

277

0   200   400   600   800   1000   1200   1400

Packet Size (bytes)

avg

Sat Jun 13 03:58:40 2020

www.tu-berlin.de_scatter
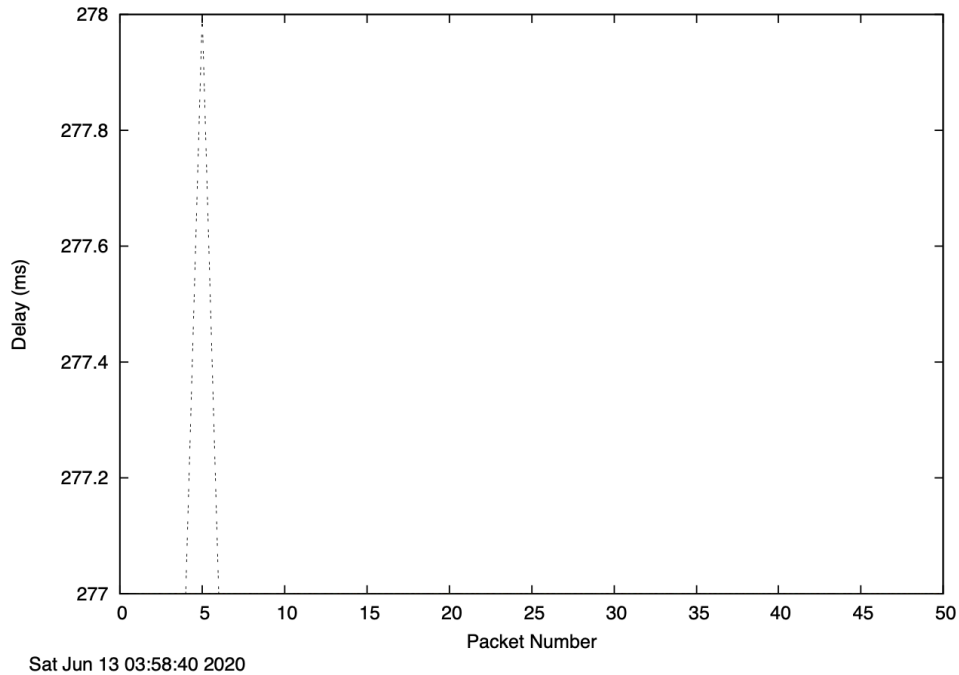
www.tu-berlin.de_delay

1.
Physical Distance to UNSW:
University of Queensland: 734km
De La Salle University: 6270km
Technische University Berlin: 16105km
Speed of Light: 3*10^8 m/s = 300000 km/s
Thus the shortest possible time T for a packet to reach:
www.uq.edu.au : 734/300000 = 0.0024s = 2.4ms
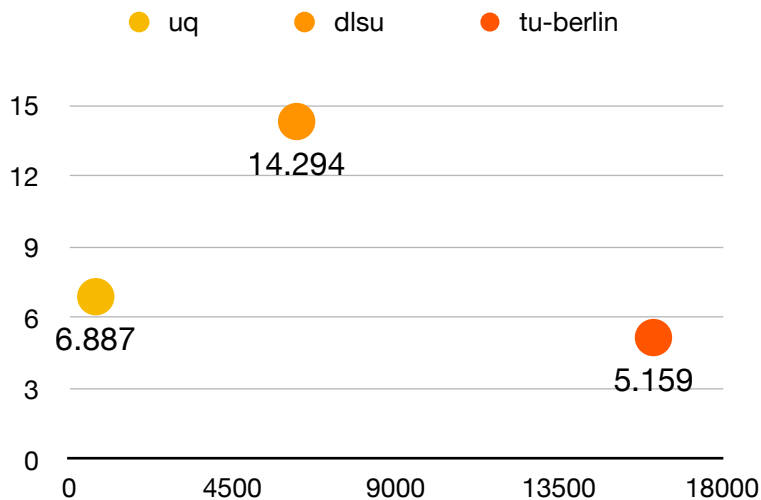(ratio between RTT and T = 16.529/2.4=6.887)
www.dlsu.edu.ph : 6270/300000 = 0.0209s = 20.9ms
(ratio between RTT and T = 298.743/20.9=14.294)
www.tu-berlin.de : 16105/300000 = 0.0537 = 53.7ms
(ratio between RTT and T = 277.050/53.7 = 5.159)

Reasons:

a. Different kinds of delay when crossing routers need to wait for queuing cache and even lost packe, or waiting for receiving complete packet to transmit.

b. Propagation speed is actually less than speed of light.

2.

It varies over time. Because the existence of many kinds of delay. Additional, the use of packet switching may make use of statistical multiplexing. The resource flow could be allocated and shared dynamically.

Sat Jun 13 03:39:04 2020
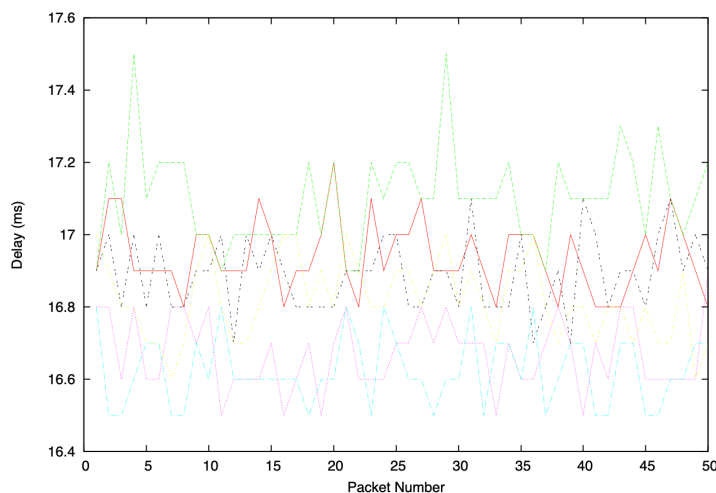
3.

No it is not in Switzerland. It resolves to a Cloudflare IP. When ping it, it only takes -2ms, so it should be hosted at Sydney.

```
*********************************************************************
wagner % ping www.epfl.ch
PING www.epfl.ch.cdn.cloudflare.net (104.20.228.42) 56(84) bytes of data.
64 bytes from 104.20.228.42: icmp_seq=1 ttl=56 time=1.65 ms
64 bytes from 104.20.228.42: icmp_seq=2 ttl=56 time=1.62 ms
64 bytes from 104.20.228.42: icmp_seq=3 ttl=56 time=1.61 ms
64 bytes from 104.20.228.42: icmp_seq=4 ttl=56 time=1.59 ms
64 bytes from 104.20.228.42: icmp_seq=5 ttl=56 time=1.68 ms
^C
--- www.epfl.ch.cdn.cloudflare.net ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4006ms
rtt min/avg/max/mdev = 1.598/1.634/1.684/0.059 ms
wagner %
```

4.

Transmission and Processing delay depend on packet size, while propagation and queueing delay don't.