

# COMP9331 Computer Networks and Applications

## Lab1

Name: Wenke Yang  
zID: z5230655

### Exercise 1: nslookup

1. IP address of the website [www.koala.com.au](http://www.koala.com.au) is: **104.18.61.21 and 104.18.60.21**, both of them are non-authoritative. In my opinion, one of the reason of having several IP addresses can be to balance the workload between different servers. Also, different regions might have different servers so that users can select the servers that are closer to them to speed up the access.
2. The name is **localhost**. This address is reserved for the local computer to access the network interface of itself (which is also called loopback). This means that when you call localhost, you are communicating with your own computer. Localhost is useful to test web applications during development because the connection to the computer itself is superfast. Besides, each computer has the same localhost IP address, 127.0.0.1 is IPV4.

### Exercise 2: Use ping to test host reachability

- [www.unsw.edu.au](http://www.unsw.edu.au) **Reachable**
- [www.getfittest.com.au](http://www.getfittest.com.au) **Unreachable**: cannot resolve www.getfittest.com.au: Unknown host
- [www.mit.edu](http://www.mit.edu) **Reachable**
- [www.intel.com.au](http://www.intel.com.au) **Reachable**
- [www.tpg.com.au](http://www.tpg.com.au) **Reachable**
- [www.hola.hp](http://www.hola.hp) **Unreachable**: cannot resolve www.hola.hp: Unknown host
- [www.amazon.com](http://www.amazon.com) **Reachable**
- [www.tsinghua.edu.cn](http://www.tsinghua.edu.cn) **Reachable**
- [www.kremlin.ru](http://www.kremlin.ru) **Unreachable**  
PING www.kremlin.ru (95.173.136.70): 56 data bytes  
  
--- www.kremlin.ru ping statistics ---  
1 packets transmitted, 0 packets received, 100.0% packet loss
- 8.8.8.8 **Reachable**

There are three hosts that are not reachable by ping command, [www.getfittest.com.au](http://www.getfittest.com.au), [www.hola.hp](http://www.hola.hp) and [www.kremlin.ru](http://www.kremlin.ru).

The former two hosts: [www.getfittest.com.au](http://www.getfittest.com.au) and [www.hola.hp](http://www.hola.hp) both have invalid host names and are both not reachable by web browser. After using nslookup command to query DNS server to parse these two hosts, both of them returns 'server can't find' which means these hosts do not exist so we can't access.

However, the last host [www.kremlin.ru](http://www.kremlin.ru) can actually be accessed via web browser. From the printed information we can see that the connection between local and host [www.kremlin.ru](http://www.kremlin.ru) was established, and packet is transmitted, however, none of the packets is received. This means the host name exists, and the host works fine via web browser means the server is working fine, so the reason that the packet is not received might be because the server blocked the PING command to **reduce the unnecessary network traffic and server load caused by PING**.

## Exercise 3: Use traceroute to understand network topology

### 1. Traceroute from a UNSW lab machine to [www.columbia.edu](http://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) 0.083 ms 0.066 ms 0.066 ms
 2 129.94.39.17 (129.94.39.17) 0.897 ms 0.868 ms 0.818 ms
 3 ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35) 1.604 ms 1.593 ms libudnex1-
  vl-3154.gw.unsw.edu.au (149.171.253.34) 1.505 ms
 4 libcr1-po-5.gw.unsw.edu.au (149.171.255.165) 1.139 ms ombcr1-po-5.gw.unsw.edu.au (149.171.255.197)
 1.116 ms 1.149 ms
 5 unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101) 1.101 ms 1.139 ms unswbr1-te-2-13.gw.unsw.edu.au
 (149.171.255.105) 1.137 ms
 6 138.44.5.0 (138.44.5.0) 1.277 ms 1.319 ms 1.309 ms
 7 et-1-3-0.pe1.sxt.bkvl.nsw.aarnet.net.au (113.197.15.149) 2.046 ms 4.410 ms 4.536 ms
 8 et-0-0-0.pe1.a.hnl.aarnet.net.au (113.197.15.99) 95.183 ms 95.088 ms 95.073 ms
 9 et-2-1-0.bdr1.a.sea.aarnet.net.au (113.197.15.201) 146.615 ms 146.571 ms 146.578 ms
10 abilene-1-lo-jmb-706.sttlwa.pacificwave.net (207.231.240.8) 146.689 ms 146.645 ms 146.671 ms
11 et-4-0-0.4079.rts.w.miss2.net.internet2.edu (162.252.70.0) 157.427 ms 157.432 ms 157.487 ms
12 et-4-0-0.4079.rts.w.minn.net.internet2.edu (162.252.70.58) 180.517 ms 180.458 ms 180.437 ms
13 et-1-1-5.4079.rts.w.eqch.net.internet2.edu (162.252.70.106) 188.726 ms 196.101 ms 195.568 ms
14 ae-0.4079.rts.w3.eqch.net.internet2.edu (162.252.70.163) 188.544 ms 188.466 ms 188.471 ms
15 ae-1.4079.rts.w.clev.net.internet2.edu (162.252.70.130) 196.925 ms 197.043 ms 197.090 ms
16 buf-9208-l2-CLEV.nysernet.net (199.109.11.33) 201.265 ms 202.606 ms 202.593 ms
17 syr-9208-buf-9208.nysernet.net (199.109.7.193) 204.594 ms 204.594 ms 204.416 ms
18 nyc111-9204-syr-9208.nysernet.net (199.109.7.94) 213.833 ms 213.695 ms 213.625 ms
19 nyc-9208-nyc111-9204.nysernet.net (199.109.7.165) 213.749 ms 214.340 ms 214.582 ms
20 columbia.nyc-9208.nysernet.net (199.109.4.14) 214.567 ms 214.802 ms 214.699 ms
21 cc-core-1-x-nyser32-gw-1.net.columbia.edu (128.59.255.5) 231.822 ms 227.554 ms 215.512 ms
22 cc-conc-1-x-cc-core-1.net.columbia.edu (128.59.255.21) 214.128 ms 214.109 ms 214.236 ms
23 teachtechaward.org (128.59.105.24) 213.967 ms 213.988 ms 214.117 ms
```

- There are **23** routers between the lab machine and [www.columbia.edu](http://www.columbia.edu).
- There are **5** routers along the path that are part of the UNSW network. From the traceroute, the number 1,3,4,5 routers all have unsw specified in their hostname, so they are all part of UNSW network. By searching for 2nd router's IP address (with whois command), we can see it's also registered as UNSW router. All routers after the 5th router are not belong to UNSW network.
- The biggest jump in RTT is between 7th router and 8th router, from 2ms to 95ms. Therefore, the packets cross the Pacific Ocean between **7th router and 8th router**.

## 2. Traceroutes from a UNSW lab machine to the following destinations:

(i). 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) 0.086 ms 0.060 ms 0.063 ms
 2 129.94.39.17 (129.94.39.17) 0.852 ms 0.812 ms 0.823 ms
 3 ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35) 11.801 ms libudnex1-vl-3154.gw.unsw.edu.au
 (149.171.253.34) 1.389 ms ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35) 11.808 ms
 4 ombcr1-po-5.gw.unsw.edu.au (149.171.255.197) 1.174 ms ombcr1-po-6.gw.unsw.edu.au (149.171.255.169)
 1.056 ms libcr1-po-5.gw.unsw.edu.au (149.171.255.165) 1.108 ms
 5 unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105) 1.155 ms unswbr1-te-1-9.gw.unsw.edu.au
 (149.171.255.101) 1.175 ms 1.099 ms
 6 138.44.5.0 (138.44.5.0) 2.875 ms 2.255 ms 2.227 ms
 7 et-1-3-0.pe1.sxt.bkvl.nsw.aarnet.net.au (113.197.15.149) 2.501 ms 2.106 ms 2.117 ms
 8 et-0-0-0.pe1.a.hnl.aarnet.net.au (113.197.15.99) 95.041 ms 95.035 ms 95.053 ms
 9 et-2-1-0.bdr1.a.sea.aarnet.net.au (113.197.15.201) 146.488 ms 146.521 ms 146.471 ms
10 cenichpr-1-is-jmb-778.snvaca.pacificwave.net (207.231.245.129) 163.086 ms 163.094 ms 163.780 ms
11 hpr-lax-hpr3--svl-hpr3-100ge.cenic.net (137.164.25.73) 160.087 ms 159.891 ms 159.842 ms
12 * * *
13 bd11f1.anderson--cr00f2.csb1.ucla.net (169.232.4.4) 161.144 ms 161.069 ms bd11f1.anderson--
cr001.anderson.ucla.net (169.232.4.6) 160.938 ms
14 cr00f1.anderson--dr00f2.csb1.ucla.net (169.232.4.55) 160.389 ms cr00f2.csb1--dr00f2.csb1.ucla.net
(169.232.4.53) 160.321 ms cr00f1.anderson--dr00f2.csb1.ucla.net (169.232.4.55) 160.302 ms
15 * * *
16 * * *
17 * * *
18 * * *
19 * * *
20 * * *
21 * * *
22 * * *
23 * * *
24 * * *
25 * * *
26 * * *
27 * * *
28 * * *
29 * * *
30 * * *
```

(ii). [www.u-tokyo.ac.jp](http://www.u-tokyo.ac.jp)

```
tracert 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 0.062 ms 0.073 ms
 2 129.94.39.17 (129.94.39.17) 0.840 ms 0.849 ms 0.869 ms
 3 ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35) 1.832 ms 1.938 ms 1.805 ms
 4 ombcr1-po-5.gw.unsw.edu.au (149.171.255.197) 1.115 ms libcr1-po-5.gw.unsw.edu.au (149.171.255.165) 1.053 ms ombcr1-po-6.gw.unsw.edu.au (149.171.255.169) 1.123 ms
 5 unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105) 24.018 ms 24.022 ms 24.023 ms
 6 138.44.5.0 (138.44.5.0) 1.273 ms 1.291 ms 1.273 ms
 7 et-0-3-0.pe1.bkvl.nsw.aarnet.net.au (113.197.15.147) 1.766 ms 1.838 ms 1.819 ms
 8 ge-4_0_0.bb1.a.pao.aarnet.net.au (202.158.194.177) 174.597 ms 174.680 ms 174.675 ms
 9 paloalto0.ijj.net (198.32.176.24) 176.151 ms 176.210 ms 176.233 ms
10 osk004bb01.IIJ.Net (58.138.88.189) 289.062 ms 288.993 ms osk004bb00.IIJ.Net (58.138.88.185) 306.957 ms
11 osk004ip57.IIJ.Net (58.138.106.166) 297.720 ms 297.941 ms 297.812 ms
12 210.130.135.130 (210.130.135.130) 299.038 ms 298.124 ms 306.829 ms
13 124.83.228.58 (124.83.228.58) 289.963 ms 289.355 ms 298.026 ms
14 124.83.252.178 (124.83.252.178) 302.165 ms 300.586 ms 316.058 ms
15 158.205.134.26 (158.205.134.26) 303.806 ms 303.913 ms 303.860 ms
16 ***
17 ***
18 ***
19 ***
20 ***
21 ***
22 ***
23 ***
24 ***
25 ***
26 ***
27 ***
28 ***
29 ***
30 ***
```

(iii). [www.lancaster.ac.uk](http://www.lancaster.ac.uk)

```
tracert 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) 0.084 ms 0.057 ms 0.069 ms
 2 129.94.39.17 (129.94.39.17) 0.879 ms 0.867 ms 0.870 ms
 3 ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35) 1.242 ms libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34) 1.443 ms ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35) 1.182 ms
 4 libcr1-po-5.gw.unsw.edu.au (149.171.255.165) 1.107 ms libcr1-po-6.gw.unsw.edu.au (149.171.255.201) 1.102 ms ombcr1-po-5.gw.unsw.edu.au (149.171.255.197) 1.070 ms
 5 unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101) 1.130 ms unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105) 1.127 ms 1.159 ms
 6 138.44.5.0 (138.44.5.0) 1.231 ms 1.354 ms 1.293 ms
 7 et-2-0-5.bdr1.sing.sin.aarnet.net.au (113.197.15.233) 92.620 ms 92.577 ms 92.568 ms
 8 138.44.226.7 (138.44.226.7) 256.193 ms 256.183 ms 256.147 ms
 9 janet-gw.mx1.lon.uk.geant.net (62.40.124.198) 256.269 ms 256.226 ms 256.218 ms
10 ae29.londpg-sbr2.ja.net (146.97.33.2) 256.755 ms 256.718 ms 256.738 ms
11 ae31.erdliss-sbr2.ja.net (146.97.33.22) 260.462 ms 260.461 ms 260.352 ms
12 ae29.manckh-sbr2.ja.net (146.97.33.42) 262.334 ms 267.999 ms 267.981 ms
13 ae24.lanclu-rbr1.ja.net (146.97.38.58) 264.664 ms 264.690 ms 264.652 ms
14 lancaster-university.ja.net (194.81.46.2) 279.841 ms 279.691 ms 279.685 ms
15 is-border01.bfw01.rtr.lancs.ac.uk (148.88.253.202) 265.079 ms 265.069 ms 265.092 ms
16 bfw01.iss-servers.is-core01.rtr.lancs.ac.uk (148.88.250.98) 269.493 ms 267.519 ms 267.919 ms
17 ***
18 www.lancs.ac.uk (148.88.65.80) 265.220 ms IX 265.204 ms IX 265.150 ms IX
```

The whois information gathered from three 7th router are same:

```
% IANA WHOIS server
% for more information on IANA, visit http://www.iana.org
% This query returned 1 object

refer:      whois.apnic.net

inetnum:    113.0.0.0 - 113.255.255.255
organisation: APNIC
status:     ALLOCATED

whois:      whois.apnic.net

changed:    2008-05
source:     IANA

% [whois.apnic.net]
% Whois data copyright terms    http://www.apnic.net/db/dbcopyright.html

% 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

irt:        IRT-AARNET-AU
address:    AARNet Pty Ltd
address:    26 Dick Perry Avenue
address:    Kensington, Western Australia
address:    Australia
e-mail:     abuse@aarnet.edu.au
abuse-mailbox: abuse@aarnet.edu.au
admin-c:    SM6-AP
tech-c:     ANOC-AP
auth:       # Filtered
mnt-by:     MAINT-AARNET-AP
last-modified: 2010-11-08T08:02:43Z
source:     APNIC

role:       AARNet Network Operations Centre
remarks:
address:    AARNet Pty Ltd
address:    GPO Box 1559
address:    Canberra
address:    ACT 2601
country:    AU
phone:      +61 1300 275 662
phone:      +61 2 6222 3555
remarks:
e-mail:     noc@aarnet.edu.au
remarks:
remarks:    Send abuse reports to abuse@aarnet.edu.au
remarks:    Please include timestamps and offset to UTC in logs
remarks:    Peering requests to peering@aarnet.edu.au
remarks:
admin-c:    SM6-AP
tech-c:     BM-AP
nic-hdl:    ANOC-AP
mnt-by:     MAINT-AARNET-AP
last-modified: 2010-06-30T13:16:48Z
source:     APNIC

% This query was served by the APNIC Whois Service version 1.88.15-46 (WHOIS-NODE2)
```

From the above three traceroute results, we can see that all three routes are same until 7th router, so they **diverge at 7th router**. The whois information indicates that all IP addresses between 113.197.15.0 - 113.197.15.255 are run by AARNet. Although the 7th routers are different, but they all have same whois information which means they all of them are running by AARNet which are nodes connecting submarine cables. Therefore, the reason they diverge here is possibly because the 6th router distribute the packets according to the destination IP address and forward them to the submarine cables connect to America, Japan and UK respectively.

My IP address is: 129.94.242.2

(i). [www.ucla.edu](http://www.ucla.edu)

IP address: 164.67.228.152

Distance: 7499.0 miles

Number of Hops: 14

Ratio of distance and no. of hops: ~536

(ii). [www.u-tokyo.ac.jp](http://www.u-tokyo.ac.jp)

IP address: 210.152.243.234

Distance: 4908.7 miles

Number of Hops: 15

Ratio of distance and no. of hops: ~327

(iii). [www.lancaster.ac.uk](http://www.lancaster.ac.uk)

IP address: 148.88.65.80

Distance: 10569.8 miles

Number of Hops: 18

Ratio of distance and no. of hops: ~587

According to the ratio of number of hops and distance shown above, the number of hops on each path is **not proportional** to the physical distance at all.

### 3. Traceroutes from below servers towards a UNSW lab machine and in the reverse direction

(i). <http://www.speedtest.com.sg/tr.php>

From speedtest to the lab machine:

```
traceroute to 129.94.242.2 (129.94.242.2), 30 hops max, 60 byte packets
 1 ge2-8.r01.sin01.ne.com.sg (202.150.221.169) 0.202 ms 0.216 ms 0.243 ms
 2 10.15.62.210 (10.15.62.210) 0.276 ms 0.286 ms 0.296 ms
 3 aarnet.sgix.sg (103.16.102.67) 221.673 ms 221.723 ms 221.692 ms
 4 et-7-3-0.pe1.nsw.brwy.aarnet.net.au (113.197.15.232) 209.550 ms 209.571 ms 209.515 ms
 5 138.44.5.1 (138.44.5.1) 206.847 ms 206.760 ms 206.872 ms
 6 ombcr1-te-1-5.gw.unsw.edu.au (149.171.255.106) 209.236 ms 209.316 ms 209.352 ms
 7 libudnex1-po-2.gw.unsw.edu.au (149.171.255.198) 204.621 ms 204.691 ms 204.711 ms
 8 ufw1-ae-1-3154.gw.unsw.edu.au (149.171.253.36) 209.852 ms 209.861 ms 209.791 ms
 9 129.94.39.23 (129.94.39.23) 207.583 ms 207.507 ms 207.529 ms
10 ***
11 ***
12 ***
13 ***
14 ***
15 ***
16 ***
17 ***
18 ***
19 ***
20 ***
21 ***
22 ***
23 ***
24 ***
25 ***
26 ***
27 ***
28 ***
29 ***
30 ***
Traceroute Completed.
```

From the lab machine to speedtest:

```
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) 0.130 ms 0.104 ms 0.083 ms
 2 129.94.39.17 (129.94.39.17) 0.864 ms 0.852 ms 0.843 ms
 3 ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35) 1.684 ms 1.632 ms libudnex1-vl-3154.gw.unsw.edu.au
(149.171.253.34) 1.319 ms
 4 libcr1-po-5.gw.unsw.edu.au (149.171.255.165) 17.326 ms ombcr1-po-5.gw.unsw.edu.au (149.171.255.197)
53.657 ms 53.649 ms
 5 unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101) 1.053 ms 1.115 ms 1.052 ms
 6 138.44.5.0 (138.44.5.0) 1.304 ms 1.306 ms 1.262 ms
 7 et-0-3-0.pe1.alxd.nsw.aarnet.net.au (113.197.15.153) 1.785 ms 1.770 ms 1.750 ms
 8 xe-0-2-7.bdr1.a.lax.aarnet.net.au (202.158.194.173) 147.535 ms 147.583 ms 147.543 ms
 9 singtel.as7473.any2ix.coresite.com (206.72.210.63) 147.661 ms 147.619 ms 147.613 ms
10 203.208.171.117 (203.208.171.117) 148.149 ms 148.052 ms 148.013 ms
11 203.208.172.145 (203.208.172.145) 245.081 ms 203.208.177.110 (203.208.177.110) 325.008 ms 328.291 ms
12 ***
13 203.208.158.185 (203.208.158.185) 326.098 ms 202-150-221-170.rev.ne.com.sg (202.150.221.170) 200.679
ms 203.208.177.110 (203.208.177.110) 330.269 ms
```

(ii). <https://www.telstra.net/cgi-bin/trace>

From telstra to the lab machine:

```
1 gigabitethernet3-3.exi2.melbourne.telstra.net (203.50.77.53) 0.334 ms 0.204 ms 0.242 ms
2 bundle-ether3-100.win-core10.melbourne.telstra.net (203.50.80.129) 2.239 ms 1.479 ms 1.992 ms
3 bundle-ether12.ken-core10.sydney.telstra.net (203.50.11.122) 13.359 ms 11.849 ms 12.610 ms
4 bundle-ether1.ken-edge901.sydney.telstra.net (203.50.11.95) 11.861 ms 11.849 ms 12.610 ms
5 aarnet6.lnk.telstra.net (139.130.0.78) 11.735 ms 11.847 ms 11.612 ms
6 xe-5-2-2.pe1.brwy.nsw.aarnet.net.au (113.197.15.32) 11.858 ms 12.598 ms 11.861 ms
7 138.44.5.1 (138.44.5.1) 12.110 ms 12.100 ms 11.985 ms
8 libcr1-te-1-5.gw.unsw.edu.au (149.171.255.102) 260.469 ms 12.098 ms 11.983 ms
9 ombudhex1-po-1.gw.unsw.edu.au (149.171.255.202) 12.610 ms
10 ufw1-ae-1-3154.gw.unsw.edu.au (149.171.253.36) 12.732 ms 12.722 ms 12.736 ms
11 129.94.39.23 (129.94.39.23) 12.861 ms 12.852 ms 12.860 ms
```

From the lab machine to telstra:

```
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) 0.091 ms 0.067 ms 0.060 ms
2 129.94.39.17 (129.94.39.17) 0.858 ms 0.821 ms 0.825 ms
3 libudhex1-vl-3154.gw.unsw.edu.au (149.171.253.34) 1.824 ms 1.819 ms 1.788 ms
4 libcr1-po-6.gw.unsw.edu.au (149.171.255.201) 19.011 ms libcr1-po-5.gw.unsw.edu.au (149.171.255.165) 19.011 ms ombcr1-po-5.gw.unsw.edu.au (149.171.255.197) 1.072 ms
5 unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101) 1.155 ms 1.144 ms unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105) 1.193 ms
6 138.44.5.0 (138.44.5.0) 1.282 ms 1.248 ms 1.249 ms
7 xe-0-0-0.bdr1.rsby.nsw.aarnet.net.au (113.197.15.33) 1.354 ms 1.575 ms 1.523 ms
8 gigabitethernet3-11.ken37.sydney.telstra.net (139.130.0.77) 2.337 ms 2.330 ms 2.401 ms
9 bundle-ether13.ken-core10.sydney.telstra.net (203.50.11.94) 3.598 ms 3.469 ms 2.930 ms
10 bundle-ether10.win-core10.melbourne.telstra.net (203.50.11.123) 15.171 ms bundle-ether13.chw-core10.sydney.telstra.net (203.50.11.98) 3.168 ms bundle-ether10.win-core10.melbourne.telstra.net (203.50.11.123) 15.150 ms
11 bundle-ether8.exi-core10.melbourne.telstra.net (203.50.11.125) 13.684 ms 13.674 ms 13.647 ms
12 bundle-ether2.exi-ncprouter101.melbourne.telstra.net (203.50.11.209) 14.442 ms 14.251 ms 14.064 ms
13 www.telstra.net (203.50.5.178) 12.908 ms 12.879 ms 12.903 ms
```

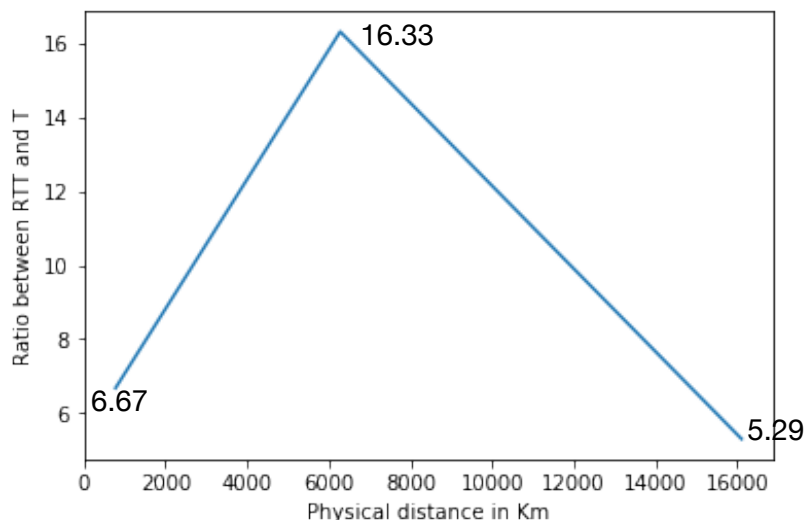
After using the nslookup command, for speedtest, the IP address I choose is: 202.150.221.170. For telstra, the IP address I choose for is: 203.50.5.178. From the forward and to traceroutes, we can see that the reverse path does not go through same routers as the forward path. However, there are some IP addresses in two routes are similar. For example, 5th router (138.44.5.1) from speedtest and 6th router (138.44.5.0) to speedtest; 8th router (149.171.253.36) from speedtest and 3rd router (149.171.253.35) to speedtest. These pair of routers only differ by the last section. Since routers might have a range of IP addresses to distribute the load, we can assume these pairs of IP addresses are different IP addresses of the same router. There are some common routers, but none of them have the same IP addresses. One of the reason might be a single router has many IP addresses because it needs to serve a lot of users, so each time the assigned router might be different. Another possible reason is that the router might serve the different transmission direction with different IP addresses, so the IP addresses in the forward and reverse path always different.



## Exercise 4: Use ping to gain insights into network performance

### 1. Ratio of RTT and T vs Physical distance from UNSW (50 bytes packet selected)

	Physical distance	T	RTT (min. delay)	Ratio between RTT and T
(i). <a href="http://www.uq.edu.au">www.uq.edu.au</a> Brisbane	775km	2.58ms	17.2ms	6.67
(ii) <a href="http://www.dlsu.edu.ph">www.dlsu.edu.ph</a> Manila	6276km	20.92ms	341.7ms	16.33
(iii) <a href="http://www.tu-berlin.de">www.tu-berlin.de</a> Berlin	16104km	53.68ms	283.8ms	5.29



The reasons y-axis values are all greater than 2 are:

- One of the reason is that the propogation speed is not as fast as speed of light( $3 \times 10^8$  m/s), there is propogation delay during the process, so the estimation of T is smaller than half of RTT.
- Another possible reason is that not only the propagation of data cause delays, the RTT delay also including the processing delay, queueing delay and transmission delay. Since it is round-trip time, all of the time including all delays are doubled, so the ratio are all greater than 2.
- In addition, the physical distance estimated I made in the graph are straight line distance, the actual routers and cables are not built in a straight line, so the total distance traversed is definitely larger than the estimated distance, and the actual RTT is double of the one trip, so the y-axis values are all greater than 2.

2. The delay to the destinations varies over time. Since the buffer queueing situation depends on current traffic load, the queueing delay is not going to be a constant, the total delay varies over time.

3. In order to figure out where the website [www.epfl.ch](http://www.epfl.ch) is hosted at, I first used nslookup command to search its corresponding IP address:

```
www.epfl.ch canonical name = www.epfl.ch.cdn.cloudflare.net.  
Name:   www.epfl.ch.cdn.cloudflare.net  
Address: 104.20.229.42  
Name:   www.epfl.ch.cdn.cloudflare.net  
Address: 104.20.228.42
```

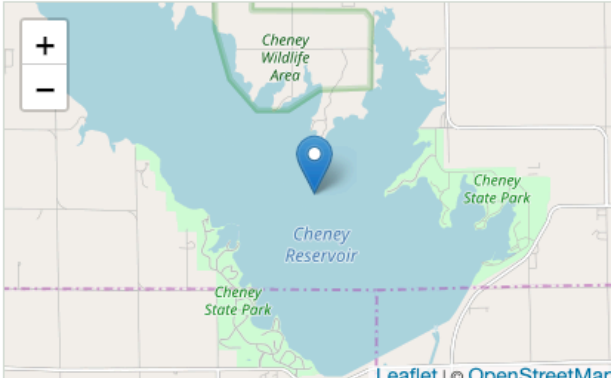
Then, I ping the IP address 104.20.229.42, the RTT is:

```
round-trip min/avg/max/stddev = 1.404/1.500/1.777/0.107 ms
```

And search for the location of the IP address online:

FIND

IP address	104.20.229.42
Latitude	37.751
Longitude	-97.822
Country	United States
Region	
City	
Organization	Cloudflare



Although the IP address shown in the above result is in the US, the avg RTT from UNSW to the address is only 1.5 ms. According to the traceroute generated, we can see that the route does not go across the ocean. Incorporating with the canonical name, we can find that the epfl website is hosted on cloudflare, a Content Distributed Network company. These CDN companies have servers with their contents distributed around the world, so according to the ping RTT, there might be a server of cloudflare holding (cached) the epfl website near Sydney.

4. Processing delay and transmission delay depends on packet size, queuing delay and propagation delay does not.

The processing procedure includes check bit error and determine output link. Determining output link just need to check the destination IP address in the overhead which is not affected by packet size. However, delay of checking bit errors depends on how large the packet size is, so the total processing delay depends on packet size.

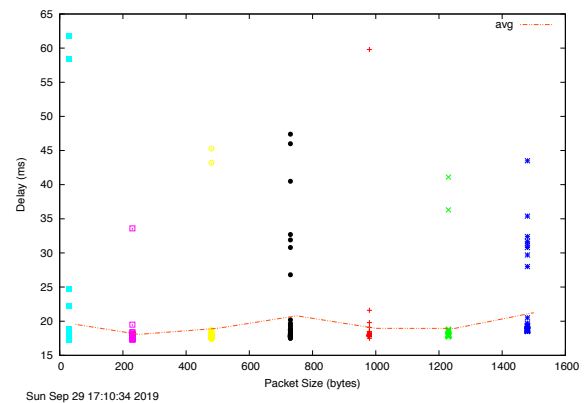
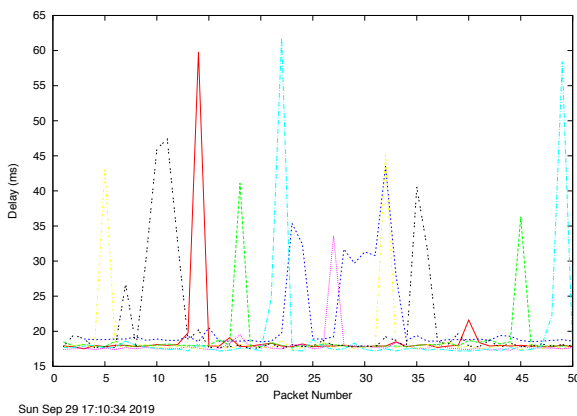
The queueing procedure depends on the traffic load at the router, so packet size does not affect the queueing delay.

The transmission delay depends on the ratio of packet length and link bandwidth, and the packet length is proportional to the packet size, so transmission delay heavily depends on packet size.

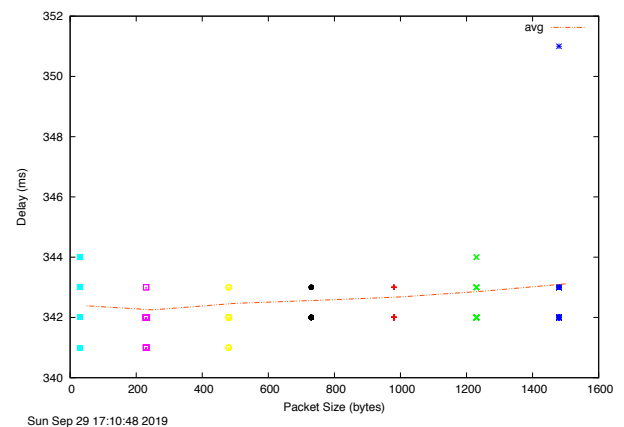
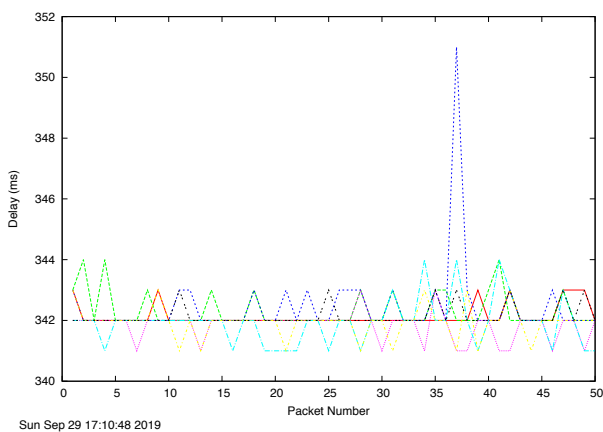
The propagation delay only depends on the length of link and the propagation speed in medium, so it has no relationship with packet size.

**The generated graphs are shown below:**

**(i). www.uq.edu.au delay(left) and scatter(right)**



**(ii). www.dlsu.edu.ph delay(left) and scatter(right)**



(iii). www.tu-berlin.de delay(left) and scatter(right)

