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Lab 1

Exercise 1: nslookup

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?

```
z5195715@bongo17:~$ nslookup www.koala.com.au
Server:         129.94.208.2
Address:        129.94.208.2#53

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

IP address of www.koala.com.au is 104.18.60.21 and 104.18.61.21

Because multiple IP addresses can balance the loads and make the website performs better especially in peak hours.

2. Find out name of the IP address 127.0.0.1. What is special about this IP address?

```
z5195715@bongo17:~$ nslookup 127.0.0.1
Server:         129.94.208.2
Address:        129.94.208.2#53

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

The name of the IP address 127.0.0.1 is localhost. 127.0.0.1 is also called the loopback address.It is not routable.It is the internal interface used by the machine to send a packet to itself.

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.

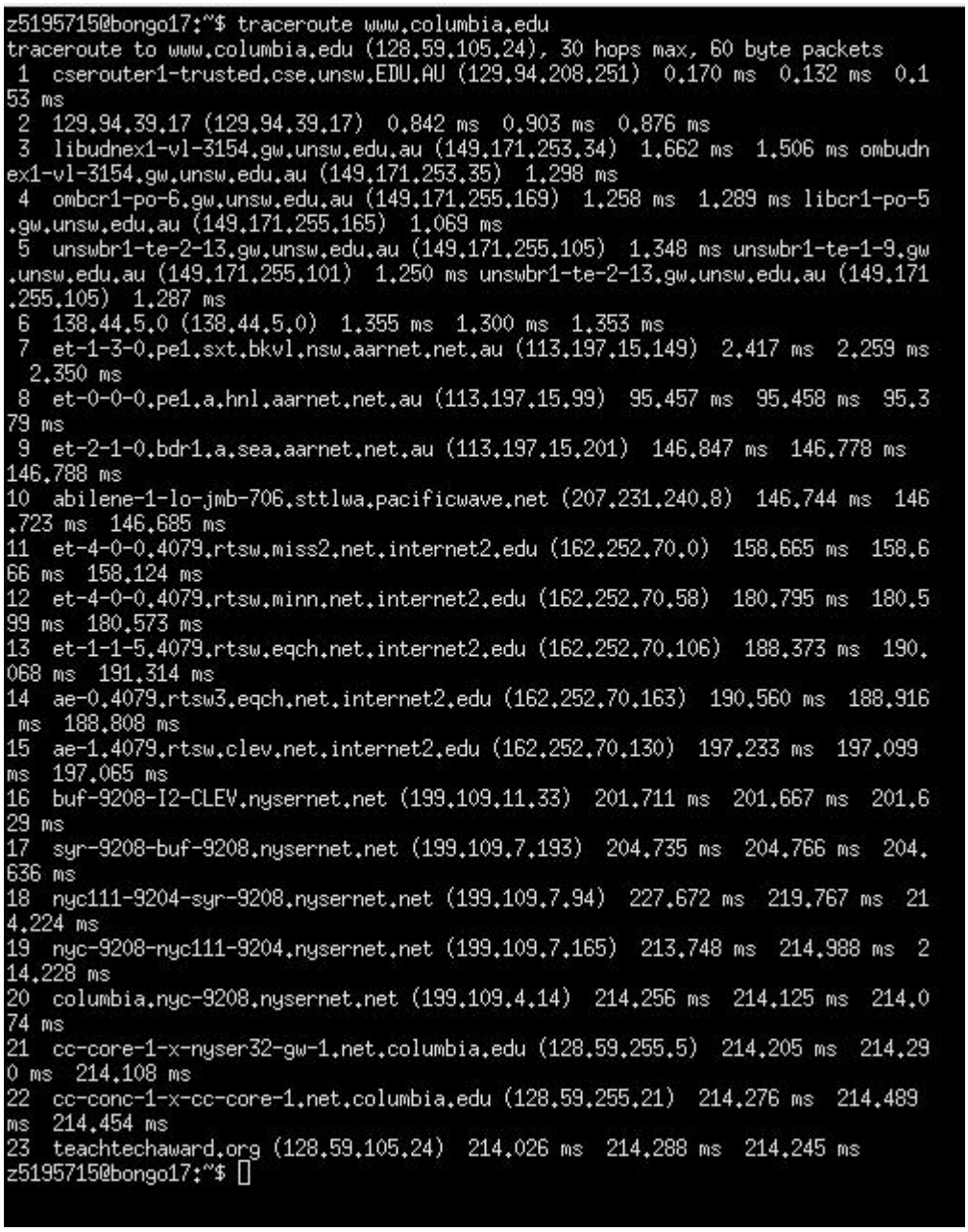
www.getfittest.com.au and www.hola.hp are unreachable by the ping command nor the Web browser, because www.getfittest.com.au and www.hola.hp are unknown host links.

www.kremlin.ru can be visited by the Web browser, but it shows request time out by ping command because of its firework for security reason.

The rest of the hosts are reachable: www.cse.unsw.edu.au ,www.mit.edu , www.intel.com.au , www.tpg.com.au , www.tsinghua.edu.cn , www.amazon.com and 8.8.8.8.

Exercise 3: Use traceroute to understand network topology

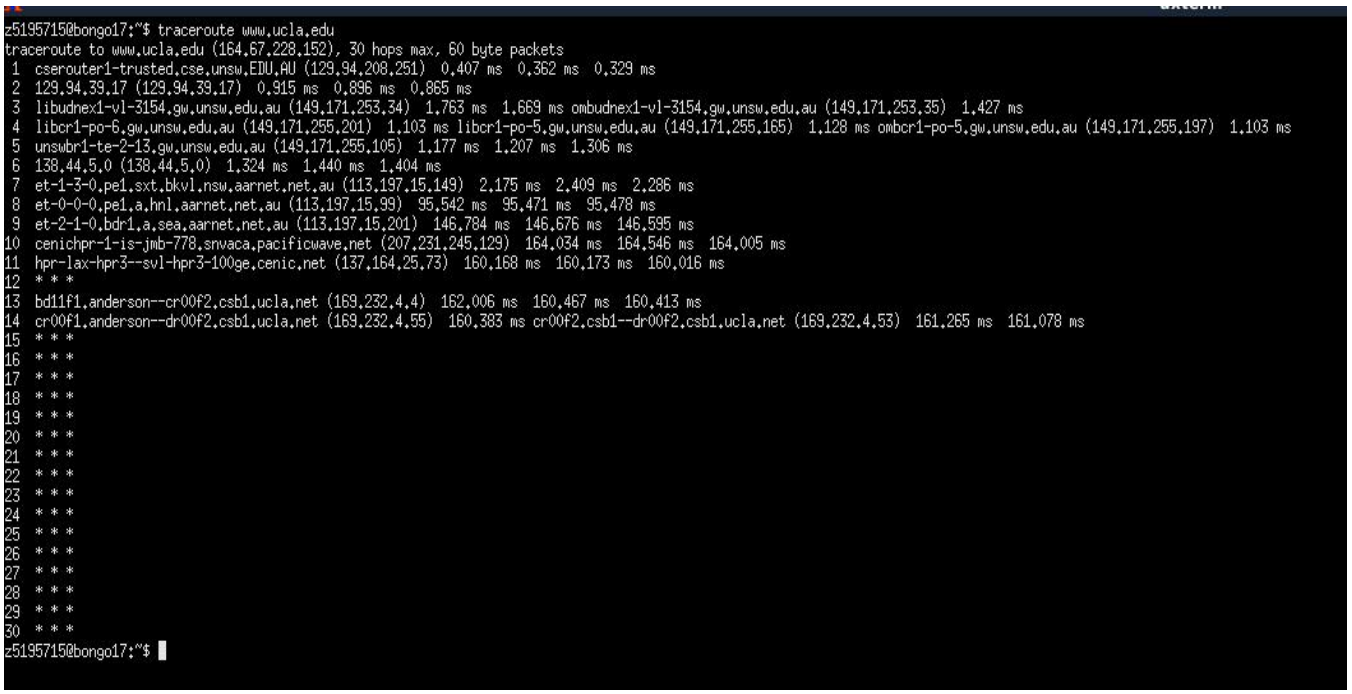
1. Run traceroute on your machine to www.columbia.edu . How many routers are there between your workstation and www.columbia.edu ? How many routers along the path are part of the UNSW network? Between which two routers do packets cross the Pacific Ocean? (Hint: compare the round trip times from your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



There are 22 routers between my workstation and www.columbia.edu.
The first 5 routers are belong to UNSW network because their hostnames contain 'unsw.edu.au'.
Between 7-8 and 8-9 packets go cross the ocean because the ping greatly increases from 2.417ms to 95.457ms and from 95.457ms to 146.847ms.

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 geographical location of a server using the following tool - http://www.yougetsignal.com/tools/network-location/)

My machine to www.ucla.edu:



My machine to www.u-tokyo.ac.jp:

```
z5195715@bongo17:~$ 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-trusted.cse.unsw.EDU.AU (129.94.208.251)  0.180 ms  0.140 ms  0.112 ms
 2  129.94.39.17 (129.94.39.17)  0.948 ms  0.933 ms  0.906 ms
 3  libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34)  1.678 ms ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35)  1.521 ms libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34)  1.754 ms
 4  libcr1-po-6.gw.unsw.edu.au (149.171.255.201)  1.121 ms libcr1-po-5.gw.unsw.edu.au (149.171.255.165)  1.106 ms ombcr1-po-6.gw.unsw.edu.au (149.171.255.169)  1.068 ms
 5  unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  1.142 ms  1.164 ms  1.285 ms
 6  138.44.5.0 (138.44.5.0)  1.369 ms  1.440 ms  1.405 ms
 7  et-0-3-0.pe1.bkvl.nsw.aarnet.net.au (113.197.15.147)  2.247 ms  1.858 ms  1.859 ms
 8  ge-4_0_0.bb1.a.pao.aarnet.net.au (202.158.194.177)  156.385 ms  156.388 ms  156.360 ms
 9  paloalto0.iij.net (198.32.176.24)  157.479 ms  157.459 ms  157.421 ms
10  osk004bb00.IIJ.Net (58.138.88.185)  288.232 ms osk004bb01.IIJ.Net (58.138.88.189)  270.670 ms  270.669 ms
11  osk004ip57.IIJ.Net (58.138.106.162)  288.090 ms osk004ip57.IIJ.Net (58.138.106.166)  270.607 ms  270.697 ms
12  210.130.135.130 (210.130.135.130)  270.526 ms  270.503 ms  279.661 ms
13  124.83.228.58 (124.83.228.58)  279.558 ms  288.419 ms  288.390 ms
14  124.83.252.178 (124.83.252.178)  294.245 ms  294.052 ms  285.405 ms
15  158.205.134.26 (158.205.134.26)  276.660 ms  276.632 ms  308.338 ms
16  * * *
17  * * *
18  * * *
19  * * *
20  * * *
21  * * *
22  * * *
23  * * *
24  * * *
25  * * *
26  * * *
27  * * *
28  * * *
29  * * *
30  * * *
z5195715@bongo17:~$
```

My machine to www.lancaster.ac.uk

```
z5195715@bongo17:~$ traceroute www.lancaster.ac.uk
traceroute to www.lancaster.ac.uk (148.88.65.80), 30 hops max, 60 byte packets
 1  cserouter1-trusted.cse.unsw.EDU.AU (129.94.208.251)  0.204 ms  0.157 ms  0.126 ms
 2  129.94.39.17 (129.94.39.17)  0.864 ms  0.841 ms  0.928 ms
 3  libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34)  1.459 ms  1.633 ms ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35)  1.454 ms
 4  ombcr1-po-6.gw.unsw.edu.au (149.171.255.169)  1.157 ms libcr1-po-5.gw.unsw.edu.au (149.171.255.165)  1.105 ms ombcr1-po-5.gw.unsw.edu.au (149.171.255.197)  1.842 ms
 5  unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101)  1.403 ms  1.379 ms  1.393 ms
 6  138.44.5.0 (138.44.5.0)  1.505 ms  1.383 ms  1.343 ms
 7  et-2-0-5.bdr1.sing.sin.aarnet.net.au (113.197.15.233)  92.811 ms  92.574 ms  92.542 ms
 8  138.44.226.7 (138.44.226.7)  256.519 ms  256.449 ms  256.457 ms
 9  janet-gw.mx1.lon.uk.geant.net (62.40.124.198)  256.545 ms  256.474 ms  256.510 ms
10  ae29.londpg-sbr2.ja.net (146.97.33.2)  256.756 ms  256.733 ms  256.705 ms
11  ae31.erdiss-sbr2.ja.net (146.97.33.22)  260.634 ms  260.559 ms  260.488 ms
12  ae29.manckh-sbr2.ja.net (146.97.33.42)  262.513 ms  262.787 ms  262.434 ms
13  ae24.lanclu-rbr1.ja.net (146.97.38.58)  264.805 ms  264.920 ms  264.890 ms
14  lancaster-university.ja.net (194.81.46.2)  275.034 ms  274.785 ms  274.711 ms
15  is-border01.bfw01.rtr.lancs.ac.uk (148.88.253.202)  265.152 ms  265.173 ms  265.118 ms
16  bfw01.iss-servers.is-core01.rtr.lancs.ac.uk (148.88.250.98)  270.491 ms  267.136 ms  267.276 ms
17  * * *
18  www.lancs.ac.uk (148.88.65.80)  265.311 ms !X  265.332 ms !X  265.337 ms !X
z5195715@bongo17:~$
```

After the 6th router(138.44.5.0), paths from my machine to these three destinations diverge.

More information about 138.44.5.0 by using whois command:

```
admin-c:        SM6-AP
tech-c:         ANOC-AP
auth:           # Filtered
mnt-by:         MAINT-AARNET-AP
last-modified:  2010-11-08T08:02:43Z
source:         APNIC

organisation:   ORG-AAAR1-AP
org-name:       Australian Academic and Research Network
country:        AU
address:        Building 9
address:        Banks Street
phone:          +61-2-6222-3530
fax-no:         +61-2-6222-3535
e-mail:         irrcontact@aarnet.edu.au
mnt-ref:        APNIC-HM
mnt-by:         APNIC-HM
last-modified:  2017-10-09T12:56:36Z
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
```

approximate geophysical location

locate a network

Remote Address www.ucla.edu Locate

Use Current IP

Source ◉ MaxMind ○ Hostip.info

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

From the distances shown above,Sydney to Los Angeles is further than it to Tokyo.However,the number of hops to Los Angeles is 14 and to Tokyo is 15.
So,the number of hops is not proportional to the physical distance.

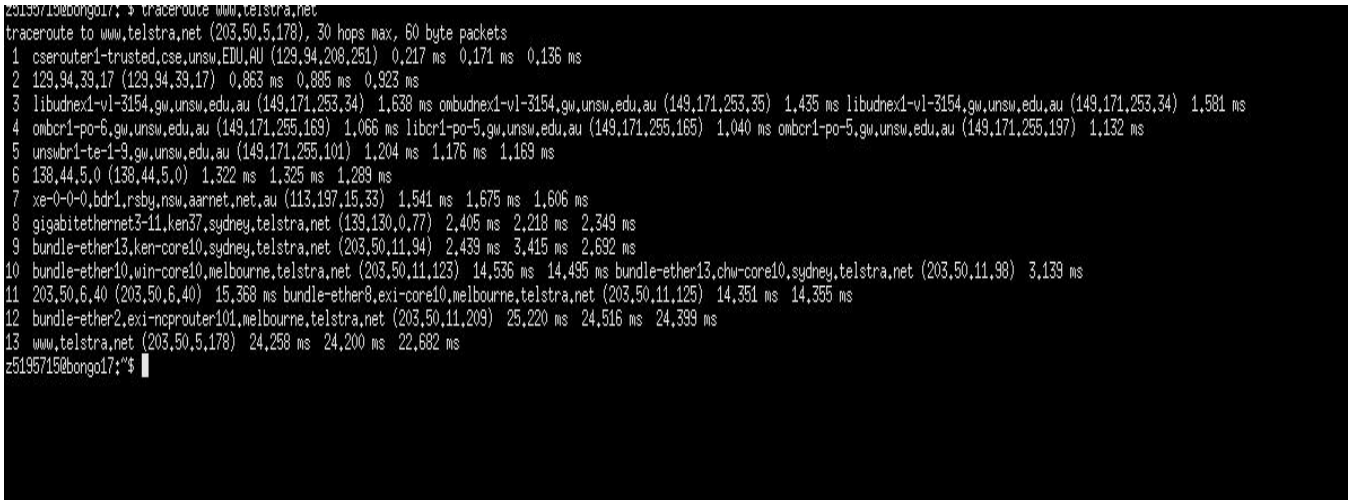
2. Several servers distributed around the world provide a web interface from which you can perform a traceroute to any other host in the Internet. Here are two examples: (i) http://www.speedtest.com.sg/tr.php and (ii) https://www.telstra.net/cgi-bin/trace . Run traceroute from both these servers towards 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?

IP address of my machine is 129.94.208.2, IP address of www.telstra.net is 203.50.5.178

Telstra to my machine:

```
 1  gigabitethernet3-3.exi2.melbourne.telstra.net (203.50.77.53)  0.475 ms  0.204 ms  0.242 ms
 2  bundle-ether3-100.win-core10.melbourne.telstra.net (203.50.80.129)  2.738 ms  1.477 ms  2.116 ms
 3  bundle-ether12.ken-core10.sydney.telstra.net (203.50.11.122)  13.861 ms  12.220 ms  13.485 ms
 4  bundle-ether1.ken-edge901.sydney.telstra.net (203.50.11.95)  11.984 ms  11.972 ms  11.985 ms
 5  aarnet6.lnk.telstra.net (139.130.0.78)  11.861 ms  11.598 ms  11.485 ms
 6  xe-5-2-2.pe1.brwy.nsw.aarnet.net.au (113.197.15.32)  11.858 ms  11.848 ms  11.858 ms
 7  138.44.5.1 (138.44.5.1)  11.985 ms  11.975 ms  11.985 ms
 8  libcr1-te-1-5.gw.unsw.edu.au (149.171.255.102)  28.352 ms  13.844 ms  15.736 ms
 9  ombudnex1-po-1.gw.unsw.edu.au (149.171.255.202)  12.481 ms  13.097 ms  13.362 ms
10  ufw1-ae-1-3154.gw.unsw.edu.au (149.171.253.36)  12.608 ms  12.597 ms  12.611 ms
11  129.94.39.23 (129.94.39.23)  13.233 ms  13.225 ms  12.985 ms
```

My machine to Telstra:

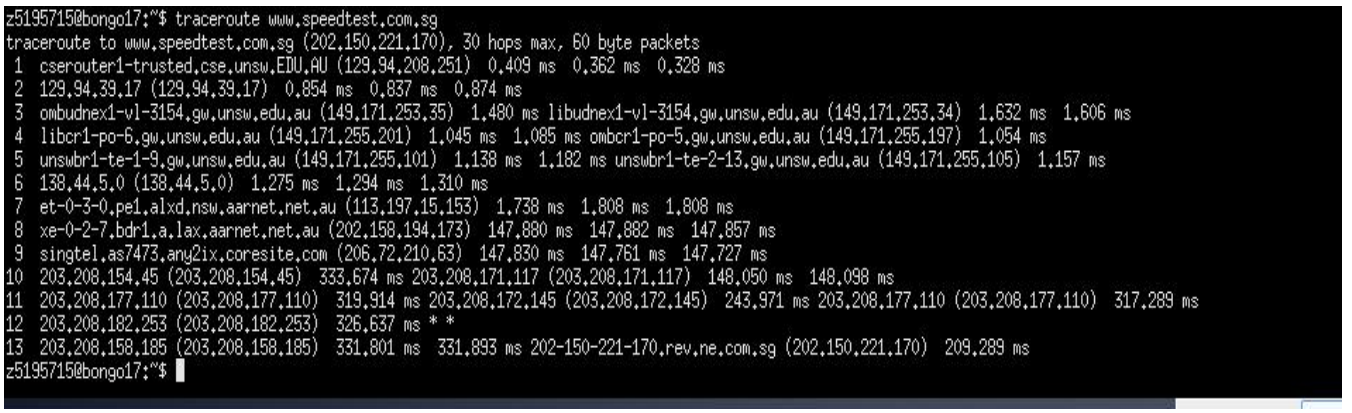


IP address of my machine is 129.94.208.2, IP address of www.speedtest.com.sg is 202.150.221.170

www.speedtest.com.sg to my machine:

```
traceroute to 129.94.208.2 (129.94.208.2), 30 hops max, 60 byte packets
 1  ge2-8.r01.sin01.ne.com.sg (202.150.221.169)  0.153 ms  0.195 ms  0.216 ms
 2  10.15.62.210 (10.15.62.210)  0.234 ms  0.239 ms  0.265 ms
 3  aarnet.sgix.sg (103.16.102.67)  199.409 ms  199.478 ms  199.451 ms
 4  et-7-3-0.pe1.nsw.brwy.aarnet.net.au (113.197.15.232)  208.156 ms  208.173 ms  208.189 ms
 5  138.44.5.1 (138.44.5.1)  213.678 ms  213.704 ms  213.837 ms
 6  ombcr1-te-1-5.gw.unsw.edu.au (149.171.255.106)  208.333 ms  208.624 ms  208.509 ms
 7  libudnex1-po-2.gw.unsw.edu.au (149.171.255.198)  207.516 ms  207.611 ms  207.522 ms
 8  ufw1-ae-1-3154.gw.unsw.edu.au (149.171.253.36)  209.040 ms  208.952 ms  208.913 ms
 9  129.94.39.23 (129.94.39.23)  200.552 ms  200.650 ms  200.662 ms
```

My machine to www.speedtest.com.sg:



Not all the routers of the reverse path is the same as forward path but they have some routers in

common.For example,138.44.5.0 and 138.44.5.1.They refer to the same router but with different IPs.

This is because IP addresses are dynamically allocated for trace-routing.

Exercise 4: Use ping to gain insights into network performance

*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?*

UNSW to Brisbane roughly 747km

UNSW to Manila roughly 6280km

UNSW to Berlin roughly 16100km

the shortest possible time that a packet will take to reach these 3 destinations are:

Brisbane:747/(3*10^8)=2.49ms

Manila:6280/(3*10^8)=20.933ms(roughly)

Berlin:16100/(3*10^8)=53.667ms(roughly)

The minimum RTT (for 50 byte packets) to these 3 destinations are:

```
--- www.uq.edu.au ping statistics ---
50 packets transmitted, 50 received, 0% packet loss, time 49091ms
rtt min/avg/max/mdev = 17.417/18.115/22.885/1.154 ms
```

So, Ratio(uq)=18.115/2.49=7.275

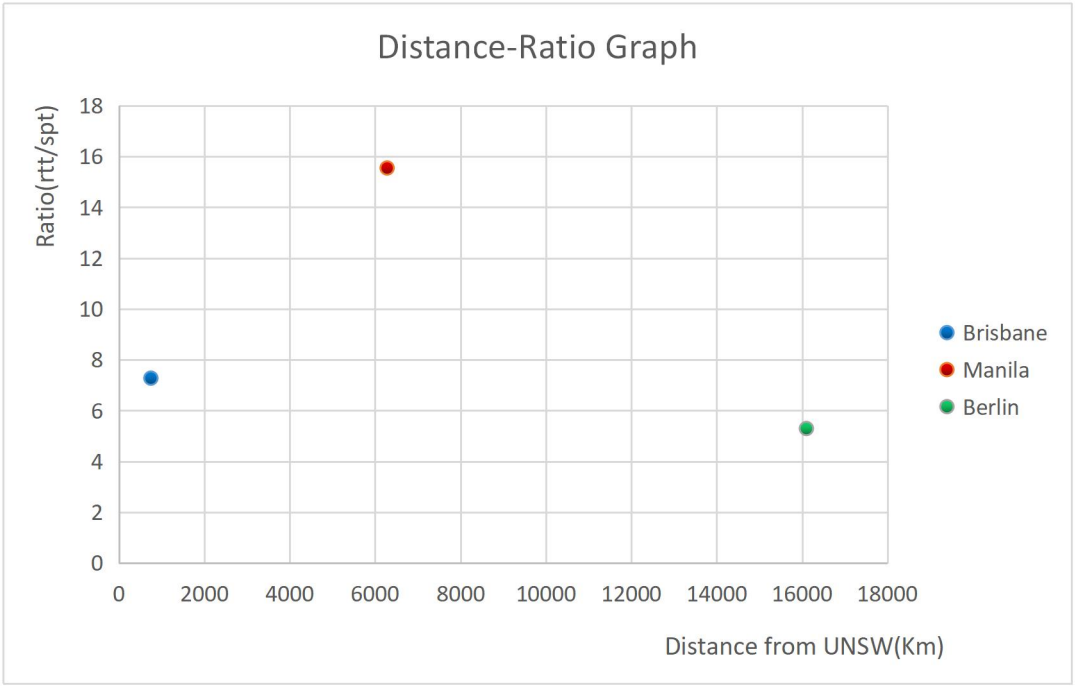
```
--- www.dlsu.edu.ph ping statistics ---
50 packets transmitted, 50 received, 0% packet loss, time 49070ms
rtt min/avg/max/mdev = 319.592/325.412/354.306/8.534 ms
```

So, Ratio(dlsu)=325.412/20.933=15.545

```
--- www.tu-berlin.de ping statistics ---
50 packets transmitted, 50 received, 0% packet loss, time 49057ms
rtt min/avg/max/mdev = 283.829/284.040/284.395/0.437 ms
```

So, Ratio(tu-berlin)=284.040/53.667=5.293

Graph as follows:



Reasons for ratio > 2:

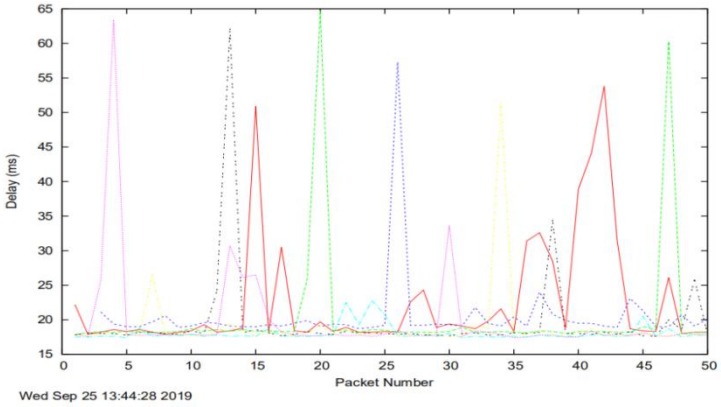
(1) speed of light does not consider delays such as transmission delays or queuing delay.

(2) In real condition(air,water,etc),speed of light is smaller than 3*10^8 m/s.

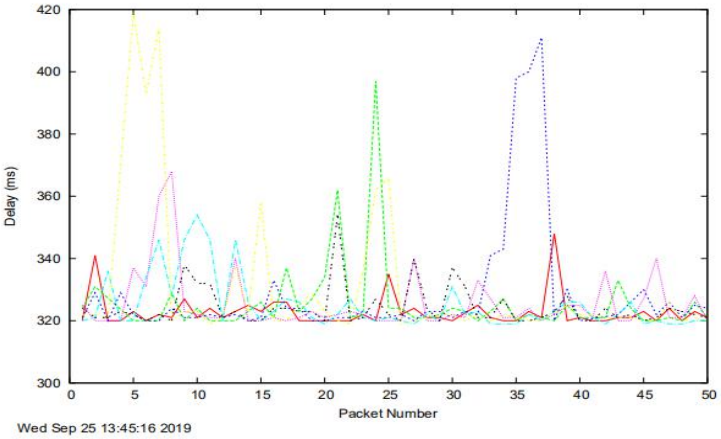
2. Is the delay to the destinations constant or does it vary over time? Explain why.

The following graphs shows for a given packet size,different delays as packet numbers increase and there are different sizes ranging from 50 to 1500.

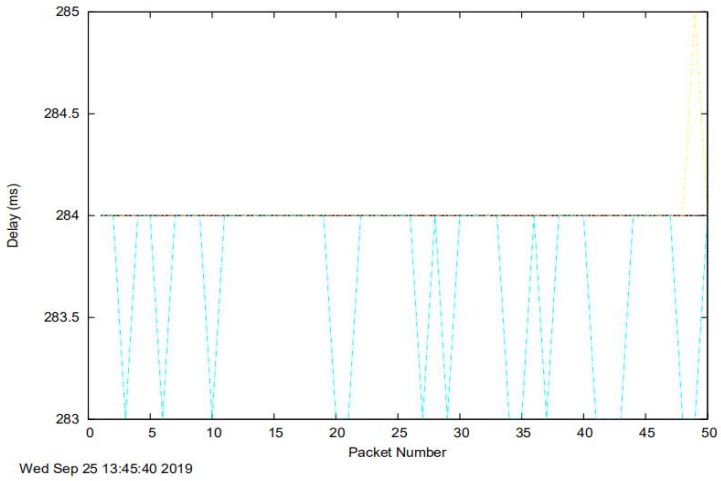
www.uq.edu.au:



www.dlsu.edu.ph:



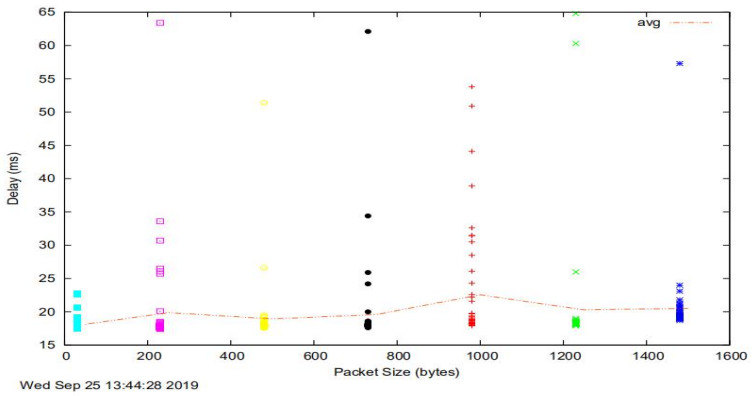
www.tu-berlin.de:



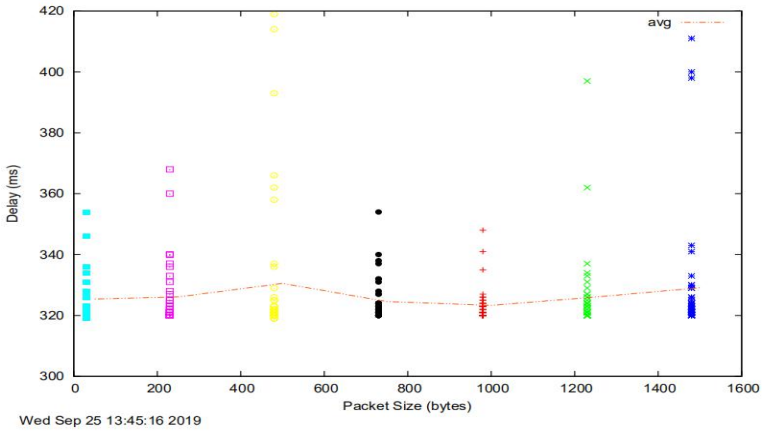
As is shown in the 3 graphs,the delay varies over time because of the different processing and queuing delays. The difference of delays are caused by the quality of the network path of different countries.

Following graphs mainly shows average delay for different size of packets among 3 countries.

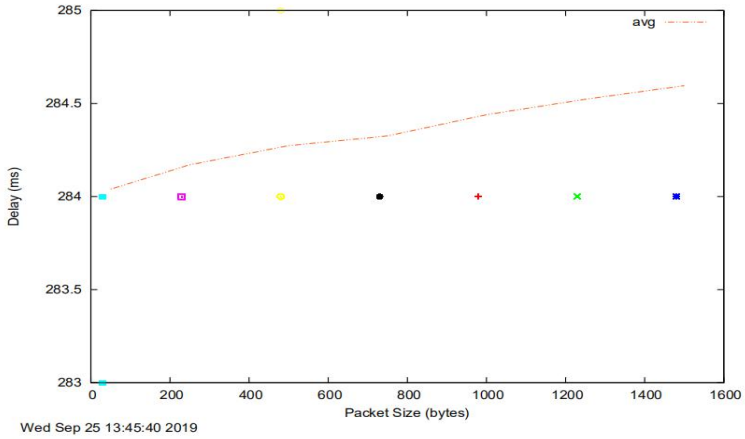
www.uq.edu.au:



www.dlsu.edu.ph:



www.tu-berlin.de:



From these 3 graphs,we can conclude that the bigger size of packet,the longer delay time is only true for tu-berlin.For uq and dlsu, packet size have a little impact on delays.These 2 graphs are relatively stable.

From above,we can conclude that the delays of 3 destinations vary over time.

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

```
z5195715@piano13:~$ traceroute www.epfl.ch
traceroute to www.epfl.ch (104.20.229.42), 30 hops max, 60 byte packets
 1  cserouter1-trusted.cse.unsw.EDU.AU (129.94.208.251)  0.217 ms  0.165 ms  0.1
55 ms
 2  129.94.39.17 (129.94.39.17)  0.897 ms  0.880 ms  0.895 ms
 3  ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35)  1.314 ms libudnex1-vl-315
4.gw.unsw.edu.au (149.171.253.34)  1.799 ms  1.748 ms
 4  libcr1-po-5.gw.unsw.edu.au (149.171.255.165)  1.141 ms  1.116 ms libcr1-po-6
.gw.unsw.edu.au (149.171.255.201)  1.140 ms
 5  unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101)  1.182 ms  1.153 ms unswbr1-
te-2-13.gw.unsw.edu.au (149.171.255.105)  1.163 ms
 6  138.44.5.0 (138.44.5.0)  1.339 ms  1.323 ms  1.360 ms
 7  113.197.15.101 (113.197.15.101)  1.442 ms  1.449 ms  1.408 ms
 8  as4826.sydney.megaport.com (103.26.68.248)  2.266 ms  3.650 ms  3.628 ms
 9  be-111.cor01.syd11.nsw.vocus.net.au (175.45.72.32)  2.154 ms  2.128 ms  2.02
0 ms
10  BE-101.bdr02.syd03.nsw.VOCUS.net.au (114.31.192.37)  2.199 ms BE-100.bdr02.s
yd03.nsw.VOCUS.net.au (114.31.192.39)  1.955 ms BE-101.bdr02.syd03.nsw.VOCUS.net
.au (114.31.192.37)  2.042 ms
11  as13335.bdr02.syd03.nsw.VOCUS.net.au (175.45.124.197)  2.166 ms  2.559 ms  2
.556 ms
12  104.20.229.42 (104.20.229.42)  1.709 ms  1.656 ms  6.102 ms
```

No it isn't.From traceroute command we know its IP (104.20.229.42) and by using whois command, we know the country is USA instead of 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?

Transmission delay depend on packet size and the others don't.

Propagation delay mainly depend on the physical distance.

Processing delay is related to the processing of packet including error check and finding the next the router,etc.

Queuing delay will occur during network congestion.