

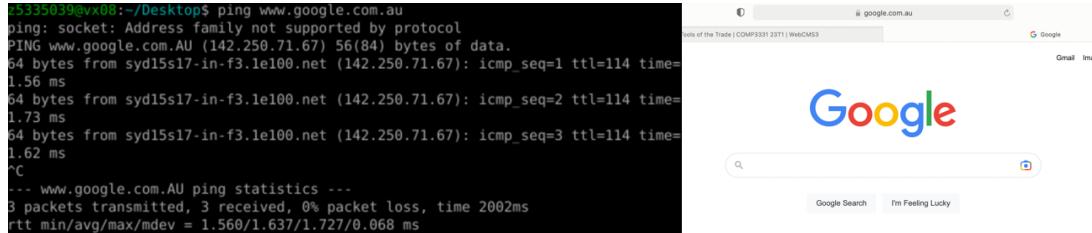
## Exercise 2: Use ping to test host reachability (2 marks)

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

- [www.google.com.au](http://www.google.com.au)
- [www.stanford.edu](http://www.stanford.edu)
- [www.wikipedia.org](http://www.wikipedia.org)
- [ec.ho](http://ec.ho)
- [pin.gs](http://pin.gs)
- [nasa.gov](http://nasa.gov)
- [yes.no](http://yes.no)
- [one.one.one.one](http://one.one.one.one)
- [theguardian.com](http://theguardian.com)
- [xn--i-7iq.ws](http://xn--i-7iq.ws)

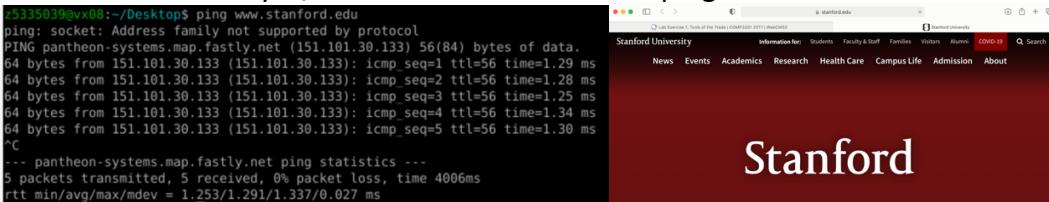
If you observe that some hosts are not reachable, then can you explain why? Check if the addresses unreachable by the ping command are reachable from the Web browser.

1. [www.google.com](http://www.google.com): yes, we can reach it from both ping command and browser.



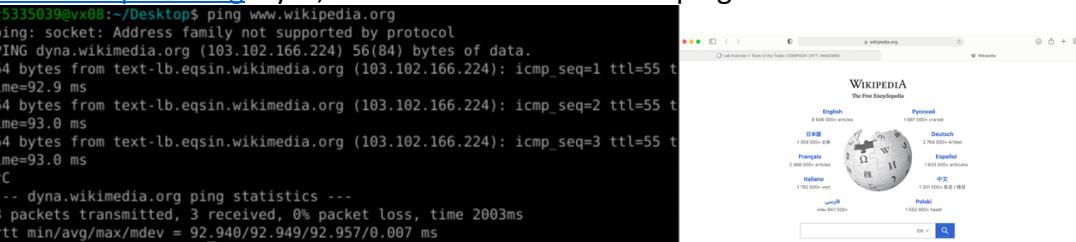
z5335039@vx08:~/Desktop\$ ping www.google.com.au  
ping: socket: Address family not supported by protocol  
PING www.google.com.AU (142.250.71.67) 56(84) bytes of data.  
64 bytes from syd15s17-in-f3.1e100.net (142.250.71.67): icmp\_seq=1 ttl=114 time=1.56 ms  
64 bytes from syd15s17-in-f3.1e100.net (142.250.71.67): icmp\_seq=2 ttl=114 time=1.73 ms  
64 bytes from syd15s17-in-f3.1e100.net (142.250.71.67): icmp\_seq=3 ttl=114 time=1.62 ms  
^C  
--- www.google.com.AU ping statistics ---  
3 packets transmitted, 3 received, 0% packet loss, time 2002ms  
rtt min/avg/max/mdev = 1.560/1.637/1.727/0.068 ms

2. [www.stanford.edu](http://www.stanford.edu): yes, we can reach it from both ping command and browser.



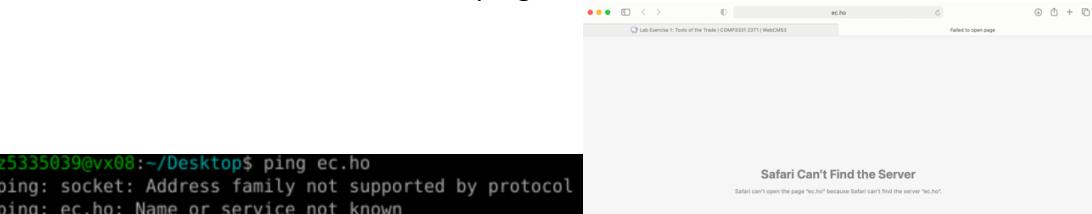
z5335039@vx08:~/Desktop\$ ping www.stanford.edu  
ping: socket: Address family not supported by protocol  
PING pantheon-systems.map.fastly.net (151.101.30.133) 56(84) bytes of data.  
64 bytes from 151.101.30.133 (151.101.30.133): icmp\_seq=1 ttl=56 time=1.29 ms  
64 bytes from 151.101.30.133 (151.101.30.133): icmp\_seq=2 ttl=56 time=1.28 ms  
64 bytes from 151.101.30.133 (151.101.30.133): icmp\_seq=3 ttl=56 time=1.25 ms  
64 bytes from 151.101.30.133 (151.101.30.133): icmp\_seq=4 ttl=56 time=1.34 ms  
64 bytes from 151.101.30.133 (151.101.30.133): icmp\_seq=5 ttl=56 time=1.30 ms  
^C  
--- pantheon-systems.map.fastly.net ping statistics ---  
5 packets transmitted, 5 received, 0% packet loss, time 4006ms  
rtt min/avg/max/mdev = 1.253/1.291/1.337/0.027 ms

3. [www.wikipedia.org](http://www.wikipedia.org) : yes, we can reach it from both ping command and browser.



z5335039@vx08:~/Desktop\$ ping www.wikipedia.org  
ping: socket: Address family not supported by protocol  
PING dyna.wikimedia.org (103.102.166.224) 56(84) bytes of data.  
64 bytes from text-lb.eqsin.wikimedia.org (103.102.166.224): icmp\_seq=1 ttl=55 time=92.9 ms  
64 bytes from text-lb.eqsin.wikimedia.org (103.102.166.224): icmp\_seq=2 ttl=55 time=93.0 ms  
64 bytes from text-lb.eqsin.wikimedia.org (103.102.166.224): icmp\_seq=3 ttl=55 time=93.0 ms  
^C  
--- dyna.wikimedia.org ping statistics ---  
3 packets transmitted, 3 received, 0% packet loss, time 2003ms  
rtt min/avg/max/mdev = 92.940/92.949/92.957/0.007 ms

4. [ec.ho](http://ec.ho) : No, we can't reach from both ping command and browser.



z5335039@vx08:~/Desktop\$ ping ec.ho  
ping: socket: Address family not supported by protocol  
ping: ec.ho: Name or service not known

5. [pin.gs](http://pin.gs): No, we can't reach from both ping command and browser.

```

z5335039@vx08:~/Desktop$ ping pin.gs
ping: socket: Address family not supported by protocol
ping: pin.gs: Name or service not known

```

6. nasa.gov: No, we can open the browser but the ping is not working which is because it has set up the firewall to detect third party package. (for security reason)

```

z5335039@vx08:~/Desktop$ ping nasa.gov
ping: socket: Address family not supported by protocol
PING nasa.gov (23.22.39.120) 56(84) bytes of data.
^C
--- nasa.gov ping statistics ---
7 packets transmitted, 0 received, 100% packet loss, time 6112ms

```

7. yes.no: yes, we can reach it from both ping command and browser.

```

z5335039@vx08:~/Desktop$ ping yes.no
ping: socket: Address family not supported by protocol
PING yes.no (162.241.218.145) 56(84) bytes of data.
64 bytes from box5569.bluehost.com (162.241.218.145): icmp_seq=1 ttl=48 time=225
ms
64 bytes from box5569.bluehost.com (162.241.218.145): icmp_seq=2 ttl=48 time=225
ms
64 bytes from box5569.bluehost.com (162.241.218.145): icmp_seq=3 ttl=48 time=226
ms
^C
--- yes.no ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2002ms
rtt min/avg/max/mdev = 224.965/225.464/226.428/0.681 ms

```

8. one.one.one.one: yes, we can reach it from both ping command and browser.

```

z5335039@vx08:~/Desktop$ ping one.one.one.one
ping: socket: Address family not supported by protocol
PING one.one.one.one (1.1.1.1) 56(84) bytes of data.
64 bytes from one.one.one.one (1.1.1.1): icmp_seq=1 ttl=55 time=1.31 ms
64 bytes from one.one.one.one (1.1.1.1): icmp_seq=2 ttl=55 time=1.30 ms
64 bytes from one.one.one.one (1.1.1.1): icmp_seq=3 ttl=55 time=1.29 ms
^C
--- one.one.one.one ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2003ms
rtt min/avg/max/mdev = 1.294/1.302/1.310/0.006 ms

```

9. theguardian.com: yes, we can reach it from both ping command and browser.

```

z5335039@vx08:~/Desktop$ ping theguardian.com
ping: socket: Address family not supported by protocol
PING theguardian.com (151.101.129.111) 56(84) bytes of data.
64 bytes from 151.101.129.111 (151.101.129.111): icmp_seq=1 ttl=56 time=1.25 ms
64 bytes from 151.101.129.111 (151.101.129.111): icmp_seq=2 ttl=56 time=1.23 ms
64 bytes from 151.101.129.111 (151.101.129.111): icmp_seq=3 ttl=56 time=1.26 ms
64 bytes from 151.101.129.111 (151.101.129.111): icmp_seq=4 ttl=56 time=1.27 ms
64 bytes from 151.101.129.111 (151.101.129.111): icmp_seq=5 ttl=56 time=1.27 ms
^C
--- theguardian.com ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4005ms
rtt min/avg/max/mdev = 1.230/1.254/1.270/0.014 ms

```

10. xn--i-7iq.ws: yes

```

z5335039@vx08:~/Desktop$ ping xn--i-7iq.ws
ping: socket: Address family not supported by protocol
PING xn--i-7iq.ws (64.70.19.203) 56(84) bytes of data.
64 bytes from mailrelay.203.website.ws (64.70.19.203): icmp_seq=1 ttl=49 time=38
8 ms
64 bytes from mailrelay.203.website.ws (64.70.19.203): icmp_seq=2 ttl=49 time=38
8 ms
64 bytes from mailrelay.203.website.ws (64.70.19.203): icmp_seq=3 ttl=49 time=38
8 ms
64 bytes from mailrelay.203.website.ws (64.70.19.203): icmp_seq=4 ttl=49 time=38
8 ms
64 bytes from mailrelay.203.website.ws (64.70.19.203): icmp_seq=5 ttl=49 time=38
8 ms
^C
--- xn--i-7iq.ws ping statistics ---
6 packets transmitted, 5 received, 16.6667% packet loss, time 5001ms
rtt min/avg/max/mdev = 387.831/387.895/387.963/0.042 ms

```

### Exercise 3: Use traceroute to understand the network topology (4 marks)

- Run traceroute on your machine to [www.tu-berlin.de](http://www.tu-berlin.de). How many routers are there between your workstation and [www.tu-berlin.de](http://www.tu-berlin.de)? How many routers along the path are part of the UNSW network? Which router is the first router outside of Australia? Which router is the first router in Europe? HINT: compare the round trip times from your machine to the routers. You might also find some router names informative and/or looking at network maps (eg. for AARNet).

- 1. www.tu-berlin.de .**

```
z5335039@vx08:~/Desktop$ traceroute www.tu-berlin.de
traceroute to www.tu-berlin.de (130.149.7.201), 30 hops max, 60 byte packets
 1 cserouter1-server.orchestra.cse.unsw.EDU.AU (129.94.242.251)  0.043 ms  0.050 ms  0.041 ms
 2 129.94.39.17 (129.94.39.17)  0.889 ms  0.852 ms  0.821 ms
 3 172.17.31.154 (172.17.31.154)  10.134 ms  10.125 ms  10.094 ms
 4 po-3-1902.ombrcl1.gw.unsw.edu.au (129.94.24.20)  1.189 ms  1.130 ms  1.099 ms
 5 unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  1.172 ms  1.061 ms  1.130 ms
 6 138.44.5.0 (138.44.5.0)  1.667 ms  1.347 ms  1.309 ms
 7 et-2-0-5.bdr1.sing.sin.aarnet.net.au (113.197.15.233)  92.923 ms  92.798 ms  92.759 ms
 8 138.44.226.7 (138.44.226.7)  256.154 ms  256.092 ms  256.177 ms
 9 ae9.mx1.ams.nl.geant.net (62.40.98.128)  263.496 ms  263.548 ms  263.514 ms
10 ae1.mx1.ham.de.geant.net (62.40.98.61)  269.826 ms  269.842 ms  269.821 ms
11 cr-tub1.x-win.dfn.de (62.40.125.171)  274.743 ms  274.705 ms  274.669 ms
12 kr-tub248.x-win.dfn.de (188.1.235.118)  274.356 ms  274.341 ms  274.349 ms
13 enc-fp.gate.tu-berlin.de (130.149.126.189)  274.751 ms  274.845 ms *
14 e-n-dist2-e-n-c.gate.tu-berlin.de (130.149.126.150)  274.837 ms  274.680 ms  274.761 ms
15 e-ns-e-n.gate.tu-berlin.de (130.149.126.78)  274.725 ms  274.865 ms  274.875 ms
16 www.tu-berlin.de (130.149.7.201)  274.616 ms  274.991 ms  274.586 ms
```

**How many routers are there between your workstation and [www.tu-berlin.de](http://www.tu-berlin.de) ?**

There are total 15 routers. (No16 is the destination.)

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

There are 4 routers (The 1<sup>st</sup>, 2<sup>nd</sup>,4<sup>th</sup>,5<sup>th</sup> )

```
z5335039@vx08:~/Desktop$ whois 129.94.39.17
% Information related to '129.94.0.0/16AS23859'

route:          129.94.0.0/16
origin:         AS23859
descr:          University of New South Wales
                UNSW IT
                Level 13 Library Building
                The University of New South Wales
mnt-by:         MAINT-AU-NSWUNIVERSITY
last-modified:  2022-08-25T03:33:33Z
source:         APNIC
```

**Which router is the first router outside of Australia?**

```
z5335039@vx08:~/Desktop$ whois 172.17.31.154
OrgName:        Internet Assigned Numbers Authority
OrgId:          IANA
Address:        12025 Waterfront Drive
Address:        Suite 300
City:           Los Angeles
StateProv:      CA
PostalCode:     90292
Country:        US
RegDate:        2012-08-31
Updated:        2012-08-31
Ref:            https://rdap.arin.net/registry/entity/IANA
```

## The first router in Europe

```
z5335039@vx00:~/Desktop$ whois 62.40.98.128
% This is the RIPE Database query service.
% The objects are in RPSL format.
%
% The RIPE Database is subject to Terms and Conditions.
% See http://www.ripe.net/db/support/db-terms-conditions.pdf

% Note: this output has been filtered.
%       To receive output for a database update, use the "-B" flag.

% Information related to '62.40.96.0 - 62.40.111.255'

% Abuse contact for '62.40.96.0 - 62.40.111.255' is 'cert@geant.org'

inetnum:      62.40.96.0 - 62.40.111.255
netname:      GEANT
descr:        IP allocation for GEANT network
country:      GB
admin-c:      DANT-RIPE
tech-c:       DANT-RIPE
status:        ASSIGNED PA
mnt-by:       DANTE-MNT
mnt-lower:    DANTE-MNT
created:      2002-09-02T10:11:54Z
last-modified: 2002-09-02T10:11:54Z
source:       RIPE

role:          GEANT Operations
address:      City House, 126-130 Hills Road
address:      Cambridge CB2 1PQ, UK
phone:        +44 1223 371300
fax-no:       +44 1223 371371
abuse-mailbox: cert@oc.geant.net
```

2. Run a traceroute from your machine to the following destinations: (i) [canterbury.ac.nz](http://canterbury.ac.nz) (ii) [stanford.edu](http://stanford.edu), and (iii) [reading.ac.uk](http://reading.ac.uk). At which router do the paths from your machine to these three destinations diverge (i.e. which is the last router they have in common)? Find out further details about this router.  
 HINT: You can learn more about a router by running the Whois command: whois router-IP-address. Is the number of hops on each path proportional to the physical distance? HINT: You may be able to find out the geographical location of a server using the following tool -  
<http://www.yougetsignal.com/tools/network-location/>.

[canterbury.ac.nz](http://canterbury.ac.nz)

```
z5335039@vx08:~/Desktop$ traceroute canterbury.ac.nz
traceroute to canterbury.ac.nz (132.181.106.9), 30 hops max, 60 byte packets
 1 cserouter1-server.orchestra.cse.unsw.EDU.AU (129.94.242.251)  0.043 ms  0.050 ms
 2 129.94.39.17 (129.94.39.17)  0.847 ms  0.863 ms  0.880 ms
 3 172.17.31.154 (172.17.31.154)  1.509 ms  1.918 ms  1.935 ms
 4 po-3-1902.ombcr1.gw.unsw.edu.au (129.94.24.20)  1.120 ms  1.194 ms  1.162 ms
 5 unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  1.105 ms  1.124 ms  1.155 ms
 6 138.44.5.0 (138.44.5.0)  1.288 ms  1.318 ms  1.281 ms
 7 et-0-1-0.bdr1.msct.nsw.aarnet.net.au (113.197.15.109)  2.353 ms  2.509 ms  1.780 ms
 8 210.7.39.22 (210.7.39.22)  1.860 ms  1.779 ms  1.871 ms
 9 210.7.37.209 (210.7.37.209)  49.415 ms  49.488 ms  49.506 ms
10 210.7.37.210 (210.7.37.210)  66.596 ms  66.561 ms  66.580 ms
11 202.36.179.65 (202.36.179.65)  49.220 ms  49.236 ms  49.254 ms
12 132.181.3.236 (132.181.3.236)  50.598 ms  50.245 ms  50.123 ms
13 132.181.106.9 (132.181.106.9)  49.221 ms  49.168 ms  49.227 ms
```

[stanford.edu](http://stanford.edu)

```
z5335039@vx08:~/Desktop$ traceroute stanford.edu
traceroute to stanford.edu (171.67.215.200), 30 hops max, 60 byte packets
 1 cserouter1-server.orchestra.cse.unsw.EDU.AU (129.94.242.251)  0.044 ms  0.052 ms  0.044 ms
 2 129.94.39.17 (129.94.39.17)  0.916 ms  0.933 ms  0.874 ms
 3 172.17.31.154 (172.17.31.154)  4.812 ms  4.780 ms  4.798 ms
 4 po-3-1902.ombcr1.gw.unsw.edu.au (129.94.24.20)  1.185 ms  1.226 ms  1.146 ms
 5 unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  1.181 ms  1.241 ms  1.139 ms
 6 138.44.5.0 (138.44.5.0)  1.273 ms  1.260 ms  1.303 ms
 7 et-1-3-0.pe1.sxt.bkvl.nsw.aarnet.net.au (113.197.15.149)  2.003 ms  2.095 ms  2.000 ms
 8 et-0-0-pe1.a.hnl.aarnet.net.au (113.197.15.99)  94.796 ms  94.624 ms  94.695 ms
 9 et-2-1-0.bdr1.a.sea.aarnet.net.au (113.197.15.201)  144.157 ms  144.150 ms  144.117 ms
10 cenichpr1-is-jmb-778.snvaca.pacificwave.net (207.231.245.129)  162.719 ms  162.758 ms  162.599 ms
11 hpr-oak-agg8-svl-hpr3-100g.cenic.net (137.164.25.95)  164.149 ms  164.170 ms  163.829 ms
12 137.164.26.241 (137.164.26.241)  164.743 ms  164.435 ms  164.409 ms
13 woa-west-rtr-vl3.SUNet (171.66.255.132)  163.854 ms  164.735 ms  164.865 ms
14 * * *
15 web.stanford.edu (171.67.215.200)  164.167 ms  164.158 ms  164.164 ms
```

[Reading.ac.uk](http://reading.ac.uk)

```
z5335039@vx07:~/Desktop$ traceroute reading.ac.uk
traceroute to reading.ac.uk (134.225.0.151), 30 hops max, 60 byte packets
 1 cserouter1-server.orchestra.cse.unsw.EDU.AU (129.94.242.251)  0.067 ms  0.058 ms  0.065 ms
 2 129.94.39.17 (129.94.39.17)  0.866 ms  0.913 ms  0.856 ms
 3 172.17.31.154 (172.17.31.154)  2.117 ms  2.218 ms  2.057 ms
 4 po-3-1902.ombcr1.gw.unsw.edu.au (129.94.24.20)  1.405 ms  1.412 ms  1.422 ms
 5 unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  1.293 ms  1.326 ms  1.283 ms
 6 138.44.5.0 (138.44.5.0)  1.357 ms  1.418 ms  1.435 ms
 7 et-2-0-5.bdr1.sing.sin.aarnet.net.au (113.197.15.233)  92.742 ms  92.777 ms  92.781 ms
 8 138.44.226.7 (138.44.226.7)  256.041 ms  255.950 ms  256.004 ms
 9 ae2.mx1.lon2.uk.geant.net (62.40.98.65)  256.972 ms  256.929 ms  256.888 ms
10 janet-bckp-gw.mx1.lon2.uk.geant.net (62.40.125.58)  257.177 ms  257.183 ms  257.037 ms
11 ae19.readdy-rbr1.ja.net (146.97.37.194)  258.730 ms  258.967 ms  258.983 ms
12 reading-university-1.ja.net (193.63.109.26)  276.899 ms  280.440 ms  280.338 ms
13 xe-0-0-7.fw-ext.net.rdg.ac.uk (134.225.255.38)  258.510 ms  258.486 ms  258.426 ms
14 wap-slb-vip.rdg.ac.uk (134.225.0.151)  259.585 ms  259.353 ms  259.383 ms
```

**At which router do the paths from your machine to these three destinations diverge (i.e. which is the last router they have in common)?**

```
z5335039@vx07:~/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 1997-2023, 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/abuse-and-spamming
Ref:          https://rdap.arin.net/registry/ip/138.44.0.0

ResourceLink: http://wq.apnic.net/whois-search/static/search.html
ResourceLink: whois.apnic.net
```

**Is the number of hops on each path proportional to the physical distance? HINT: You may be able to find out the geographical location of a server using the following tool -**  
<http://www.yougetsignal.com/tools/network-location/>

canterbury.ac.nz

### Network Location Tool

#### approximate geophysical location



#### locate a network

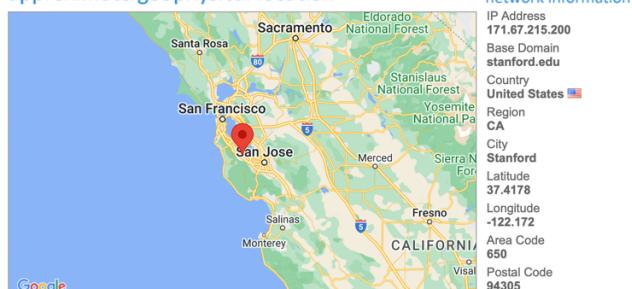
Remote Address 132.181.106.9   Use Current IP

Source  MaxMind  Hostip.info

stanford.edu

### Network Location Tool

#### approximate geophysical location



#### locate a network

Remote Address 171.67.215.200   Use Current IP

Source  MaxMind  Hostip.info

Reading.ac.uk

### Network Location Tool

#### approximate geophysical location



#### locate a network

Remote Address 134.225.0.151   Use Current IP

Source  MaxMind  Hostip.info

$$\text{Physical Distances (miles)} \div \text{number of routers}$$

canterbury.ac.nz

$$1339.7 \div 13 \approx 103.05$$

stanford.edu

$$6759.1 \div 15 \approx 450.61$$

Reading.ac.uk

$$5351.1 \div 14 \approx 382.22$$

From the above information we know that the physical distance is not proportional to the numbers of routers that goes through.

3. Several servers are distributed worldwide to provide a web interface from which you can perform a traceroute to any other host on the Internet. Here are two examples: (i) [www.speedtest.com.sg/tr.php](http://www.speedtest.com.sg/tr.php) and (ii) [www.as13030.net/traceroute.php](http://www.as13030.net/traceroute.php). Run a traceroute from both these servers towards your machine and in the reverse direction (i.e. from your machine to these servers - do not include the full URL while doing this, e.g. just " [www.speedtest.com.sg](http://www.speedtest.com.sg) ". You may also try other traceroute servers from the list at [www.traceroute.org](http://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 standard routers between the forward and the reverse path, do you also observe the same IP addresses? Why or why not?

```
z5335039@vx09:~/Desktop$ /sbin/ifconfig
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
        inet 129.94.242.91 netmask 255.255.255.0 broadcast 129.94.242.255
              ether 00:62:0b:1d:f0 txqueuelen 1000 (Ethernet)
              RX packets 1214793312 bytes 1267071899290 (1.1 TiB)
              RX errors 0 dropped 0 overruns 0 frame 0
              TX packets 862452465 bytes 455993828846 (424.6 GiB)
              TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING> mtu 65536
        inet 127.0.0.1 netmask 255.0.0.0
          loop txqueuelen 1000 (Local Loopback)
          RX packets 672957913 bytes 9158007447380 (8.3 TiB)
          RX errors 0 dropped 0 overruns 0 frame 0
          TX packets 672957913 bytes 9158007447380 (8.3 TiB)
          TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
```

## Traceroute from CSE VLAD to [www.speedtest.com.sg](http://www.speedtest.com.sg)

```
z5335039@vx07:~/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.orchestra.cse.unsw.EDU.AU (129.94.242.251)  0.044 ms  0.068 ms  0.050 ms
 2 129.94.39.17 (129.94.39.17)  0.995 ms  0.883 ms  0.896 ms
 3 172.17.31.154 (172.17.31.154)  1.520 ms  1.937 ms  1.951 ms
 4 po-3-1902.ombcr1.gw.unsw.edu.au (129.94.24.20)  1.153 ms  1.213 ms  1.178 ms
 5 unswbri-te-2-13.gw.unsw.edu.au (149.171.255.105)  1.214 ms  1.254 ms  1.216 ms
 6 138.44.5.0 (138.44.5.0)  1.323 ms  1.263 ms  1.278 ms
 7 et-0-3-0.pe1.alxd.nsw.aarnet.net.au (113.197.15.153)  1.812 ms  1.783 ms  1.833 ms
 8 xe-0-2-7.bdr1.a.lax.aarnet.net.au (202.158.194.173)  147.635 ms  147.693 ms  147.639 ms
 9 singtel.as7473.any2ix.coresite.com (206.72.210.63)  147.747 ms  147.819 ms  147.746 ms
10 203.208.182.153 (203.208.182.153)  335.795 ms  203.208.171.117 (203.208.171.117)  147.912 ms  203.208.182.153 (203.208.182.153)  335.756 ms
11 203.208.177.110 (203.208.177.110)  318.897 ms  322.693 ms  203.208.172.121 (203.208.172.121)  224.489 ms
12 203.208.152.193 (203.208.152.193)  254.191 ms * *
13 202.150.221.170 (202.150.221.170)  200.729 ms  209.157 ms  203.208.182.253 (203.208.182.253)  329.899 ms
```

## Traceroute from <http://www.speedtest.com.sg/tr.php> to CSE VLAD

Traceroute Result:

```
traceroute to 129.94.242.91 (129.94.242.91), 30 hops max, 60 byte packets
 1 202.150.221.169 (202.150.221.169)  0.145 ms  0.192 ms  0.211 ms
 2 10.11.34.146 (10.11.34.146)  0.520 ms  0.611 ms  0.714 ms
 3 aarnet.sqix.sg (103.16.102.67)  218.916 ms  218.932 ms  218.939 ms
 4 et-7-3-0.pe1.nsw.brwy.aarnet.net.au (113.197.15.232)  211.810 ms  211.844 ms  211.867 ms
 5 138.44.5.1 (138.44.5.1)  213.004 ms  213.023 ms  213.049 ms
 6 libcr1-te-1-5.gw.unsw.edu.au (149.171.255.102)  213.093 ms  213.521 ms  213.007 ms
 7 * irb-51901.kecdl-176q4-cbl-e1.gw.unsw.edu.au (129.94.24.10)  214.337 ms *
 8 * *
 9 129.94.39.23 (129.94.39.23)  215.034 ms  215.323 ms  215.398 ms
10 * *
11 * *
12 * *
13 * *
14 * *
15 * *
16 * *
17 * *
18 * *
19 * *
20 * *
21 * *
22 * *
23 * *
24 * *
25 * *
26 * *
27 * *
28 * *
29 * *
30 * *
```

Traceroute Completed.

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

The IP address of [www.speedtest.com.sg](http://www.speedtest.com.sg): 202.150.221.169 as the above shows.

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

From those two images we can see that the routers go through similar path but not the same.

If you observe standard routers between the forward and the reverse path, do you also observe the same IP addresses? Why or why not?

When they are having the same routers, the IP addresses are different because there are multiple factors that may affect the fastest route. E.g. To balance the loading when there are many users using from different places, it will pass through the same route with different IP address.

## Traceroute from CSE VLAB to [www.telstra.net](http://www.telstra.net)

```
z5335039@vx07:~/Desktop$ traceroute www.telstra.net
traceroute to www.telstra.net (203.50.5.178), 30 hops max, 60 byte packets
 1 cserouter1-server.orchestra.cse.unsw.EDU.AU (129.94.242.251)  0.042 ms  0.057 ms  0.048 ms
 2 129.94.39.17 (129.94.39.17)  0.816 ms  0.846 ms  0.863 ms
 3 172.17.31.154 (172.17.31.154)  21.367 ms  21.386 ms  21.379 ms
 4 po-3-1902.ombcr1.gw.unsw.edu.au (129.94.24.20)  1.213 ms  1.118 ms  1.145 ms
 5 unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  1.178 ms  1.080 ms  1.097 ms
 6 138.44.5.0 (138.44.5.0)  1.313 ms  1.250 ms  1.270 ms
 7 et-1-1-0.pe1.rsb1.nsw.aarnet.net.au (113.197.15.12)  1.766 ms  1.825 ms  1.763 ms
 8 xe-0-0-3.bdr1.rsb1.nsw.aarnet.net.au (113.197.15.31)  1.401 ms  1.439 ms  1.455 ms
 9 139.130.0.77 (139.130.0.77)  2.107 ms  2.215 ms  2.338 ms
10 bundle-ether17.ken-core10.sydney.telstra.net (203.50.11.172)  2.282 ms  2.357 ms  2.288 ms
11 bundle-ether3.cla-core30.melbourne.telstra.net (203.50.13.133)  13.962 ms  12.794 ms  13.266 ms
12 bundle-ether2.exi-core30.melbourne.telstra.net (203.50.13.125)  13.510 ms  13.552 ms  13.403 ms
13 bundle-ether2.exi-ncprouter101.melbourne.telstra.net (203.50.11.209)  13.629 ms  16.018 ms  13.623 ms
14 www.telstra.net (203.50.5.178)  12.944 ms  12.961 ms  12.952 ms
```

## Traceroute from [www.telstra.net/cgi-bin/trace](http://www.telstra.net/cgi-bin/trace) to CSE VLAB

```
1 gigabitethernet3-3.exi1.melbourne.telstra.net (203.50.77.49)  0.886 ms  0.720 ms  0.494 ms
2 TenGigE0-0-0-21.lon-dlr20.melbourne.telstra.net (203.50.233.22)  0.619 ms  0.739 ms  0.495 ms
3 bundle-ether30.exi1-core30.melbourne.telstra.net (203.50.11.246)  3.117 ms  1.487 ms  1.995 ms
4 bundle-ether2.cla-core30.melbourne.telstra.net (203.50.13.124)  1.745 ms  2.112 ms  1.369 ms
5 bundle-ether3.hay-core30.sydney.telstra.net (203.50.13.132)  13.114 ms  11.730 ms  12.113 ms
6 bundle-ether1.ken-edge903.sydney.telstra.net (203.50.11.173)  12.114 ms  12.232 ms  12.238 ms
7 139.130.0.78 (139.130.0.78)  11.988 ms  11.733 ms  11.989 ms
8 et-7-1-0.pe1.brwy.nsw.aarnet.net.au (113.197.15.13)  16.360 ms  12.356 ms  11.989 ms
9 138.44.5.1 (138.44.5.1)  12.239 ms  12.230 ms  12.238 ms
10 libcr1-te-1-5.gw.unsw.edu.au (149.171.255.102)  12.239 ms  12.232 ms  12.239 ms
11 irb-51901.kecd1-176q4-cbl-e1.gw.unsw.edu.au (129.94.24.10)  15.736 ms  12.732 ms  12.739 ms
```

The IP address of localhost: 129.94.242.251.

The IP address of [www.telstra.net/cgi-bin/trace](http://www.telstra.net/cgi-bin/trace): 203.50.77.49.

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

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 plan to do this exercise on your machine.

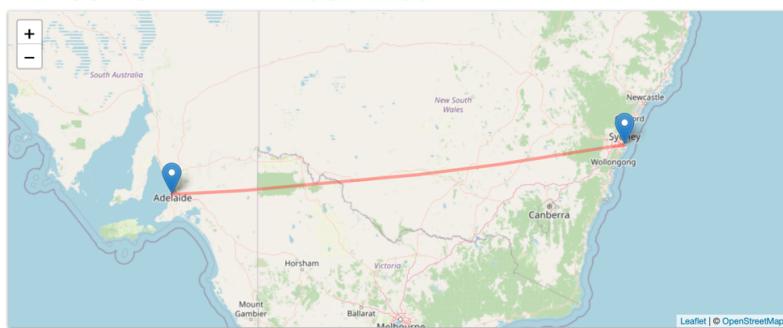
We now use the ping utility to investigate network delay and its implications on network performance. In particular, we will analyze the dependency of packet size and delay.

There is a shell script `runping.sh`, provided that you can use it 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, with 50 ping packets per size (-c 50). Note since ping is sent once per second (-i 1), this script will take a few minutes to finish. Additional options are enabled to use IPv4 only (-4) and not lookup symbolic names for host addresses (-n). Basically, this script only executes the commands:

Flinders University - Adelaide, Australia

1163.48 km 722.95 miles

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```
z5335039@vx09:~/Desktop$ ./plot.sh flinders.edu.au-p*
flinders.edu.au
processing flinders.edu.au-p1000
1000 23.928 23.833
processing flinders.edu.au-p1250
1250 23.958 23.910
processing flinders.edu.au-p1500
1500 24.037 24.006
processing flinders.edu.au-p250
250 23.671 23.572
processing flinders.edu.au-p50
50 23.527 23.448
processing flinders.edu.au-p500
500 23.765 23.679
processing flinders.edu.au-p750
750 23.867 23.783
ps2pdf flinders.edu.au_delay.ps
ps2pdf flinders.edu.au_scatter.ps
```

The speed of the light:

$$L = 3 * 10^8 \text{ m/s} = 3 * 10^5 \text{ km/s}$$

The shortest possible time:

$$T = 1163.48 \div (3 * 10^5) \approx 0.003878 \text{ s}$$

The minimum delay for 50-byte packet:

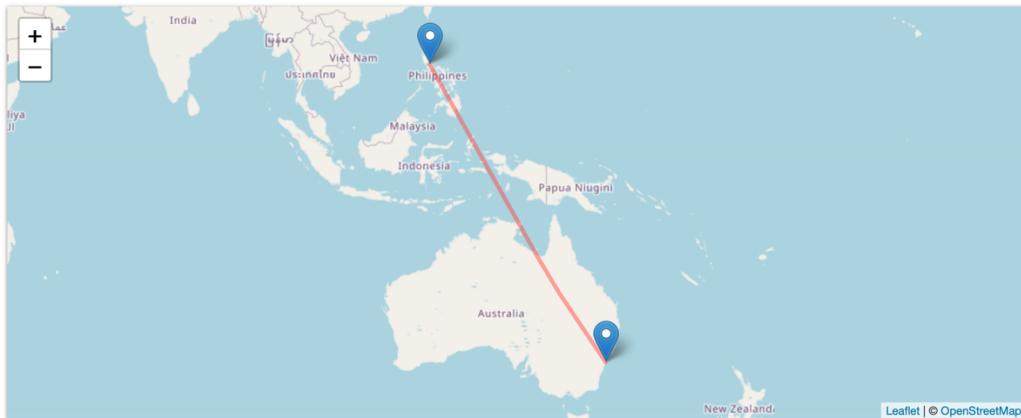
$$RTT = 23.448 \text{ ms}$$

$$Y \text{ axis} = RTT/T = 6.046416$$

University of the Philippines Diliman - Quezon City, Philippines

6270.06 km  
3896.03 miles

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```
z5335039@vx11:~/Desktop$ ./plot.sh upd.edu.ph-p*
upd.edu.ph
processing upd.edu.ph-p1000
1000 122.540 122.313
processing upd.edu.ph-p1250
1250 122.726 122.384
processing upd.edu.ph-p1500
1500 123.608 123.608
processing upd.edu.ph-p250
250 122.364 122.105
processing upd.edu.ph-p50
50 122.240 121.991
processing upd.edu.ph-p500
500 122.486 122.193
processing upd.edu.ph-p750
750 122.504 122.228
ps2pdf upd.edu.ph_delay.ps
ps2pdf upd.edu.ph_scatter.ps
```

The speed of the light:

$$L = 3 * 10^8 \text{ m/s} = 3 * 10^5 \text{ km/s}$$

The shortest possible time:

$$T = 6270.06 \div (3 * 10^5) \approx 0.0209 \text{ s}$$

The minimum delay for 50-byte packet:

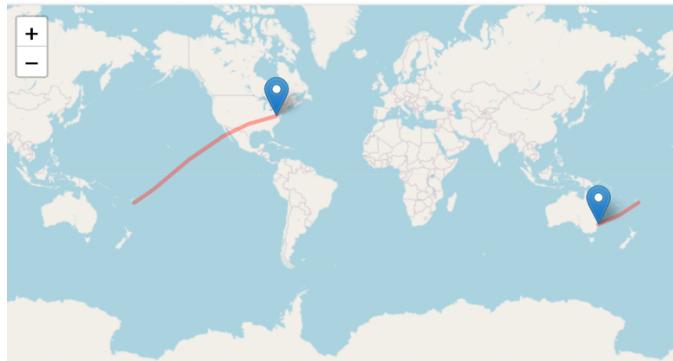
$$RTT = 121.991 \text{ ms}$$

$$Y \text{ axis} = RTT/T = 5.8$$

University of Oslo - Oslo, Norway

15570.17 km      9674.85 miles

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```
z3335039@vx09:~/Desktop$ ./plot.sh uio.no-p*
uio.no
processing uio.no-p1000
1000 313.549 313.521
processing uio.no-p1250
1250 313.562 313.546
processing uio.no-p1500
1500 313.939 313.563
processing uio.no-p250
250 313.222 313.185
processing uio.no-p50
50 313.158 313.070
processing uio.no-p500
500 313.358 313.317
processing uio.no-p750
750 313.582 313.441
ps2pdf uio.no_delay.ps
ps2pdf uio.no_scatter.ps
```

The speed of the light:

$$L = 3 * 10^8 \text{ m/s} = 3 * 10^5 \text{ km/s}$$

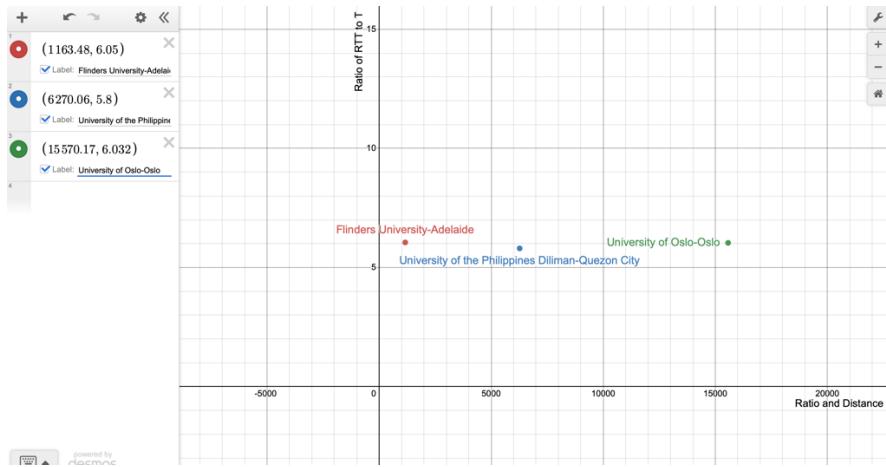
The shortest possible time:

$$T = 15570.17 \div (3 * 10^5) \approx 0.0519 \text{ s}$$

The minimum delay for 50-byte packet:

$$RTT = 313.070 \text{ ms}$$

$$Y \text{ axis } = RTT/T = 6.032$$



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

1. If the transmission rate is less than the speed of light.
2. The delays (processing, queueing, transmission, and propagation) increase the time while transition.

#### **4.2 Is the delay to the destinations constant, or does it vary over time? Explain why.**

Because the delay may or may not happen, and the delay consist of propagation delay, transmission delay, processing delay and queuing delay which cause it vary over time.

#### **4.3 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?**

The transmission delay is affected by the size of the packet that are being transmitted. While the queuing delay, processing delay, and propagation delay are not.