## Exercise 1: nslookup

### 1

```
z5125710@vx5:/tmp_amd/ravel/export/ravel/3/z5125710$ nslookup www.koala.com.au
Server:         129.94.242.45
Address:        129.94.242.45#53

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

z5125710@vx5:/tmp_amd/ravel/export/ravel/3/z5125710$
```

Ans: 1.The IP addresses are 172.67.219.46/ 104.18.60.21/ 104.18.61.21

2. Having several IP addresses can improve load balancing and once one server goes done, the others can be used.

### 2

```
z5125710@vx5:/tmp_amd/ravel/export/ravel/3/z5125710$ 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.
```

Ans: The name is 'localhost', this IP address is our private address and to help device to communicate internally.

## Exercise 2: Use ping to test host reachability

- www.unsw.edu.au

**Reachable (Time around 1.08ms)**

```
z5125710@vx6:/tmp_amd/ravel/export/ravel/3/z5125710/Desktop/COMP3331$ ping www.unsw.edu.au
PING cdn.prod65.unsw.adobecqms.net (13.35.145.40) 56(84) bytes of data.
64 bytes from server-13-35-145-40.syd1.r.cloudfront.net (13.35.145.40): icmp_seq=1 ttl=244 time=1.08 ms
64 bytes from server-13-35-145-40.syd1.r.cloudfront.net (13.35.145.40): icmp_seq=2 ttl=244 time=1.08 ms
64 bytes from server-13-35-145-40.syd1.r.cloudfront.net (13.35.145.40): icmp_seq=3 ttl=244 time=1.07 ms
64 bytes from server-13-35-145-40.syd1.r.cloudfront.net (13.35.145.40): icmp_seq=4 ttl=244 time=1.07 ms
^C
--- cdn.prod65.unsw.adobecqms.net ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3001ms
rtt min/avg/max/mdev = 1.072/1.079/1.087/0.033 ms
z5125710@vx6:/tmp_amd/ravel/export/ravel/3/z5125710/Desktop/COMP3331$
```

- www.getfittest.com.au

**Unreachable, because this web page does not exist.**

```
z5125710@vx6:/tmp_amd/ravel/export/ravel/3/z5125710/Desktop/COMP3331$ ping www.getfittest.com.au
ping: unknown host www.getfittest.com.au
```

- www.mit.edu

**Reachable (Time around 1.25ms)**

```
z5125710@vx6:/tmp_amd/ravel/export/ravel/3/z5125710/Desktop/COMP3331$ ping www.mit.edu
PING e9566.dscb.akamaiedge.net (23.77.154.132) 56(84) bytes of data.
64 bytes from a23-77-154-132.deploy.static.akamaitechnologies.com (23.77.154.132): icmp_seq=1 ttl=56 time=1.30 ms
64 bytes from a23-77-154-132.deploy.static.akamaitechnologies.com (23.77.154.132): icmp_seq=2 ttl=56 time=1.30 ms
64 bytes from a23-77-154-132.deploy.static.akamaitechnologies.com (23.77.154.132): icmp_seq=3 ttl=56 time=1.24 ms
64 bytes from a23-77-154-132.deploy.static.akamaitechnologies.com (23.77.154.132): icmp_seq=4 ttl=56 time=1.24 ms
^C
--- e9566.dscb.akamaiedge.net ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3003ms
rtt min/avg/max/mdev = 1.243/1.275/1.308/0.029 ms
```

- www.intel.com.au

**Reachable (Time around 16.3ms)**

```
z5125710@vx6:/tmp_amd/ravel/export/ravel/3/z5125710/Desktop/COMP3331$ ping www.intel.com.au
PING e19235.dsca.akamaiedge.net (23.62.254.117) 56(84) bytes of data.
64 bytes from a23-62-254-117.deploy.static.akamaitechnologies.com (23.62.254.117): icmp_seq=1 ttl=56 time=16.3 ms
64 bytes from a23-62-254-117.deploy.static.akamaitechnologies.com (23.62.254.117): icmp_seq=2 ttl=56 time=16.3 ms
64 bytes from a23-62-254-117.deploy.static.akamaitechnologies.com (23.62.254.117): icmp_seq=3 ttl=56 time=16.3 ms
64 bytes from a23-62-254-117.deploy.static.akamaitechnologies.com (23.62.254.117): icmp_seq=4 ttl=56 time=16.3 ms
^C
--- e19235.dsca.akamaiedge.net ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3004ms
rtt min/avg/max/mdev = 16.304/16.330/16.375/0.130 ms
```

- www.tpg.com.au

**Reachable (Time around 1.60ms)**

```
z5125710@vx6:/tmp_amd/ravel/export/ravel/3/z5125710/Desktop/COMP3331$ ping www.tpg.com.au
PING www.tpg.com.au (203.26.27.38) 56(84) bytes of data.
64 bytes from www.tpg.com.au (203.26.27.38): icmp_seq=1 ttl=119 time=1.70 ms
64 bytes from www.tpg.com.au (203.26.27.38): icmp_seq=2 ttl=119 time=1.59 ms
64 bytes from www.tpg.com.au (203.26.27.38): icmp_seq=3 ttl=119 time=1.61 ms
^C
--- www.tpg.com.au ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2001ms
rtt min/avg/max/mdev = 1.596/1.639/1.709/0.049 ms
```

- www.hola.hp

**Unreachable, domain name does not exist.**

```
z5125710@vx6:/tmp_amd/ravel/export/ravel/3/z5125710/Desktop/COMP3331$ ping www.hola.hp
ping: unknown host www.hola.hp
```

- www.amazon.com

**Reachable (Time around 1.10ms)**

```
z5125710@vx6:/tmp_amd/ravel/export/ravel/3/z5125710/Desktop/COMP3331$ ping www.hola.hp
ping: unknown host www.hola.hp
z5125710@vx6:/tmp_amd/ravel/export/ravel/3/z5125710/Desktop/COMP3331$ ping www.amazon.com
PING e15316.e22.akamaiedge.net (138.44.25.122) 56(84) bytes of data.
64 bytes from 138.44.25.122: icmp_seq=1 ttl=57 time=1.26 ms
64 bytes from 138.44.25.122: icmp_seq=2 ttl=57 time=1.04 ms
64 bytes from 138.44.25.122: icmp_seq=3 ttl=57 time=1.01 ms
64 bytes from 138.44.25.122: icmp_seq=4 ttl=57 time=1.08 ms
64 bytes from 138.44.25.122: icmp_seq=5 ttl=57 time=1.14 ms
^C
--- e15316.e22.akamaiedge.net ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4004ms
rtt min/avg/max/mdev = 1.017/1.112/1.267/0.097 ms
```

- www.tsinghua.edu.cn

**Reachable (Time around 242ms)**

```
z5125710@vx6:/tmp_amd/ravel/export/ravel/3/z5125710/Desktop/COMP3331$ ping www.tsinghua.edu.cn
PING www.tsinghua.edu.cn (166.111.4.100) 56(84) bytes of data.
64 bytes from www.tsinghua.edu.cn (166.111.4.100): icmp_seq=1 ttl=42 time=242 ms
64 bytes from www.tsinghua.edu.cn (166.111.4.100): icmp_seq=2 ttl=42 time=242 ms
64 bytes from www.tsinghua.edu.cn (166.111.4.100): icmp_seq=3 ttl=42 time=242 ms
64 bytes from www.tsinghua.edu.cn (166.111.4.100): icmp_seq=4 ttl=42 time=242 ms
64 bytes from www.tsinghua.edu.cn (166.111.4.100): icmp_seq=5 ttl=42 time=242 ms
^C
--- www.tsinghua.edu.cn ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4000ms
rtt min/avg/max/mdev = 242.091/242.141/242.175/0.312 ms
```

- www.kremlin.ru

Unreachable by ping, reachable from the Web browser.

For safety, this web will block sequential requests, so we cannot ping this IP address.

```
z5125710@vx6:/tmp_amd/ravel/export/ravel/3/z5125710/Desktop/COMP3331$ ping www.kremlin.ru
PING www.kremlin.ru (95.173.136.71) 56(84) bytes of data.

^C
--- www.kremlin.ru ping statistics ---
6 packets transmitted, 0 received, 100% packet loss, time 5100ms
```

- 8.8.8.8

**Reachable (Time around 1.60ms)**

```
z5125710@vx6:/tmp_amd/ravel/export/ravel/3/z5125710/Desktop/COMP3331$ ping 8.8.8.8
PING 8.8.8.8 (8.8.8.8) 56(84) bytes of data.
64 bytes from 8.8.8.8: icmp_seq=1 ttl=114 time=1.60 ms
64 bytes from 8.8.8.8: icmp_seq=2 ttl=114 time=1.55 ms
64 bytes from 8.8.8.8: icmp_seq=3 ttl=114 time=1.70 ms
64 bytes from 8.8.8.8: icmp_seq=4 ttl=114 time=1.58 ms
64 bytes from 8.8.8.8: icmp_seq=5 ttl=114 time=1.62 ms

64 bytes from 8.8.8.8: icmp_seq=6 ttl=114 time=1.52 ms
64 bytes from 8.8.8.8: icmp_seq=7 ttl=114 time=1.54 ms
^C
--- 8.8.8.8 ping statistics ---
7 packets transmitted, 7 received, 0% packet loss, time 6009ms
rtt min/avg/max/mdev = 1.520/1.589/1.700/0.072 ms
```

## Exercise 3: Use traceroute to understand network topology

```
z5125710@vx5:/tmp_amd/ravel/export/ravel/3/z5125710$ 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)  0.143 ms  0.127 ms  0.11
2 ms
 2  129.94.39.17 (129.94.39.17)  0.889 ms  0.847 ms  0.916 ms
 3  libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34)  1.847 ms ombudnex1-vl-315
4.gw.unsw.edu.au (149.171.253.35)  1.810 ms libudnex1-vl-3154.gw.unsw.edu.au (14
9.171.253.34)  1.838 ms
 4  ombcr1-po-6.gw.unsw.edu.au (149.171.255.169)  1.189 ms  1.256 ms ombcr1-po-5
.gw.unsw.edu.au (149.171.255.197)  1.178 ms
 5  unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101)  1.421 ms  1.445 ms unswbr1-
te-2-13.gw.unsw.edu.au (149.171.255.105)  1.409 ms
 6  138.44.5.0 (138.44.5.0)  1.746 ms  1.338 ms  1.290 ms
 7  et-1-3-0.pe1.sxt.bkvl.nsw.aarnet.net.au (113.197.15.149)  13.730 ms  13.312
ms  13.301 ms
 8  et-0-0-0.pe1.a.hnl.aarnet.net.au (113.197.15.99)  95.679 ms  95.586 ms  95.6
70 ms
 9  et-2-1-0.bdr1.a.sea.aarnet.net.au (113.197.15.201)  146.613 ms  146.665 ms
146.604 ms
10  abilene-1-lo-jmb-706.sttlwa.pacificwave.net (207.231.240.8)  146.734 ms  146
.566 ms  146.564 ms
11  ae-1.4079.rtsw.minn.net.internet2.edu (162.252.70.173)  179.332 ms  179.288
ms  179.271 ms
12  ae-1.4079.rtsw.eqch.net.internet2.edu (162.252.70.106)  187.698 ms  190.298
ms  190.289 ms
13  ae-0.4079.rtsw3.eqch.net.internet2.edu (162.252.70.163)  187.251 ms  187.400
 ms  187.336 ms
14  ae-1.4079.rtsw.clev.net.internet2.edu (162.252.70.130)  193.124 ms  193.260
ms  193.201 ms
15  buf-9208-I2-CLEV.nysernet.net (199.109.11.33)  196.525 ms  196.496 ms  196.4
22 ms
16  syr-9208-buf-9208.nysernet.net (199.109.7.193)  199.840 ms  199.719 ms  199.
610 ms
17  nyc111-9204-syr-9208.nysernet.net (199.109.7.94)  208.771 ms  209.151 ms  20
8.871 ms
18  nyc-9208-nyc111-9204.nysernet.net (199.109.7.165)  209.026 ms  209.028 ms  2
09.000 ms
19  columbia.nyc-9208.nysernet.net (199.109.4.14)  208.919 ms  208.902 ms  208.9
95 ms
20  cc-core-1-x-nyser32-gw-1.net.columbia.edu (128.59.255.5)  209.179 ms  209.22
3 ms  209.348 ms
21  cc-conc-1-x-cc-core-1.net.columbia.edu (128.59.255.21)  209.299 ms  209.380
ms  209.502 ms
22  p-i-r.org (128.59.105.24)  209.223 ms  209.170 ms  209.252 ms
z5125710@vx5:/tmp_amd/ravel/export/ravel/3/z5125710$
```

Ans:

1. There are 21 routers between my workstation and www.columbia.edu. Router 1 to 5 are part of the UNSW network. From router 7 to 9, packets cross the Pacific Ocean, because the time cost is larger than others.

2.

```
z5125710@vx8:/tmp_amd/ravel/export/ravel/3/z5125710/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)  0.129 ms  0.118 ms  0.116 ms
 2  129.94.39.17 (129.94.39.17)  0.858 ms  0.914 ms  0.869 ms
 3  ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35)  1.482 ms  1.757 ms  1.507 ms
 4  libcr1-po-5.gw.unsw.edu.au (149.171.255.165)  1.091 ms ombcr1-po-6.gw.unsw.edu.au (149.171.255.169)  1.112 ms libcr1-po-5.gw
.unsw.edu.au (149.171.255.165)  1.078 ms
 5  unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  1.142 ms unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101)  1.196 ms unswbr1
-te-2-13.gw.unsw.edu.au (149.171.255.105)  1.210 ms
 6  138.44.5.0 (138.44.5.0)  1.299 ms  1.294 ms  1.224 ms
 7  et-1-3-0.pe1.sxt.bkvl.nsw.aarnet.net.au (113.197.15.149)  1.887 ms  2.006 ms  2.184 ms
 8  et-0-0-0.pe1.a.hnl.aarnet.net.au (113.197.15.99)  96.124 ms  96.213 ms  96.152 ms
 9  et-2-1-0.bdr1.a.sea.aarnet.net.au (113.197.15.201)  146.761 ms  146.835 ms  146.794 ms
10  cenichpr-1-is-jmb-778.snvaca.pacificwave.net (207.231.245.129)  164.638 ms  164.544 ms  163.956 ms
11  svl-agg10-hpr--svl-hpr3--100g.cenic.net (137.164.25.106)  164.948 ms  164.907 ms  164.933 ms
12  hpr-lax-agg10--svl-agg10-100ge.cenic.net (137.164.25.73)  163.011 ms  163.040 ms  162.999 ms
13  * * *
14  bd11f1.anderson--cr00f2.csb1.ucla.net (169.232.4.4)  160.899 ms  160.866 ms bd11f1.anderson--cr001.anderson.ucla.net (169.23
2.4.6)  160.272 ms
15  cr00f2.csb1--rtr11f4.mathsci.ucla.net (169.232.8.181)  161.135 ms cr00f1.anderson--rtr11f4.mathsci.ucla.net (169.232.8.185)
 161.175 ms cr00f2.csb1--rtr11f4.mathsci.ucla.net (169.232.8.181)  160.411 ms
16  * * *
17  * * *
18  * * *
19  * * *
20  * * *
21  * * *
22  * * *
23  * * *
24  * * *
25  * * *
26  * * *
27  * * *
28  * * *
29  * * *
30  * * *
```

```
z5125710@vx8:/tmp_amd/ravel/export/ravel/3/z5125710/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)  0.118 ms  0.099 ms  0.087 ms
 2  129.94.39.17 (129.94.39.17)  0.793 ms  0.884 ms  0.841 ms
 3  ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35)  1.527 ms  1.603 ms libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34)  1.2
61 ms
 4  ombcr1-po-5.gw.unsw.edu.au (149.171.255.197)  1.104 ms ombcr1-po-6.gw.unsw.edu.au (149.171.255.169)  1.125 ms  1.151 ms
 5  unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  1.233 ms  1.192 ms unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101)  1.214
ms
 6  138.44.5.0 (138.44.5.0)  1.397 ms  1.287 ms  1.285 ms
 7  et-0-3-0.pe1.bkvl.nsw.aarnet.net.au (113.197.15.147)  1.937 ms  1.923 ms  2.024 ms
 8  ge-4_0_0.bb1.a.pao.aarnet.net.au (202.158.194.177)  154.939 ms  154.904 ms  154.992 ms
 9  paloalto0.iij.net (198.32.176.24)  156.522 ms  156.494 ms  156.498 ms
10  osk004bb01.IIJ.Net (58.138.88.189)  269.357 ms osk004bb00.IIJ.Net (58.138.88.185)  287.244 ms  287.106 ms
11  osk004ip57.IIJ.Net (58.138.106.162)  277.951 ms osk004ip57.IIJ.Net (58.138.106.166)  277.982 ms osk004ip57.IIJ.Net (58.138.1
06.162)  277.907 ms
12  210.130.135.130 (210.130.135.130)  269.201 ms  278.098 ms  278.078 ms
13  124.83.228.58 (124.83.228.58)  278.162 ms  287.275 ms  287.225 ms
14  124.83.252.178 (124.83.252.178)  292.933 ms  293.161 ms  284.016 ms
15  158.205.134.26 (158.205.134.26)  284.041 ms  293.001 ms  284.065 ms
16  * * *
17  * * *
18  * * *
19  * * *
20  * * *
21  * * *
22  * * *
23  * * *
24  * * *
25  * * *
26  * * *
27  * * *
28  * * *
29  * * *
30  * * *
```

```
z5125710@vx8:/tmp_amd/ravel/export/ravel/3/z5125710/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)  0.082 ms  0.065 ms  0.049 ms
 2  129.94.39.17 (129.94.39.17)  0.842 ms  0.859 ms  0.899 ms
 3  libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34)  1.336 ms ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35)  6.722 ms  6.7
11 ms
 4  ombcr1-po-6.gw.unsw.edu.au (149.171.255.169)  1.234 ms libcr1-po-5.gw.unsw.edu.au (149.171.255.165)  1.021 ms ombcr1-po-6.gw
.unsw.edu.au (149.171.255.169)  1.124 ms
 5  unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101)  1.200 ms  1.193 ms  1.212 ms
 6  138.44.5.0 (138.44.5.0)  1.369 ms  1.219 ms  1.249 ms
 7  et-2-0-5.bdr1.sing.sin.aarnet.net.au (113.197.15.233)  93.284 ms  92.814 ms  92.813 ms
 8  138.44.226.7 (138.44.226.7)  265.005 ms  264.907 ms  264.859 ms
 9  janet-gw.mx1.lon.uk.geant.net (62.40.124.198)  263.681 ms  263.710 ms  263.666 ms
10  ae29.londpg-sbr2.ja.net (146.97.33.2)  264.257 ms  264.219 ms  264.228 ms
11  ae31.erdiss-sbr2.ja.net (146.97.33.22)  268.046 ms  268.013 ms  267.990 ms
12  ae29.manckh-sbr2.ja.net (146.97.33.42)  282.792 ms  269.802 ms  269.909 ms
13  ae25.manckh-ban1.ja.net (146.97.35.50)  269.868 ms  270.111 ms  270.055 ms
14  lancaster-uni.ja.net (146.97.40.178)  291.754 ms  291.298 ms  291.282 ms
15  * * *
16  * * *
17  * * *
18  * * *
19  * * *
20  * * *
21  * * *
22  * * *
23  * * *
24  * * *
25  * * *
26  * * *
27  * * *
28  * * *
29  * * *
30  * * *
```

The paths from my machine to these three destinations diverge at the router with IP address 138.44.5.0 The information is:

```
inetnum:        138.44.0.0 - 138.44.255.255
netname:        AARNET
descr:          Australian Academic and Research Network
descr:          Building 9
descr:          Banks Street
country:        AU
org:            ORG-AAAR1-AP
admin-c:        SM6-AP
tech-c:         ANOC-AP
abuse-c:        AA1638-AP
status:         ALLOCATED PORTABLE
remarks:        -+-+-+-+-+-+-+-+-+-+-++-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
remarks:        This object can only be updated by APNIC hostmasters.
remarks:        To update this object, please contact APNIC
remarks:        hostmasters and include your organisation's account
remarks:        name in the subject line.
remarks:        -+-+-+-+-+-+-+-+-+-+-++-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
notify:         irrcontact@aarnet.edu.au
mnt-by:         APNIC-HM
mnt-lower:      MAINT-AARNET-AP
mnt-routes:     MAINT-AARNET-AP
mnt-irt:        IRT-AARNET-AU
last-modified:  2020-06-22T05:22:11Z
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
remarks:        abuse@aarnet.edu.au was validated on 2020-06-22
mnt-by:         MAINT-AARNET-AP
last-modified:  2020-06-22T05:21:20Z
source:         APNIC
```

The number of hops on each path is not proportional to the physical distance, at each hop 14, locations are London, Los Angle, Tokyo, respectively. Physical distances are different.

3.

Backward path 1

Traceroute Result:

```
traceroute to 129.94.242.121 (129.94.242.121), 30 hops max, 60 byte packets
 1  ge2-8.r01.sin01.ne.com.sg (202.150.221.169)  0.151 ms  0.172 ms  0.195 ms
 2  10.11.34.146 (10.11.34.146)  0.389 ms  0.626 ms  0.694 ms
 3  aarnet.sgix.sg (103.16.102.67)  212.875 ms  212.891 ms  212.845 ms
 4  et-7-3-0.pe1.nsw.brwy.aarnet.net.au (113.197.15.232)  209.347 ms  209.429 ms  209.404 ms
 5  138.44.5.1 (138.44.5.1)  208.470 ms  208.488 ms  208.341 ms
 6  libcr1-te-1-5.gw.unsw.edu.au (149.171.255.102)  208.400 ms  208.307 ms  208.298 ms
 7  ombudnex1-po-1.gw.unsw.edu.au (149.171.255.202)  210.015 ms  209.969 ms  210.042 ms
 8  ufw1-ae-1-3154.gw.unsw.edu.au (149.171.253.36)  200.426 ms  200.422 ms  200.324 ms
 9  129.94.39.23 (129.94.39.23)  209.231 ms  209.185 ms  209.027 ms
10  * * *
11  * * *
12  * * *
13  * * *
14  * * *
15  * * *
16  * * *
17  * * *
18  * * *
19  * * *
20  * * *
21  * * *
22  * * *
23  * * *
24  * * *
25  * * *
26  * * *
27  * * *
28  * * *
29  * * *
30  * * *
```

Traceroute Completed.

Forward path 1

```
z5125710@vx8:/tmp_amd/ravel/export/ravel/3/z5125710/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)  0.061 ms  0.071 ms  0.083 ms
 2  129.94.39.17 (129.94.39.17)  0.916 ms  0.874 ms  0.914 ms
 3  ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35)  1.953 ms libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34)  1.404 ms  1.7
93 ms
 4  libcr1-po-5.gw.unsw.edu.au (149.171.255.165)  1.149 ms ombcr1-po-6.gw.unsw.edu.au (149.171.255.169)  1.258 ms ombcr1-po-5.gw
.unsw.edu.au (149.171.255.197)  1.204 ms
 5  unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  1.438 ms unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101)  1.325 ms  1.392
ms
 6  138.44.5.0 (138.44.5.0)  1.446 ms  1.294 ms  1.254 ms
 7  et-0-3-0.pe1.alxd.nsw.aarnet.net.au (113.197.15.153)  1.630 ms  1.568 ms  1.664 ms
 8  xe-0-2-7.bdr1.a.lax.aarnet.net.au (202.158.194.173)  147.912 ms  147.914 ms  147.835 ms
 9  singtel.as7473.any2ix.coresite.com (206.72.210.63)  147.672 ms  148.145 ms  147.686 ms
10  203.208.173.161 (203.208.173.161)  320.757 ms 203.208.171.117 (203.208.171.117)  147.976 ms 203.208.173.21 (203.208.173.21)
 320.963 ms
11  203.208.172.145 (203.208.172.145)  245.950 ms 203.208.177.110 (203.208.177.110)  333.018 ms 203.208.171.85 (203.208.171.85)
 242.289 ms
12  * 203.208.158.17 (203.208.158.17)  326.091 ms 203.208.182.253 (203.208.182.253)  326.202 ms
13  202-150-221-170.rev.ne.com.sg (202.150.221.170)  212.335 ms  212.381 ms  213.105 ms
```

Backward path 2

```
 1  gigabitethernet3-3.exi2.melbourne.telstra.net (203.50.77.53)  0.520 ms  0.329 ms  0.240 ms
 2  bundle-ether3-100.win-core10.melbourne.telstra.net (203.50.80.129)  2.741 ms  1.853 ms  1.992 ms
 3  bundle-ether12.ken-core10.sydney.telstra.net (203.50.11.122)  12.111 ms  12.223 ms  13.360 ms
 4  bundle-ether1.ken-edge903.sydney.telstra.net (203.50.11.173)  12.359 ms  12.098 ms  11.986 ms
 5  aar3533567.lnk.telstra.net (139.130.0.78)  11.734 ms  11.596 ms  11.613 ms
 6  et-7-1-0.pe1.brwy.nsw.aarnet.net.au (113.197.15.13)  11.859 ms  11.847 ms  11.863 ms
 7  138.44.5.1 (138.44.5.1)  12.108 ms  12.101 ms  12.109 ms
 8  libcr1-te-1-5.gw.unsw.edu.au (149.171.255.102)  12.110 ms  12.098 ms  11.986 ms
 9  libudnex1-po-1.gw.unsw.edu.au (149.171.255.166)  12.487 ms
10  ufw1-ae-1-3154.gw.unsw.edu.au (149.171.253.36)  12.722 ms  12.723 ms  12.611 ms
11  129.94.39.23 (129.94.39.23)  12.860 ms  12.976 ms  12.859 ms
```

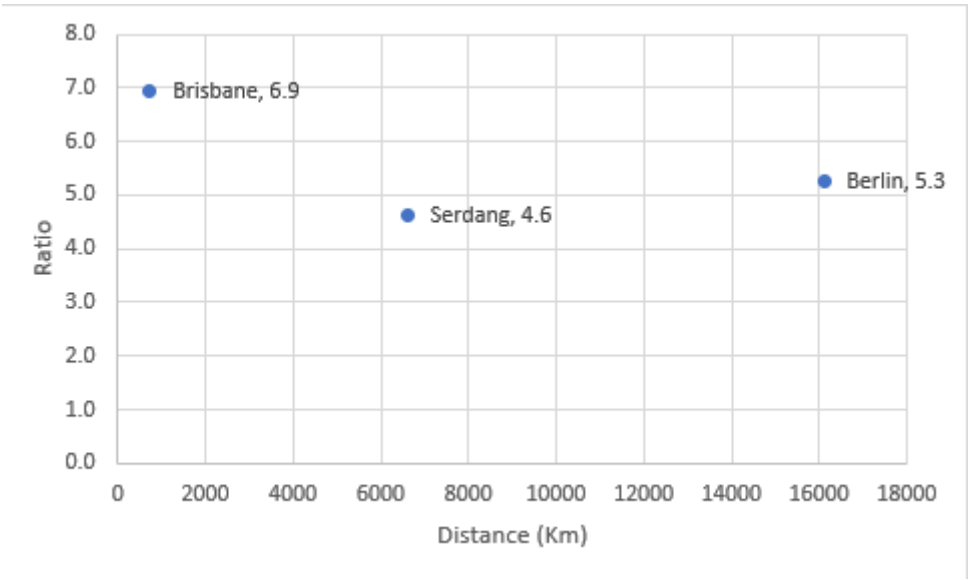
Forward path 2

```
z5125710@vx4:/tmp_amd/ravel/export/ravel/3/z5125710$ 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)  0.070 ms  0.047 ms  0.044 ms
 2  129.94.39.17 (129.94.39.17)  0.828 ms  0.827 ms  0.815 ms
 3  ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35)  1.384 ms libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34)  1.272 ms ombudnex1-vl-3154.gw.unsw.edu.au (
149.171.253.35)  1.791 ms
 4  ombcr1-po-6.gw.unsw.edu.au (149.171.255.169)  1.166 ms ombcr1-po-5.gw.unsw.edu.au (149.171.255.197)  1.054 ms libcr1-po-5.gw.unsw.edu.au (149.171.255.165)
  1.083 ms
 5  unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  1.167 ms unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101)  1.156 ms  1.225 ms
 6  138.44.5.0 (138.44.5.0)  3.219 ms  2.433 ms  2.297 ms
 7  et-1-1-0.pe1.rsby.nsw.aarnet.net.au (113.197.15.12)  2.750 ms  1.619 ms  1.582 ms
 8  xe-0-0-3.bdr1.rsby.nsw.aarnet.net.au (113.197.15.31)  1.456 ms  1.415 ms  1.584 ms
 9  HundredGigE0-1-0-4.ken-edge903.sydney.telstra.net (139.130.0.77)  2.284 ms  2.282 ms  2.268 ms
10  bundle-ether2.chw-edge903.sydney.telstra.net (203.50.11.175)  2.270 ms  2.385 ms  2.455 ms
11  bundle-ether10.win-core10.melbourne.telstra.net (203.50.11.123)  15.319 ms bundle-ether17.chw-core10.sydney.telstra.net (203.50.11.176)  3.338 ms  2.197 m
s
12  bundle-ether8.exi-core10.melbourne.telstra.net (203.50.11.125)  15.010 ms  14.944 ms 203.50.6.40 (203.50.6.40)  16.009 ms
13  bundle-ether2.exi-ncprouter101.melbourne.telstra.net (203.50.11.209)  15.033 ms  15.077 ms  15.142 ms
14  www.telstra.net (203.50.5.178)  14.309 ms  14.365 ms  14.257 ms
z5125710@vx4:/tmp_amd/ravel/export/ravel/3/z5125710$
```

From the above graphs, we can see, the reverse path does not go through the same routers as the forward path, because each router has several interfaces (IP address), hence though the packet pass the same router but it will arrange to different IP address.

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

1.




First reason is the path between city is not a straight line which means the real distance is lager than the shortest distance. Second reason is RTT include transmission, processing, and queuing delay.

2. The delay time is varying, the traffic load can affect the delay.

3. This website is hosted in San Francisco, US, but it really depends on user location.

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

4. Only transmission delay depends on the packet size. Propagation, processing, queuing delay do not depend on packet size.