

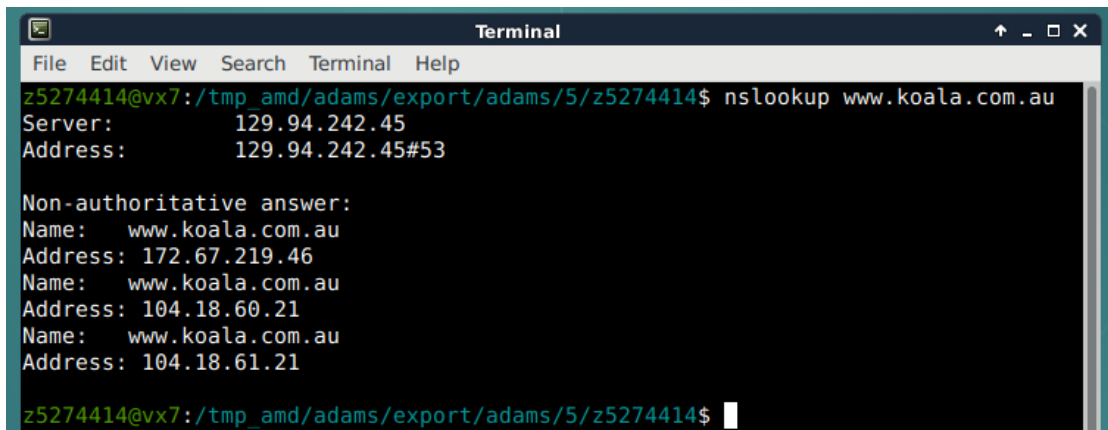
COMP9331 Lab1

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Exercise 1: nslookup

1. The addresses of the website www.koala.com.au are 172.67.219.46 / 104.18.60.21 / 104.18.61.21

There are two reasons of having several IP addresses as an output. First, if one IP address goes down, there're still other addresses for users to use. Second, having several IP addresses can prevent traffic from being exchanged via the gateway, speeding things up and reducing the load, and improving user's experience at the same time.

A terminal window titled "Terminal" with a menu bar (File, Edit, View, Search, Terminal, Help). The prompt is "z5274414@vx7:/tmp_amd/adams/export/adams/5/z5274414\$". The command "nslookup www.koala.com.au" has been executed. The output shows a server address (129.94.242.45) and a non-authoritative answer with three IP addresses for www.koala.com.au: 172.67.219.46, 104.18.60.21, and 104.18.61.21.

```
z5274414@vx7:/tmp_amd/adams/export/adams/5/z5274414$ 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: 172.67.219.46
Name:   www.koala.com.au
Address: 104.18.60.21
Name:   www.koala.com.au
Address: 104.18.61.21

z5274414@vx7:/tmp_amd/adams/export/adams/5/z5274414$
```

2. The name of the IP address 127.0.0.1 is local host. This address is for the local computer to connect the network interface of itself and it's also called loopback. This means when I call localhost, I am actually call with my own computer. Each computer has the same localhost IP address.

Reference: <https://en.wikipedia.org/wiki/Loopback>

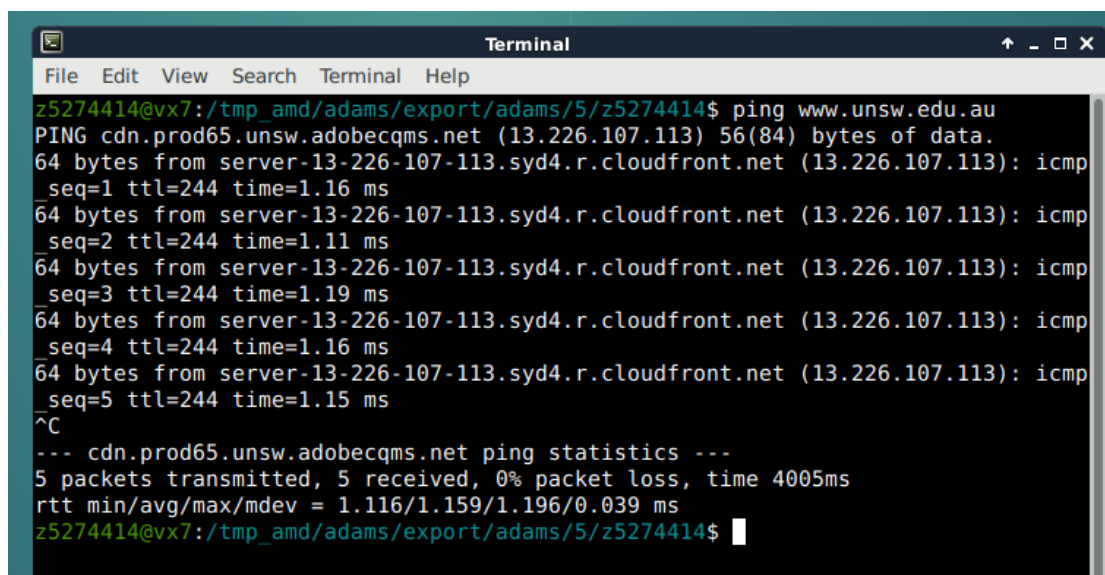
```
z5274414@vx7:/tmp_amd/adams/export/adams/5/z5274414$ nslookup 127.0.0.1
Server:      129.94.242.45
Address:     129.94.242.45#53

1.0.0.127.in-addr.arpa  name = localhost.

z5274414@vx7:/tmp_amd/adams/export/adams/5/z5274414$
```

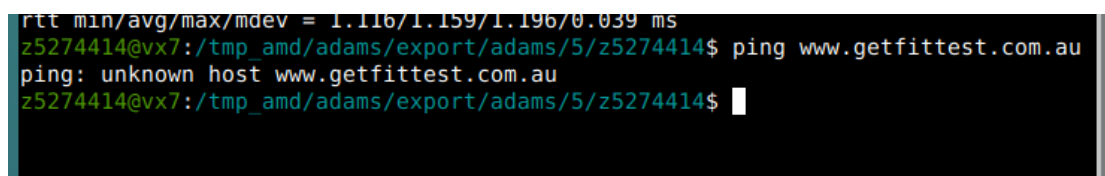
Exercise 2: Us ping to test host reachability

www.unsw.edu.au reachable

A terminal window titled "Terminal" with a menu bar (File, Edit, View, Search, Terminal, Help). The prompt is "z5274414@vx7:/tmp_amd/adams/export/adams/5/z5274414\$". The user enters "ping www.unsw.edu.au". The output shows a successful ping to "cdn.prod65.unsw.adobecqms.net (13.226.107.113)" with 56(84) bytes of data. Five ICMP echo requests are shown with sequence numbers 1 through 5, all with TTL=244 and response times between 1.11ms and 1.19ms. The user presses Ctrl-C (^C). The terminal shows "--- cdn.prod65.unsw.adobecqms.net ping statistics ---" followed by "5 packets transmitted, 5 received, 0% packet loss, time 4005ms" and "rtt min/avg/max/mdev = 1.116/1.159/1.196/0.039 ms". The prompt returns to "z5274414@vx7:/tmp_amd/adams/export/adams/5/z5274414\$".

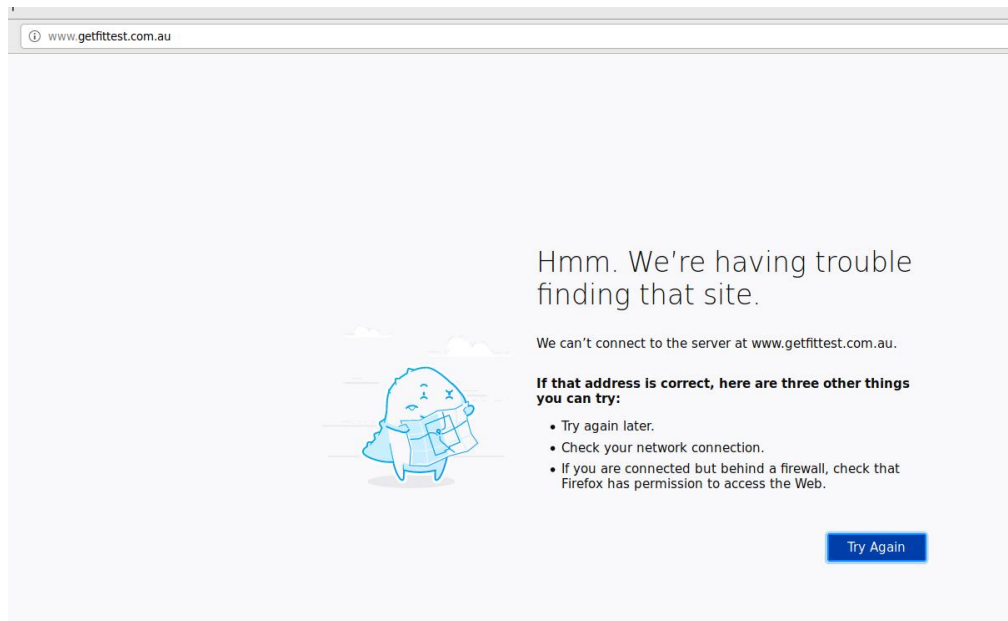
```
z5274414@vx7:/tmp_amd/adams/export/adams/5/z5274414$ ping www.unsw.edu.au
PING cdn.prod65.unsw.adobecqms.net (13.226.107.113) 56(84) bytes of data.
64 bytes from server-13-226-107-113.syd4.r.cloudfront.net (13.226.107.113): icmp
_seq=1 ttl=244 time=1.16 ms
64 bytes from server-13-226-107-113.syd4.r.cloudfront.net (13.226.107.113): icmp
_seq=2 ttl=244 time=1.11 ms
64 bytes from server-13-226-107-113.syd4.r.cloudfront.net (13.226.107.113): icmp
_seq=3 ttl=244 time=1.19 ms
64 bytes from server-13-226-107-113.syd4.r.cloudfront.net (13.226.107.113): icmp
_seq=4 ttl=244 time=1.16 ms
64 bytes from server-13-226-107-113.syd4.r.cloudfront.net (13.226.107.113): icmp
_seq=5 ttl=244 time=1.15 ms
^C
--- cdn.prod65.unsw.adobecqms.net ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4005ms
rtt min/avg/max/mdev = 1.116/1.159/1.196/0.039 ms
z5274414@vx7:/tmp_amd/adams/export/adams/5/z5274414$
```

www.getfittest.com.au unreachable

A terminal window showing the continuation of the previous session. The prompt is "z5274414@vx7:/tmp_amd/adams/export/adams/5/z5274414\$". The user enters "ping www.getfittest.com.au". The output shows "ping: unknown host www.getfittest.com.au". The prompt returns to "z5274414@vx7:/tmp_amd/adams/export/adams/5/z5274414\$".

```
rtt min/avg/max/mdev = 1.116/1.159/1.196/0.039 ms
z5274414@vx7:/tmp_amd/adams/export/adams/5/z5274414$ ping www.getfittest.com.au
ping: unknown host www.getfittest.com.au
z5274414@vx7:/tmp_amd/adams/export/adams/5/z5274414$
```

It's still unreachable from the Web browser.



It's unreachable both for ping command and web browser. The reason is its unknown host and server can't be found so we can't access.

www.mit.edu reachable

```
Terminal
File Edit View Search Terminal Help
z5274414@vx6:/tmp_amd/adams/export/adams/5/z5274414$ 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=1.24 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=1.28 ms
64 bytes from a23-77-154-132.deploy.static.akamaitechnologies.com (23.77.154.132): icmp_seq=5 ttl=56 time=1.24 ms
^C
--- e9566.dscb.akamaiedge.net ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4005ms
rtt min/avg/max/mdev = 1.240/1.264/1.308/0.052 ms
z5274414@vx6:/tmp_amd/adams/export/adams/5/z5274414$
```

www.intel.com.au reachable

```
z5274414@vx6:/tmp_amd/adams/export/adams/5/z5274414$ ping www.intel.com.au
PING e19235.dsca.akamaiedge.net (104.116.196.207) 56(84) bytes of data.
64 bytes from a104-116-196-207.deploy.static.akamaitechnologies.com (104.116.196.207): icmp_seq=1 ttl=52 time=12.5 ms
64 bytes from a104-116-196-207.deploy.static.akamaitechnologies.com (104.116.196.207): icmp_seq=2 ttl=52 time=12.8 ms
64 bytes from a104-116-196-207.deploy.static.akamaitechnologies.com (104.116.196.207): icmp_seq=3 ttl=52 time=12.5 ms
64 bytes from a104-116-196-207.deploy.static.akamaitechnologies.com (104.116.196.207): icmp_seq=4 ttl=52 time=12.5 ms
64 bytes from a104-116-196-207.deploy.static.akamaitechnologies.com (104.116.196.207): icmp_seq=5 ttl=52 time=12.5 ms
64 bytes from a104-116-196-207.deploy.static.akamaitechnologies.com (104.116.196.207): icmp_seq=6 ttl=52 time=12.5 ms
^C
--- e19235.dsca.akamaiedge.net ping statistics ---
6 packets transmitted, 6 received, 0% packet loss, time 5008ms
rtt min/avg/max/mdev = 12.506/12.593/12.844/0.115 ms
z5274414@vx6:/tmp_amd/adams/export/adams/5/z5274414$
```

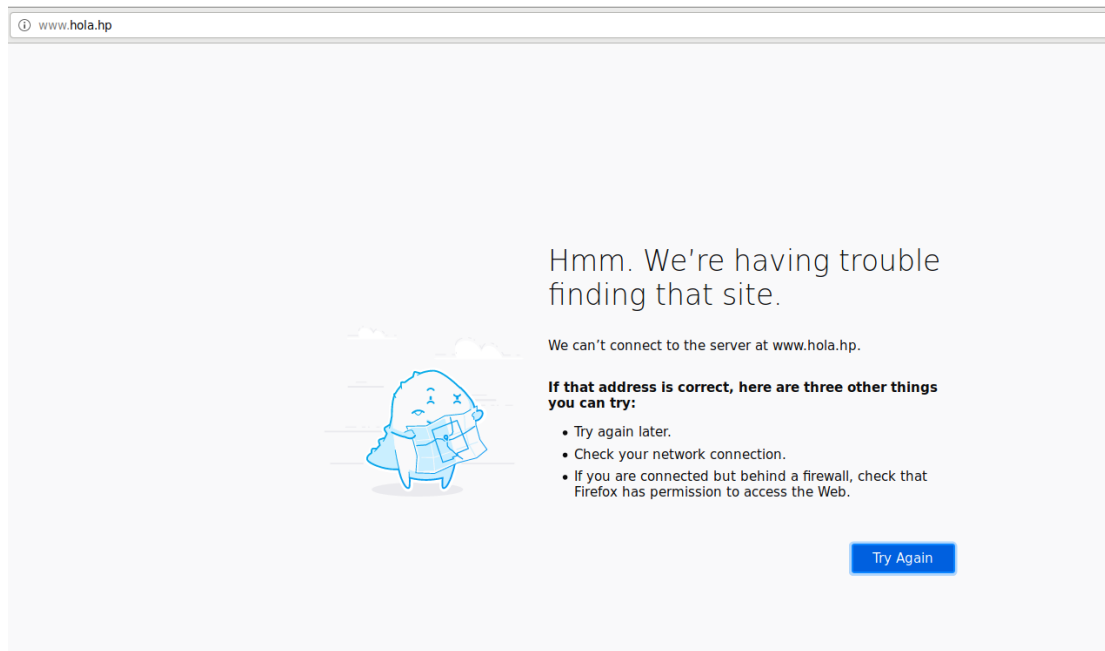
www.tpg.com.au reachable

```
z5274414@vx6:/tmp_amd/adams/export/adams/5/z5274414$ 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=1.74 ms
64 bytes from www.tpg.com.au (203.26.27.38): icmp_seq=2 ttl=119 time=1.54 ms
64 bytes from www.tpg.com.au (203.26.27.38): icmp_seq=3 ttl=119 time=1.59 ms
64 bytes from www.tpg.com.au (203.26.27.38): icmp_seq=4 ttl=119 time=1.52 ms
64 bytes from www.tpg.com.au (203.26.27.38): icmp_seq=5 ttl=119 time=1.58 ms
64 bytes from www.tpg.com.au (203.26.27.38): icmp_seq=6 ttl=119 time=1.60 ms
^C
--- www.tpg.com.au ping statistics ---
6 packets transmitted, 6 received, 0% packet loss, time 5008ms
rtt min/avg/max/mdev = 1.525/1.600/1.743/0.086 ms
z5274414@vx6:/tmp_amd/adams/export/adams/5/z5274414$
```

www.hola.hp unreachable

```
z5274414@vx6:/tmp_amd/adams/export/adams/5/z5274414$ ping www.hola.hp
ping: unknown host www.hola.hp
z5274414@vx6:/tmp_amd/adams/export/adams/5/z5274414$
```

It's still unreachable from the Web browser.



It's unreachable both for ping command and web browser. The reason is its unknown host and server can't be found so we can't access.

www.amazon.com reachable

```
ping: unknown host www.hola.hp
z5274414@vx6:/tmp_amd/adams/export/adams/5/z5274414$ ping www.amazon.com
PING d3ag4hukkh62yn.cloudfront.net (13.226.82.204) 56(84) bytes of data.
64 bytes from server-13-226-82-204.syd4.r.cloudfront.net (13.226.82.204): icmp_s
eq=1 ttl=244 time=1.26 ms
64 bytes from server-13-226-82-204.syd4.r.cloudfront.net (13.226.82.204): icmp_s
eq=2 ttl=244 time=1.18 ms
64 bytes from server-13-226-82-204.syd4.r.cloudfront.net (13.226.82.204): icmp_s
eq=3 ttl=244 time=1.23 ms
64 bytes from server-13-226-82-204.syd4.r.cloudfront.net (13.226.82.204): icmp_s
eq=4 ttl=244 time=1.31 ms
64 bytes from server-13-226-82-204.syd4.r.cloudfront.net (13.226.82.204): icmp_s
eq=5 ttl=244 time=1.21 ms
^C
--- d3ag4hukkh62yn.cloudfront.net ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4005ms
rtt min/avg/max/mdev = 1.189/1.243/1.315/0.053 ms
z5274414@vx6:/tmp_amd/adams/export/adams/5/z5274414$
```

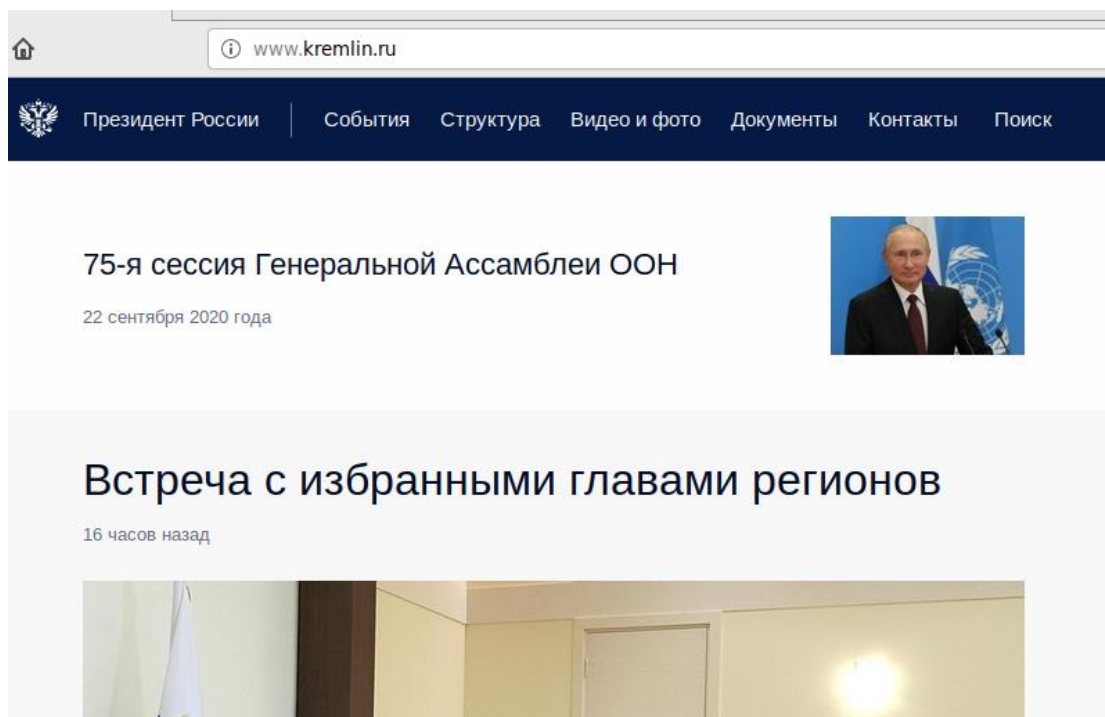
www.tsinghua.edu.cn reachable

```
z5274414@vx6:/tmp_amd/adams/export/adams/5/z5274414$ 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
64 bytes from www.tsinghua.edu.cn (166.111.4.100): icmp_seq=6 ttl=42 time=242 ms
^C
--- www.tsinghua.edu.cn ping statistics ---
6 packets transmitted, 6 received, 0% packet loss, time 5005ms
rtt min/avg/max/mdev = 242.243/242.271/242.331/0.029 ms
z5274414@vx6:/tmp_amd/adams/export/adams/5/z5274414$
```

www.kremlin.ru unreachable

```
Terminal
File Edit View Search Terminal Help
z5274414@vx6:/tmp_amd/adams/export/adams/5/z5274414$ ping www.kremlin.ru
PING www.kremlin.ru (95.173.136.72) 56(84) bytes of data.
^C
--- www.kremlin.ru ping statistics ---
15 packets transmitted, 0 received, 100% packet loss, time 14340ms
z5274414@vx6:/tmp_amd/adams/export/adams/5/z5274414$
```

It's reachable from the Web browser.



It's unreachable for ping command because none of packets is received.

The reason may be the server blocks the ping command considering the national security or reducing unnecessary network traffic and server load caused by ping.

8.8.8.8 reachable

```
z5274414@vx6:/tmp_amd/adams/export/adams/5/z5274414$ 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=1.62 ms
64 bytes from 8.8.8.8: icmp_seq=2 ttl=114 time=1.57 ms
64 bytes from 8.8.8.8: icmp_seq=3 ttl=114 time=1.59 ms
64 bytes from 8.8.8.8: icmp_seq=4 ttl=114 time=1.68 ms
64 bytes from 8.8.8.8: icmp_seq=5 ttl=114 time=1.60 ms
^C
--- 8.8.8.8 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4007ms
rtt min/avg/max/mdev = 1.574/1.616/1.685/0.052 ms
z5274414@vx6:/tmp_amd/adams/export/adams/5/z5274414$
```

Exercise 3: Use traceroute to understand network topology

1. There are 22 routers between my workstation and www.columbia.edu.

There are 5 routers along the path are part of UNSW network.

Between the 7th and 9th routers, the packets cross the Pacific Ocean.

because the time delay between those two routers increases significantly.


```
Terminal
File Edit View Search Terminal Help

z5274414@vx2:/tmp_amd/adams/export/adams/5/z5274414$ 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) 0.093 ms 0.057 ms 0.05
 9 ms
 2 129.94.39.17 (129.94.39.17) 0.854 ms 0.840 ms 0.819 ms
 3 libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34) 1.363 ms ombudnex1-vl-315
 4.gw.unsw.edu.au (149.171.253.35) 39.906 ms 39.893 ms
 4 ombcr1-po-6.gw.unsw.edu.au (149.171.255.169) 1.273 ms 1.259 ms 1.288 ms
 5 unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105) 1.174 ms unswbr1-te-1-9.gw
 .unsw.edu.au (149.171.255.101) 1.205 ms 1.200 ms
 6 138.44.5.0 (138.44.5.0) 1.332 ms 1.361 ms 1.336 ms
 7 et-1-3-0.pe1.sxt.bkvl.nsw.aarnet.net.au (113.197.15.149) 1.975 ms 1.938 ms
 1.883 ms
 8 et-0-0-0.pe1.a.hnl.aarnet.net.au (113.197.15.99) 95.291 ms 95.176 ms 95.2
 74 ms
 9 et-2-1-0.bdr1.a.sea.aarnet.net.au (113.197.15.201) 146.660 ms 146.612 ms
 146.639 ms
 10 abilene-1-lo-jmb-706.sttlwa.pacificwave.net (207.231.240.8) 146.686 ms 146
 .648 ms 146.646 ms
 11 ae-1.4079.rtsw.minn.net.internet2.edu (162.252.70.173) 179.490 ms 179.485
 ms 179.490 ms
 12 ae-1.4079.rtsw.eqch.net.internet2.edu (162.252.70.106) 187.442 ms 187.423
 ms 187.195 ms
 13 ae-0.4079.rtsw3.eqch.net.internet2.edu (162.252.70.163) 188.268 ms 187.611
 ms 187.602 ms
 14 ae-1.4079.rtsw.clev.net.internet2.edu (162.252.70.130) 193.192 ms 195.972
 ms 193.184 ms
 15 buf-9208-I2-CLEV.nysernet.net (199.109.11.33) 201.316 ms 201.264 ms 201.2
 22 ms
 16 syr-9208-buf-9208.nysernet.net (199.109.7.193) 199.700 ms 199.663 ms 199.
 640 ms
 17 nyc111-9204-syr-9208.nysernet.net (199.109.7.94) 208.919 ms 208.953 ms 20
 8.871 ms
 18 nyc-9208-nyc111-9204.nysernet.net (199.109.7.165) 229.215 ms 209.104 ms 2
 09.043 ms
 19 columbia.nyc-9208.nysernet.net (199.109.4.14) 208.909 ms 208.915 ms 208.9
 41 ms
 20 cc-core-1-x-nyser32-gw-1.net.columbia.edu (128.59.255.5) 209.272 ms 209.30
 9 ms 209.169 ms
 21 cc-conc-1-x-cc-core-1.net.columbia.edu (128.59.255.21) 209.356 ms 209.311
 ms 209.308 ms
 22 www-ltm.cc.columbia.edu (128.59.105.24) 209.090 ms 209.098 ms 209.069 ms
 z5274414@vx2:/tmp_amd/adams/export/adams/5/z5274414$
```

2. www.ucla.edu

```
z5274414@vx2:/tmp_amd/adams/export/adams/5/z5274414$ 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) 0.527 ms 0.504 ms 0.480 ms
 2 129.94.39.17 (129.94.39.17) 0.857 ms 0.852 ms 0.850 ms
 3 ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35) 1.432 ms libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34) 1.743 ms ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35) 1.619 ms
 4 libcr1-po-5.gw.unsw.edu.au (149.171.255.165) 1.166 ms 1.118 ms 1.132 ms
 5 unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105) 1.144 ms 1.141 ms unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101) 1.157 ms
 6 138.44.5.0 (138.44.5.0) 1.262 ms 1.277 ms 1.338 ms
 7 et-1-3-0.pe1.sxt.bkvl.nsw.aarnet.net.au (113.197.15.149) 2.070 ms 2.016 ms 2.014 ms
 8 et-0-0-0.pe1.a.hnl.aarnet.net.au (113.197.15.99) 95.076 ms 95.547 ms 95.570 ms
 9 et-2-1-0.bdr1.a.sea.aarnet.net.au (113.197.15.201) 146.725 ms 146.724 ms 146.706 ms
 10 cenichpr1-is-jmb-778.snvac.pacificwave.net (207.231.245.129) 163.847 ms 163.231 ms 163.860 ms
 11 svl-agg10-hpr-svl-hpr3-100g.cenitc.net (137.164.25.106) 164.227 ms 164.126 ms 164.032 ms
 12 hpr-lax-agg10-svl-agg10-100g.cenitc.net (137.164.25.73) 160.073 ms 159.840 ms 159.807 ms
 13 * * *
 14 bd11f1.anderson--cr001.anderson.ucla.net (169.232.4.6) 160.864 ms bd11f1.anderson--cr00f2.csbl.ucla.net (169.232.4.4) 161.194 ms bd11f1.anderson--cr001.anderson.ucla.net (169.232.4.6) 160.196 ms
 15 cr00f1.anderson--rt11f4.mathsci.ucla.net (169.232.8.185) 160.964 ms cr00f2.csbl--rt11f4.mathsci.ucla.net (169.232.8.181) 160.309 ms 161.888 ms
 16 * * *
 17 * * *
 18 * * *
 19 * * *
 20 * * *
 21 * * *
 22 * * *
 23 * * *
 24 * * *
 25 * * *
 26 * * *
 27 * * *
 28 * * *
 29 * * *
 30 * * *
```


www.u-tokyo.ac.jp

```
5274414@vx2:/tmp_and/adams/export/adams/5/z5274414$ 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) 0.154 ms 0.124 ms 0.116 ms
 2 129.94.39.17 (129.94.39.17) 0.876 ms 0.871 ms 0.875 ms
 3 ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35) 1.778 ms 1.720 ms 1.748 ms
 4 ombcr1-po-6.gw.unsw.edu.au (149.171.255.169) 1.062 ms libcr1-po-5.gw.unsw.edu.au (149.171.255.165) 1.002 ms ombcr1-po-6.gw.unsw.edu.au (149.171.255.169) 1.063 ms
 5 unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105) 1.172 ms 1.168 ms 1.155 ms
 6 138.44.5.0 (138.44.5.0) 9.892 ms 9.213 ms 9.178 ms
 7 et-0-3-0.pel.bkvl.nsw.aarnet.net.au (113.197.15.147) 1.700 ms 1.681 ms 1.758 ms
 8 ge-4-0-0.bb1.a.pao.aarnet.net.au (202.158.194.177) 155.195 ms 155.080 ms 155.084 ms
 9 paloalto001.iij.net (198.32.176.24) 156.459 ms 156.456 ms 156.486 ms
10 osk004bb01.IIJ.Net (58.138.88.189) 269.224 ms osk004bb00.IIJ.Net (58.138.88.185) 286.998 ms 286.989 ms
11 osk004ip57.IIJ.Net (58.138.106.166) 269.093 ms 269.093 ms osk004ip57.IIJ.Net (58.138.106.162) 278.014 ms
12 210.130.135.130 (210.130.135.130) 286.944 ms 278.052 ms 286.976 ms
13 124.83.220.58 (124.83.220.58) 286.976 ms 288.438 ms 278.175 ms
14 124.83.252.178 (124.83.252.178) 284.112 ms 293.036 ms 283.961 ms
15 158.205.134.26 (158.205.134.26) 284.007 ms 284.098 ms 284.945 ms
16 * * *
17 * * *
18 * * *
19 * * *
20 * * *
21 * * *
22 * * *
23 * * *
24 * * *
25 * * *
26 * * *
27 * * *
28 * * *
29 * * *
30 * * *
```

www.lancaster.ac.uk

```
5274414@vx2:/tmp_and/adams/export/adams/5/z5274414$ 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) 0.110 ms 0.089 ms 0.068 ms
 2 129.94.39.17 (129.94.39.17) 0.890 ms 0.891 ms 0.857 ms
 3 ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35) 10.784 ms libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34) 1.589 ms 1.508 ms
 4 libcr1-po-6.gw.unsw.edu.au (149.171.255.201) 1.161 ms ombcr1-po-5.gw.unsw.edu.au (149.171.255.197) 1.115 ms ombcr1-po-6.gw.unsw.edu.au (149.171.255.169) 1.140 ms
 5 unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101) 1.127 ms 1.126 ms unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105) 1.149 ms
 6 138.44.5.0 (138.44.5.0) 1.291 ms 3.747 ms 3.728 ms
 7 et-2-0-5.bdr1.sing.sin.aarnet.net.au (113.197.15.233) 92.754 ms 92.902 ms 92.839 ms
 8 138.44.226.7 (138.44.226.7) 263.771 ms 263.720 ms 263.657 ms
 9 janet-gw.mxl.lon.uk.geant.net (62.40.124.198) 264.619 ms 264.615 ms 264.616 ms
10 ae29.londpg-sbr2.ja.net (146.97.33.2) 264.442 ms 264.446 ms 264.375 ms
11 ae31.erdis-sbr2.ja.net (146.97.33.22) 268.640 ms 268.593 ms 267.997 ms
12 ae29.manckh-sbr2.ja.net (146.97.33.42) 269.877 ms 270.000 ms 269.927 ms
13 ae25.manckh-ban1.ja.net (146.97.35.58) 269.927 ms 270.277 ms 270.265 ms
14 lancaster-un1.ja.net (146.97.40.170) 269.108 ms 269.010 ms 269.009 ms
15 * * *
16 * * *
17 * * *
18 * * *
19 * * *
20 * * *
21 * * *
22 * * *
23 * * *
24 * * *
25 * * *
26 * * *
27 * * *
28 * * *
29 * * *
30 * * *
```

Because the 6th route 138.44.5.0 is the last common router, so the paths from my machine to these three destinations diverge at 6th route 138.44.5.0.

```
File Edit View Search Terminal Help
z5274414@vx6:/tmp_amd/adams/export/adams/5/z5274414$ whois 138.44.5.0

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

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

OrgName: Asia Pacific Network Information Centre
OrgId: APNIC
Address: PO Box 3646
City: South Brisbane
StateProv: QLD
PostalCode: 4101
Country: AU
RegDate:
Updated: 2012-01-24
```

```
PostalCode: 4101
Country: AU
RegDate:
Updated: 2012-01-24
Ref: https://rdap.arin.net/registry/entity/APNIC

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

OrgTechHandle: AWC12-ARIN
OrgTechName: APNIC Whois Contact
OrgTechPhone: +61 7 3858 3188
OrgTechEmail: search-apnic-not-arin@apnic.net
OrgTechRef: https://rdap.arin.net/registry/entity/AWC12-ARIN

OrgAbuseHandle: AWC12-ARIN
OrgAbuseName: APNIC Whois Contact
OrgAbusePhone: +61 7 3858 3188
OrgAbuseEmail: search-apnic-not-arin@apnic.net
OrgAbuseRef: https://rdap.arin.net/registry/entity/AWC12-ARIN

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

Found a referral to whois.apnic.net.

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

% Information related to '138.44.0.0 - 138.44.255.255'

% Abuse contact for '138.44.0.0 - 138.44.255.255' is 'abuse@aarnet.edu.au'

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
```

```

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@arnet.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@arnet.edu.au
abuse-mailbox: abuse@arnet.edu.au
admin-c:    SM6-AP
tech-c:     ANOC-AP
auth:       # Filtered
remarks:    abuse@arnet.edu.au was validated on 2020-06-22
mnt-by:     MAINT-AARNET-AP
last-modified: 2020-06-22T05:21:20Z
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@arnet.edu.au
mnt-ref:    APNIC-HM
mnt-by:     APNIC-HM
last-modified: 2017-10-09T12:56:36Z

```

```

last-modified: 2017-10-09T12:56:36Z
source:        APNIC

role:          ABUSE AARNETAU
address:       AARNet Pty Ltd
address:       26 Dick Perry Avenue
address:       Kensington, Western Australia
address:       Australia
country:       ZZ
phone:         +000000000
e-mail:        abuse@arnet.edu.au
admin-c:       SM6-AP
tech-c:        ANOC-AP
nic-hdl:       AA1638-AP
remarks:       Generated from irt object IRT-AARNET-AU
abuse-mailbox: abuse@arnet.edu.au
mnt-by:        APNIC-ABUSE
last-modified: 2020-06-22T05:22:10Z
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@arnet.edu.au
remarks:
remarks:       Send abuse reports to abuse@arnet.edu.au
remarks:       Please include timestamps and offset to UTC in logs
remarks:       Peering requests to peering@arnet.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

person:        Steve Maddocks
remarks:       Director Operations
address:       AARNet Pty Ltd
address:       26 Dick Perry Avenue
address:       Kensington
address:       Perth

```

```

address: 26 Dick Perry Avenue
address: Kensington
address: Perth
address: WA 6151
country: AU
phone: +61-8-9289-2210
fax-no: +61-2-6222-7509
e-mail: steve.maddocks@aarnet.edu.au
nic-hdl: SM6-AP
mnt-by: MAINT-AARNET-AP
last-modified: 2011-02-01T08:37:06Z
source: APNIC

% Information related to '138.44.5.0/24AS7575'

route: 138.44.5.0/24
origin: AS7575
descr: Australian Academic and Research Network
       Building 9
       Banks Street
mnt-by: MAINT-AARNET-AP
last-modified: 2019-04-03T03:55:51Z
source: APNIC

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

```

My IP address is 129.94.242.119.

www.ucla.edu	164.67.228.152	7499.0 miles	14 routers
www.u-tokyo.ac.jp	210.152.243.234	4908.7 miles	15 routers
www.lancaster.ac.uk	144.88.65.80	10569.8 miles	14 routers

Thus, the number of hops on each path is not proportional the physical distance.

3. My IP address is 129.94.242.119.

www.speedtest.com.sg IP is 202.150.221.170

www.telstra.net IP is 203.50.5.178

From www.speedtest.com.sg to my machine

Traceroute Result:

```
traceroute to 129.94.242.119 (129.94.242.119), 30 hops max, 60 byte packets
 1  ge2-8-r01.sin01.ne.com.sg (202.150.221.169)  0.152 ms  0.162 ms  0.168 ms
 2  10.11.34.146 (10.11.34.146)  0.375 ms  0.454 ms  0.522 ms
 3  aarnet.sgix.sg (103.16.102.67)  209.080 ms  209.044 ms  209.056 ms
 4  et-7-3-0.pe1.nsw.brwy.aarnet.net.au (113.197.15.232)  214.862 ms  214.886 ms  214.870 ms
 5  138.44.5.1 (138.44.5.1)  206.758 ms  206.902 ms  206.826 ms
 6  ombcr1-te-1-5.gw.unsw.edu.au (149.171.255.106)  209.264 ms  209.242 ms  209.232 ms
 7  libudnex1-po-2.gw.unsw.edu.au (149.171.255.198)  200.894 ms  200.764 ms  200.817 ms
 8  ufw1-ae-1-3154.gw.unsw.edu.au (149.171.253.36)  209.883 ms  209.917 ms  209.925 ms
 9  129.94.39.23 (129.94.39.23)  212.450 ms  212.513 ms  212.372 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 www.telstra.net to my machine

```
 1  gigabitethernet3-3.exi2.melbourne.telstra.net (203.50.77.53)  0.477 ms  0.326 ms  0.242 ms
 2  bundle-ether3-100.win-core10.melbourne.telstra.net (203.50.80.129)  1.864 ms  1.602 ms  2.115 ms
 3  bundle-ether12.ken-core10.sydney.telstra.net (203.50.11.122)  13.236 ms  12.598 ms  13.485 ms
 4  bundle-ether1.ken-edge903.sydney.telstra.net (203.50.11.173)  12.110 ms  12.098 ms  12.109 ms
 5  aar3533567.lnk.telstra.net (139.130.0.78)  20.357 ms  15.096 ms  11.737 ms
 6  et-7-1-0.pe1.brwy.nsw.aarnet.net.au (113.197.15.13)  12.485 ms  15.220 ms  11.859 ms
 7  138.44.5.1 (138.44.5.1)  12.112 ms  11.976 ms  11.987 ms
 8  libcr1-te-1-5.gw.unsw.edu.au (149.171.255.102)  12.109 ms  12.099 ms  11.985 ms
 9  ombudnex1-po-1.gw.unsw.edu.au (149.171.255.202)  12.484 ms
10  ufw1-ae-1-3154.gw.unsw.edu.au (149.171.253.36)  12.732 ms  12.724 ms  12.733 ms
11  129.94.39.23 (129.94.39.23)  12.861 ms  12.851 ms  12.860 ms
```

There are other traceroute sites listed [here](#).

From my machine to www.speedtest.com.sg

```
z5274414@vx6:/tmp_amd/adams/export/adams/5/z5274414$ 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) 0.107 ms 0.086 ms 0.071 ms
 2 129.94.39.17 (129.94.39.17) 0.798 ms 0.806 ms 0.842 ms
 3 ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35) 1.414 ms libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34) 1.517 ms 1.527 ms
 4 libcr1-po-5.gw.unsw.edu.au (149.171.255.165) 1.109 ms ombcr1-po-6.gw.unsw.edu.au (149.171.255.169) 1.113 ms 1.119 ms
 5 unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101) 1.133 ms 1.151 ms 1.161 ms
 6 138.44.5.0 (138.44.5.0) 1.291 ms 1.328 ms 1.276 ms
 7 et-0-3-0.pel.alxd.nsw.aarnet.net.au (113.197.15.153) 1.961 ms 1.642 ms 1.690 ms
 8 xe-0-2-7.bdr1.a.lax.aarnet.net.au (202.158.194.173) 147.624 ms 147.556 ms 147.560 ms
 9 singtel.as7473.any2ix.coresite.com (206.72.210.63) 147.712 ms 147.719 ms 147.631 ms
10 203.208.151.181 (203.208.151.181) 316.342 ms 203.208.171.117 (203.208.171.117) 147.911 ms 203.208.172.165 (203.208.172.165) 330.181 ms
11 203.208.172.145 (203.208.172.145) 246.067 ms 246.026 ms 203.208.151.233 (203.208.151.233) 233.580 ms
12 * * 203.208.158.17 (203.208.158.17) 321.924 ms
13 203.208.158.185 (203.208.158.185) 317.314 ms 202-150-221-170.rev.ne.com.sg (202.150.221.170) 213.184 ms 205.156 ms
z5274414@vx6:/tmp_amd/adams/export/adams/5/z5274414$
```

From my machine to www.telstra.net

```
Terminal
File Edit View Search Terminal Help
z5274414@vx6:/tmp_amd/adams/export/adams/5/z5274414$ 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) 0.145 ms 0.129 ms 0.113 ms
 2 129.94.39.17 (129.94.39.17) 0.863 ms 0.867 ms 0.875 ms
 3 ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35) 1.456 ms libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34) 1.592 ms 1.620 ms
 4 ombcr1-po-5.gw.unsw.edu.au (149.171.255.197) 1.076 ms 1.120 ms 1.126 ms
 5 unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101) 7.976 ms unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105) 7.977 ms unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101) 7.992 ms
 6 138.44.5.0 (138.44.5.0) 1.636 ms 1.271 ms 1.223 ms
 7 et-1-1-0.pel.rsby.nsw.aarnet.net.au (113.197.15.12) 1.566 ms 1.607 ms 1.657 ms
 8 xe-0-0-3.bdr1.rsby.nsw.aarnet.net.au (113.197.15.31) 1.424 ms 1.387 ms 1.393 ms
 9 HundredGigE0-1-0-4.ken-edge903.sydney.telstra.net (139.130.0.77) 2.177 ms 2.434 ms 2.204 ms
10 bundle-ether17.ken-core10.sydney.telstra.net (203.50.11.172) 3.659 ms 2.498 ms bundle-ether2.chw-edge903.sydney.telstra.net (203.50.11.175) 2.500 ms
11 bundle-ether10.win-core10.melbourne.telstra.net (203.50.11.123) 14.837 ms bundle-ether17.chw-core10.sydney.telstra.net (203.50.11.176) 3.210 ms bundle-ether10.win-core10.melbourne.telstra.net (203.50.11.123) 14.037 ms
12 bundle-ether8.exi-core10.melbourne.telstra.net (203.50.11.125) 14.318 ms 203.50.6.40 (203.50.6.40) 15.120 ms bundle-ether8.exi-core10.melbourne.telstra.net (203.50.11.125) 14.195 ms
13 bundle-ether2.exi-ncprouter101.melbourne.telstra.net (203.50.11.209) 15.117 ms 16.805 ms 16.742 ms
14 www.telstra.net (203.50.5.178) 14.214 ms 14.192 ms 14.242 ms
z5274414@vx6:/tmp_amd/adams/export/adams/5/z5274414$
```

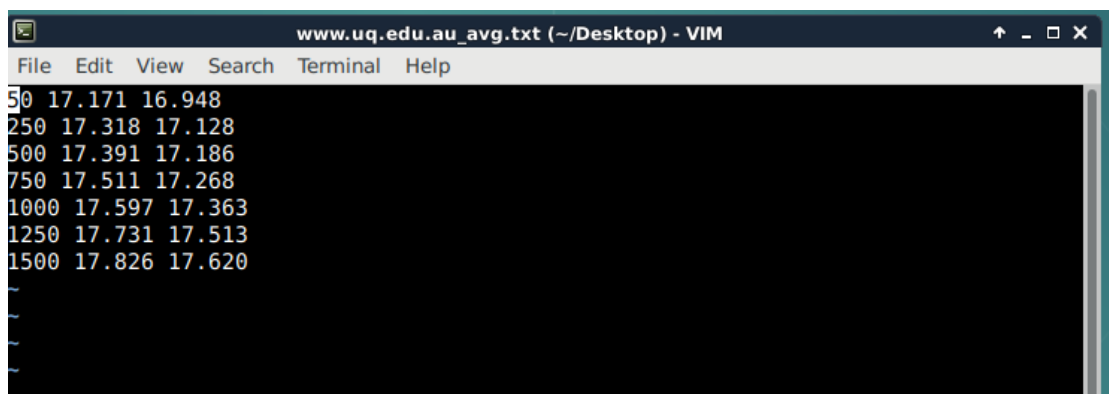

The reverse path doesn't go through the same routers as the forward path, but there are some routers are similar. For example, 5th router (138.44.5.1) from speedtest and 6th router (138.44.5.0) to speedtest. 8th router (149.171.253.36) and 3rd router (149.171.253.35) to speedtest.

These similar routers' last number is different. One reason may be the router have a group of IP addresses to receive and send packets, also it needs to lots of users, so each time the router address may be different.

Exercise 4: Use ping to gain insights into network performance

www.uq.edu.au

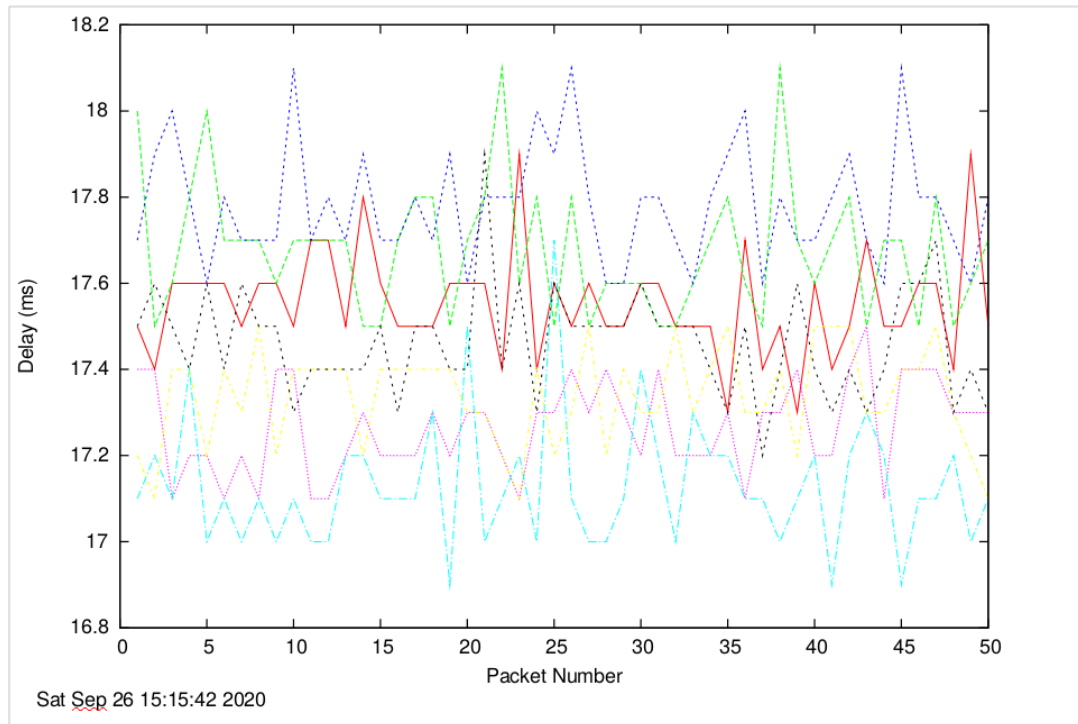
text



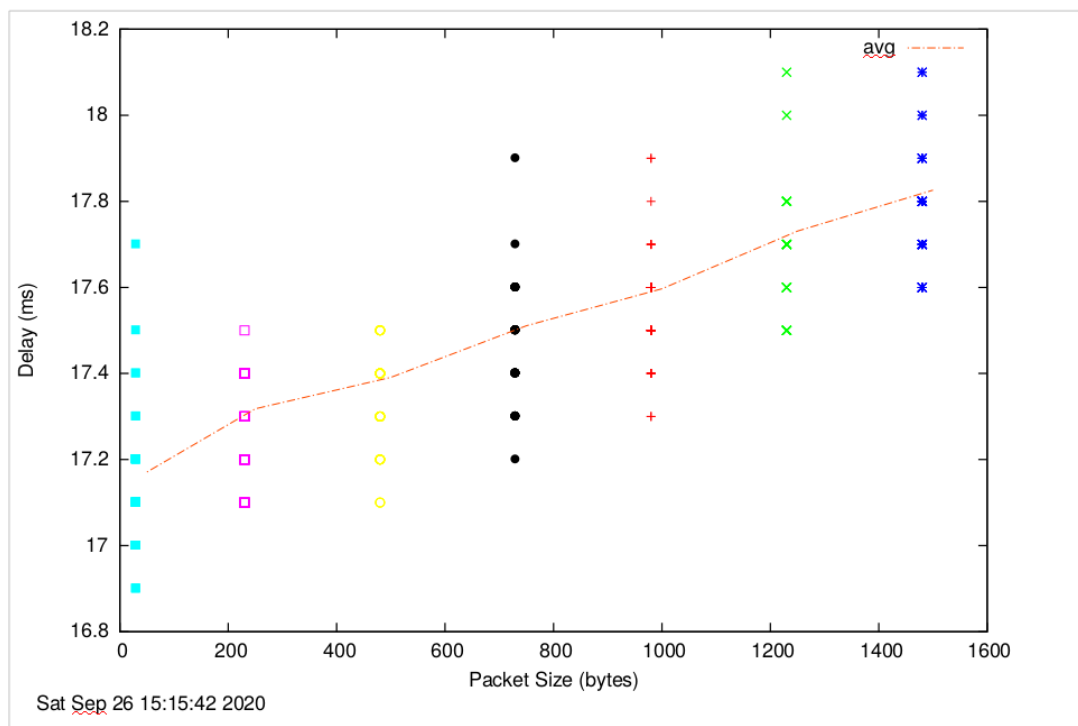
The screenshot shows a VIM editor window titled "www.uq.edu.au_avg.txt (~/.Desktop) - VIM". The window contains a table of ping results with columns for packet size, round-trip time (RTT), and loss percentage. The data is as follows:

Size	RTT	Loss
50	17.171	16.948
250	17.318	17.128
500	17.391	17.186
750	17.511	17.268
1000	17.597	17.363
1250	17.731	17.513
1500	17.826	17.620

delay



scatter

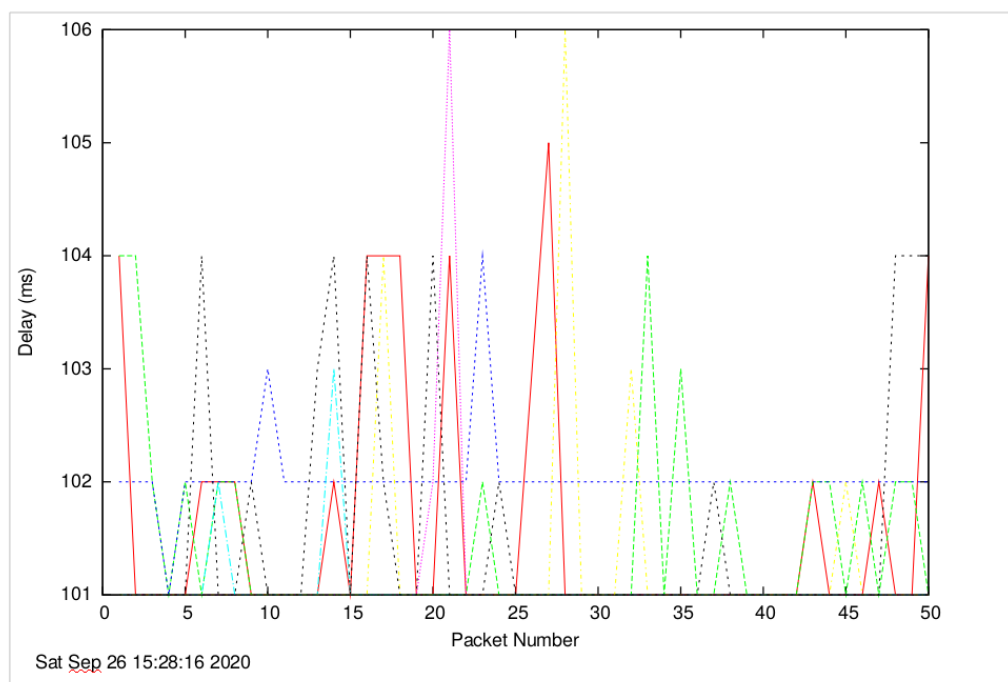


www.upm.edu.my

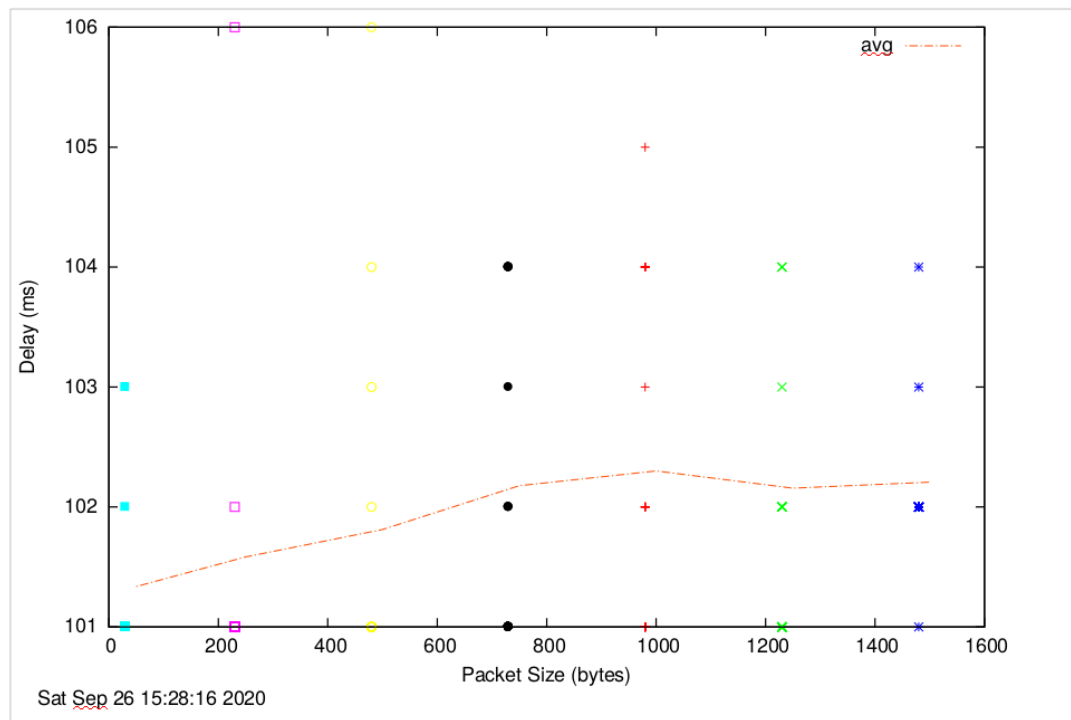
text

```
www.upm.edu.my_avg.txt (~/Desktop) - VIM
File Edit View Search Terminal Help
50 101.337 101.167
250 101.584 101.329
500 101.812 101.483
750 102.178 101.566
1000 102.301 101.734
1250 102.157 101.805
1500 102.207 101.966
~
~
~
~
~
```

delay



scatter

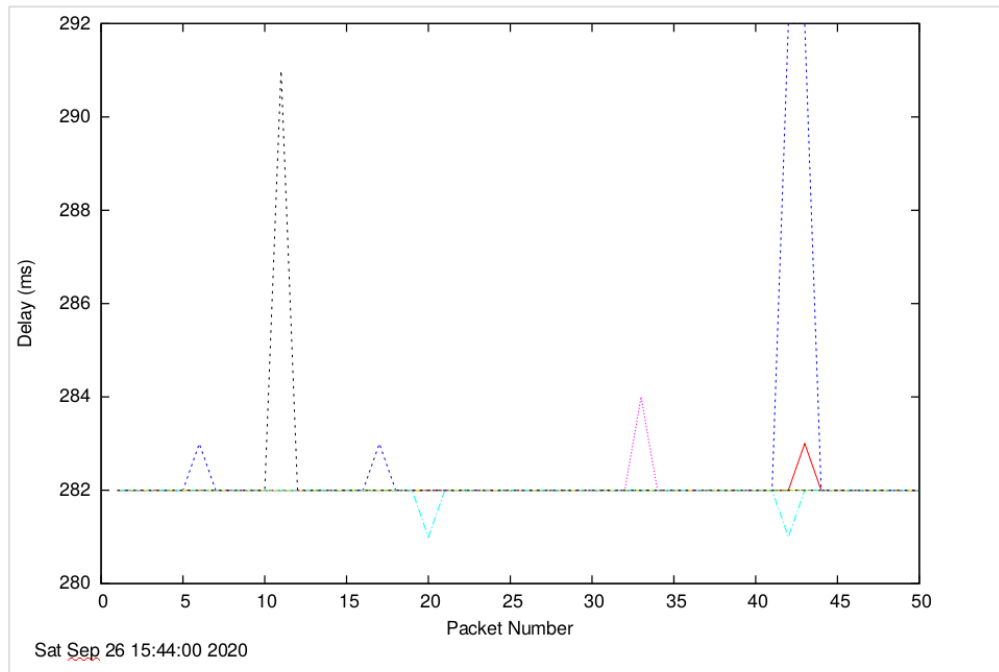


www.tu-berlin.de

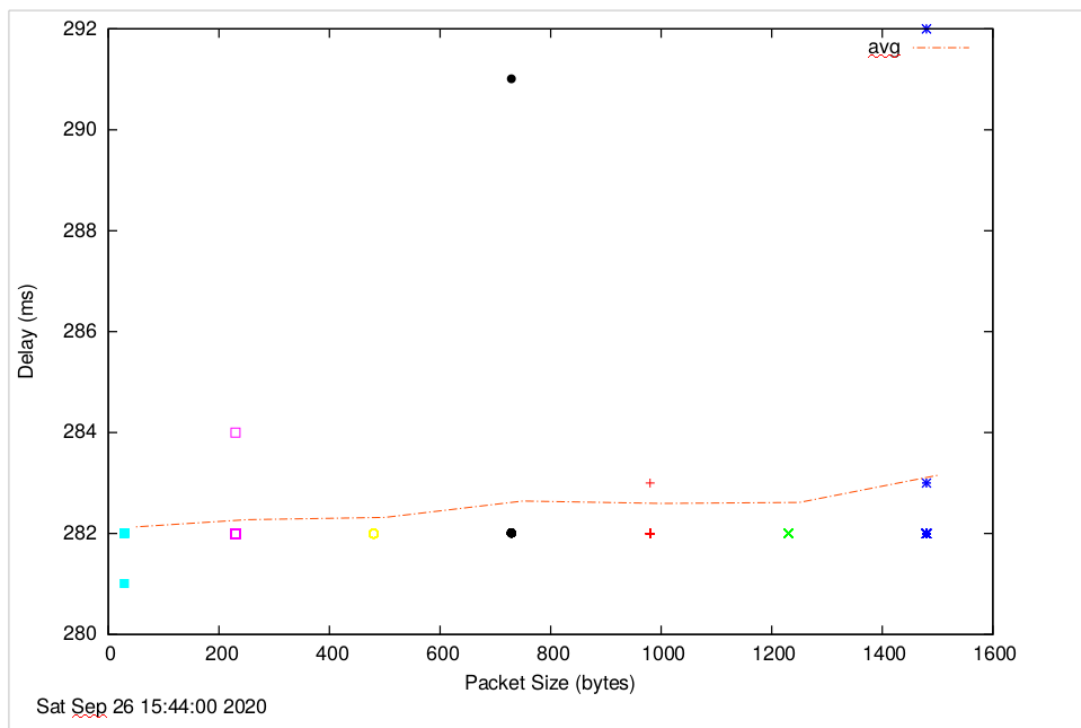
text

```
www.tu-berlin.de_avg.txt (~/Desktop) - VIM
File Edit View Search Terminal Help
50 282.133 281.975
250 282.276 282.125
500 282.319 282.138
750 282.645 282.294
1000 282.598 282.393
1250 282.617 282.469
1500 283.154 282.609
~
~
~
~
```

delay



scatter



1.

	Distance(km)	T(ms)	RTT(ms)	Ratio
UQ	923	3.08	16.948	5.503
UPM	6608	22.02	101.167	4.594
TU-Berlin	16106	53.69	281.975	5.252



The reasons why the y-axis values are greater than 2 are that

First, the propagation speed is slower than that of light in the fiber, and there is propagation delay during this process.

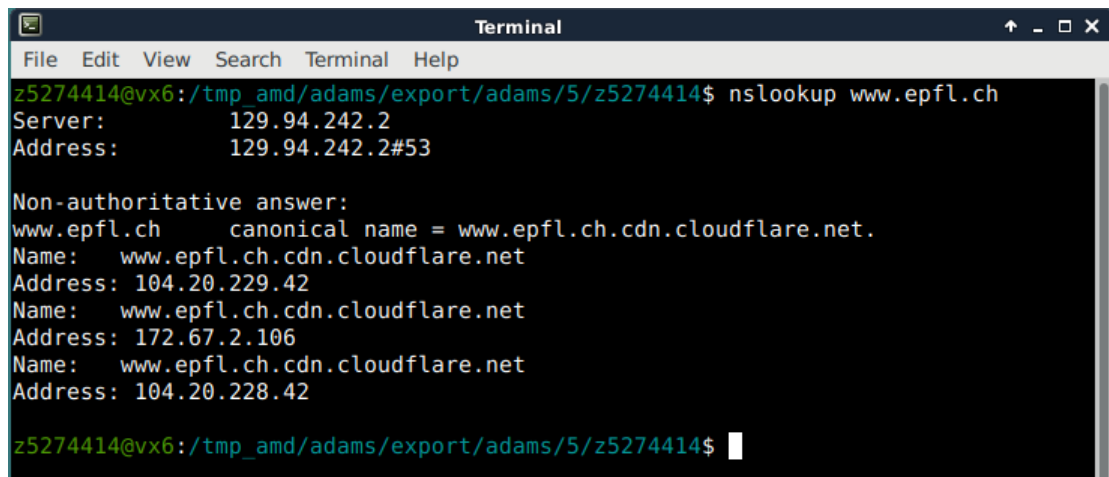
Second, the physical distance is not the actual cable distance, because that physical distance is made by google map which is straight length, and the real distance is longer than that.

Third, the RTT delay may also happen during this process, all the time which includes double delay, so it's greater than 2.

2. The delay to the destinations varies over time, because delay is related to several factors, like propagation, transmission, processing delay, queuing delay. Although the delay has no relation with packet number or physical distance, the delay may be influenced by queuing and variability of processing.

3. No, it's not in Switzerland. It's hosted in San Francisco, USA.

Firstly, I use nslookup to check its IP address. (104.20.229.42)

A screenshot of a terminal window titled "Terminal". The terminal shows the command "nslookup www.epfl.ch" being executed. The output displays the server IP as 129.94.242.2 and the address as 129.94.242.2#53. It then shows a "Non-authoritative answer:" for "www.epfl.ch" with a canonical name of "www.epfl.ch.cdn.cloudflare.net". It lists three IP addresses for this name: 104.20.229.42, 172.67.2.106, and 104.20.228.42. The prompt at the bottom is "z5274414@vx6:/tmp_amd/adams/export/adams/5/z5274414\$".

```
Terminal
File Edit View Search Terminal Help
z5274414@vx6:/tmp_amd/adams/export/adams/5/z5274414$ nslookup www.epfl.ch
Server:      129.94.242.2
Address:     129.94.242.2#53

Non-authoritative answer:
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: 172.67.2.106
Name:   www.epfl.ch.cdn.cloudflare.net
Address: 104.20.228.42

z5274414@vx6:/tmp_amd/adams/export/adams/5/z5274414$
```

Secondly, I use whois 104.20.229.42 to check its hosted location, and it said in San Francisco, USA.

```

z5274414@vx6:/tmp_amd/adams/export/adams/5/z5274414$ whois 104.20.229.42
#
# ARIN WHOIS data and services are subject to the Terms of Use
# available at: https://www.arin.net/resources/registry/whois/tou/
#
# If you see inaccuracies in the results, please report at
# https://www.arin.net/resources/registry/whois/inaccuracy\_reporting/
#
# Copyright 1997-2020, American Registry for Internet Numbers, Ltd.
#

NetRange:      104.16.0.0 - 104.31.255.255
CIDR:          104.16.0.0/12
NetName:       CLOUDFLARENET
NetHandle:     NET-104-16-0-0-1
Parent:        NET104 (NET-104-0-0-0-0)
NetType:       Direct Assignment
OriginAS:      AS13335
Organization:  Cloudflare, Inc. (CLOUD14)
RegDate:       2014-03-28
Updated:       2017-02-17
Comment:       All Cloudflare abuse reporting can be done via https://www.cloudflare.com/abuse
Ref:           https://rdap.arin.net/registry/ip/104.16.0.0

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. Transmission delay and processing delay depend on the packet size and propagation delay and queuing delay don't depend on the packet size.