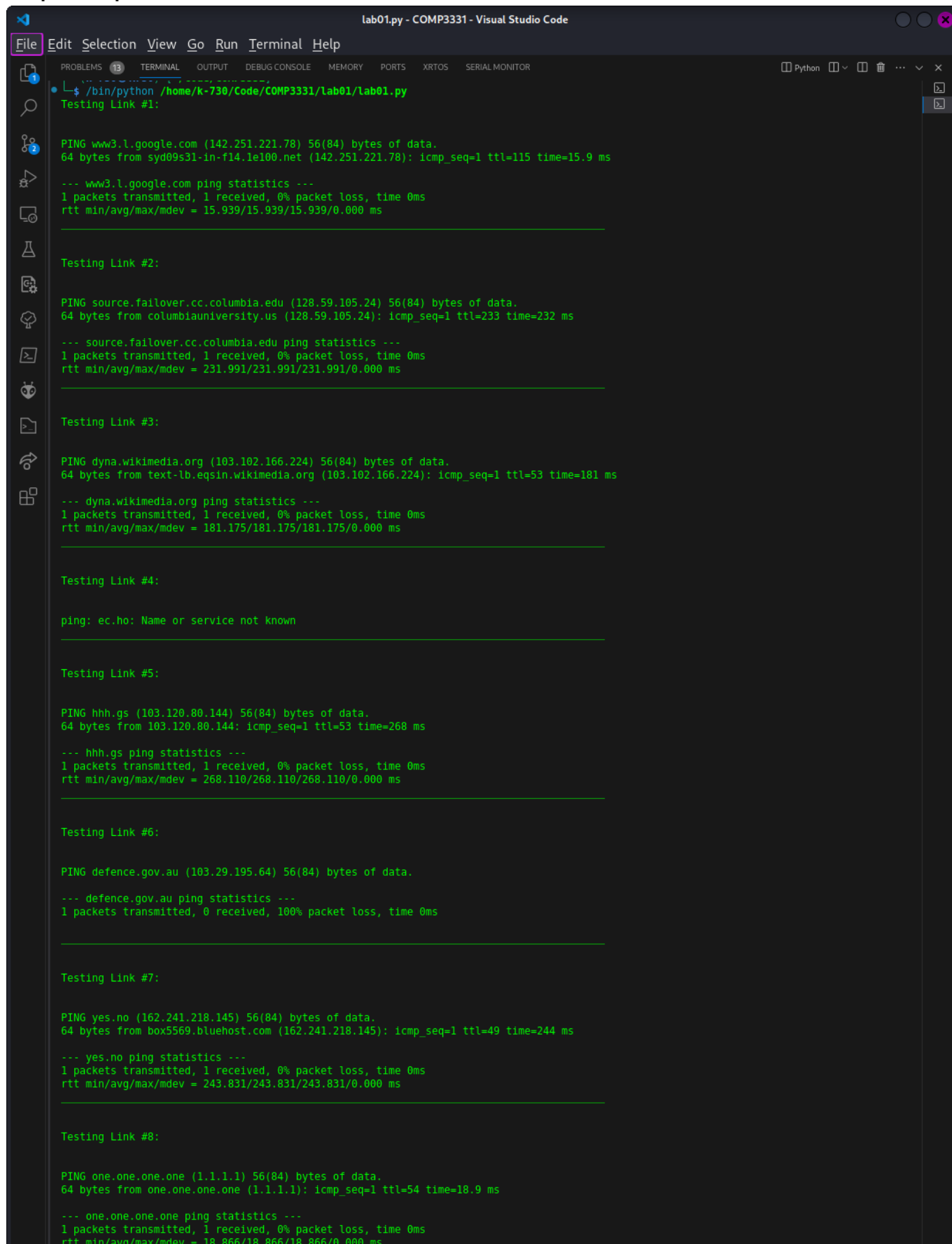


Lab01

Q2

Output for q2



```
lab01.py - COMP3331 - Visual Studio Code
File Edit Selection View Go Run Terminal Help
PROBLEMS 13 TERMINAL OUTPUT DEBUG CONSOLE MEMORY PORTS XRTOS SERIAL MONITOR
Python

$ /bin/python /home/k-730/Code/COMP3331/Lab01/lab01.py
Testing Link #1:

PING www3.l.google.com (142.251.221.78) 56(84) bytes of data.
64 bytes from syd09s31-in-f14.1e100.net (142.251.221.78): icmp_seq=1 ttl=115 time=15.9 ms

--- www3.l.google.com ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 15.939/15.939/15.939/0.000 ms

Testing Link #2:

PING source.failover.cc.columbia.edu (128.59.105.24) 56(84) bytes of data.
64 bytes from columbiauniversity.us (128.59.105.24): icmp_seq=1 ttl=233 time=232 ms

--- source.failover.cc.columbia.edu ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 231.991/231.991/231.991/0.000 ms

Testing Link #3:

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=53 time=181 ms

--- dyna.wikimedia.org ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 181.175/181.175/181.175/0.000 ms

Testing Link #4:

ping: ec.ho: Name or service not known

Testing Link #5:

PING hhh.gs (103.120.80.144) 56(84) bytes of data.
64 bytes from 103.120.80.144: icmp_seq=1 ttl=53 time=268 ms

--- hhh.gs ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 268.110/268.110/268.110/0.000 ms

Testing Link #6:

PING defence.gov.au (103.29.195.64) 56(84) bytes of data.

--- defence.gov.au ping statistics ---
1 packets transmitted, 0 received, 100% packet loss, time 0ms

Testing Link #7:

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=49 time=244 ms

--- yes.no ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 243.831/243.831/243.831/0.000 ms

Testing Link #8:

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=54 time=18.9 ms

--- one.one.one.one ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 18.866/18.866/18.866/0.000 ms
```

```

Testing Link #9:

PING theguardian.com (151.101.193.111) 56(84) bytes of data.
64 bytes from 151.101.193.111 (151.101.193.111): icmp_seq=1 ttl=55 time=12.0 ms

--- theguardian.com ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 12.025/12.025/12.025/0.000 ms

Testing Link #10:

PING i♥.ws (132.148.137.119) 56(84) bytes of data.
64 bytes from 119.137.148.132.host.secureserver.net (132.148.137.119): icmp_seq=1 ttl=45 time=262 ms

--- i♥.ws ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 262.320/262.320/262.320/0.000 ms

```

1. www.google.co.uk is reachable
2. www.columbia.edu is reachable
3. www.wikipedia.org is reachable
4. ec.ho is NOT reachable. This is because the DNS(link) does not not exist. This is confirmed with the browser
5. hhh.gs is reachable.
6. defence.gov.au is reachable. However, the reply packet is absent, yet the link is accessible via browser
7. yes.no is reachable
8. one.one.one.one is reachable
9. theguardian.com is reachable
10. xn--i7iq.ws is reachable

Q3

a)

```

(k-730@K730) - [~/Code/COMP3331]
$ /bin/python /home/k-730/Code/COMP3331/lab01/lab01.py
tracert to usi.ch (195.176.55.64): 30 hops max, 60 byte packets
 1 192.168.0.1 (192.168.0.1) 5.631 ms 7.287 ms 7.680 ms
 2 gateway.nsw.superloop.au (122.199.32.1) 20.203 ms 25.686 ms 25.667 ms
 3 202.90.206.100 (202.90.206.100) 22.153 ms 23.230 ms 23.213 ms
 4 103.200.13.153 (103.200.13.153) 115.581 ms 115.565 ms 115.550 ms
 5 hundredgige0-0-1-2-132.bdr01-ipt-15pioneer-sin.sg.superloop.net.co (202.177.40.22) 115.534 ms 115.518 ms 115.501 ms
 6 te0-1-0-18.br04-sin02.pccwbttn.net (63.217.25.225) 115.486 ms 104.842 ms 102.663 ms
 7 * Hu0-0-0-0.br05-sin02.pccwbttn.net (63.218.164.66) 107.154 ms *
 8 63-216-144-42.static.pccwglobal.net (63.216.144.42) 105.931 ms 113.424 ms 113.746 ms
 9 ae4.crl-gva4.ip4.gtt.net (213.200.127.226) 264.239 ms 252.074 ms 63-216-144-42.static.pccwglobal.net (63.216.144.42) 107.016 ms
10 ip4.gtt.net (154.14.130.90) 258.011 ms 250.601 ms ae4.crl-gva4.ip4.gtt.net (213.200.127.226) 261.678 ms
11 swiE2-B1.switch.ch (130.59.36.69) 262.554 ms 262.514 ms ip4.gtt.net (154.14.130.90) 260.704 ms
12 swiG2-400GE-0-0-0-0.switch.ch (130.59.38.70) 260.657 ms 261.020 ms 255.678 ms
13 swiG1-B1.switch.ch (130.59.36.77) 260.096 ms swiG2-400GE-0-0-0-0.switch.ch (130.59.38.70) 261.239 ms 259.803 ms
14 lu-pop1-bkb02-100g-1-0-48.usi.ch (195.176.176.210) 256.760 ms swiG1-B1.switch.ch (130.59.36.77) 267.512 ms lu-pop1-bkb02-100g-1-0-48.usi.ch (195.176.176.210) 258.752 ms
15 ma-pop1-dcfw01.net.ti-edu.ch (195.176.176.34) 259.767 ms 259.727 ms lu-pop1-bkb02-100g-1-0-48.usi.ch (195.176.176.210) 256.239 ms
16 * ma-pop1-dcfw01.net.ti-edu.ch (195.176.176.34) 263.650 ms 263.630 ms
17 selenio.ti-edu.ch (195.176.55.64) 263.618 ms 263.601 ms 263.583 ms

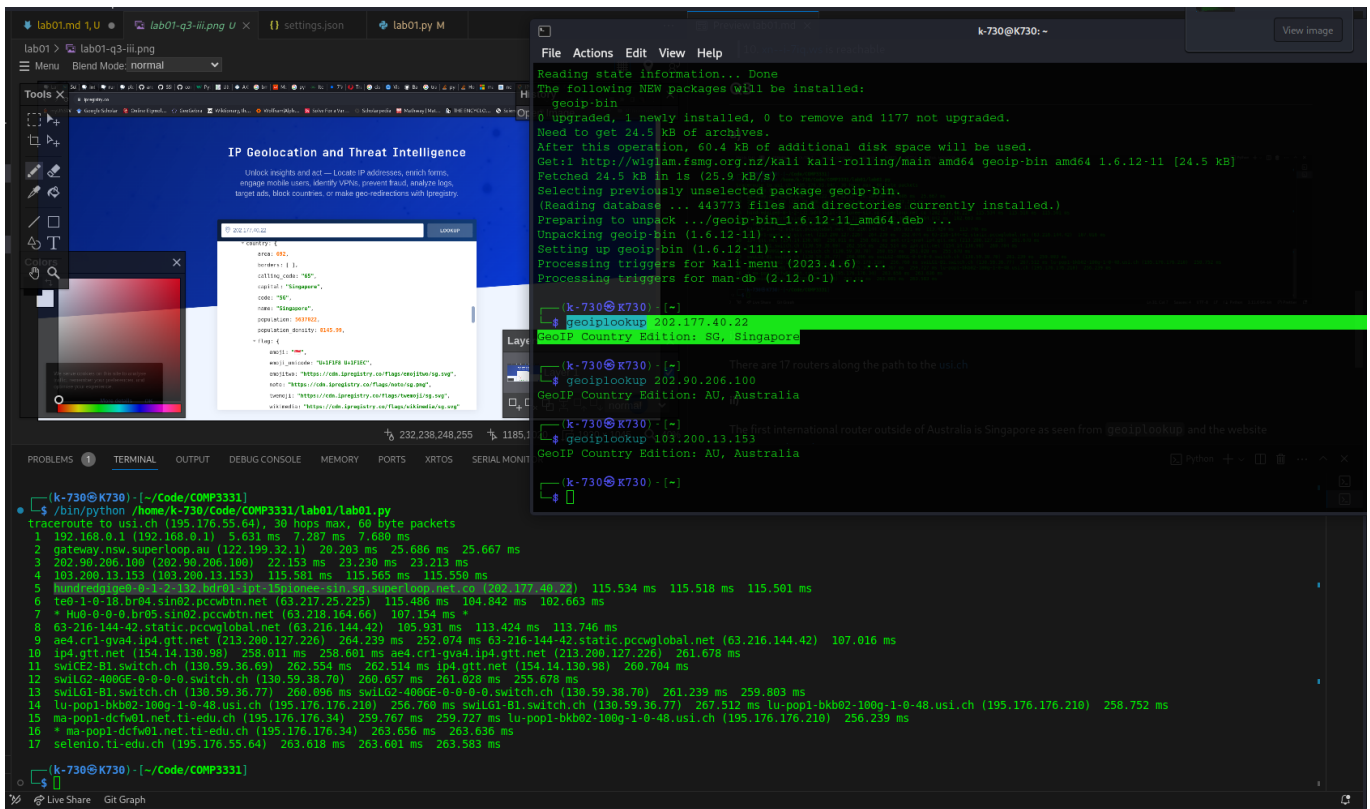
```

i)

There are 17 routers along the path to the usi.ch

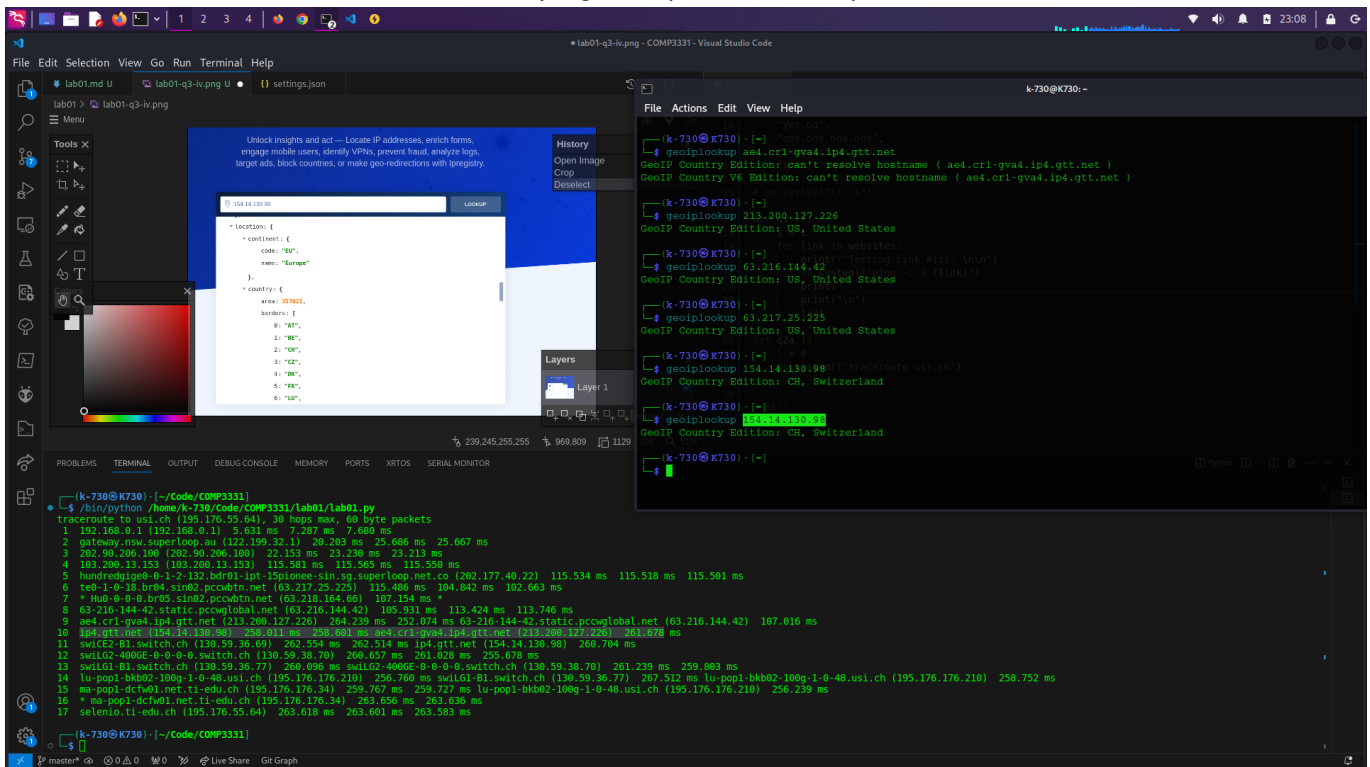
ii)

The first international router outside of Australia is Singapore as seen from geoipllookup and the website geolocator ipregistry.co



iii)

The first EU router is number 10. Which is ip4.gtt.net (154.14.130.98).



b)

i)

The last router that the routes have in common is #3 with IP address: 202.90.206.100

Testing Link #1:

```
tracert to jhu.edu (128.220.192.230), 30 hops max, 60 byte packets
 1  192.168.0.1 (192.168.0.1)  15.191 ms  21.288 ms  27.416 ms
 2  gateway.nsw.superloop.au (122.199.32.1)  46.606 ms  46.539 ms  46.475
ms
 3  202.90.206.100 (202.90.206.100)  46.410 ms  46.346 ms  46.281 ms
 4  Bundle-Ether31.bdr02-ipt-47bourke-syd.au.superloop.com (103.200.13.67)
68.853 ms  87.230 ms  87.166 ms
 5  HundredGigE0-0-1-2.122.bdr01-ipt-220queen-akl.nz.superloop.com
(111.118.196.23)  79.248 ms  79.183 ms  79.119 ms
 6  as6939.akl.ix.nz (43.243.21.17)  87.803 ms  34.513 ms  35.063 ms
 7  100ge0-32.core1.akl2.he.net (184.104.196.117)  39.621 ms  39.571 ms
39.623 ms
 8  100ge0-28.core1.pdx3.he.net (184.104.188.77)  240.374 ms  240.333 ms
240.294 ms
 9  * * *
10  * * *
11  * * port-channel15.core2.sea1.he.net (184.104.199.69)  242.199 ms
12  * * *
13  * * *
14  * johns-hopkins-university.e0-2.switch2.ash1.he.net (209.51.168.62)
327.658 ms  309.595 ms
15  addr16212925394.testippl.jhmi.edu (162.129.253.94)  306.398 ms * *
16  * addr16212925394.testippl.jhmi.edu (162.129.253.94)  297.923 ms
297.888 ms
17  addr16212925394.testippl.jhmi.edu (162.129.253.94)  297.854 ms
162.129.255.245 (162.129.255.245)  300.153 ms *
18  * * *
19  * * *
20  * * *
21  collaborate.johnshopkins.edu (128.220.192.230)  328.693 ms * *
```

Testing Link #2:

```
tracert to usp.br (200.144.248.41), 30 hops max, 60 byte packets
 1  192.168.0.1 (192.168.0.1)  2.067 ms  2.085 ms  2.005 ms
 2  gateway.nsw.superloop.au (122.199.32.1)  12.071 ms  19.326 ms  19.336
ms
 3  202.90.206.100 (202.90.206.100)  19.283 ms  19.263 ms  19.236 ms
 4  Bundle-Ether30.bdr02-ipt-639garde-syd.au.superloop.com (103.200.13.65)
19.199 ms  19.174 ms  19.153 ms
 5  8.245.132.225 (8.245.132.225)  45.071 ms  45.049 ms  45.028 ms
 6  NTT-level3-Sydney1.Level3.net (4.68.38.206)  28.267 ms  9.160 ms  9.004
ms
 7  ae-1.r20.sydna05.au.bb.gin.ntt.net (129.250.2.133)  17.019 ms  16.985
ms  16.966 ms
 8  ae-5.r24.lsanca07.us.bb.gin.ntt.net (129.250.2.52)  226.123 ms  226.107
```

```

ms 226.090 ms
 9 ae-3.r22.dllstx14.us.bb.gin.ntt.net (129.250.7.68) 226.443 ms 226.425
ms 226.409 ms
10 ae-2.r22.miamfl02.us.bb.gin.ntt.net (129.250.2.218) 268.188 ms
233.320 ms 233.275 ms
11 ae-0.a02.miamfl02.us.bb.gin.ntt.net (129.250.2.4) 233.253 ms ae-
0.a03.miamfl02.us.bb.gin.ntt.net (129.250.7.44) 233.234 ms ae-
0.a02.miamfl02.us.bb.gin.ntt.net (129.250.2.4) 233.216 ms
12 xe-1-5-0-2.a02.miamfl02.us.ce.gin.ntt.net (129.250.200.158) 234.152 ms
xe-3-3-0-1.a03.miamfl02.us.ce.gin.ntt.net (129.250.202.94) 225.462 ms xe-
1-5-0-2.a02.miamfl02.us.ce.gin.ntt.net (129.250.200.158) 229.025 ms
13 mia2-mia1.bkb.rnp.br (200.143.252.26) 245.074 ms cce2-mia2-
monet.bkb.rnp.br (170.79.213.46) 290.252 ms mia2-mia1.bkb.rnp.br
(200.143.252.26) 229.121 ms
14 cce2-mia2-monet.bkb.rnp.br (170.79.213.46) 302.256 ms 170.79.212.249
(170.79.212.249) 337.082 ms 337.038 ms
15 170.79.212.249 (170.79.212.249) 339.438 ms csp2-csp1-100g-via-
sp2.bkb.rnp.br (170.79.213.233) 335.766 ms 170.79.212.249 (170.79.212.249)
337.233 ms
16 csp2-csp1-100g-via-sp2.bkb.rnp.br (170.79.213.233) 342.245 ms 342.225
ms e72361-sp2-r06-nx-swc.uspnet.usp.br (143.107.249.38) 350.788 ms
17 * as28571.saopaulo.sp.ix.br (187.16.220.3) 347.215 ms 345.300 ms
18 * e72361-sp2-r06-nx-swc.uspnet.usp.br (143.107.249.38) 349.355 ms
337.955 ms
19 * * *
20 * * *
21 * * *
22 * * *
23 * * *
24 * * *
25 * * *
26 * * *
27 * * *
28 * * *
29 * * *
30 * * *

```

Testing Link #3:

```

traceroute to ed.ac.uk (129.215.235.217), 30 hops max, 60 byte packets
 1 192.168.0.1 (192.168.0.1) 2.158 ms 3.556 ms 3.505 ms
 2 gateway.nsw.superloop.au (122.199.32.1) 15.328 ms 16.180 ms 15.236
ms
 3 202.90.206.100 (202.90.206.100) 15.191 ms 15.144 ms 10.882 ms
 4 103.200.13.153 (103.200.13.153) 338.927 ms 338.883 ms 338.838 ms
 5 hundredgige0-0-1-2-132.bdr01-ipt-15pioneer-sin.sg.superloop.net.co
(202.177.40.22) 338.793 ms 338.748 ms 338.700 ms
 6 202-130-207-34.ip4.superloop.au (202.130.207.34) 338.657 ms 323.728
ms 293.988 ms
 7 mei-b5-link.ip.twelve99.net (62.115.176.152) 293.918 ms 293.884 ms

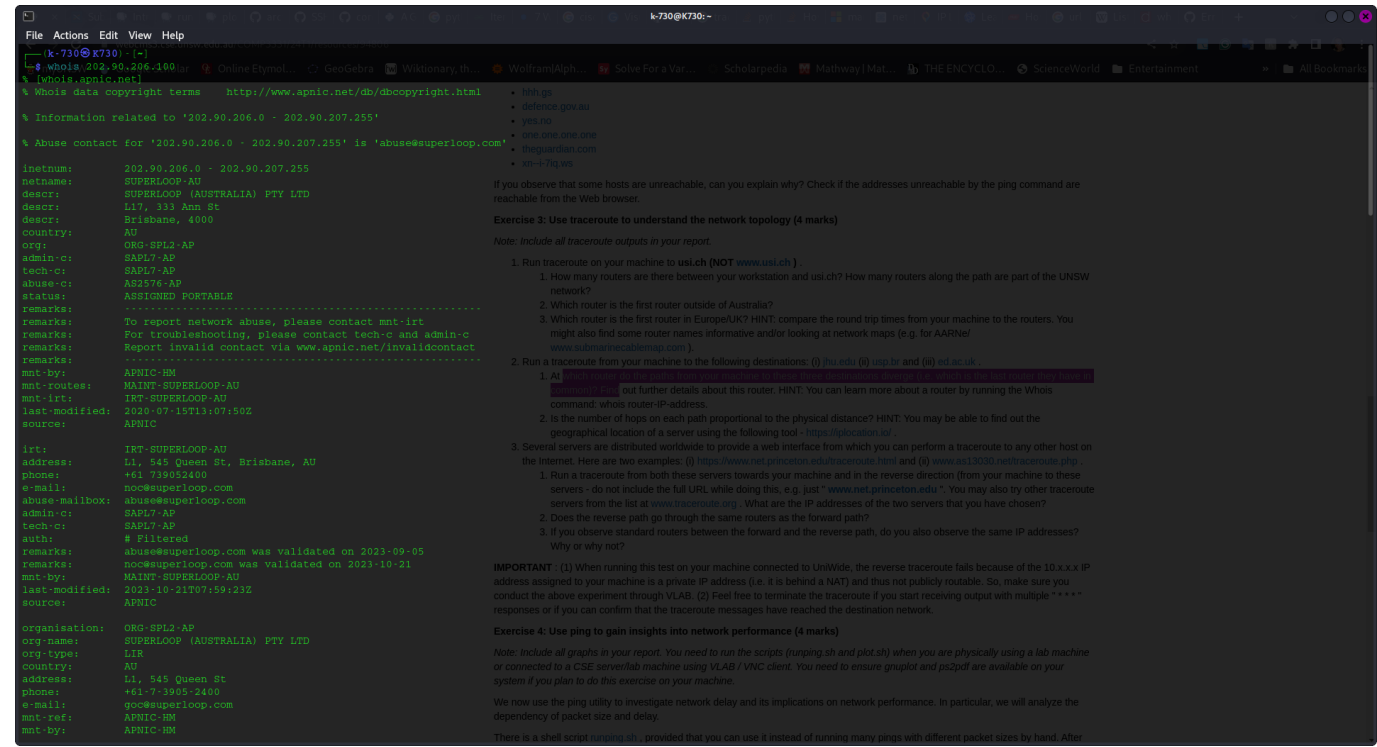
```

```

293.852 ms
 8 prs-bb1-link.ip.twelve99.net (62.115.124.54) 293.819 ms prs-bb2-
link.ip.twelve99.net (62.115.124.56) 293.749 ms prs-bb1-
link.ip.twelve99.net (62.115.124.54) 293.700 ms
 9 * * *
10 ldn-b2-link.ip.twelve99.net (62.115.122.189) 326.696 ms ldn-b2-
link.ip.twelve99.net (62.115.120.239) 326.622 ms 326.604 ms
11 jisc-ic-345131.ip.twelve99-cust.net (62.115.175.131) 326.586 ms
326.570 ms 326.554 ms
12 ae24.londhx-sbr1.ja.net (146.97.35.197) 326.596 ms 326.579 ms
326.562 ms
13 ae29.londpg-sbr2.ja.net (146.97.33.2) 326.486 ms 326.468 ms 326.451
ms
14 ae31.erdiss-sbr2.ja.net (146.97.33.22) 326.493 ms 311.451 ms 311.333
ms
15 ae29.manckh-sbr2.ja.net (146.97.33.42) 311.266 ms 311.201 ms 311.133
ms
16 ae31.glasss-sbr1.ja.net (146.97.33.54) 311.067 ms 311.005 ms 310.938
ms
17 ae29.edinat-rbr2.ja.net (146.97.38.38) 310.934 ms 310.823 ms 310.735
ms
18 ae25.edinkb-rbr2.ja.net (146.97.74.34) 310.668 ms 310.606 ms 405.933
ms
19 university-of-edinburgh.ja.net (146.97.156.78) 405.820 ms 405.753 ms
405.689 ms
20 remote.net.ed.ac.uk (192.41.103.209) 405.623 ms 405.561 ms 405.496
ms
21 * * *
22 * * *
23 * * *
24 * * *
25 * * *
26 * * *
27 * * *
28 * * *
29 * * *
30 * * *

```

Further information about this router reveals my Internet Service Provider with SuperLoop. It is apparently located in Brisbane



ii)

Hop count and physical distance is weakly correlated. Since the hop count to Edinburgh is lower than to New York, despite New York being closer to Sydney.

However, it also seems that the hop count to Sao Paulo is the lowest but only by a small amount when compared to Edinburgh.

Ultimately, hop count and physical distance must be weakly correlated as there must be other factors that contribute to varying hop count. (Scepticism is required here because the sample size is small)

#	Link	Hops	Location	Euclidean Distance from Sydney(km)
1	jhu.edu	21	New York	15,728
2	usp.br	18	Sao Paulo	14,235
3	ed.ac.uk	20	Edinburgh	17,006

c)

i)

My public ip address is as follows:

iplocation.net

DNS LOOKUP

BRE/

MY IP

IP TRACKER

TOOLS

WEB

PRIVACY

CYBERSECURITY

AP

What is My IP Location? | Geolocation

Grammarly

Works Where You Write

INSTALL >

IP Location Finder

Pv4, IPv6 or Domain Name

IP Lookup

Looking to query more than 1 IP? Try our Bulk IP Lookup

IP Address Details

IP

IPv4: 116.255.12.95

IP LOCATION:

Penrith, New South Wales (AU) [Details]

HOST NAME:

116-255-12-95.Ip4.Superloop.Au

ISP:

SuperLoop (Australia) Pty Ltd

PROXY:

Not Detected.

IP

IPv6: Not Detected

BROWSER:

Chrome 121.0.0.0 [User Agent]

SCREEN SIZE:

1920px X 1080px

JAVASCRIPT:

Enabled

COOKIE:

Enabled

Output from <https://www.net.princeton.edu/traceroute.html> to my IP address

8 / 15

net.princeton.edu/cgi-bin/traceroute.pl

myUNSWGoogle ScholarOnline Etymol...GeoGebraWiktionary, th...WolframAlph...Solve For a Var...ScholarpediaMathway | Mat...THE ENCYCLO...

Traceroute

tracing path from www.net.princeton.edu to 116.255.12.95 ...

```
traceroute to 116.255.12.95 (116.255.12.95), 30 hops max, 40 byte packets
 1 core-ns-router (128.112.128.2)  0.895 ms  0.995 ms  0.836 ms
 2 rtr-core-east-router.princeton.edu (128.112.12.225)  0.880 ms  0.655 ms  0.555 ms
 3 fw-border-87-router.princeton.edu (128.112.12.10)  1.078 ms  1.026 ms  0.928 ms
 4 rtr-border-87-router.princeton.edu (204.153.48.1)  1.491 ms  1.646 ms  1.388 ms
 5 172-96-130.unassigned.userdns.com (172.96.130.53)  4.199 ms  5.047 ms  3.829 ms
 6 172-96-130.unassigned.userdns.com (172.96.130.77)  6.265 ms  5.464 ms  172-96-130.unassigned.userdns.com (172.96.130.61)  6.130 ms
 7 bundle-ether240.202.corel.newy32aaa.net.internet2.edu (198.71.47.232)  6.623 ms  5.804 ms  6.177 ms
 8 fourhundredge-0-0-48.4079.agg2.newy2.net.internet2.edu (163.253.2.149)  6.487 ms  5.844 ms  6.094 ms
 9 162.252.69.209 (162.252.69.209)  4.362 ms  18.446 ms  4.450 ms
10 * * *
11 * * *
12 * * *
13 * * *
14 * * *
15 ael.mcs1.lax112.us.eth.zayo.com (64.125.28.235)  68.585 ms  69.633 ms  79.148 ms
16 64.124.204.202.IPYX-145412-001-ZY0.zip.zayo.com (64.124.204.202)  69.617 ms  68.742 ms  69.026 ms
17 * * *
18 * * *
19 Bundle-Ether1.4041.bdr01-sat-4edenpar-syd.au.superloop.com (203.153.18.241)  224.144 ms  224.406 ms  221.660 ms
20 * * *
21 * * *
22 * * *
23 * * *
24 * * *
25 * * *
26 * * *
27 * * *
28 * * *
29 * * *
30 * * *
```

Done.

Output from <https://www.as13030.net> to my IP address

as13030.net/traceroute.php

myUNSWGoogle ScholarOnline Etymol...GeoGebraWiktionary, th...WolframAlph...Solve For a Var...ScholarpediaMathway | Mat...THE ENCYCLO...ScienceWorld

InfoTools

Looking Glass

IP Address Test

Traceroute

AS13030

Traceroute

Traceroute, Tracert, Trace oder Tracepath meint immer das selbe: nmlich die Anzeige des "Wegs" von Datenpaketen durch das Internet. Dabei "hangelt" sich das Traceroute-Programm von Router zu Router, bis es schliesslich das Ziel (Target) erreicht.

Testen Sie den "Pfad" der Datenpakete von www.init7.net zu Ihrem Computer. *Dies kann eine Weile dauern, haben Sie also bitte etwas Geduld.* Falls ab einem bestimmten Hop nur noch * * * Sterne angezeigt werden, verhindert mutmasslich eine Firewall die weitere Anzeige.

Traceroute Ausgabe

```
traceroute to 116.255.12.95 (116.255.12.95), 30 hops max, 60 byte packets
 1 r2win7.core.init7.net (213.144.137.193) [AS13030]  0.932 ms  1.108 ms  1.501 ms
 2 r2win9.core.init7.net (5.180.135.31) [AS13030]  0.868 ms  1.103 ms  1.448 ms
 3 r1win9.core.init7.net (5.180.135.1) [AS13030]  0.935 ms  1.309 ms  1.568 ms
 4 r1zrh10.core.init7.net (5.180.135.56) [AS13030]  1.363 ms  1.670 ms  1.971 ms
 5 r1glb3.core.init7.net (5.180.135.59) [AS13030]  1.527 ms  1.830 ms  2.139 ms
 6 r2zrh5.core.init7.net (5.180.135.69) [AS13030]  1.380 ms  1.482 ms  1.631 ms
 7 r2zrh2.core.init7.net (5.180.135.232) [AS13030]  1.297 ms  1.947 ms  2.264 ms
 8 r1fra3.core.init7.net (5.180.135.173) [AS13030]  6.868 ms  7.023 ms  7.425 ms
 9 pni-pccw.fra3.init7.net (77.109.135.34) [AS13030]  6.824 ms  6.820 ms  6.847 ms
10 Hundredge0-2-0-0.br04.lax05.pccwbtn.net (63.223.43.66) [AS3491]  147.451 ms  147.440 ms  147.426 ms
11 63.222.112.51 (63.222.112.51) [AS3491]  149.699 ms  149.689 ms  149.642 ms
12 * * *
13 * * *
14 Bundle-Ether1.4041.bdr01-sat-4edenpar-syd.au.superloop.com (203.153.18.241) [AS38195]  300.205 ms * *
15 * Bundle-Ether1.4041.bdr01-sat-4edenpar-syd.au.superloop.com (203.153.18.241) [AS38195]  306.946 ms *
16 * * *
17 * * *
18 * * *
19 * * *
```

[Neuer Traceroute](#)

IP address of the selected links:

Link	IP Address
https://www.net.princeton.edu	128.112.128.55
https://www.as13030.net	213.144.137.198

My output to 128.112.128.55

Testing Link #1:

```
traceroute to 128.112.128.55 (128.112.128.55), 30 hops max, 60 byte packets
 1  192.168.0.1 (192.168.0.1)  3.304 ms  3.253 ms  3.225 ms
 2  gateway.nsw.superloop.au (122.199.32.1)  13.004 ms  17.284 ms  17.259
ms
 3  202.90.206.100 (202.90.206.100)  17.236 ms  17.211 ms  17.187 ms
 4  Bundle-Ether31.bdr02-ipt-47bourke-syd.au.superloop.com (103.200.13.67)
171.438 ms  171.416 ms  171.390 ms
 5  103.200.13.168 (103.200.13.168)  171.366 ms  171.345 ms  171.322 ms
 6  ae7.er3.lax112.us.zip.zayo.com (64.124.204.201)  167.721 ms  169.392 ms
169.347 ms
 7  ae1.cs1.lax112.us.eth.zayo.com (64.125.28.234)  169.325 ms  160.977 ms
160.932 ms
 8  * * *
 9  lsan0.tr-cps.internet2.edu (206.223.123.199)  171.397 ms  168.440 ms
169.764 ms
10  fourhundredge-0-0-0-0.4079.core1.losa.net.internet2.edu (163.253.1.18)
241.399 ms  237.475 ms  241.261 ms
11  fourhundredge-0-0-0-2.4079.core2.salt.net.internet2.edu (163.253.1.115)
237.342 ms  237.277 ms  236.843 ms
12  fourhundredge-0-0-0-23.4079.core1.salt.net.internet2.edu (163.253.1.32)
235.586 ms fourhundredge-0-0-0-0.4079.core2.denv.net.internet2.edu
(163.253.1.168)  240.552 ms  240.479 ms
13  fourhundredge-0-0-0-0.4079.core1.denv.net.internet2.edu (163.253.1.170)
241.289 ms  241.116 ms  234.982 ms
14  fourhundredge-0-0-0-0.4079.core1.kans.net.internet2.edu (163.253.1.243)
232.442 ms  228.669 ms  228.619 ms
15  fourhundredge-0-0-0-3.4079.core2.chic.net.internet2.edu (163.253.1.244)
234.947 ms  235.354 ms  235.320 ms
16  fourhundredge-0-0-0-3.4079.core2.eqch.net.internet2.edu (163.253.2.19)
243.913 ms  242.835 ms  238.887 ms
17  fourhundredge-0-0-0-0.4079.core2.clev.net.internet2.edu (163.253.2.16)
238.835 ms  237.978 ms  237.925 ms
18  fourhundredge-0-0-0-3.4079.core2.ashb.net.internet2.edu (163.253.1.138)
239.343 ms  237.192 ms  247.316 ms
19  fourhundredge-0-0-0-1.4079.core1.phil.net.internet2.edu (163.253.1.137)
242.496 ms  237.738 ms  244.364 ms
20  198.71.47.99 (198.71.47.99)  245.536 ms  229.349 ms  234.627 ms
21  172-96-130.unassigned.userdns.com (172.96.130.54)  239.439 ms  234.492
ms  239.305 ms
22  fw-border-87-router.princeton.edu (204.153.48.2)  232.358 ms  227.431
ms  243.333 ms
23  rtr-core-east-router.princeton.edu (128.112.12.9)  234.012 ms  236.782
ms  233.528 ms
24  core-ns-router.princeton.edu (128.112.12.226)  236.484 ms  235.197 ms
231.769 ms
25  www.net.princeton.edu (128.112.128.55)  239.396 ms  237.406 ms  237.373
ms
```

My output to 213.144.137.198

Testing Link #2:

traceroute to 213.144.137.198 (213.144.137.198), 30 hops max, 60 byte packets

```
 1 192.168.0.1 (192.168.0.1)  2.394 ms  2.187 ms  2.080 ms
 2 gateway.nsw.superloop.au (122.199.32.1)  16.766 ms  16.695 ms  16.630
ms
 3 202.90.206.100 (202.90.206.100)  16.562 ms  16.499 ms  16.434 ms
 4 Bundle-Ether31.bdr02-ipt-47bourke-syd.au.superloop.com (103.200.13.67)
170.546 ms  170.481 ms  170.402 ms
 5 103.200.13.168 (103.200.13.168)  170.312 ms  170.238 ms  170.165 ms
 6 ae7.er3.lax112.us.zip.zayo.com (64.124.204.201)  166.297 ms  162.300 ms
165.952 ms
 7 * * *
 8 * ae3.cs1.dfw2.us.eth.zayo.com (64.125.29.52)  302.892 ms *
 9 * * *
10 * * *
11 * * *
12 * * *
13 ae4.mpr1.lhr15.uk.zip.zayo.com (64.125.28.195)  411.204 ms  411.053 ms
410.948 ms
14 linux-1.init7.net (195.66.224.175)  409.406 ms  304.998 ms  303.598 ms
15 r2lon2.core.init7.net (5.180.134.18)  319.055 ms  318.987 ms  306.551
ms
16 r2fra3.core.init7.net (5.180.135.129)  316.665 ms  306.787 ms  312.380
ms
17 r1fra3.core.init7.net (77.109.135.33)  305.750 ms  350.166 ms  309.587
ms
18 r2zrh2.core.init7.net (5.180.135.172)  320.704 ms  318.045 ms  318.820
ms
19 r2zrh5.core.init7.net (5.180.135.233)  317.848 ms  317.750 ms  317.664
ms
20 r1glb3.core.init7.net (5.180.135.68)  320.151 ms  319.714 ms  316.152
ms
21 r1zrh10.core.init7.net (5.180.135.58)  317.145 ms  316.989 ms  315.228
ms
22 r1win9.core.init7.net (5.180.135.57)  313.904 ms  411.340 ms  411.220
ms
23 r2win9.core.init7.net (5.180.135.0)  402.618 ms  402.474 ms  402.363 ms
24 r2win7.core.init7.net (5.180.135.30)  402.224 ms  401.876 ms  400.120
ms
25 * * *
26 * * *
27 * * *
28 * * *
```

```
29 * * *
30 * * *

_____

_____
```

ii)

The paths of the reverse and forward route are different.

Albeit, as seen above the reverse route goes through some similar routers with the forward route as with the case for <Bundle-Ether31.bdr02-ipt-47bourke-syd.au.superloop.com> which implies my Superloop ISP. However, for both routes there are many routers which are different because of the different IP addresses.

Something to note is the close proximity of the IP addresses for <https://init.7>, which may imply a server hosting many machines to achieve this.

iii)

Standard routers appear if the IP address has not been translated. This is the case with <https://www.net.princeton.edu/traceroute.html> . However, it appears with the <https://init.7> and my SuperLoop ISP have used a translated IP (NAT Gateway) which may explain why the terminating IP addresses are different.

Q4)

Data:

<http://cdu.edu.au>:

Delay vs Time and Packet Number

Delay vs. Packet Size

Average and Min delay for packet size

Packet-Size	Avg	Min
50	71.14	61.694
250	67.106	61.878
500	68.239	62.84
750	67.265	63.326
1000	67.785	62.549

Packet-Size	Avg	Min
1250	67.948	62.787
1500	69.891	62.854

<http://usp.br>:

Delay vs Time and Packet Number

Delay vs. Packet Size

Average and Min delay for packet size

Packet-Size	Avg	Min
50	392.834	334.572
250	404.478	332.872
500	397.889	335.137
750	389.037	333.947
1000	397.218	335.194
1250	397.085	335.352
1500	395.499	333.484

<http://ed.ac.uk>:

Delay vs Time and Packet Number

Delay vs. Packet Size

Average and Min delay for packet size

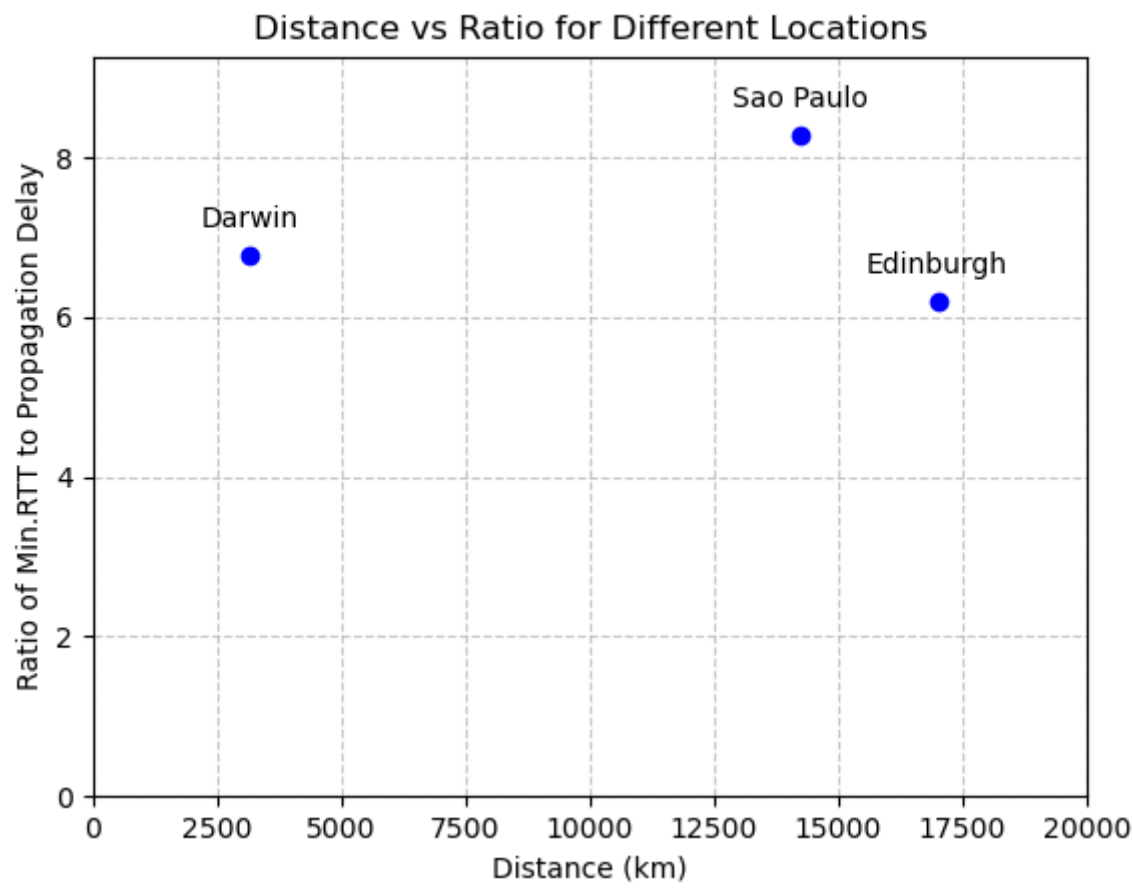
Packet-Size	Avg	Min
50	350.898	284.239
250	345.494	291.038
500	345.516	284.403

Packet-Size	Avg	Min
750	340.107	288.637
1000	339.109	286.988
1250	357.529	289.484
1500	339.793	284.49

a)

Link	Location	Euclidean Distance from Sydney(km)	Time to Destination(s)	Time to destination (ms)	Speed of light (m/s)	300000000
cdu.edu.au	Darwin	3,149	0.010496666667	10.496666667	Speed of light (km/s)	300000
usp.br	Sao Paulo	14,235	0.04745	47.45		
ed.ac.uk	Edinburgh	17,006	0.056686666667	56.686666667		

b)



c)

Possible reasons that the y-axis is greater than two are:

1. Transmission delay incurred along the route because each node(router) needs to manage other packets.
2. Propagation speed of a packet is not actually $3 \times 10^8 \text{ m/s}$. It is more closer to $2 \times 10^8 \text{ m/s}$ because the speed of light (a packet) will travel slower in fibre optic (a different material)
3. Possible Processing and Queuing delay from individual routers as they will be managing other packets
4. The Round Trip Time (RTT) represents at least twice the time of the minimum time taken, because it requires going forwards and returning from the destination

d)

Delay to the destination will vary over time. This is because the nodes/routers to the destination will have manage other packets and this means that factors such as processing, queueing and transmission time will also wildly vary.

e)

#	Delay type	Definition	Formula
1	Processing	time required to examine the packet headers and determine redirection	
2	Queueing	time spent by the packet waiting to be transmitted onto the link	
3	Transmission	time required to push the packet into the link	(L / R)
4	Propagation	time spent by the packet travelling from the beginning to end node	(d / v)

Where:

R = Transmission rate of the link

L = The packet length in bits

d = The distance between two nodes (routers)

v = The speed of light in a physical medium

Therefore, only transmission delay depends on the size of the packet L . The others do not.