Lab1

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Exercise 1:

1.The series of IP addresses that appear when using the nslookup command on the Telstra website are all its IP addresses. This is to avoid system overload, which may occur when a website suddenly generates high traffic or large-scale activity, and multiple IP addresses can spread the traffic. Improve the efficiency and usefulness of your website.

```
z5382484@vx05:~$ nslookup www.telstra.com.au
Server:         129.94.242.2
Address:        129.94.242.2#53

Non-authoritative answer:
www.telstra.com.au      canonical name = d213pjybjlbg0l.cloudfront.net.
Name:   d213pjybjlbg0l.cloudfront.net
Address: 65.8.134.9
Name:   d213pjybjlbg0l.cloudfront.net
Address: 65.8.134.70
Name:   d213pjybjlbg0l.cloudfront.net
Address: 65.8.134.47
Name:   d213pjybjlbg0l.cloudfront.net
Address: 65.8.134.89
Name:   d213pjybjlbg0l.cloudfront.net
Address: 2600:9000:209a:e400:17:876d:b540:93a1
Name:   d213pjybjlbg0l.cloudfront.net
Address: 2600:9000:209a:7200:17:876d:b540:93a1
Name:   d213pjybjlbg0l.cloudfront.net
Address: 2600:9000:209a:fc00:17:876d:b540:93a1
Name:   d213pjybjlbg0l.cloudfront.net
Address: 2600:9000:209a:a200:17:876d:b540:93a1
Name:   d213pjybjlbg0l.cloudfront.net
Address: 2600:9000:209a:200:17:876d:b540:93a1
Name:   d213pjybjlbg0l.cloudfront.net
Address: 2600:9000:209a:2400:17:876d:b540:93a1
Name:   d213pjybjlbg0l.cloudfront.net
Address: 2600:9000:209a:d200:17:876d:b540:93a1
Name:   d213pjybjlbg0l.cloudfront.net
Address: 2600:9000:209a:fa00:17:876d:b540:93a1
```

2.

The name of IP address 127.0.0.1 is localhost, which is usually used to refer to the local computer. localhost is usually used for testing, development and debugging.

```
z5382484@vx05:~$ nslookup 127.0.0.1
1.0.0.127.in-addr.arpa  name = localhost.
```

Exercise 2:

1.www.google.co.uk

This site is reachable.

2.www.columbia.edu

This site is reachable.

3.www.wikipedia.org

This site is reachable.

4.ec.ho

This site is unreachable. No information can be obtained using the ping command, and the website cannot be accessed through web browser. This may be because the URL name is incorrect or the URL does not exist.

```
z5382484@vx22:~$ ping ec.ho
ping: ec.ho: Name or service not known
```

5.hhh.gs

This site is reachable.

6.defence.gov.au

This site is unreachable. But this website can be accessed through a web browser and is an Australian government website. In order to avoid attacks and hacker access, government agencies' websites usually set up firewalls to prevent ping requests (ICMP packets) from passing through. Therefore, even if the website can be accessed through a browser, it may not be possible to conduct a ping test from the external network.

```
z5382484@vx22:~$ ping defence.gov.au
PING defence.gov.au (103.29.195.64) 56(84) bytes of data.
^C
--- defence.gov.au ping statistics ---
390 packets transmitted, 0 received, 100% packet loss, time 398282ms
```

7.yes.no

This site is reachable.

8.one.one.one.one

This site is reachable.

9.theguardian.com

This site is reachable.

10.xn--i-7iq.ws

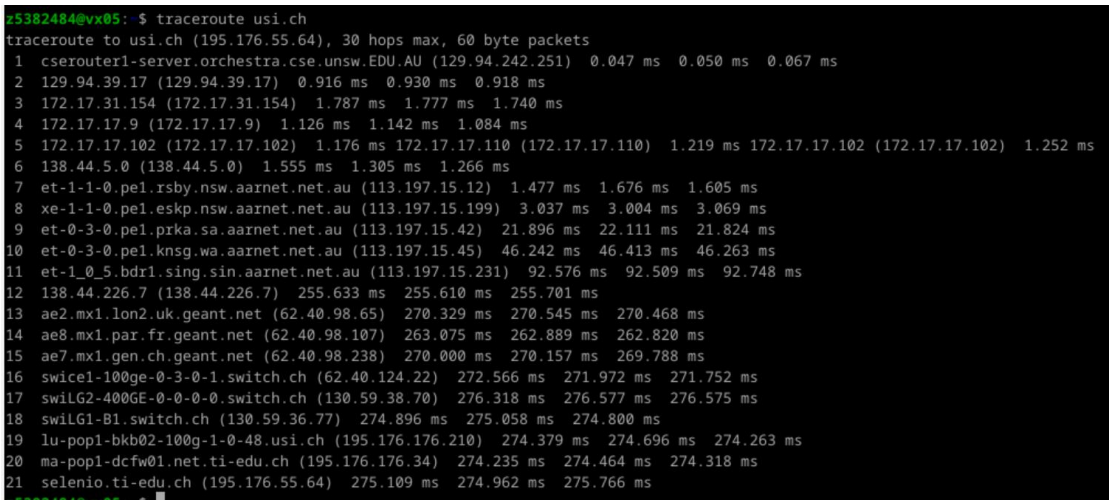
This site is reachable.

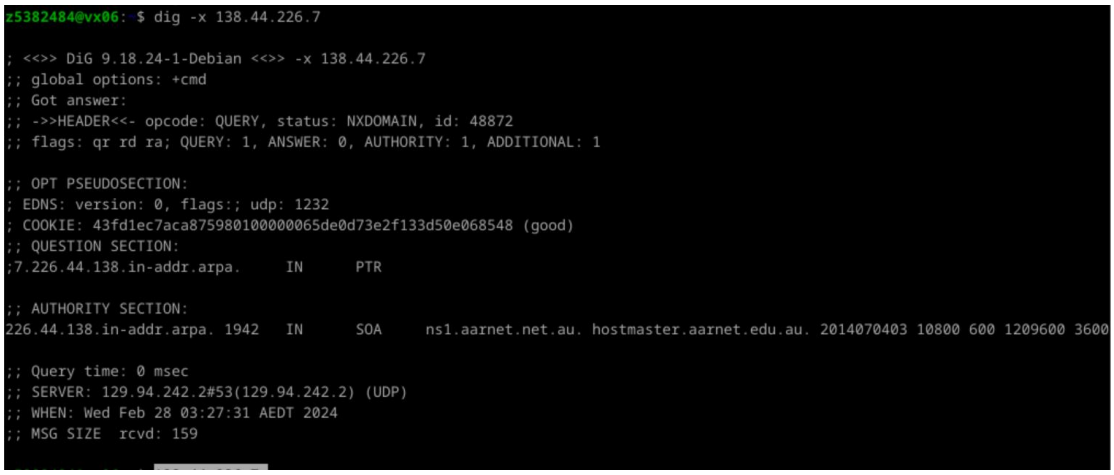
Exercise 3:

1.

(1) The screenshot shows that when I used the traceroute command on the URL usi.ch, I got 21 pieces of data, which means that 20 routers passed through my workstation to usi.ch. The first five of these routers are part of the UNSW network based on their IP address(Within private IP address range). The sixth router is verified to belong to Australia, so the first five routers are part of UNSW.

(2) The 11th router is the first outside Australia. Judging from the IP address, this website belongs to Singapore. It can also be seen from the RTT data that the data packet spends longer on the 11th router than before.
(3) The 13th router is the first one in Europe. The RTT is very different between the 11th and 12th piece of data which means the packet travels further which will take more time. However, after checking, the 12th router still belongs to Australia(AARNeT). The thirteenth router contains the "uk" field, and the RTT data proves that it is the first router in the UK.





2.

(1) As we can see from the three screenshots below, the paths from my workstation to these three destinations are spread out on the 6th router, and the first six routers are the same on these three paths.
(2) The number of hops on each path is not proportional to the physical distance, The distance between UNSW and the University of Edinburgh in the UK is longer than the distance from the University of São Paulo in Brazil, but the number of hops is fewer, which is obviously not proportional.

```
z5382484@vx05:~$ traceroute jhu.edu
traceroute to jhu.edu (128.220.192.230), 30 hops max, 60 byte packets
 1  cserouter1-server.orchestra.cse.unsw.EDU.AU (129.94.242.251)  0.051 ms  0.054 ms  0.043 ms
 2  129.94.39.17 (129.94.39.17)  0.890 ms  0.903 ms  0.918 ms
 3  172.17.31.154 (172.17.31.154)  2.212 ms  2.228 ms  1.644 ms
 4  172.17.17.9 (172.17.17.9)  1.195 ms  1.207 ms  1.222 ms
 5  172.17.17.102 (172.17.17.102)  1.249 ms  1.372 ms  1.387 ms
 6  138.44.5.0 (138.44.5.0)  1.447 ms  2.409 ms  2.370 ms
 7  et-0-3-0.pe1.bkvl.nsw.aarnet.net.au (113.197.15.147)  2.294 ms  1.761 ms  1.764 ms
 8  113.197.15.151 (113.197.15.151)  72.224 ms  72.228 ms  72.207 ms
 9  138.44.228.5 (138.44.228.5)  185.542 ms  185.570 ms  185.525 ms
10  fourhundredge-0-0-0-2.4079.core2.salt.net.internet2.edu (163.253.1.115)  243.202 ms  243.206 ms  243.211 ms
11  fourhundredge-0-0-0-0.4079.core2.denv.net.internet2.edu (163.253.1.168)  244.258 ms  245.008 ms  244.969 ms
12  fourhundredge-0-0-0-0.4079.core2.kans.net.internet2.edu (163.253.1.251)  243.125 ms  243.139 ms  243.273 ms
13  fourhundredge-0-0-0-0.4079.core1.chic.net.internet2.edu (163.253.2.28)  245.624 ms  245.592 ms  245.506 ms
14  fourhundredge-0-0-0-0.4079.core1.eqch.net.internet2.edu (163.253.1.207)  244.932 ms  243.630 ms  243.625 ms
15  fourhundredge-0-0-0-0.4079.core1.clev.net.internet2.edu (163.253.1.210)  243.915 ms  245.479 ms  244.603 ms
16  fourhundredge-0-0-0-3.4079.core1.ashb.net.internet2.edu (163.253.1.122)  243.221 ms  243.229 ms  243.973 ms
17  et-0-1-8-1275.ashb-core.maxgigapop.net (206.196.177.2)  242.238 ms  242.232 ms  242.464 ms
18  206.196.178.141 (206.196.178.141)  242.405 ms  242.326 ms  242.292 ms
19  addr16212925394.testippl.jhmi.edu (162.129.253.94)  242.476 ms  242.346 ms addr16212925332.testippl.jhmi.edu (162.129.253.32)  242.269 ms
20  162.129.255.245 (162.129.255.245)  244.889 ms  244.807 ms  245.002 ms
21  * * *
22  * * *
23  * * *
24  * * *
25  collaborate.johnshopkins.edu (128.220.192.230)  248.772 ms *  248.293 ms
z5382484@vx05:~$
```

```
z5382484@vx05:~$ traceroute usp.br
traceroute to usp.br (200.144.248.41), 30 hops max, 60 byte packets
 1  cserouter1-server.orchestra.cse.unsw.EDU.AU (129.94.242.251)  0.042 ms  0.045 ms  0.070 ms
 2  129.94.39.17 (129.94.39.17)  0.896 ms  0.911 ms  0.901 ms
 3  172.17.31.154 (172.17.31.154)  1.814 ms  1.802 ms  1.768 ms
 4  172.17.17.9 (172.17.17.9)  1.112 ms 172.17.17.45 (172.17.17.45)  1.169 ms 172.17.17.9 (172.17.17.9)  1.068 ms
 5  172.17.17.110 (172.17.17.110)  1.195 ms 172.17.17.102 (172.17.17.102)  1.207 ms 172.17.17.110 (172.17.17.110)  1.261 ms
 6  138.44.5.0 (138.44.5.0)  1.380 ms  3.022 ms  3.031 ms
 7  et-1-1-0.pe1.mcqp.nsw.aarnet.net.au (113.197.15.4)  1.875 ms  1.913 ms  1.909 ms
 8  et-0_0_2.bdr1.guam.gum.aarnet.net.au (113.197.14.137)  71.870 ms  71.884 ms  71.901 ms
 9  138.44.228.5 (138.44.228.5)  186.015 ms  186.006 ms  185.971 ms
10  fourhundredge-0-0-0-19.4079.core2.losa.net.internet2.edu (163.253.1.47)  231.679 ms  231.646 ms fourhundredge-0-0-0-20.4079.core2.losa.net.interne
t2.edu (163.253.1.49)  230.994 ms
11  fourhundredge-0-0-0-0.4079.core2.elpa.net.internet2.edu (163.253.1.202)  232.795 ms  232.760 ms  232.057 ms
12  fourhundredge-0-0-0-22.4079.core1.elpa.net.internet2.edu (163.253.1.72)  232.011 ms fourhundredge-0-0-0-0.4079.core2.hous.net.internet2.edu (163.2
53.1.247)  232.660 ms  232.576 ms
13  fourhundredge-0-0-0-0.4079.core1.hous.net.internet2.edu (163.253.2.39)  232.613 ms fourhundredge-0-0-0-22.4079.core1.hous.net.internet2.edu (163.2
53.1.60)  230.170 ms fourhundredge-0-0-0-0.4079.core1.hous.net.internet2.edu (163.253.2.39)  230.283 ms
14  fourhundredge-0-0-0-0.4079.core1.houh.net.internet2.edu (163.253.2.24)  232.790 ms  233.244 ms  232.252 ms
15  fourhundredge-0-0-0-0.4079.core1.pens.net.internet2.edu (163.253.2.35)  232.364 ms  232.261 ms  233.170 ms
16  fourhundredge-0-0-0-0.4079.core1.jack.net.internet2.edu (163.253.1.0)  232.553 ms  231.889 ms  232.868 ms
17  64.57.28.62 (64.57.28.62)  236.884 ms  236.709 ms  236.698 ms
18  mia2-mia1.bkb.rnp.br (200.143.252.26)  237.219 ms  237.174 ms  238.185 ms
19  cce2-mia2-monet.bkb.rnp.br (170.79.213.46)  301.025 ms  300.951 ms  300.946 ms
20  sp2-cce2-tisparkle.bkb.rnp.br (170.79.213.3)  341.458 ms  341.411 ms  341.392 ms
21  as28571.saopaulo.sp.ix.br (187.16.220.3)  342.185 ms  342.132 ms  342.213 ms
22  e72361-sp2-r06-nx-swc.uspnet.usp.br (143.107.249.38)  342.705 ms  342.580 ms  342.532 ms
23  * * *
24  * * *
```

```
z5382484@vx05:~$ traceroute ed.ac.uk
traceroute to ed.ac.uk (129.215.235.216), 30 hops max, 60 byte packets
 1  cserouter1-server.orchestra.cse.unsw.EDU.AU (129.94.242.251)  0.041 ms  0.047 ms  0.035 ms
 2  129.94.39.17 (129.94.39.17)  0.853 ms  0.791 ms  0.808 ms
 3  172.17.31.154 (172.17.31.154)  1.523 ms  1.539 ms  1.554 ms
 4  172.17.17.9 (172.17.17.9)  1.123 ms 172.17.17.45 (172.17.17.45)  1.195 ms  1.163 ms
 5  172.17.17.102 (172.17.17.102)  1.201 ms  1.215 ms  1.234 ms
 6  138.44.5.0 (138.44.5.0)  1.378 ms  1.456 ms  1.404 ms
 7  et-1-1-0.pe1.mcqp.nsw.aarnet.net.au (113.197.15.4)  1.766 ms  1.952 ms  1.827 ms
 8  et-0-3-0.pe1.eskp.nsw.aarnet.net.au (113.197.15.3)  3.727 ms  2.932 ms  3.010 ms
 9  et-0-3-0.pe1.prka.sa.aarnet.net.au (113.197.15.42)  20.283 ms  20.199 ms  20.366 ms
10  et-0-3-0.pe1.knsg.wa.aarnet.net.au (113.197.15.45)  46.574 ms  46.645 ms  46.479 ms
11  et-1_0_5.bdr1.sing.sin.aarnet.net.au (113.197.15.231)  92.699 ms  92.713 ms  92.755 ms
12  138.44.226.7 (138.44.226.7)  256.705 ms  256.672 ms  256.722 ms
13  ae2.mx1.lon2.uk.geant.net (62.40.98.65)  256.770 ms  256.782 ms  256.997 ms
14  janet-bckp-gw.mx1.lon2.uk.geant.net (62.40.125.58)  257.880 ms  257.106 ms  257.122 ms
15  ae31.erdiss-sbr2.ja.net (146.97.33.22)  261.033 ms  261.117 ms  289.712 ms
16  ae29.manckh-sbr2.ja.net (146.97.33.42)  262.794 ms  263.888 ms  263.840 ms
17  ae31.glasss-sbr1.ja.net (146.97.33.54)  267.361 ms  267.207 ms  267.130 ms
18  ae29.edinat-rbr2.ja.net (146.97.38.38)  267.922 ms  267.948 ms  267.902 ms
19  ae25.edinkb-rbr2.ja.net (146.97.74.34)  268.341 ms  268.302 ms  268.285 ms
20  university-of-edinburgh.ja.net (146.97.156.78)  268.893 ms  268.839 ms  268.944 ms
21  remote.net.ed.ac.uk (192.41.103.209)  268.361 ms  268.247 ms  268.282 ms
22  * * *
23  * * *
```

3.

1. The two selected IP addresses are:

www.net.princeton.edu：128.112.128.55

www.as13030.net：213.144.137.198

```
z5382484@vx17:~$ traceroute www.net.princeton.edu
traceroute to www.net.princeton.edu (128.112.128.55), 30 hops max, 60 byte packets
 1  cserouter1-server.orchestra.cse.unsw.EDU.AU (129.94.242.251)  0.050 ms  0.046 ms  0.053 ms
 2  129.94.39.17 (129.94.39.17)  0.868 ms  0.882 ms  0.883 ms
 3  172.17.31.154 (172.17.31.154)  1.716 ms  1.723 ms  1.727 ms
 4  172.17.17.45 (172.17.17.45)  1.230 ms 172.17.17.9 (172.17.17.9)  1.117 ms 172.17.17.45 (172.17.17.45)  1.188 ms
 5  172.17.17.110 (172.17.17.110)  1.155 ms 172.17.17.102 (172.17.17.102)  1.248 ms 172.17.17.110 (172.17.17.110)  1.199 m
s
 6  138.44.5.0 (138.44.5.0)  2.730 ms  1.982 ms  2.031 ms
 7  et-1-1-0.pe1.mcqp.nsw.aarnet.net.au (113.197.15.4)  1.841 ms  1.706 ms  1.753 ms
 8  et-0_0_2.bdr1.guam.gum.aarnet.net.au (113.197.14.137)  71.452 ms  71.429 ms  71.448 ms
 9  138.44.228.5 (138.44.228.5)  186.849 ms  186.866 ms  186.898 ms
10  fourhundredge-0-0-0-2.4079.core2.salt.net.internet2.edu (163.253.1.115)  247.539 ms  246.844 ms  247.140 ms
11  fourhundredge-0-0-0-22.4079.core1.salt.net.internet2.edu (163.253.1.30)  249.197 ms fourhundredge-0-0-0-21.4079.core1.
salt.net.internet2.edu (163.253.1.28)  248.374 ms fourhundredge-0-0-0-0.4079.core2.denv.net.internet2.edu (163.253.1.168)
 246.871 ms
12  fourhundredge-0-0-0-0.4079.core1.denv.net.internet2.edu (163.253.1.170)  247.472 ms fourhundredge-0-0-0-0.4079.core2.k
ans.net.internet2.edu (163.253.1.251)  246.743 ms fourhundredge-0-0-0-0.4079.core1.denv.net.internet2.edu (163.253.1.170)
 247.431 ms
13  fourhundredge-0-0-0-0.4079.core1.kans.net.internet2.edu (163.253.1.243)  246.974 ms  248.002 ms fourhundredge-0-0-0-0.
4079.core1.chic.net.internet2.edu (163.253.2.28)  247.855 ms
14  fourhundredge-0-0-0-3.4079.core2.chic.net.internet2.edu (163.253.1.244)  248.844 ms  247.425 ms fourhundredge-0-0-0-22
.4079.core2.chic.net.internet2.edu (163.253.1.97)  247.342 ms
15  fourhundredge-0-0-0-3.4079.core2.eqch.net.internet2.edu (163.253.2.19)  249.459 ms  249.565 ms  249.479 ms
16  fourhundredge-0-0-0-0.4079.core2.clev.net.internet2.edu (163.253.2.16)  248.022 ms  249.366 ms  249.285 ms
17  fourhundredge-0-0-0-3.4079.core2.ashb.net.internet2.edu (163.253.1.138)  248.383 ms  248.053 ms  247.970 ms
18  fourhundredge-0-0-0-1.4079.core1.phil.net.internet2.edu (163.253.1.137)  247.244 ms  247.336 ms  247.692 ms
19  163.253.5.9 (163.253.5.9)  248.109 ms  248.030 ms  248.000 ms
20  172.96.130.54 (172.96.130.54)  257.154 ms  257.113 ms  257.136 ms
21  fw-border-87-router.princeton.edu (204.153.48.2)  247.650 ms  247.772 ms  247.785 ms
22  rtr-core-east-router.princeton.edu (128.112.12.9)  247.959 ms  248.136 ms  248.054 ms
23  core-ns-router.princeton.edu (128.112.12.226)  248.517 ms  248.546 ms  248.641 ms
24  www.net.princeton.edu (128.112.128.55)  248.260 ms  248.229 ms  248.200 ms
z5382484@vx17:~$
```

tracing path from www.net.princeton.edu to 129.94.242.2 ...

```
traceroute to 129.94.242.2 (129.94.242.2), 30 hops max, 40 byte packets
 1  core-ns-router (128.112.128.2)  1.164 ms  1.175 ms  0.908 ms
 2  rtr-core-east-router.princeton.edu (128.112.12.225)  0.863 ms  0.685 ms  0.546 ms
 3  fw-border-87-router.princeton.edu (128.112.12.10)  0.997 ms  1.027 ms  1.005 ms
 4  rtr-border-87-router.princeton.edu (204.153.48.1)  1.527 ms  1.461 ms  1.819 ms
 5  172-96-130.unassigned.userdns.com (172.96.130.53)  5.666 ms  4.902 ms  4.084 ms
 6  bundle-ether1.102.core1.phil.net.internet2.edu (163.253.5.8)  4.550 ms  5.962 ms  3.946 ms
 7  fourhundredge-0-0-0-2.4079.core2.ashb.net.internet2.edu (163.253.1.136)  65.687 ms  66.851 ms  67.156 ms
 8  fourhundredge-0-0-0-1.4079.core2.clev.net.internet2.edu (163.253.1.139)  66.013 ms fourhundredge-0-0-0-16.4079.core1.ashb.net.internet2.edu (163.253.1.2)  66.848 ms  66.706 ms
 9  fourhundredge-0-0-0-1.4079.core1.clev.net.internet2.edu (163.253.1.123)  65.488 ms  66.699 ms  66.962 ms
10  fourhundredge-0-0-0-2.4079.core1.eqch.net.internet2.edu (163.253.1.211)  67.804 ms  67.235 ms  66.851 ms
11  fourhundredge-0-0-0-1.4079.core1.chic.net.internet2.edu (163.253.1.206)  68.353 ms  66.338 ms  67.112 ms
12  fourhundredge-0-0-0-1.4079.core2.kans.net.internet2.edu (163.253.2.29)  67.022 ms  66.776 ms  67.454 ms
13  fourhundredge-0-0-0-1.4079.core2.denv.net.internet2.edu (163.253.1.250)  67.645 ms  67.208 ms  67.058 ms
14  fourhundredge-0-0-0-3.4079.core2.salt.net.internet2.edu (163.253.1.169)  65.379 ms  66.368 ms  66.727 ms
15  fourhundredge-0-0-0-8.4079.core1.losa.net.internet2.edu (163.253.1.114)  67.681 ms  67.240 ms  68.127 ms
16  et-1_1_2_897.bdr1.guam.gum.aarnet.net.au (138.44.228.4)  177.244 ms  177.225 ms  177.203 ms
17  et-5-1-0.pe1.brwy.nsw.aarnet.net.au (113.197.15.5)  248.203 ms  247.494 ms et-3-1-0.pe1.brwy.nsw.aarnet.net.au (113.197.15.146)  247.249 ms
18  138.44.5.1 (138.44.5.1)  252.702 ms  247.196 ms  247.401 ms
19  * * *
20  * * *
21  * * *
22  129.94.39.23 (129.94.39.23)  248.305 ms  248.175 ms  248.068 ms
23  * * *
24  * * *
25  * * *
26  * * *
27  * * *
28  * * *
29  * * *
30  * * *
```

Done.

```
z5382484@vx17: $ traceroute as13030.net
traceroute to as13030.net (213.144.137.198), 30 hops max, 60 byte packets
 1  cserouter1-server.orchestra.cse.unsw.EDU.AU (129.94.242.251)  0.061 ms  0.047 ms  0.047 ms
 2  129.94.39.17 (129.94.39.17)  0.828 ms  0.874 ms  0.871 ms
 3  172.17.31.154 (172.17.31.154)  1.694 ms  2.522 ms  2.235 ms
 4  172.17.17.45 (172.17.17.45)  1.147 ms 172.17.17.9 (172.17.17.9)  1.275 ms  1.281 ms
 5  172.17.17.102 (172.17.17.102)  22.823 ms 172.17.17.110 (172.17.17.110)  22.850 ms 172.17.17.102 (172.17.17.102)  22.851 ms
 6  138.44.5.0 (138.44.5.0)  2.888 ms  2.396 ms  2.344 ms
 7  et-0-3-0.pe1.bkvl.nsw.aarnet.net.au (113.197.15.147)  2.053 ms  1.896 ms  1.881 ms
 8  xe-0-2-5.bdr1.b.sea.aarnet.net.au (202.158.194.121)  140.727 ms  140.959 ms  140.850 ms
 9  xe-4-1-1.mpr1.sea1.us.above.net (64.125.193.129)  140.849 ms  140.734 ms  140.659 ms
10  ae27.cs1.sea1.us.eth.zayo.com (64.125.29.0)  263.150 ms  263.035 ms  263.049 ms
11  * * *
12  ae3.cs1.lga5.us.eth.zayo.com (64.125.29.208)  264.412 ms  263.047 ms  263.010 ms
13  * * *
14  ae4.mpr1.lhr15.uk.zip.zayo.com (64.125.28.195)  262.954 ms  262.959 ms  262.887 ms
15  linx-1.init7.net (195.66.224.175)  263.833 ms  263.532 ms  263.805 ms
16  r2lon2.core.init7.net (5.180.135.248)  264.847 ms  264.461 ms  264.043 ms
17  r2fra3.core.init7.net (5.180.135.129)  274.941 ms  275.389 ms  275.013 ms
18  r1fra3.core.init7.net (80.81.192.67)  274.902 ms  274.447 ms  274.853 ms
19  r2zrh2.core.init7.net (5.180.135.172)  280.077 ms  280.113 ms  280.367 ms
20  r2zrh5.core.init7.net (5.180.135.233)  280.414 ms  280.309 ms  280.367 ms
21  r1glb3.core.init7.net (5.180.135.68)  280.594 ms  280.580 ms  280.897 ms
22  r1zrh10.core.init7.net (5.180.135.58)  280.903 ms  280.689 ms  280.701 ms
23  r1win9.core.init7.net (5.180.135.57)  280.655 ms  280.615 ms  280.614 ms
24  r1win7.core.init7.net (5.180.135.24)  281.033 ms  281.110 ms  281.133 ms
25  r1win1.core.init7.net (5.180.134.123)  281.308 ms  280.875 ms  280.911 ms
26  r2win7.core.init7.net (5.180.134.124)  280.912 ms  281.302 ms  281.337 ms
27  * * *
28  * * *
29  * * *
30  * * *
```

Traceroute Ausgabe

```
traceroute to 129.94.242.2 (129.94.242.2), 30 hops max, 60 byte packets
 1  r2win7.core.init7.net (213.144.137.193) [AS13030]  1.008 ms  1.146 ms  1.444 ms
 2  r1win1.core.init7.net (5.180.134.125) [AS13030]  1.022 ms  1.273 ms  1.596 ms
 3  r1win7.core.init7.net (5.180.134.122) [AS13030]  1.146 ms  1.536 ms  1.864 ms
 4  r1win9.core.init7.net (5.180.135.25) [AS13030]  0.927 ms  1.165 ms  1.492 ms
 5  r1zrh10.core.init7.net (5.180.135.56) [AS13030]  1.394 ms  1.716 ms  2.019 ms
 6  r1glb3.core.init7.net (5.180.135.59) [AS13030]  1.299 ms  1.156 ms  1.364 ms
 7  r2zrh5.core.init7.net (5.180.135.69) [AS13030]  1.462 ms  1.544 ms  1.710 ms
 8  r2zrh2.core.init7.net (5.180.135.232) [AS13030]  1.513 ms  1.674 ms  2.012 ms
 9  r1fra3.core.init7.net (5.180.135.173) [AS13030]  7.034 ms  7.300 ms  7.722 ms
10  xe-1-2-0.mpr1.fra4.de.above.net (80.81.194.26) [*]  6.529 ms  6.499 ms  6.484 ms
11  * ae12.cs1.fra6.de.eth.zayo.com (64.125.26.172) [*]  140.759 ms  140.029 ms
12  * * ae2.cs1.ams17.nl.eth.zayo.com (64.125.29.59) [*]  139.903 ms
13  * * *
14  * * *
15  * * *
16  * * *
17  * * *
18  * * *

19  ae27.mpr1.sea1.us.zip.zayo.com (64.125.29.1) [*]  139.966 ms  140.003 ms  139.982 ms
20  64.125.193.130.i223.above.net (64.125.193.130) [*]  140.027 ms  140.014 ms  139.999 ms
21  et-10-0-5.170.pe1.brwy.nsw.aarnet.net.au (113.197.15.62) [AS7575]  279.606 ms  279.614 ms  279.602 ms
22  138.44.5.1 (138.44.5.1) [AS7575]  279.665 ms  279.665 ms  279.646 ms
23  * * *
24  * * *
25  * * *
26  129.94.39.23 (129.94.39.23) [AS23859]  280.562 ms  280.535 ms  280.623 ms
27  * * *
28  * * *
29  * * *
30  * * *
```

2.From the above figure, we can see that the reverse path and the forward path pass through different routers. This is because a router may choose a path based on a specific routing policy, such as router configuration, network protocol, or routing information in a routing table. Therefore, different routers may be selected for the forward path and reverse path at different times or situations.

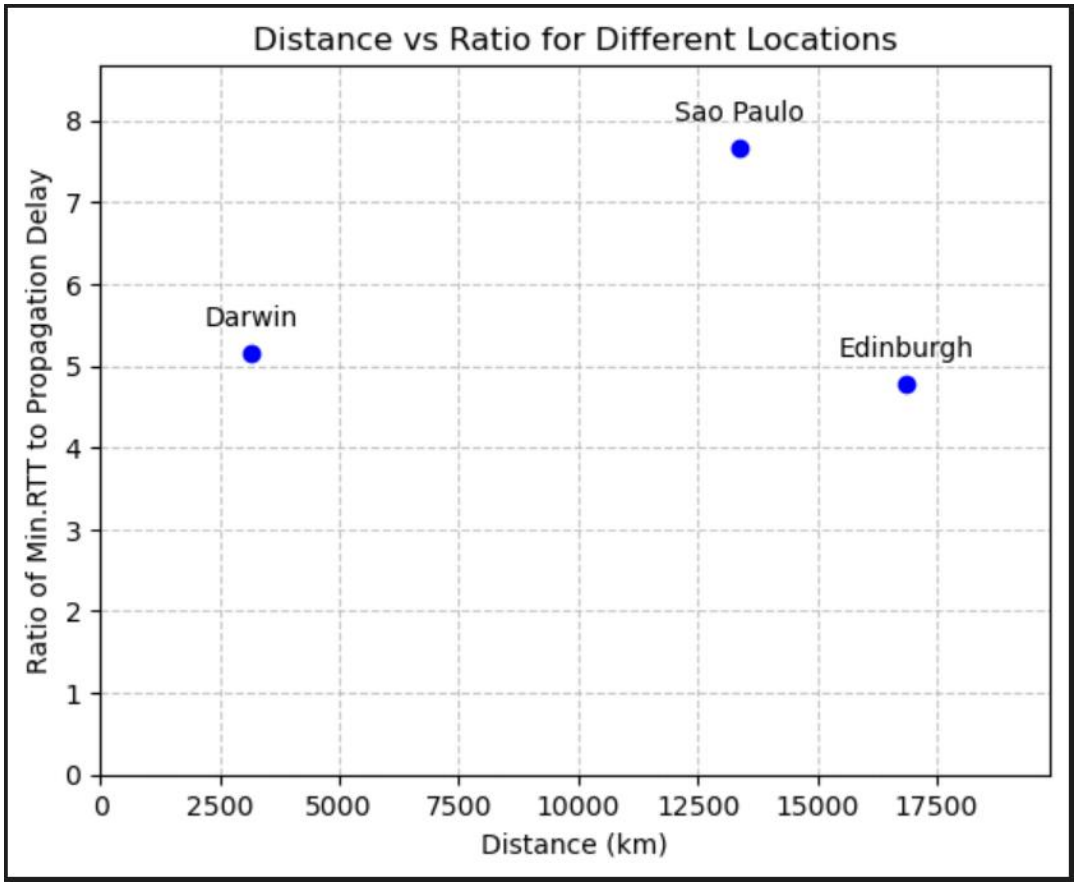
3.I did not observe the same IP address appearing in the forward and reverse paths from my

machine to these two websites. This is likely because the same website can have multiple IP addresses, in order to share traffic and improve performance. Routers also usually randomly select IP addresses during the transmission of data packets to avoid network traffic load.

Exercise 4:

1. The physical distance between UNSW University and the three locations is as follows:
Darwin:3151km, Sao Paulo:13370km , Edinburgh:16869km.
The shortest known possible time is the distance divided by the speed of light. Therefore, the shortest possible time T for UNSW data packets to reach these three locations is as follows:
Darwin:10.5ms, Sao Paulo:44.57ms , Edinburgh:56.23 ms.

2. From the *avg.txt file, we can know that the minimum RTT (select the value of the 50-byte data packet) of these three locations are,
Darwin:54.077ms, Sao Paulo:341.952ms , Edinburgh:268.561 ms.
and the calculated ratios are:
Darwin:5.15, Sao Paulo:7.67 , Edinburgh:4.78.
Draw the image as follows:

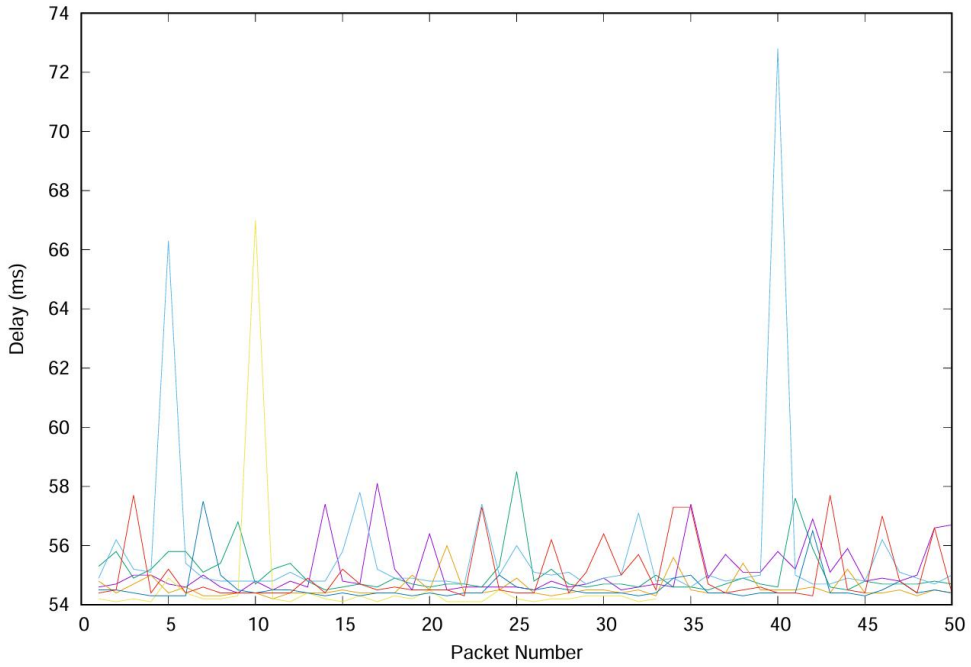


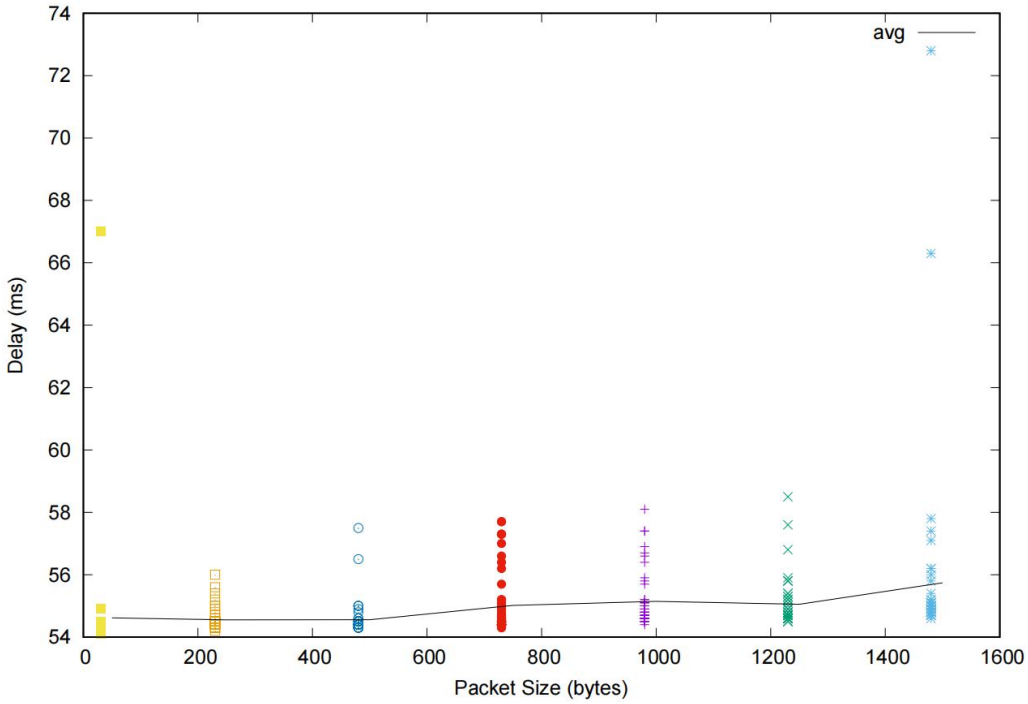
3. The reasons are as follows:
1. Light propagates in a straight line, but the transmission path of data packets is not a "straight line". It usually needs to pass through many routers and network nodes, which will increase the transmission delay and reduce the transmission speed.
2. There are various delays in the transmission process of data packets, including propagation

delay, transmission delay, processing delay and queuing delay. When encountering a sudden increase in network traffic, the router may face congestion, causing data packets to be queued for processing. This also increases latency.

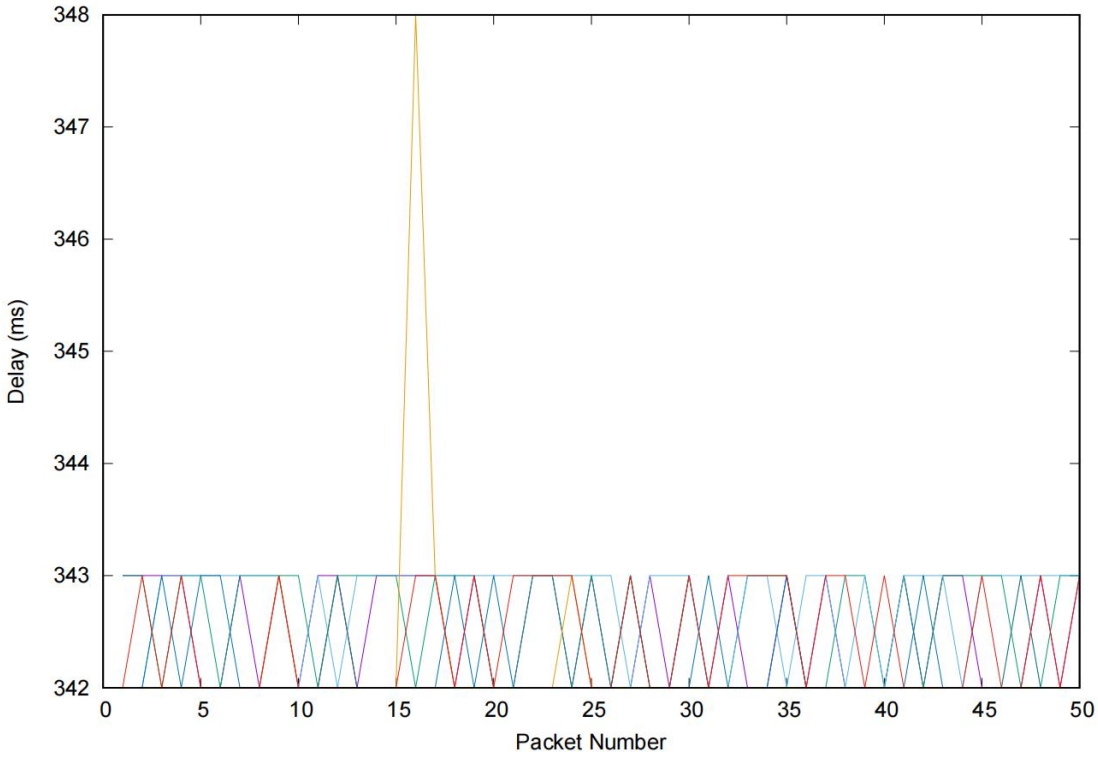
4. The delay time of a router to reach the destination usually changes with time, rather than being fixed. The router may encounter various situations in the process of transmitting data, such as network congestion. When network traffic increases, the router may face congestion, causing data packets to be queued for processing, which will increase the delay time. There are also network failures and other situations that may result in packet loss.

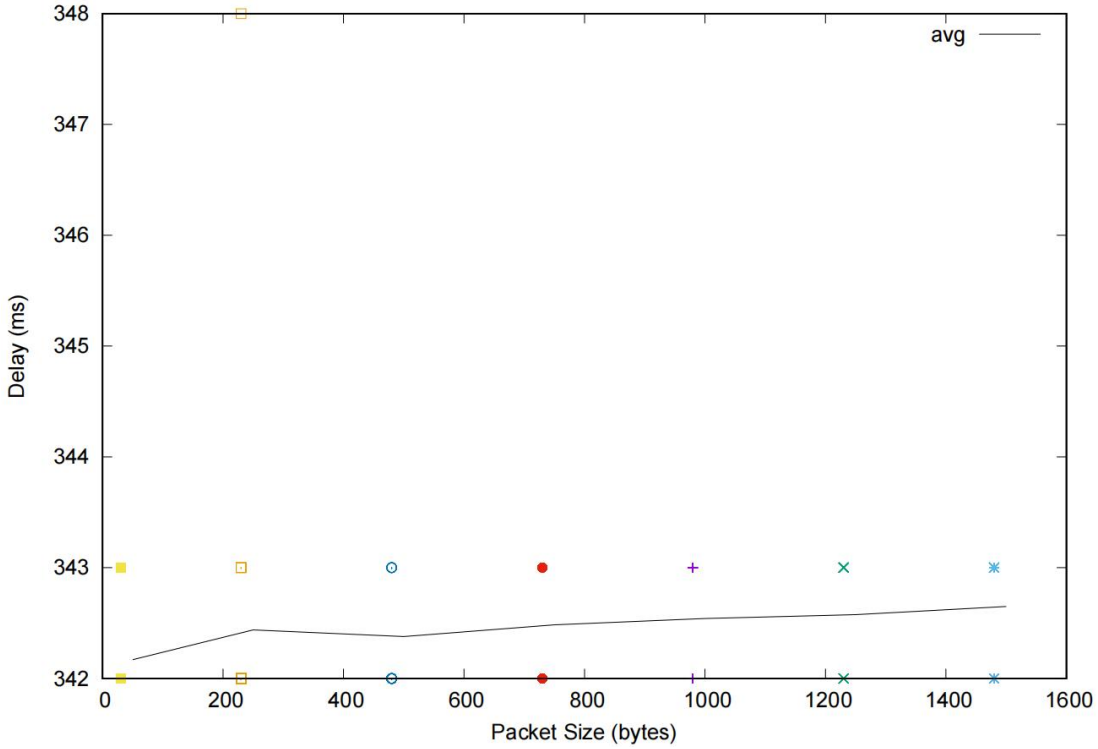
5. The delay effects of the three paths are as follows:
cdu.edu.au：



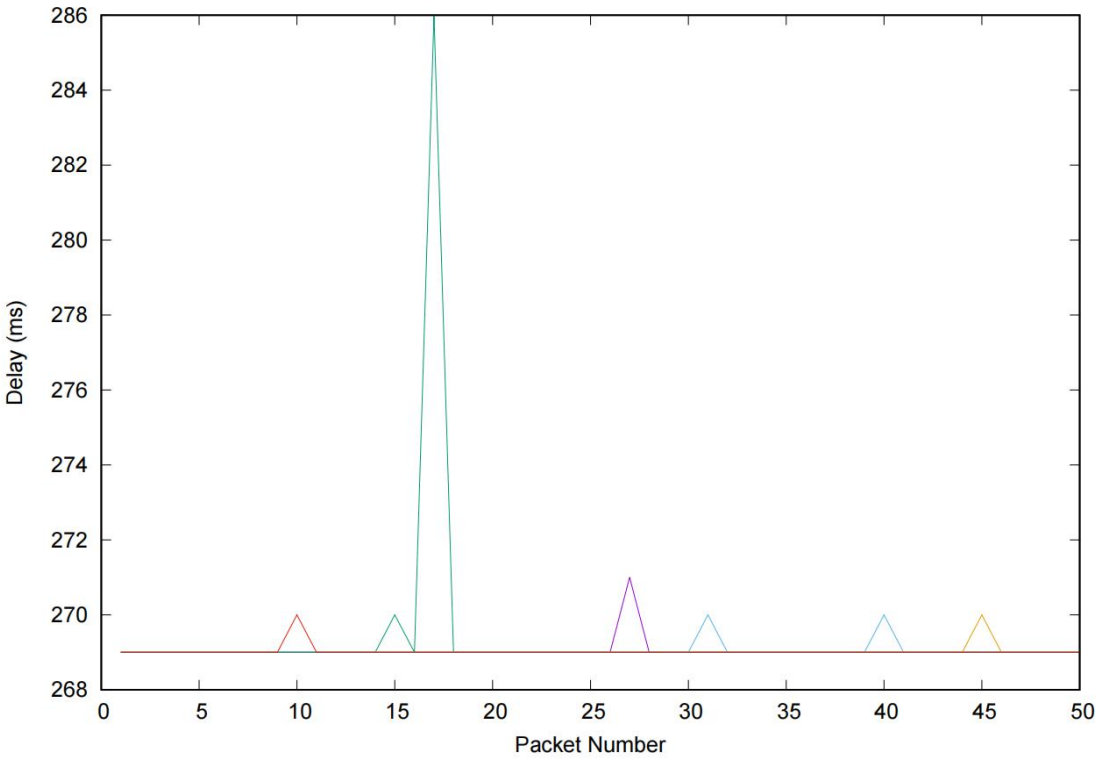

avg
Delay (ms)
Packet Size (bytes)
74
72
70
68
66
64
62
60
58
56
54
0
200
400
600
800
1000
1200
1400
1600

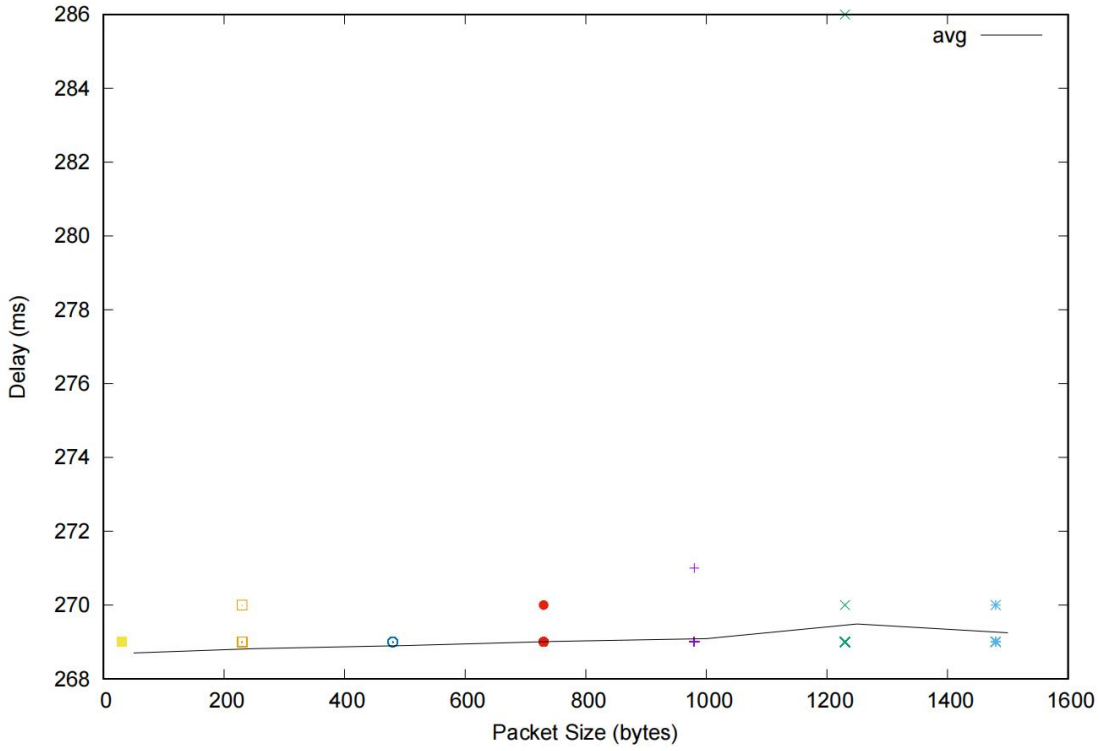
usp.br：


Delay (ms)
Packet Number
348
347
346
345
344
343
342
0
5
10
15
20
25
30
35
40
45
50


avg
Delay (ms)
Packet Size (bytes)
348
347
346
345
344
343
342
0
200
400
600
800
1000
1200
1400
1600

ed.ac.uk：


Delay (ms)
Packet Number
286
284
282
280
278
276
274
272
270
268
0
5
10
15
20
25
30
35
40
45
50



Among the measured delays, propagation delay and transmission delay are independent of packet size, while processing delay and queuing delay are dependent on packet size.

Propagation delay: This delay is equal to the ratio of the physical link length d and the propagation speed s, that is $d_{Prop=}$ d/s. Therefore, the propagation delay depends on the length of the physical link and the propagation speed.

Transmission delay: This delay is equal to the ratio of the length L of the data packet and the link bandwidth R, that is, d_{trans}=L/R, regardless of the size of the data packet.

Processing latency: Processing latency is the time it takes for a router or device to process a packet. Processing latency may be affected by packet size, as larger packets may require more processing work.

Queuing delay: This delay is caused by waiting for transmission on the output link. This depends on how congested the router is, as large packets may take up more buffer space, resulting in longer queuing delays.