Exercise 1：

```
z5325156@vx08:~/COMP3331/Labs/lab01$ nslookup www.koala.com.au
Server:         129.94.242.2
Address:        129.94.242.2#53

Non-authoritative answer:
Name:   www.koala.com.au
Address: 172.67.219.46
Name:   www.koala.com.au
Address: 104.21.45.210
Name:   www.koala.com.au
Address: 2606:4700:3031::6815:2dd2
Name:   www.koala.com.au
Address: 2606:4700:3032::ac43:db2e
```

1. the IP address of the website www.koala.com.au is 129.94.242.2.

The remaining IP is a non-authoritative answer, indicating that it was read directly from the local DNS cache, not the name server that is actually responsible for the domain name that asks for it. This is because the more commonly used domains are cached for quick resolution.

2. 127.0.0.1 is the Loopback Address. is used for network software testing and communication between local processes

Exercise 2：

The next two hosts are not accessible and cannot be accessed from a browser, probably because the name of the target is not registered in DNS at all

```
z5325156@vx08:~/COMP3331$ ping www.getfittest.com.au
 ping: socket: Address family not supported by protocol
 ping: www.getfittest.com.au: Name or service not known
```

```
z5325156@vx08:~/COMP3331$ ping www.hola.hp
 ping: socket: Address family not supported by protocol
 ping: www.hola.hp: Name or service not known
```

This host is not accessible by ping, but it is accessible from the browser. The reason may be because the packet I sent did not reach its destination, or the

host I trying to access is not connected or offline for some reason.

```
z5325156@vx08:~/COMP3331$ ping www.kremlin.ru
ping: socket: Address family not supported by protocol
PING www.kremlin.ru (95.173.136.70) 56(84) bytes of data.
^C
--- www.kremlin.ru ping statistics ---
8 packets transmitted, 0 received, 100% packet loss, time 7147ms
```

Exercise 3：

1.

```
z5325156@vx08:~/COMP3331$ traceroute www.columbia.edu
traceroute to www.columbia.edu (128.59.105.24), 30 hops max, 60 byte packets
 1  cserouter1-server.orchestra.cse.unsw.EDU.AU (129.94.242.251)  0.048 ms  0.057 ms  0.048 ms
 2  129.94.39.17 (129.94.39.17)  0.922 ms  0.849 ms  0.878 ms
 3  172.17.31.154 (172.17.31.154)  1.590 ms  2.144 ms  1.535 ms
 4  po-3-1902.ombcr1.gw.unsw.edu.au (129.94.24.20)  1.165 ms  1.289 ms  1.190 ms
 5  unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  1.172 ms  1.142 ms  1.188 ms
 6  138.44.5.0 (138.44.5.0)  1.603 ms  1.314 ms  1.330 ms
 7  et-1-1-0.pe1.mcqp.nsw.aarnet.net.au (113.197.15.4)  1.677 ms  1.664 ms  1.751 ms
 8  et-0_0_2.bdr1.guam.gum.aarnet.net.au (113.197.14.137)  73.640 ms  73.303 ms  73.315 ms
 9  138.44.228.5 (138.44.228.5)  186.102 ms  186.140 ms  186.101 ms
10  fourhundredge-0-0-0-2.4079.core2.salt.net.internet2.edu (163.253.1.115)  236.323 ms  236.096 ms  236.082 ms
11  fourhundredge-0-0-0.4079.core2.denv.net.internet2.edu (163.253.1.168)  238.301 ms fourhundredge-0-0-0-22.4079.core1.salt.net.internet2.ed
u (163.253.1.30)  236.833 ms fourhundredge-0-0-0-23.4079.core1.salt.net.internet2.edu (163.253.1.32)  236.830 ms
12  fourhundredge-0-0-0-0.4079.core1.denv.net.internet2.edu (163.253.1.170)  235.572 ms  237.520 ms  237.207 ms
13  fourhundredge-0-0-0.4079.core1.kans.net.internet2.edu (163.253.1.243)  238.328 ms  237.609 ms  237.577 ms
14  fourhundredge-0-0-0-3.4079.core2.chic.net.internet2.edu (163.253.1.244)  237.538 ms fourhundredge-0-0-0-22.4079.core2.chic.net.internet2.ed
u (163.253.1.97)  237.682 ms fourhundredge-0-0-0-3.4079.core2.chic.net.internet2.edu (163.253.1.244)  237.625 ms
15  fourhundredge-0-0-0-3.4079.core2.eqch.net.internet2.edu (163.253.2.19)  235.886 ms  236.584 ms  236.587 ms
16  fourhundredge-0-0-0.4079.core2.clev.net.internet2.edu (163.253.2.16)  238.297 ms  238.225 ms  237.529 ms
17  buf-9208-I2-CLEV.nysernet.net (199.109.11.33)  238.368 ms  238.294 ms  238.295 ms
18  syr-55a1-buf-9208.nysernet.net (199.109.7.213)  241.881 ms  241.751 ms  241.748 ms
19  nyc32-55a1-syr-55a1.nysernet.net (199.109.7.206)  247.047 ms  247.081 ms  247.040 ms
20  nyc32-9208-nyc32-55a1.nysernet.net (199.109.7.201)  246.838 ms  246.781 ms  246.739 ms
21  columbia.nyc-9208.nysernet.net (199.109.4.14)  290.552 ms  288.863 ms  288.840 ms
22  cc-core-1-x-nyser32-gw-1.net.columbia.edu (128.59.255.5)  247.048 ms  247.063 ms  246.974 ms
23  cc-conc-1-x-cc-core-1.net.columbia.edu (128.59.255.21)  247.075 ms  265.887 ms  265.826 ms
24  www.neurotheory.columbia.edu (128.59.105.24)  247.067 ms  246.964 ms  247.016 ms
z5325156@vx08:~/COMP3331$
```

There are 22 routers are there between UNSW workstation
and www.columbia.edu.

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

Packets cross the Pacific Ocean between the 9th and 10th routers

```
z5325156@vx08:~/COMP3331$ traceroute -n www.ucla.edu
traceroute to www.ucla.edu (13.224.2.43), 30 hops max, 60 byte packets
 1  129.94.242.251  0.041 ms  0.057 ms  0.050 ms
 2  129.94.39.17  0.848 ms  0.866 ms  0.859 ms
 3  * * *
 4  129.94.24.20  1.260 ms  1.200 ms  1.271 ms
 5  149.171.255.105  1.148 ms  1.092 ms  1.134 ms
 6  138.44.5.0  1.301 ms  1.330 ms  1.360 ms
 7  113.197.15.147  1.670 ms  1.692 ms  1.752 ms
 8  202.158.194.121  143.439 ms  144.203 ms  144.188 ms
 9  64.125.193.129  143.458 ms  143.454 ms  143.424 ms
10  64.125.29.0  154.036 ms  154.003 ms  153.943 ms
11  64.125.29.103  143.393 ms  143.471 ms  143.672 ms
12  99.82.182.102  143.894 ms  143.813 ms  143.782 ms
13  150.222.136.67  144.415 ms 150.222.136.59  144.613 ms 150.222.136.67  144.131 ms
14  52.95.54.238  143.648 ms 52.95.53.147  144.117 ms 52.95.53.5  143.491 ms
15  205.251.225.231  144.760 ms 205.251.225.255  149.328 ms 205.251.225.231  144.772 ms
16  52.95.55.101  152.505 ms 52.95.54.26  147.482 ms 52.95.54.167  144.948 ms
17  205.251.225.95  143.587 ms 205.251.225.91  143.572 ms 205.251.225.95  143.538 ms
18  * * *
19  * * *
20  * * *
21  * * *
22  * * *
23  13.224.2.43  143.429 ms  143.482 ms  143.375 ms
```

2.

```
z5325156@vx08:~/COMP3331$ traceroute -n www.u-tokyo.ac.jp
traceroute to www.u-tokyo.ac.jp (210.152.243.234), 30 hops max, 60 byte packets
 1  129.94.242.251  0.049 ms  0.055 ms  0.046 ms
 2  129.94.39.17  0.886 ms  0.879 ms  0.847 ms
 3  172.17.31.154  1.918 ms  1.697 ms  1.664 ms
 4  129.94.24.20  1.297 ms  1.201 ms  1.218 ms
 5  149.171.255.105  26.441 ms  26.484 ms  26.504 ms
 6  138.44.5.0  1.723 ms  1.713 ms  1.763 ms
 7  113.197.15.147  1.868 ms  2.166 ms  2.267 ms
 8  202.158.194.177  154.990 ms  154.968 ms  154.971 ms
 9  198.32.176.24  156.572 ms  156.915 ms  156.927 ms
10  58.138.88.189  266.667 ms 58.138.88.185  265.671 ms 58.138.88.189  266.620 ms
11  58.138.81.66  266.862 ms 58.138.106.166  266.428 ms 58.138.81.78  266.034 ms
12  210.138.106.238  301.353 ms 210.130.135.130  266.691 ms  265.769 ms
13  124.83.228.58  266.847 ms  265.859 ms  265.951 ms
14  124.83.252.178  271.966 ms  272.154 ms  271.871 ms
15  158.205.134.26  272.721 ms 158.205.134.22  273.039 ms  272.971 ms
16  * * *
17  * * *
```

```
z5325156@vx08:~/COMP3331$ traceroute -n www.lancaster.ac.uk
traceroute to www.lancaster.ac.uk (148.88.65.80), 30 hops max, 60 byte packets
 1  129.94.242.251  0.051 ms  0.047 ms  0.040 ms
 2  129.94.39.17  0.874 ms  0.819 ms  0.876 ms
 3  172.17.31.154  2.053 ms  1.436 ms  1.979 ms
 4  129.94.24.20  1.354 ms  1.410 ms  1.290 ms
 5  149.171.255.105  1.112 ms  1.146 ms  1.104 ms
 6  138.44.5.0  1.352 ms  1.304 ms  1.311 ms
 7  113.197.15.233  92.636 ms  92.646 ms  92.623 ms
 8  138.44.226.7  255.908 ms  256.037 ms  256.052 ms
 9  62.40.124.198  256.248 ms  256.110 ms  256.107 ms
10  146.97.33.2  256.423 ms  256.365 ms  256.339 ms
11  146.97.33.22  260.275 ms  260.218 ms  260.186 ms
12  146.97.33.42  264.332 ms  262.098 ms  262.007 ms
13  146.97.35.50  262.062 ms  262.216 ms  262.070 ms
14  146.97.40.178  282.076 ms  281.927 ms  281.839 ms
15  * * *
16  * * *
```

The paths to these three destinations fork on router 138.44.5.0, The Asia Pacific Network Information Centre (APNIC).

physical distance(miles)/number of jumps

www.ucla.edu: 10392/22=472

www.u-tokyo.ac.jp: 5120/14=365

www.lancaster.ac.uk: 10519/13=809

The number of jumps on each path is not proportional to the physical distance.

3.

```
z5325156@vx08:~/COMP3331$ traceroute -n www.speedtest.com.sg
traceroute to www.speedtest.com.sg (202.150.221.170), 30 hops max, 60 byte packets
 1  129.94.242.251  0.060 ms  0.067 ms  0.085 ms
 2  129.94.39.17  0.881 ms  0.909 ms  0.960 ms
 3  172.17.31.154  2.107 ms  1.779 ms  2.067 ms
 4  129.94.24.20  1.344 ms  1.363 ms  1.686 ms
 5  149.171.255.105  1.364 ms  1.408 ms  1.374 ms
 6  138.44.5.0  1.545 ms  1.529 ms  1.548 ms
 7  113.197.15.153  1.933 ms  2.598 ms  2.687 ms
 8  202.158.194.173  147.638 ms  147.616 ms  147.629 ms
 9  206.72.210.63  147.737 ms  147.759 ms  147.705 ms
10  203.208.151.181  319.891 ms 203.208.178.185  328.334 ms 203.208.171.117  148.519 ms
11  203.208.151.233  236.275 ms 203.208.177.110  343.353 ms 203.208.182.125  251.070 ms
12  * 203.208.182.121  340.209 ms 203.208.178.205  338.659 ms
13  202.150.221.170  209.160 ms 203.208.177.110  331.538 ms 202.150.221.170  209.121 ms
z5325156@vx08:~/COMP3331$
```

Traceroute Result:

```
traceroute to 129.94.242.251 (129.94.242.251), 30 hops max, 60 byte packets
 1  202.150.221.169 (202.150.221.169)  0.218 ms  0.254 ms  0.267 ms
 2  10.11.34.146 (10.11.34.146)  0.354 ms  0.431 ms  0.490 ms
 3  aarnet.sgix.sg (103.16.102.67)  200.395 ms  200.410 ms  200.422 ms
 4  et-7-3-0.pe1.nsw.brwy.aarnet.net.au (113.197.15.232)  208.105 ms  208.135 ms  208.113 ms
 5  138.44.5.1 (138.44.5.1)  208.426 ms  208.532 ms  208.541 ms
 6  libcr1-te-1-5.gw.unsw.edu.au (149.171.255.102)  208.498 ms  208.492 ms  208.463 ms
 7  * irb-51901.kecd1-176q4-cbl-e1.gw.unsw.edu.au (129.94.24.10)  209.593 ms  209.559 ms
 8  * * *
 9  * * *
10  * * *
11  * * *
12  * * *
13  * * *
14  * * *
15  * * *
16  * * *
17  * * *
18  * * *
19  * * *
20  * * *
21  * * *
22  * * *
23  * * *
24  * * *
25  * * *
26  * * *
27  * * *
28  * * *
29  * * *
30  * * *
```

Traceroute Completed.

I chose the servers 202.150.221.170 and 129.94.242.251.

I did not observe exactly the same two IP addresses, but there are many IP's that have the same network address for the first three segments. Only the last part that has a different address. The reason for this may be because the addresses are dynamically assigned, which is for load balancing. Or the server has multiple outlets for automatic routing.

Exercise 4：

1.

Brisbane:

shortest possible time T = 740km / light per second = 0.002468
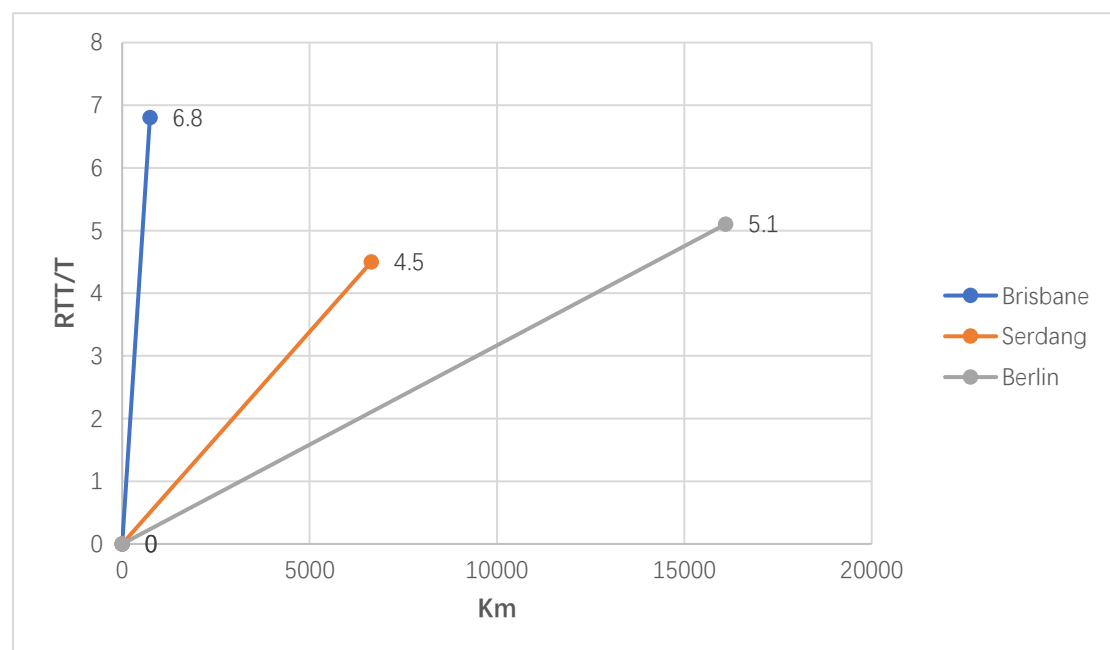
ratio between RTT and T = 0.016903 / 0.002468 = 6.8

Serdang:

shortest possible time T = 6650km / light per second = 0.022182

ratio between RTT and T = 0.022182 / 0.100042 = 4.5

Berlin:

shortest possible time T = 16100km / light per second = 0.053704

ratio between RTT and T = 0.053704 / 0.053704 = 5.1

2.

The delay in reaching the destination is time-varying, as there are times when longer queuing delays are encountered. as can be seen in destination_delay.pdf, the lines are not smooth, but occasionally packages encounter longer delays.

3.

Propagation delay, processing delay and queuing delay do not depend on packet size

Only transmission latency depends on packet size. It is a combination of packet size and link transmission rate
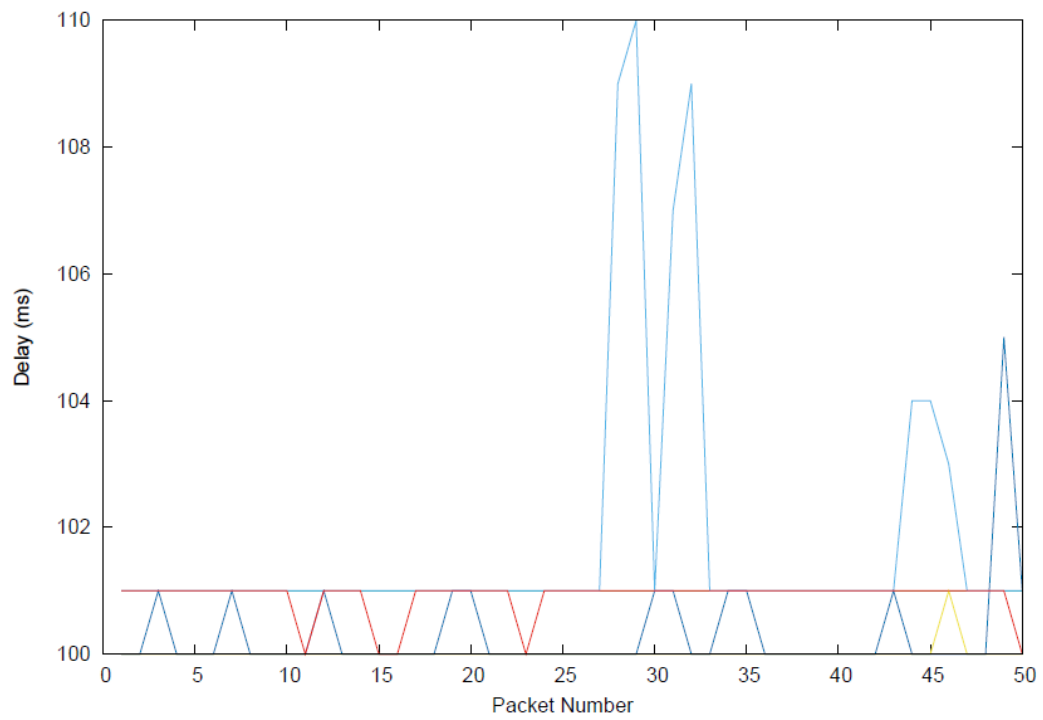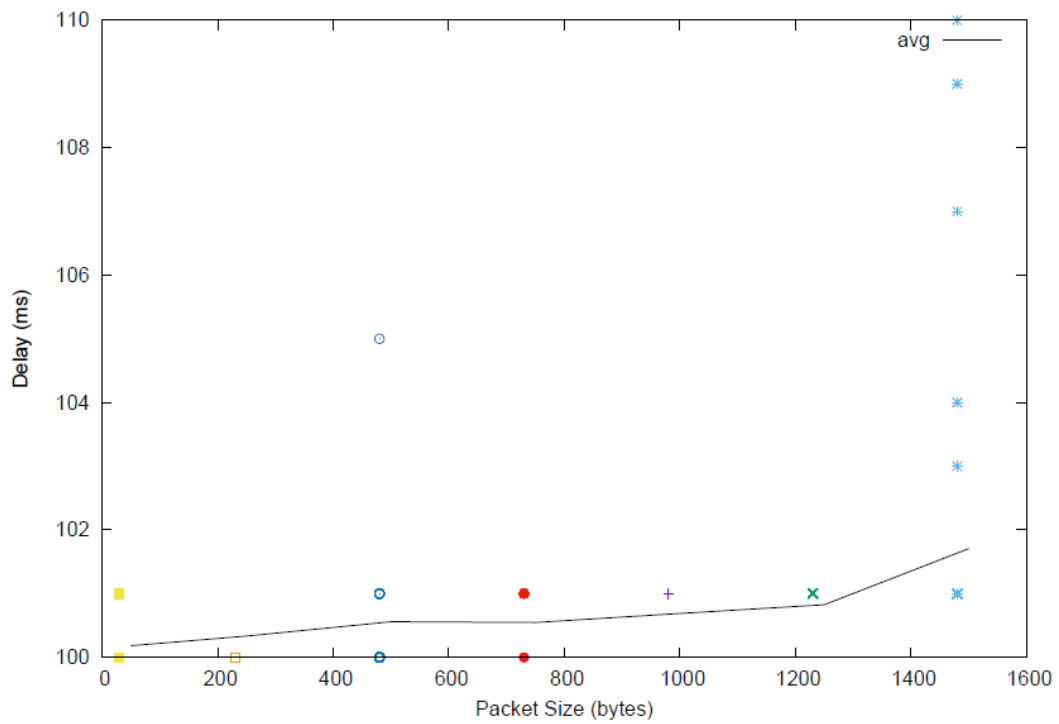
All graphs:

www.uq.edu.au:

Sun Sep 25 08:07:21 2022
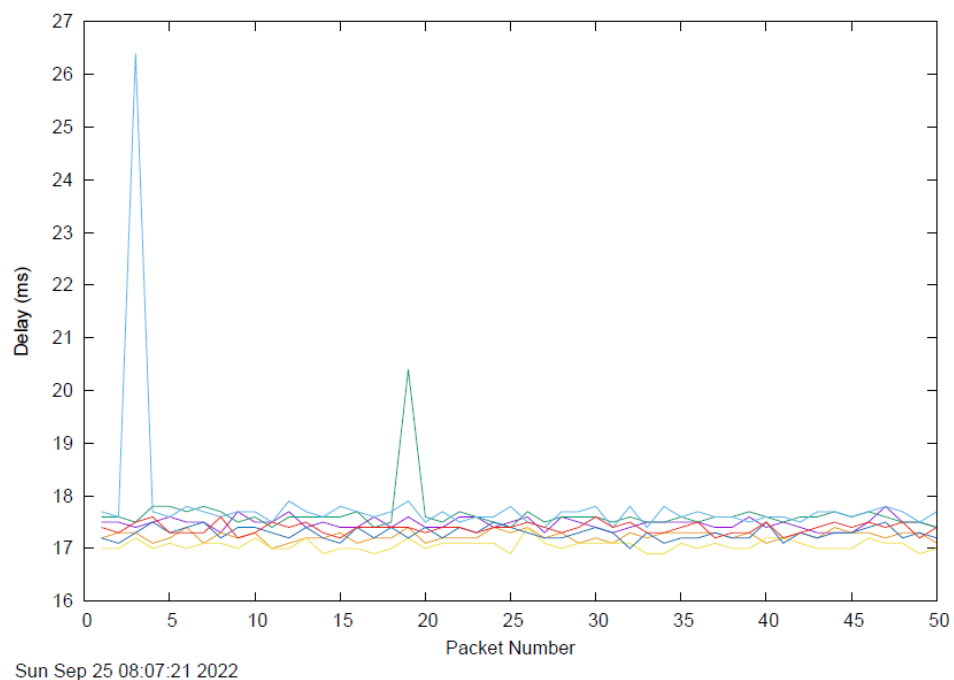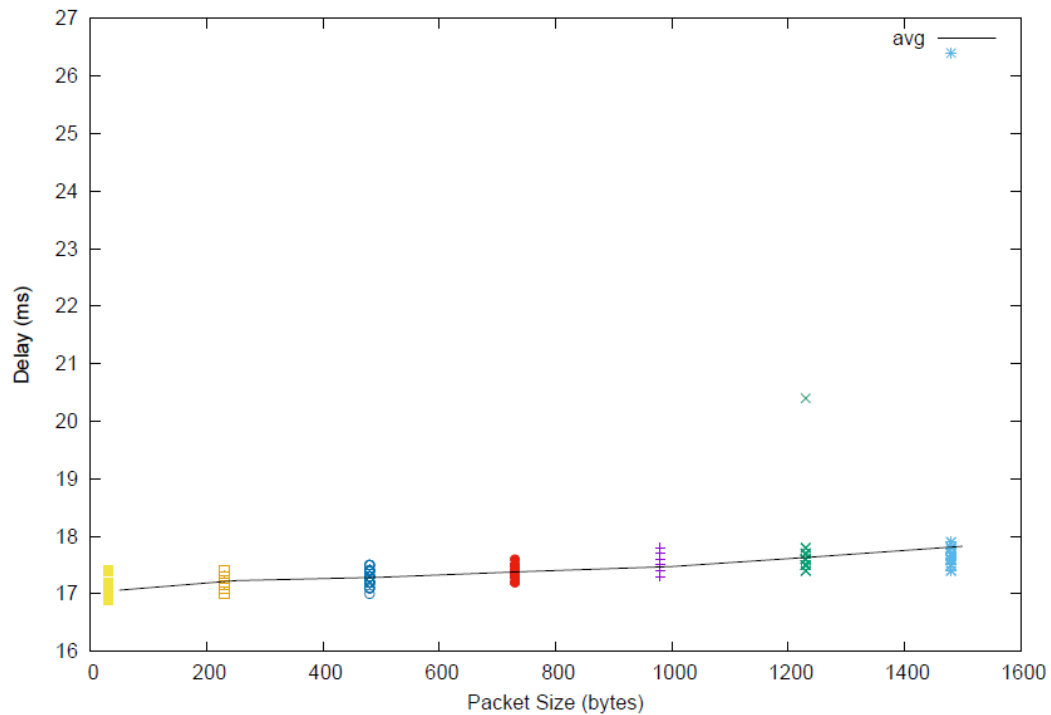
Sun Sep 25 08:07:21 2022

Labs > lab01 > 📄 www.uq.edu.au_avg.txt

```
1    50 17.065 16.903
2    250 17.231 17.048
3    500 17.288 17.005
4    750 17.389 17.189
5    1000 17.476 17.275
6    1250 17.646 17.380
7    1500 17.826 17.422
8
```
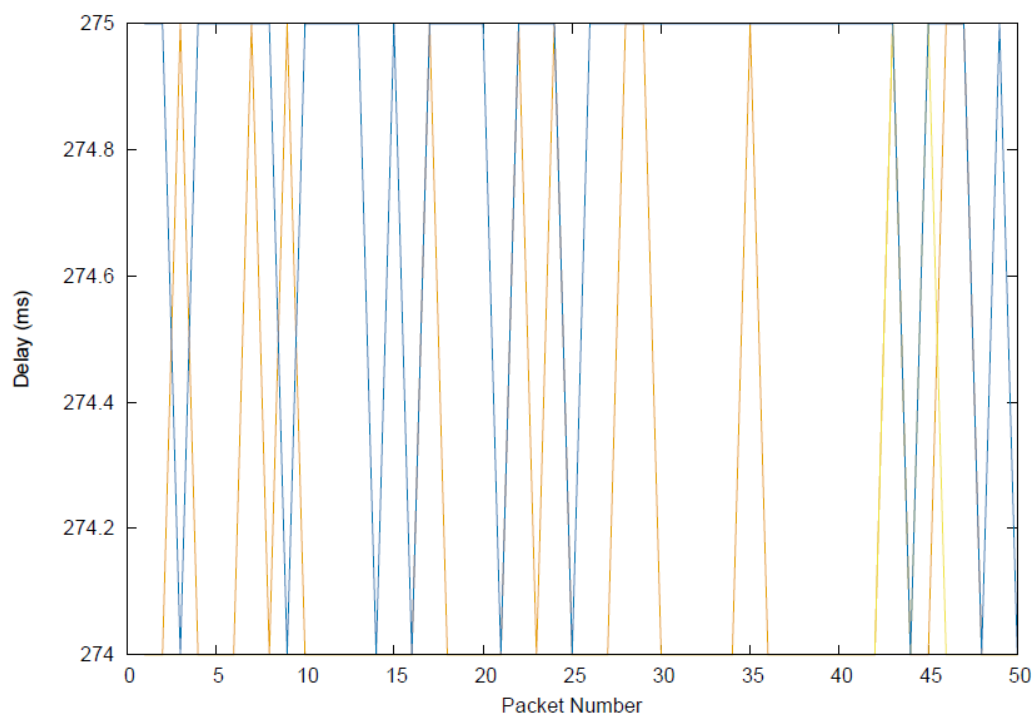
www.upm.edu.my:

Sun Sep 25 08:32:20 2022
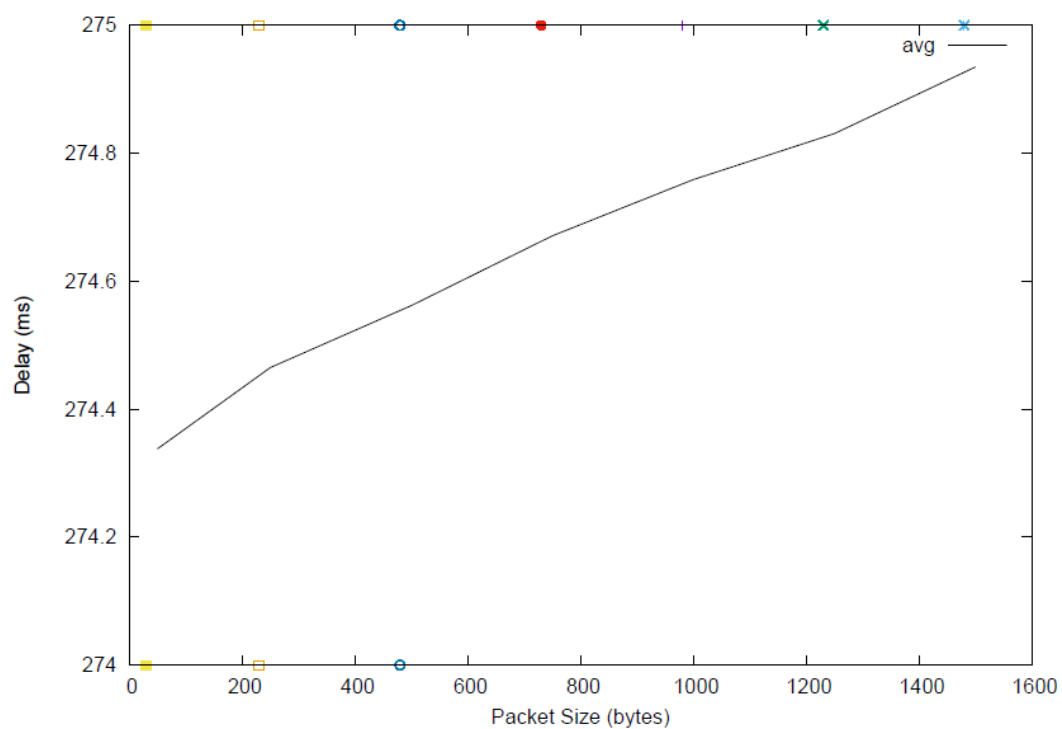

Sun Sep 25 08:32:21 2022

```
Labs > lab01 > 📄 www.upm.edu.my_avg.txt
    1      50  100.184  100.042
    2     250  100.333  100.237
    3     500  100.559  100.354
    4     750  100.548  100.466
    5    1000  100.689  100.622
    6    1250  100.826  100.751
    7    1500  101.707  100.825
    8
```

www.tu-berlin.de:

Sun Sep 25 08:32:25 2022

Sun Sep 25 08:32:25 2022

Labs > lab01 > 📄 www.tu-berlin.de_avg.txt

```
1    50 274.338 274.223
2    250 274.465 274.300
3    500 274.562 274.412
4    750 274.671 274.574
5    1000 274.759 274.629
6    1250 274.831 274.707
7    1500 274.935 274.812
8
```