

# CS3331 Lab 1: Tools of the Trade

---

## Exercise 1

---

### Reachable hosts

- [www.cse.unsw.edu.au](http://www.cse.unsw.edu.au)
- compnet.epfl.ch - 14.3 % packet loss
- [www.intel.com.au](http://www.intel.com.au)
- [www.telstra.com.au](http://www.telstra.com.au) - 14.3 % packet loss
- [www.amazon.com](http://www.amazon.com)
- [www.wikileaks.org](http://www.wikileaks.org)
- [www.tsinghua.edu.cn](http://www.tsinghua.edu.cn)
- 8.8.8.8

### Unreachable hosts

- [www.cancercouncil.org.au](http://www.cancercouncil.org.au) - Request timeout
- [www.hola.hp](http://www.hola.hp) - cannot resolve: Unknown host
- [www.kremlin.ru](http://www.kremlin.ru) - Request timeout

[www.cancercouncil.org.au](http://www.cancercouncil.org.au) is not reachable via a browser or ping and appears to simply time out because it takes too long to wait for a reply from the host.

www.hola.hp is not reachable via a browser or ping and returns an unknown host error most likely because the host is down and a route doesn't exist for the destination host.

www.kremlin.ru appears to be reachable via a browser but not via ping most likely because the website has purposefully turned it off to avoid DoS attacks, otherwise known as the "Ping of death" or "Ping flood" in which an attacker overwhelms a network with excess ping packets which if successful consumes both outgoing and incoming bandwidth leading to network downtime.

## Exercise 2

---

### Question 1

#### Traceroute output

```
traceroute to www.nyu.edu (216.165.47.12), 30 hops max, 60 byte packets
 1  cserouter1-server.cse.unsw.EDU.AU (129.94.242.251)  0.383 ms  0.370 ms  0.358 ms
 2  129.94.39.17 (129.94.39.17)  1.264 ms  1.240 ms  1.255 ms
 3  libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34)  8.239 ms  ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34)  4.068 ms  4.058 ms
 4  libcr1-po-5.gw.unsw.edu.au (149.171.255.165)  1.433 ms  ombcr1-po-5.gw.unsw.edu.au (149.171.255.197)  4.068 ms  4.058 ms
 5  unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101)  1.431 ms  unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.101)  4.068 ms  4.058 ms
 6  138.44.5.0 (138.44.5.0)  1.555 ms  1.391 ms  1.431 ms
 7  et-1-3-0.pe1.sxt.bkvl.nsw.aarnet.net.au (113.197.15.149)  2.122 ms  4.068 ms  4.058 ms
 8  et-0-0-0.pe1.a.hnl.aarnet.net.au (113.197.15.99)  96.909 ms  96.892 ms  96.883 ms
 9  et-2-1-0.bdr1.a.sea.aarnet.net.au (113.197.15.201)  147.976 ms  148.043 ms  147.933 ms
10  abilene-1-lo-jmb-706.sttlwa.pacificwave.net (207.231.240.8)  148.027 ms  148.023 ms  148.008 ms
11  et-4-0-0.4079.sdn-sw.miss2.net.internet2.edu (162.252.70.0)  158.735 ms  159.074 ms  157.868 ms
12  et-4-0-0.4079.sdn-sw.minn.net.internet2.edu (162.252.70.58)  180.348 ms  180.312 ms  180.407 ms
13  et-7-0-0.4079.sdn-sw.eqch.net.internet2.edu (162.252.70.106)  188.062 ms  188.126 ms  188.160 ms
14  et-4-1-0.4079.rtsw.clev.net.internet2.edu (162.252.70.112)  196.808 ms  196.921 ms  197.151 ms
15  buf-9208-I2-CLEV.nysernet.net (199.109.11.33)  201.168 ms  201.139 ms  201.140 ms
16  syr-9208-buf-9208.nysernet.net (199.109.7.193)  205.254 ms  205.171 ms  205.318 ms
17  nyc-9208-syr-9208.nysernet.net (199.109.7.162)  210.123 ms  213.722 ms  213.714 ms
18  199.109.5.6 (199.109.5.6)  210.518 ms  210.608 ms  210.748 ms
19  DMZGWA-PTP-EXTGWA.NET.NYU.EDU (128.122.254.65)  211.111 ms  211.034 ms  211.112 ms
20  NYUGWA-PTP-DMZGWA-NGFW.NET.NYU.EDU (128.122.254.108)  230.657 ms  224.863 ms  224.808 ms
21  NYUFW-OUTSIDE-NGFW.NET.NYU.EDU (128.122.254.116)  211.306 ms  211.199 ms  211.282 ms
```

```

22 * * *
23 WSQDCGWA-VL902.NET.NYU.EDU (128.122.1.38) 211.609 ms 211.935 ms 211.858 ms
24 * * *
25 * * *
26 * * *
27 * * *
28 * * *
29 * * *
30 * * *

```

## Answer

There appears to be 23 routers between my workstation and `www.nyu.edu`. 5 routers along the path are part of the UNSW network. Between routers 11 - `et-4-0-0.4079.sdn-sw.miss2.net.internet2.edu` (162.252.70.0) - and 12 - `et-4-0-0.4079.sdn-sw.minn.net.internet2.edu` (162.252.70.58) - do the packets appear to cross the Pacific Ocean since there appears to be a significantly larger average RTT between these two routers than between the previous routers which have only been about 10 ms difference apart while the RTT between these two routers was ~23 ms.

## Question 2

### Traceroute output

Traceroute to [www.ucla.edu](http://www.ucla.edu)

```

traceroute to www.ucla.edu (164.67.228.152), 30 hops max, 60 byte packets
 1 cserouter1-server.cse.unsw.EDU.AU (129.94.242.251) 0.129 ms 0.126 ms 0.171 ms
 2 129.94.39.17 (129.94.39.17) 1.083 ms 1.030 ms 1.230 ms
 3 ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35) 1.684 ms libudnex1-vl-3154.gw.unsw.edu.au (149.171.2
 4 libcr1-po-5.gw.unsw.edu.au (149.171.255.165) 1.446 ms ombcr1-po-6.gw.unsw.edu.au (149.171.255.169) 1.
 5 unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101) 1.456 ms 1.477 ms 1.492 ms
 6 138.44.5.0 (138.44.5.0) 1.573 ms 1.629 ms 1.612 ms
 7 et-1-3-0.pe1.sxt.bkvl.nsw.aarnet.net.au (113.197.15.149) 2.601 ms 4.037 ms 3.978 ms
 8 et-0-0-0.pe1.a.hnl.aarnet.net.au (113.197.15.99) 95.629 ms 95.621 ms 95.645 ms
 9 et-2-1-0.bdr1.a.sea.aarnet.net.au (113.197.15.201) 146.861 ms 146.813 ms 146.793 ms
10 cenichpr-1-is-jmb-778.snvaca.pacificwave.net (207.231.245.129) 163.551 ms 163.558 ms 163.517 ms
11 hpr-lax-hpr3--svl-hpr3-100ge.cenic.net (137.164.25.73) 172.240 ms 172.359 ms 172.356 ms

```

```

12 * * *
13 bd11f1.anderson--cr00f2.csb1.ucla.net (169.232.4.4) 171.953 ms bd11f1.anderson--cr001.anderson.ucla.net
14 cr00f1.anderson--dr00f2.csb1.ucla.net (169.232.4.55) 171.363 ms cr00f2.csb1--dr00f2.csb1.ucla.net (169
15 * * *
16 * * *
17 * * *
18 * * *
19 * * *
20 * * *
21 * * *
22 * * *
23 * * *
24 * * *
25 * * *
26 * * *
27 * * *
28 * * *
29 * * *
30 * * *

```

#### Traceroute to [www.u-tokyo.ac.jp](http://www.u-tokyo.ac.jp)

```

traceroute to www.u-tokyo.ac.jp (210.152.135.178), 30 hops max, 60 byte packets
 1 cserouter1-server.cse.unsw.EDU.AU (129.94.242.251) 0.379 ms 0.371 ms 0.359 ms
 2 129.94.39.17 (129.94.39.17) 1.246 ms 1.240 ms 1.229 ms
 3 ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35) 1.963 ms 1.928 ms libudnex1-vl-3154.gw.unsw.edu.au
 4 ombcr1-po-5.gw.unsw.edu.au (149.171.255.197) 1.412 ms libcr1-po-6.gw.unsw.edu.au (149.171.255.201) 1.
 5 unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101) 1.464 ms 1.485 ms 1.503 ms
 6 138.44.5.0 (138.44.5.0) 1.608 ms 1.435 ms 1.350 ms
 7 et-0-3-0.pe1.bkvl.nsw.aarnet.net.au (113.197.15.147) 3.323 ms 2.125 ms 2.087 ms
 8 ge-4_0_0.bb1.a.pao.aarnet.net.au (202.158.194.177) 156.757 ms 156.850 ms 156.824 ms
 9 paloalto0.iiij.net (198.32.176.24) 158.627 ms 158.648 ms 158.574 ms
10 osk004bb01.IIJ.Net (58.138.88.189) 271.904 ms 271.972 ms 271.930 ms
11 osk004ix51.IIJ.Net (58.138.106.126) 290.736 ms 290.715 ms osk004ix51.IIJ.Net (58.138.106.130) 281.08
12 210.130.135.130 (210.130.135.130) 322.247 ms 321.291 ms 321.286 ms
13 124.83.228.93 (124.83.228.93) 290.519 ms 283.366 ms 309.060 ms
14 124.83.228.74 (124.83.228.74) 271.650 ms 271.815 ms 281.254 ms
15 124.83.252.242 (124.83.252.242) 288.793 ms 288.814 ms 288.831 ms

```

```
16 158.205.134.22 (158.205.134.22) 279.214 ms 279.172 ms 279.223 ms
17 * * *
18 * * *
19 * * *
20 * * *
21 * * *
22 * * *
23 * * *
24 * * *
25 * * *
26 * * *
27 * * *
28 * * *
29 * * *
30 * * *
```

#### Traceroute to [www.lancaster.ac.uk](http://www.lancaster.ac.uk)

```
traceroute to www.lancaster.ac.uk (148.88.2.80), 30 hops max, 60 byte packets
 1 cserouter1-server.cse.unsw.EDU.AU (129.94.242.251) 0.380 ms 0.375 ms 0.363 ms
 2 129.94.39.17 (129.94.39.17) 1.330 ms 1.302 ms 1.280 ms
 3 libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34) 1.641 ms ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34) 1.522 ms ombcr1-po-5.gw.unsw.edu.au (149.171.255.197) 1.522 ms ombcr1-po-6.gw.unsw.edu.au (149.171.255.169) 1.585 ms unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101) 1.527 ms 1.584 ms
 6 138.44.5.0 (138.44.5.0) 1.641 ms 1.442 ms 1.447 ms
 7 et-1-3-0.pe1.sxt.bkvl.nsw.aarnet.net.au (113.197.15.149) 2.340 ms 2.493 ms 2.483 ms
 8 et-0-0-0.pe1.a.hnl.aarnet.net.au (113.197.15.99) 95.245 ms 95.469 ms 95.408 ms
 9 et-2-1-0.bdr1.a.sea.aarnet.net.au (113.197.15.201) 146.719 ms 146.680 ms 146.659 ms
10 abilene-1-lo-jmb-706.sttlwa.pacificwave.net (207.231.240.8) 147.343 ms 147.311 ms 147.350 ms
11 et-4-0-0.4079.sdn-sw.miss2.net.internet2.edu (162.252.70.0) 157.512 ms 157.509 ms 157.636 ms
12 et-4-0-0.4079.sdn-sw.minn.net.internet2.edu (162.252.70.58) 180.860 ms 180.704 ms 180.644 ms
13 et-7-0-0.4079.sdn-sw.eqch.net.internet2.edu (162.252.70.106) 189.741 ms 188.456 ms 199.316 ms
14 et-4-1-0.4079.rts.w.clev.net.internet2.edu (162.252.70.112) 197.009 ms 197.165 ms 197.155 ms
15 et-2-0-0.4079.sdn-sw.ashb.net.internet2.edu (162.252.70.54) 204.675 ms 204.635 ms 204.549 ms
16 et-4-1-0.4079.rts.w.wash.net.internet2.edu (162.252.70.65) 204.776 ms 204.955 ms 204.925 ms
17 internet2.mx1.lon.uk.geant.net (62.40.124.44) 279.595 ms 279.615 ms 279.607 ms
18 janet-gw.mx1.lon.uk.geant.net (62.40.124.198) 279.774 ms 279.648 ms 279.649 ms
19 ae29.londpg-sbr2.ja.net (146.97.33.2) 285.777 ms 285.776 ms 285.760 ms
```

```

20 ae31.erdis-sbr2.ja.net (146.97.33.22)  284.152 ms  284.144 ms  284.118 ms
21 ae29.manckh-sbr1.ja.net (146.97.33.42)  285.781 ms  285.791 ms  285.842 ms
22 cnl.manckh-sbr1.ja.net (146.97.41.54)  288.149 ms  288.042 ms  288.495 ms
23 * * *
24 ismx-issrx.rtr.lancs.ac.uk (148.88.255.17)  289.874 ms  289.473 ms  289.792 ms
25 dc.iss.srv.rtrcloud.lancs.ac.uk (148.88.253.3)  310.623 ms  307.690 ms  307.699 ms
26 www-ha.lancs.ac.uk (148.88.2.80)  289.755 ms !X  289.523 ms !X  289.294 ms !X

```

## Answer

The path of my machine to these three destinations seem to diverge at a router with the IP address 138.44.5.0 . Upon running the `whois` command on this router, this router appears to be called AARNET which stands for the Australian Academic and Research Network. The number of hops along each path also appears to be proportional to the physical distance from my computer to the destination, that is, the greater the distance, the more hops it takes to reach the destination. For example the first destination is bound for LA, ~12087 km away from Sydney. The second destination is bound for somewhere in Japan, ~7915 km away from Sydney. The third destination is bound for Lancaster in the UK, ~17008 km away.

Destination	Approximate distance from my computer	Hops taken to reach destination
1	12087 km	14
2	7915 km	16
3	17008 km	26

## Question 3

### Traceroute output

Forward path: From my machine to [www.speedtest.com.sg](http://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)  0.189 ms  0.178 ms  0.167 ms
 2 129.94.39.17 (129.94.39.17)  1.052 ms  1.077 ms  1.069 ms

```

```

3  ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35) 1.625 ms libudnex1-vl-3154.gw.unsw.edu.au (149.171.2
4  ombcr1-po-6.gw.unsw.edu.au (149.171.255.169) 1.240 ms ombcr1-po-5.gw.unsw.edu.au (149.171.255.197) 1.
5  unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105) 1.353 ms 1.390 ms unswbr1-te-1-9.gw.unsw.edu.au (149
6  138.44.5.0 (138.44.5.0) 1.419 ms 1.389 ms 1.394 ms
7  et-0-3-0.pe1.alxd.nsw.aarnet.net.au (113.197.15.153) 1.709 ms 1.794 ms 1.796 ms
8  xe-0-0-3.pe1.wnpa.akl.aarnet.net.au (113.197.15.67) 24.261 ms xe-0-2-1-204.pe1.wnpa.alxd.aarnet.net.au
9  et-0-1-0.200.pe1.tkpa.akl.aarnet.net.au (113.197.15.69) 24.595 ms 24.496 ms 24.536 ms
10 xe-0-2-6.bdr1.a.lax.aarnet.net.au (202.158.194.173) 147.995 ms 147.986 ms 147.963 ms
11 singtel.as7473.any2ix.coresite.com (206.72.210.63) 309.517 ms 309.410 ms 309.446 ms
12 203.208.171.117 (203.208.171.117) 310.748 ms 203.208.172.173 (203.208.172.173) 305.897 ms 203.208.158
13 203.208.154.45 (203.208.154.45) 331.657 ms 203.208.182.125 (203.208.182.125) 358.598 ms 203.208.173.7
14 203.208.171.198 (203.208.171.198) 338.623 ms 203.208.182.45 (203.208.182.45) 327.320 ms 203.208.171.1
15 203.208.177.110 (203.208.177.110) 334.582 ms 322.519 ms 336.447 ms
16 202-150-221-170.rev.ne.com.sg (202.150.221.170) 328.271 ms 337.710 ms 328.535 ms

```

Reverse path: From [www.speedtest.com.sg](http://www.speedtest.com.sg) back to my machine

```

1  ge2-8.r01.sin01.ne.com.sg (202.150.221.169) 0.309 ms 0.335 ms 0.380 ms
2  10.12.0.101 (10.12.0.101) 38.259 ms 38.289 ms 38.298 ms
3  hutchcity3-10g.hkix.net (123.255.90.140) 39.830 ms 39.844 ms 39.852 ms
4  d1-10-238-143-118-on-nets.com (118.143.238.10) 39.766 ms d1-42-238-143-118-on-nets.com (118.143.238.42
5  d1-26-224-143-118-on-nets.com (118.143.224.26) 194.577 ms 194.548 ms d1-10-224-143-118-on-nets.com (1
6  aarnet.as7575.any2ix.coresite.com (206.72.210.64) 174.594 ms 181.709 ms 173.296 ms
7  xe-0-0-3.pe1.tkpa.akl.aarnet.net.au (202.158.194.172) 309.155 ms 317.949 ms 317.924 ms
8  et-0-1-0.200.pe1.wnpa.akl.aarnet.net.au (113.197.15.68) 298.867 ms 299.803 ms 298.724 ms
9  xe-0-2-2-204.pe1.alxd.nsw.aarnet.net.au (113.197.15.182) 337.887 ms xe-1-2-1.pe1.msct.nsw.aarnet.net.a
10 et-8-1-0.pe1.brwy.nsw.aarnet.net.au (113.197.15.152) 337.503 ms 337.447 ms 337.896 ms
11 138.44.5.1 (138.44.5.1) 320.277 ms 321.381 ms 328.878 ms
12 ombcr1-te-1-5.gw.unsw.edu.au (149.171.255.106) 342.282 ms 333.984 ms 342.219 ms
13 libudnex1-po-2.gw.unsw.edu.au (149.171.255.198) 341.112 ms 341.393 ms 342.579 ms
14 ufw1-ae-1-3154.gw.unsw.edu.au (149.171.253.36) 334.660 ms 334.639 ms 343.420 ms

```

Forward path: From my machine to [www.telstra.net/cgi-bin/trace](http://www.telstra.net/cgi-bin/trace)

```

1  cserouter1-server.cse.unsw.EDU.AU (129.94.242.251) 0.134 ms 0.122 ms 0.167 ms
2  129.94.39.17 (129.94.39.17) 1.083 ms 1.086 ms 1.060 ms
3  ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35) 2.173 ms 2.139 ms 2.158 ms

```

```

4  ombcr1-po-6.gw.unsw.edu.au (149.171.255.169)  1.395 ms ombcr1-po-5.gw.unsw.edu.au (149.171.255.197)  1.
5  unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  1.440 ms unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.1
6  138.44.5.0 (138.44.5.0)  1.969 ms  1.407 ms  1.376 ms
7  et-0-3-0.pe1.alxd.nsw.aarnet.net.au (113.197.15.153)  1.928 ms  1.885 ms  1.915 ms
8  ae9.bb1.b.syd.aarnet.net.au (113.197.15.65)  2.226 ms  2.283 ms  2.266 ms
9  gigabitethernet1-1.pe1.b.syd.aarnet.net.au (202.158.202.18)  2.319 ms  2.349 ms  2.714 ms
10 gigabitethernet3-11.ken37.sydney.telstra.net (139.130.0.77)  2.838 ms  2.731 ms  2.714 ms
11 bundle-ether13.ken-core10.sydney.telstra.net (203.50.11.94)  3.615 ms  3.559 ms  2.706 ms
12 bundle-ether12.win-core10.melbourne.telstra.net (203.50.11.123)  16.060 ms  14.340 ms  14.301 ms
13 tengigabitethernet8-1.exi2.melbourne.telstra.net (203.50.80.154)  13.715 ms * *

```

Reverse path: From [www.telstra.net/cgi-bin/trace](http://www.telstra.net/cgi-bin/trace) to my machine

```

1  gigabitethernet3-3.exi2.melbourne.telstra.net (203.50.77.53)  0.398 ms  0.223 ms  0.241 ms
2  bundle-ether3-100.win-core10.melbourne.telstra.net (203.50.80.129)  1.744 ms  1.361 ms  2.243 ms
3  bundle-ether12.ken-core10.sydney.telstra.net (203.50.11.122)  13.111 ms  12.105 ms  13.237 ms
4  bundle-ether1.ken-edge901.sydney.telstra.net (203.50.11.95)  11.984 ms  11.857 ms  11.985 ms
5  aarnet6.lnk.telstra.net (139.130.0.78)  11.737 ms  11.606 ms  11.738 ms
6  ge-6-0-0.bb1.a.syd.aarnet.net.au (202.158.202.17)  11.736 ms  11.733 ms  11.738 ms
7  ae9.pe2.brwy.nsw.aarnet.net.au (113.197.15.56)  11.986 ms  12.105 ms  11.988 ms
8  et-3-1-0.pe1.brwy.nsw.aarnet.net.au (113.197.15.146)  16.233 ms  12.605 ms  12.239 ms
9  138.44.5.1 (138.44.5.1)  12.360 ms  12.232 ms  12.236 ms
10 ombcr1-te-1-5.gw.unsw.edu.au (149.171.255.106)  12.362 ms  12.356 ms  12.238 ms
11 libudnex1-po-2.gw.unsw.edu.au (149.171.255.198)  12.861 ms  12.731 ms  12.613 ms
12 ufw1-ae-1-3154.gw.unsw.edu.au (149.171.253.36)  12.862 ms  12.855 ms  12.862 ms

```

## Answer

The reverse path does not appear to go through the same routers as the forward path as can be seen in making a quick comparison of the traceroute output of the forward and reverse path of my local CSE machine to the two servers [www.speedtest.com.sg](http://www.speedtest.com.sg) and [www.telstra.net/cgi-bin/trace](http://www.telstra.net/cgi-bin/trace) . However the reverse and the forward path do appear to be hopping through routers with close numerical IP addresses to each other which suggests that might be smaller routers of a larger network - for example on hop 7 on the forward path and hop 8 on the backward path to [www.telstra.net/cgi-bin/trace](http://www.telstra.net/cgi-bin/trace) the traceroute appears to be going through close numerical IP addresses of 113.197.15.153 and 113.197.15.146 . This is most likely because these routers are smaller routers that are part of a



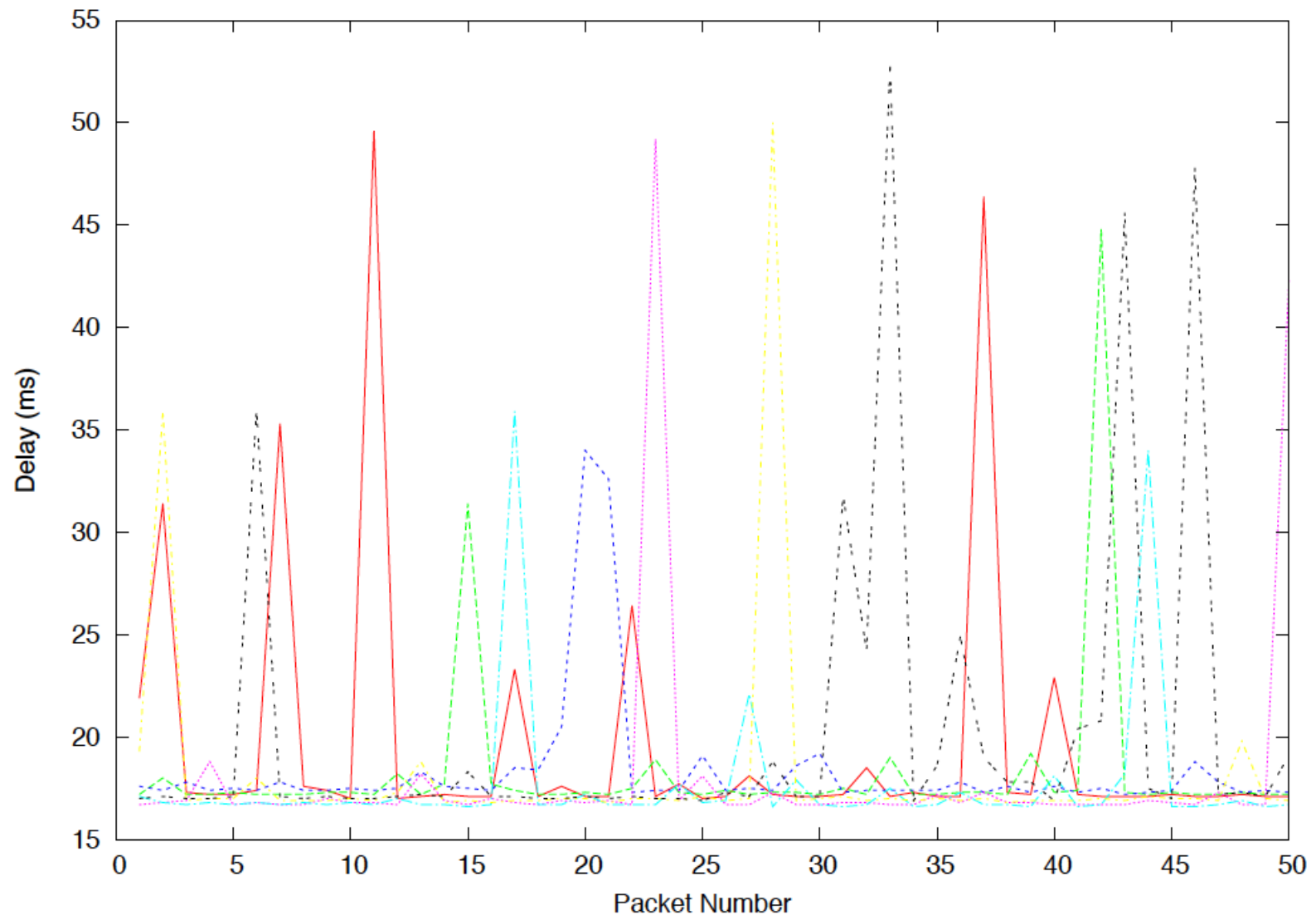
larger server as these two servers appear to be quite large as well as my local CSE server being also part of a larger server hence while they don't go through exactly the same routers getting there they will go through routers with similar numerical IP addresses.

## Exercise 3

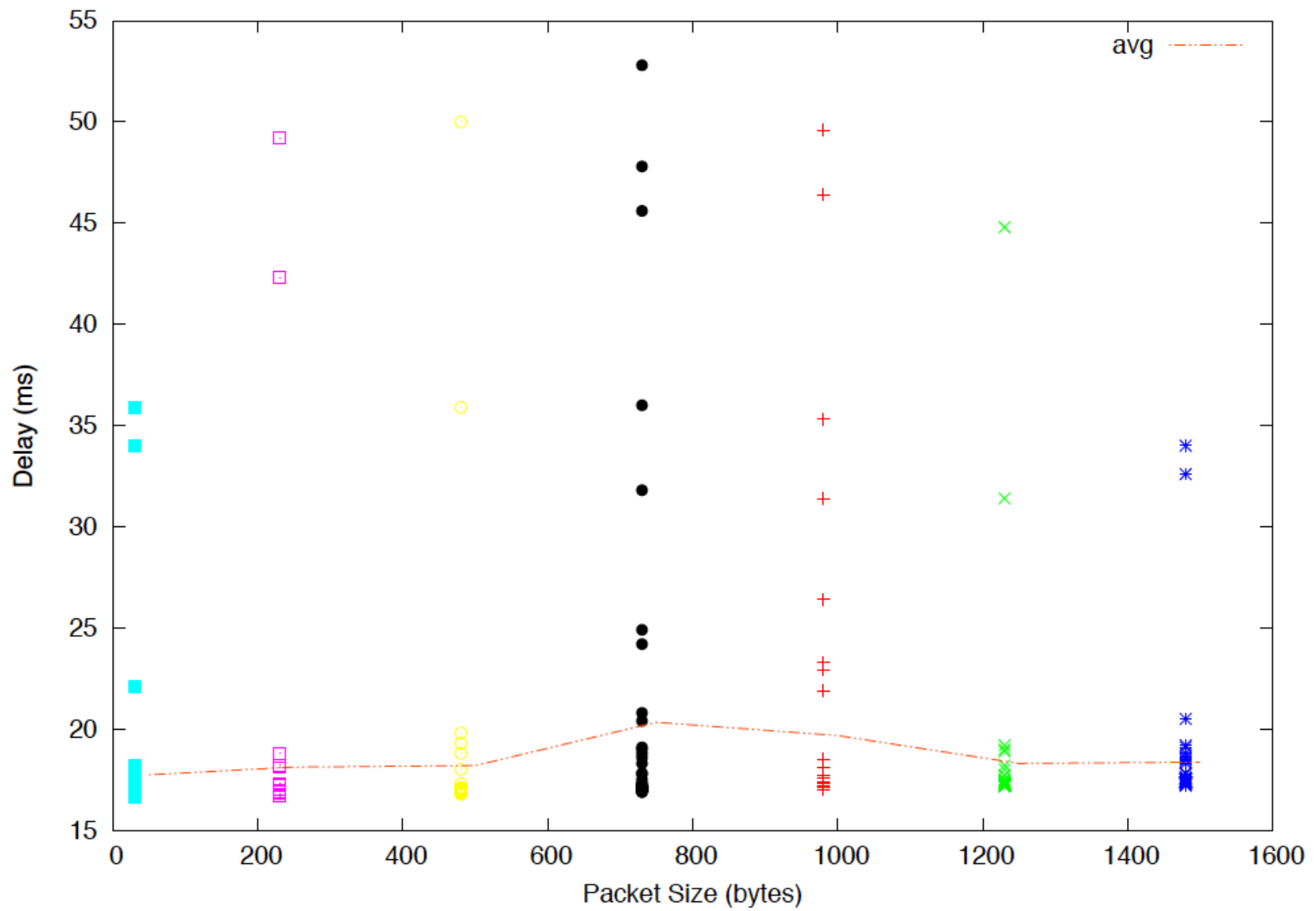
---

[www.uq.edu.au](http://www.uq.edu.au)

Delay vs Time



Delay vs. Packet Size



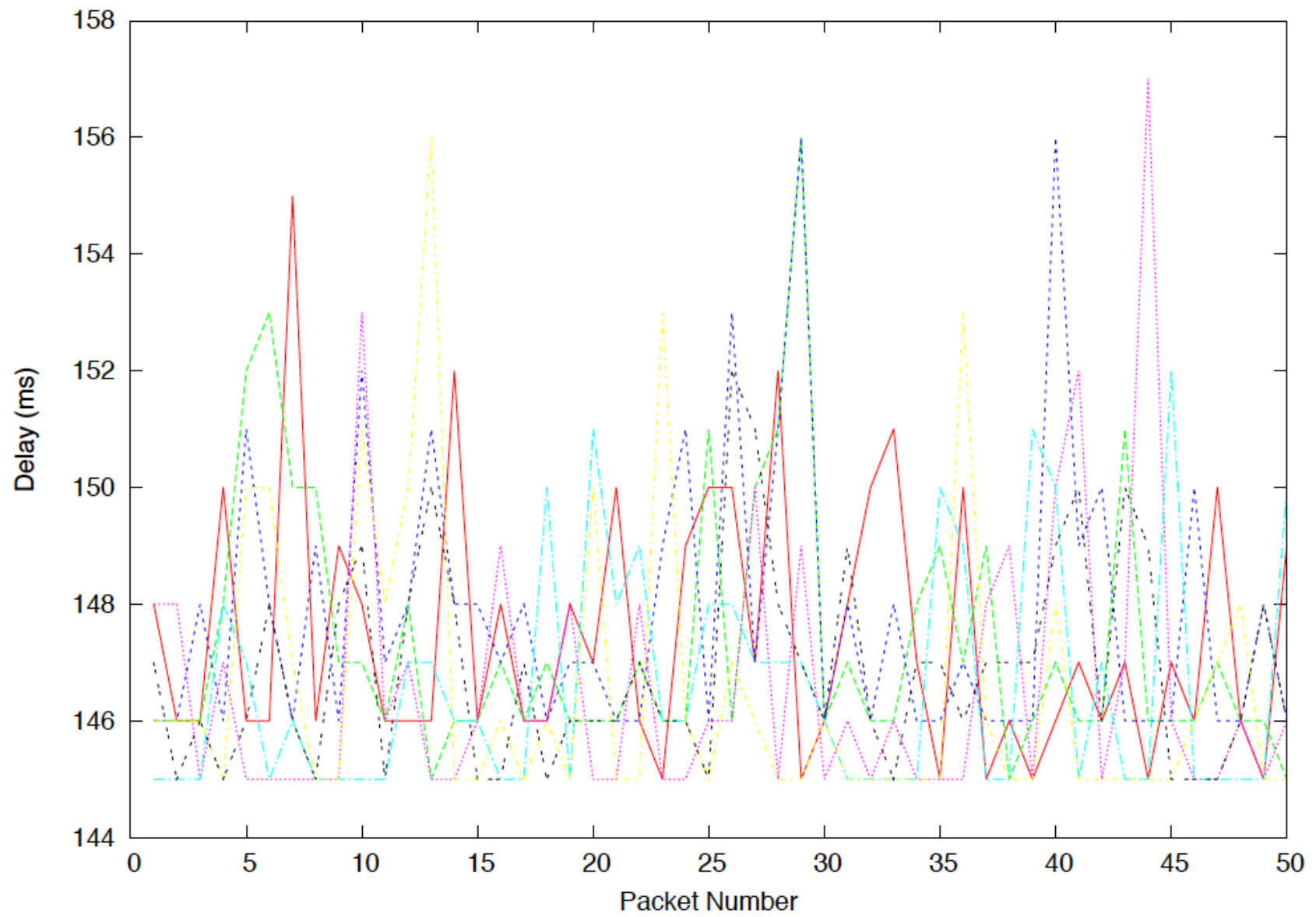
Packet sizes and average and minimum delay times

Packet size (bytes)	Average delay (ms)	Minimum delay (ms)
---------------------	--------------------	--------------------

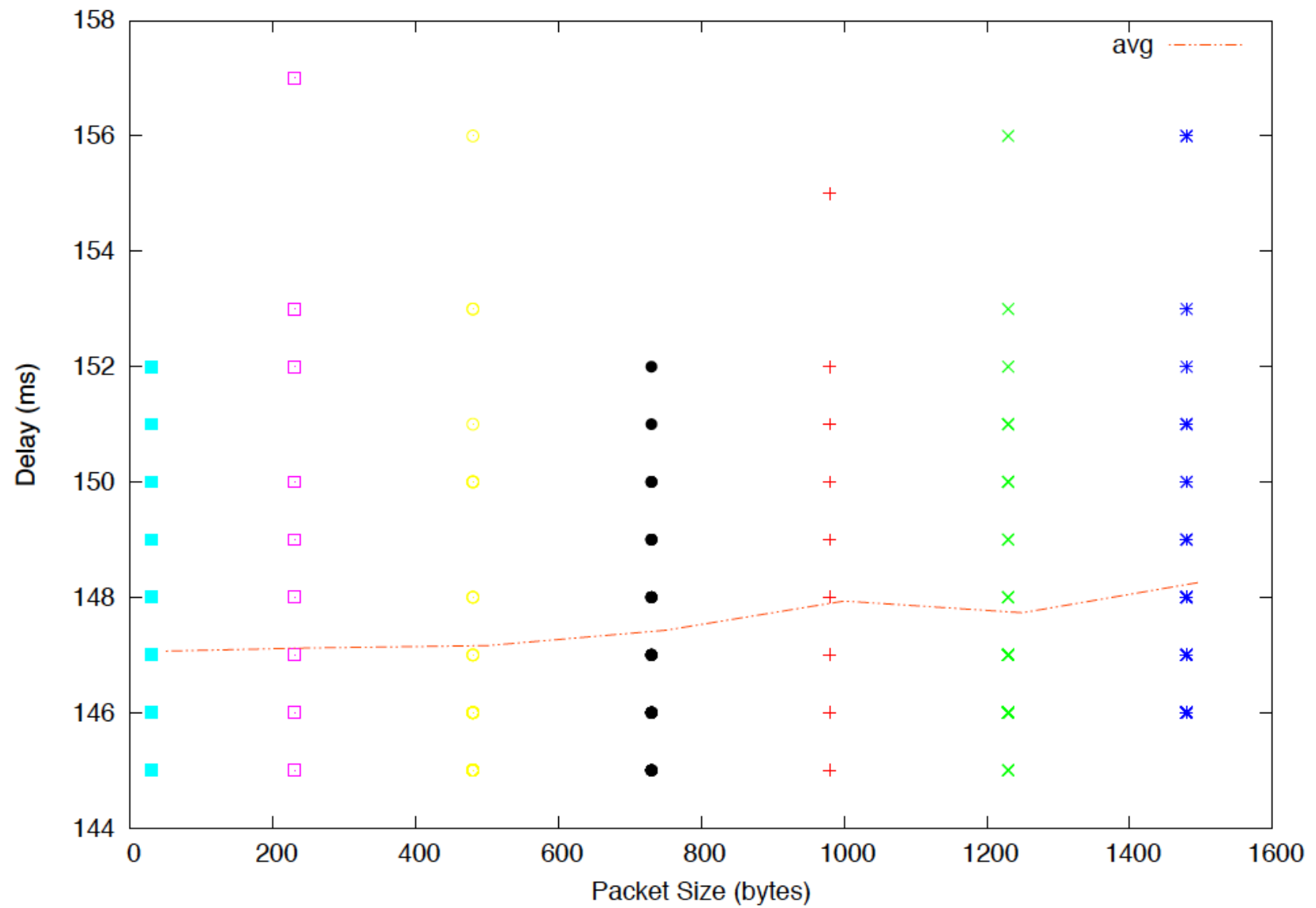
50	17.741	16.611
250	18.120	16.711
500	18.194	16.866
750	20.339	16.970
1000	19.674	17.061
1250	18.304	17.217
1500	18.368	17.297

[www.nus.edu.sg](http://www.nus.edu.sg)

**Delay vs. Time**



Delay vs. Packet Size



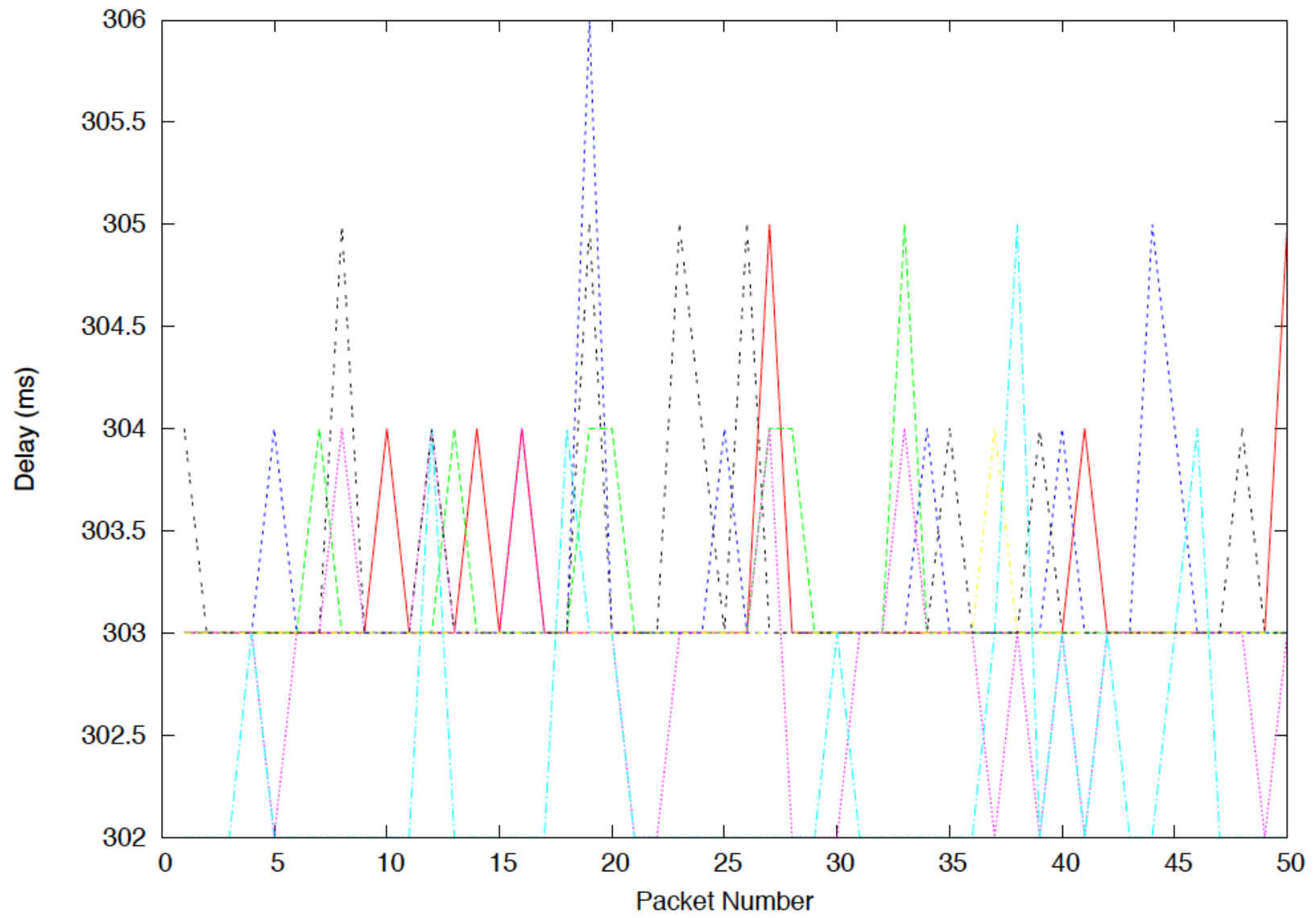
Packet sizes and average and minimum delay times

Packet size (bytes)	Average delay (ms)	Minimum delay (ms)
50	147.066	145.204

Packet size (bytes)	Average delay (ms)	Minimum delay (ms)
250	147.120	145.372
500	147.161	145.503
750	147.427	145.585
1000	147.934	145.864
1250	147.733	145.990
1500	148.265	146.071

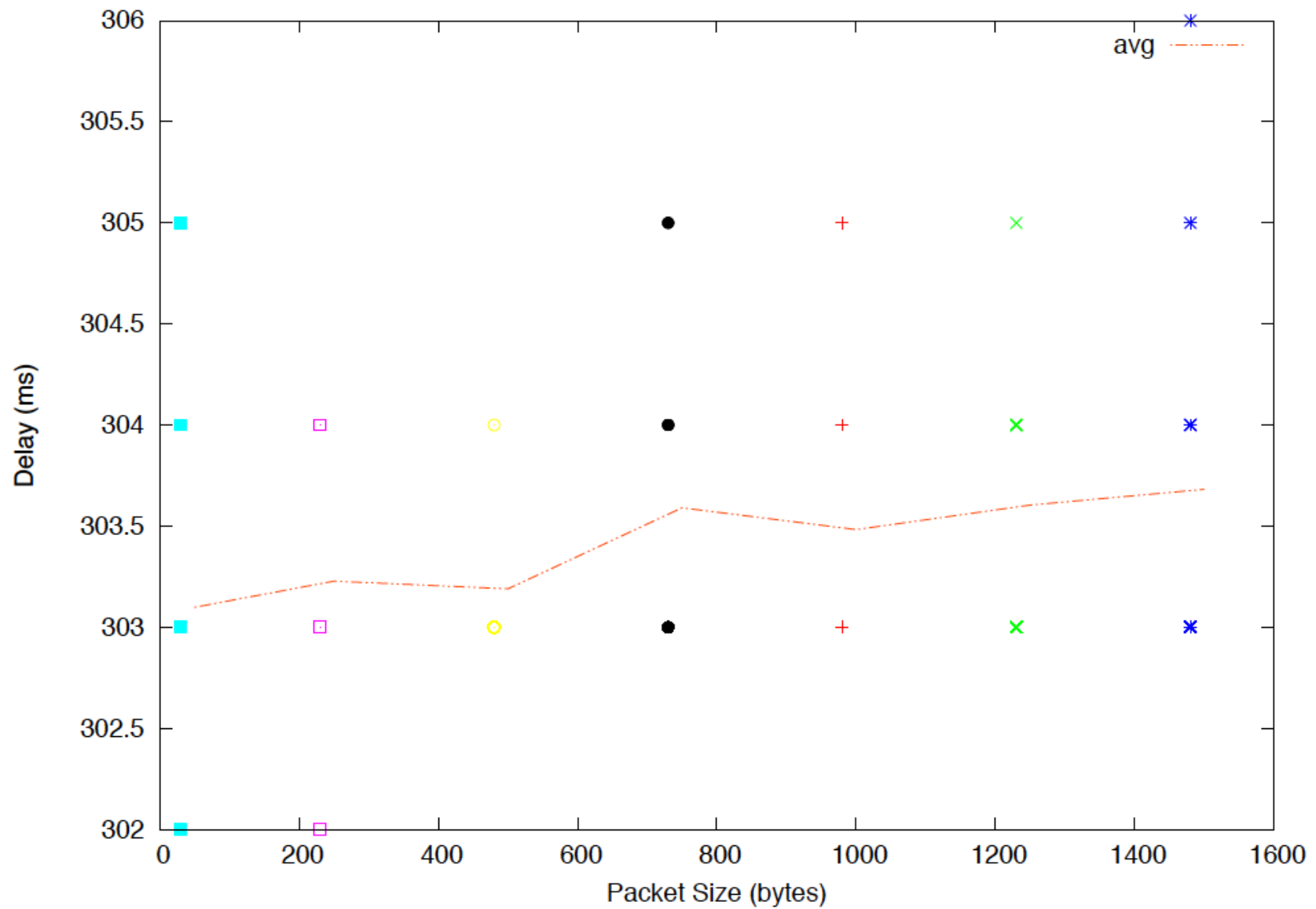
[www.tu-berlin.de](http://www.tu-berlin.de)

**Delay vs. Time**



Delay vs. Packet Size





Packet sizes and average and minimum delay times

Packet size (bytes)	Average delay (ms)	Minimum delay (ms)
50	303.099	302.788

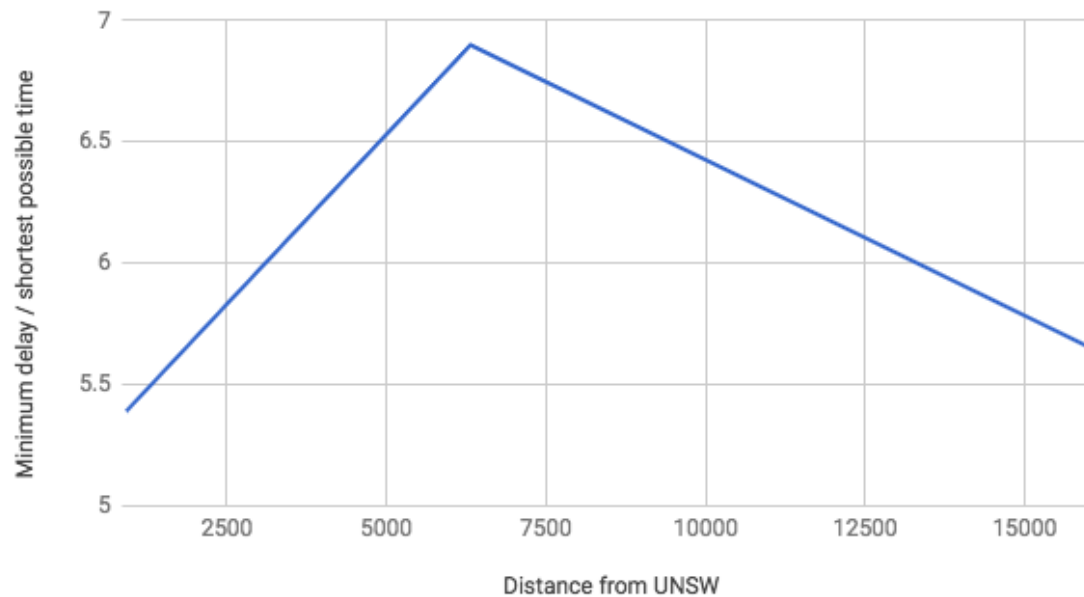
Packet size (bytes)	Average delay (ms)	Minimum delay (ms)
250	303.228	302.929
500	303.190	303.004
750	303.591	303.085
1000	303.483	303.190
1250	303.604	303.272
1500	303.682	303.370

## Answer

### Question 1

Destination	Approximate distance from UNSW (km)	Minimum delay (RTT @ packet size = 50 bytes) / shortest possible time (ratio)
UQ	925	$16.611 / 3.083 = 5.39$
NUS	6317	$145.204 / 21.057 = 6.90$
TU BERLIN	16118	$302.788 / 53.73 = 5.64$

Distance from UNSW vs Ratio of Minimum Delay / Shortest Possible Time



Two possible other reasons why the y-axis values plotted might be greater than 2:

- Network traffic and congestion delays
- Transmission delay caused by the limited data rate transmission of different links packets must travel to reach the destination

## Question 2

The delays to the destination appears to not be constant but varies over time. This is possibly due to the different type of delays that the packets might have encountered at the time they were transmitted such as network congestion and queueing. For [www.nus.edu.sg](http://www.nus.edu.sg) and [www.tu-berlin.de](http://www.tu-berlin.de), the packet delays seems to be depend on the size of the packet size (delay is greater the greater the packet size).

## Question 3

Delays that depend on packet size

- Transmission delay

**Delays that aren't affected by packet size**

- Propagation delay
- Queueing delay
- Processing delay