COMP3331

Lab 1

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Exercise 1: nslookup

1. *Which is the IP address of the website www.koala.com.au? In your opinion, what is the reason of having several IP addresses as an output?*

www.koala.com.au has two IP addresses: 172.67.219.46 and 104.21.45.210. There are several IP addresses (possibly due to a cdn service) in the output as it may boost website performance by accessing the IP closest to users and reduce congestion.

2. *Find out the name of the IP address 127.0.0.1. What is special about this IP address?*

The name of the IP address 127.0.0.1 is called local host. It is special as refers to the current computer and is used to access locally running network services often for testing purposes.

Exercise 2: Use ping to test host reachability

- www.unsw.edu.au is reachable via ping.
- www.getfittest.com.au is unreachable using ping and the web browser, thus it is likely that there is no website hosted under that hostname and thus cannot be pinged.
- www.mit.edu is reachable via ping.
- www.intel.com.au is reachable via ping.
- www.tpg.com.au is reachable via ping.
- www.hola.hp is unreachable using ping and the web browser, therefore, same reason as www.getfittest.com.au as we cannot ping it.
- www.amazon.com is reachable via ping.
- www.tsinghua.edu.cn is reachable via ping.
- www.kremlin.ru is unreachable via ping but reachable via web browser. Most likely due to a firewall blocking pings.
- 8.8.8.8 is reachable via ping.

Exercise 3: Use traceroute to understand network topology

1. *Traceroute to www.columbia.edu*

```
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)  0.067 ms  0.064 ms  0.082 ms
 2  129.94.39.17 (129.94.39.17)  0.936 ms  0.942 ms  0.875 ms
 3  libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34)  8.200 ms  8.213 ms ombudnex1-vl-
3154.gw.unsw.edu.au (149.171.253.35)  1.488 ms
 4  libcr1-po-5.gw.unsw.edu.au (149.171.255.165)  1.154 ms ombcr1-po-5.gw.unsw.edu.au (149.171.255.197)
1.117 ms  1.193 ms
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5 unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101) 1.157 ms unswbr1-te-2-13.gw.unsw.edu.au
(149.171.255.105) 1.259 ms 1.196 ms
 6 138.44.5.0 (138.44.5.0) 1.364 ms 1.283 ms 1.237 ms
 7 et-1-3-0.pe1.sxt.bkvl.nsw.aarnet.net.au (113.197.15.149) 2.042 ms 1.933 ms 1.912 ms
 8 et-0-0-0.pe1.a.hnl.aarnet.net.au (113.197.15.99) 95.138 ms 95.009 ms 95.054 ms
 9 et-2-1-0.bdr1.a.sea.aarnet.net.au (113.197.15.201) 146.779 ms 146.728 ms 146.734 ms
10 abilene-1-lo-jmb-706.sttlwa.pacificwave.net (207.231.240.8) 177.236 ms 177.183 ms 177.181 ms
11 ae-1.4079.rtsw.minn.net.internet2.edu (162.252.70.173) 202.113 ms 202.112 ms 201.900 ms
12 ae-1.4079.rtsw.eqch.net.internet2.edu (162.252.70.106) 207.782 ms 207.912 ms 208.805 ms
13 ae-0.4079.rtsw3.eqch.net.internet2.edu (162.252.70.163) 207.234 ms 206.994 ms 207.008 ms
14 ae-1.4079.rtsw.clev.net.internet2.edu (162.252.70.130) 212.839 ms 212.828 ms 212.848 ms
15 buf-9208-I2-CLEV.nysernet.net (199.109.11.33) 216.305 ms 217.135 ms 217.092 ms
16 syr-9208-buf-9208.nysernet.net (199.109.7.193) 219.536 ms 219.461 ms 219.401 ms
17 syr-55a1-syr-9208.nysernet.net (199.109.7.198) 220.106 ms 220.191 ms 220.096 ms
18 nyc32-55a1-syr-55a1.nysernet.net (199.109.7.206) 225.442 ms 225.389 ms 225.593 ms
19 nyc32-9208-nyc32-55a1.nysernet.net (199.109.7.201) 225.037 ms 225.134 ms 225.123 ms
20 columbia.nyc-9208.nysernet.net (199.109.4.14) 224.830 ms 224.707 ms 224.846 ms
21 cc-core-1-x-nyser32-gw-1.net.columbia.edu (128.59.255.5) 225.153 ms 225.088 ms 225.119 ms
22 cc-conc-1-x-cc-core-1.net.columbia.edu (128.59.255.21) 229.901 ms 228.887 ms 266.263 ms
23 columbiauniversity.info (128.59.105.24) 225.040 ms 225.023 ms 224.946 ms

The last trace labelled '23' is the destination, thus there are 22 routers between my workstation and www.columbia.edu.

There are 5 routers apart of the UNSW network.

Between router 7 to 9, the packets are crossing the Pacific Ocean: from NSW to Honolulu to Seattle. Which can be seen through aarnet documentation as well as the RTTs increasing drastically.

2. Traceroute to www.ucla.edu, www.u-tokyo.ac.jp, and www.lancaster.ac.uk

Traceroute to 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) 0.102 ms 0.054 ms 0.046 ms
 2 129.94.39.17 (129.94.39.17) 0.934 ms 0.869 ms 0.881 ms
 3 libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34) 1.382 ms ombudnex1-vl-3154.gw.unsw.edu.au
(149.171.253.35) 1.338 ms libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34) 1.492 ms
 4 ombcr1-po-5.gw.unsw.edu.au (149.171.255.197) 1.026 ms ombcr1-po-6.gw.unsw.edu.au
(149.171.255.169) 1.149 ms libcr1-po-6.gw.unsw.edu.au (149.171.255.201) 1.085 ms
 5 unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101) 1.153 ms 1.126 ms 1.140 ms
 6 138.44.5.0 (138.44.5.0) 1.264 ms 1.382 ms 1.344 ms
 7 et-1-3-0.pe1.sxt.bkvl.nsw.aarnet.net.au (113.197.15.149) 2.041 ms 1.867 ms 1.859 ms
 8 et-0-0-0.pe1.a.hnl.aarnet.net.au (113.197.15.99) 95.256 ms 95.202 ms 95.331 ms
 9 et-2-1-0.bdr1.a.sea.aarnet.net.au (113.197.15.201) 146.697 ms 146.696 ms 146.662 ms
10 cenichpr-1-is-jmb-778.snvaca.pacificwave.net (207.231.245.129) 163.524 ms 163.771 ms 163.553 ms
11 svl-agg10-hpr--svl-hpr3--100g.cenic.net (137.164.25.106) 163.278 ms 163.202 ms 163.171 ms
12 hpr-lax-agg10--svl-agg10-100ge.cenic.net (137.164.25.73) 160.511 ms 160.060 ms 160.448 ms
13 * * *
14 bd11f1.anderson--cr00f2.csb1.ucla.net (169.232.4.4) 160.889 ms 160.137 ms 160.118 ms
15 cr00f2.csb1--rtr11f4.mathsci.ucla.net (169.232.8.181) 160.965 ms 161.124 ms cr00f1.anderson--
rtr11f4.mathsci.ucla.net (169.232.8.185) 161.137 ms
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Traceroute to 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)  0.109 ms  0.096 ms  0.079 ms
 2  129.94.39.17 (129.94.39.17)  0.857 ms  0.814 ms  0.818 ms
 3  ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35)  50.534 ms libudnex1-vl-3154.gw.unsw.edu.au
(149.171.253.34)  1.343 ms ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35)  50.229 ms
 4  libcr1-po-6.gw.unsw.edu.au (149.171.255.201)  1.061 ms ombcr1-po-6.gw.unsw.edu.au (149.171.255.169)
1.099 ms ombcr1-po-5.gw.unsw.edu.au (149.171.255.197)  1.066 ms
 5  unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  1.096 ms unswbr1-te-1-9.gw.unsw.edu.au
(149.171.255.101)  1.131 ms unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  1.075 ms
 6  138.44.5.0 (138.44.5.0)  1.263 ms  1.235 ms  1.208 ms
 7  et-0-3-0.pe1.bkvl.nsw.aarnet.net.au (113.197.15.147)  1.700 ms  1.717 ms  1.759 ms
 8  ge-4_0_0.bb1.a.pao.aarnet.net.au (202.158.194.177)  154.952 ms  154.964 ms  154.971 ms
 9  paloalto0.iij.net (198.32.176.24)  156.514 ms  156.416 ms  156.549 ms
10  osk004bb01.IIJ.Net (58.138.88.189)  266.626 ms osk004bb00.IIJ.Net (58.138.88.185)  287.210 ms  287.226
ms
11  osk004ip57.IIJ.Net (58.138.106.194)  276.781 ms osk004ip57.IIJ.Net (58.138.106.162)  286.923 ms
osk004ip57.IIJ.Net (58.138.106.166)  276.769 ms
12  210.130.135.130 (210.130.135.130)  276.983 ms  276.956 ms  266.736 ms
13  124.83.228.58 (124.83.228.58)  276.903 ms  276.878 ms  266.743 ms
14  124.83.252.178 (124.83.252.178)  282.951 ms  282.817 ms  282.847 ms
15  158.205.134.26 (158.205.134.26)  272.737 ms  272.975 ms  272.799 ms
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Traceroute to 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)  0.098 ms  0.074 ms  0.053 ms
 2  129.94.39.17 (129.94.39.17)  0.816 ms  0.835 ms  0.843 ms
 3  libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34)  1.610 ms ombudnex1-vl-3154.gw.unsw.edu.au
(149.171.253.35)  1.351 ms libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34)  1.578 ms
```

```
 4  ombcr1-po-6.gw.unsw.edu.au (149.171.255.169)  1.059 ms  1.063 ms libcr1-po-5.gw.unsw.edu.au
(149.171.255.165)  0.996 ms
 5  unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101)  1.054 ms unswbr1-te-2-13.gw.unsw.edu.au
(149.171.255.105)  1.077 ms  1.088 ms
 6  138.44.5.0 (138.44.5.0)  1.315 ms  1.304 ms  1.244 ms
 7  et-1-3-0.pe1.sxt.bkvl.nsw.aarnet.net.au (113.197.15.149)  1.958 ms  1.915 ms  1.860 ms
 8  et-0-0-0.pe1.a.hnl.aarnet.net.au (113.197.15.99)  95.042 ms  95.029 ms  95.028 ms
 9  et-2-1-0.bdr1.a.sea.aarnet.net.au (113.197.15.201)  146.623 ms  146.620 ms  146.617 ms
10  abilene-1-lo-jmb-706.sttlwa.pacificwave.net (207.231.240.8)  179.154 ms  179.104 ms  179.135 ms
11  ae-1.4079.rtsw.minn.net.internet2.edu (162.252.70.173)  202.055 ms  202.097 ms  202.066 ms
12  ae-1.4079.rtsw.eqch.net.internet2.edu (162.252.70.106)  207.185 ms  207.140 ms  206.809 ms
13  ae-0.4079.rtsw3.eqch.net.internet2.edu (162.252.70.163)  206.953 ms  215.321 ms  215.296 ms
14  ae-1.4079.rtsw.clev.net.internet2.edu (162.252.70.130)  213.091 ms  213.032 ms  213.735 ms
15  ae-0.4079.rtsw.ashb.net.internet2.edu (162.252.70.128)  220.429 ms  220.250 ms  220.292 ms
16  ae-2.4079.rtsw2.ashb.net.internet2.edu (162.252.70.75)  220.433 ms  220.270 ms  220.272 ms
17  ae-2.4079.rtsw.wash.net.internet2.edu (162.252.70.136)  220.132 ms  220.335 ms  220.321 ms
18  internet2.mx1.lon.uk.geant.net (62.40.124.44)  294.451 ms  294.455 ms  294.517 ms
19  janet-gw.mx1.lon.uk.geant.net (62.40.124.198)  302.830 ms  302.317 ms  295.050 ms
20  ae29.londpg-sbr2.ja.net (146.97.33.2)  295.207 ms  295.230 ms  295.388 ms
21  ae31.erdiss-sbr2.ja.net (146.97.33.22)  298.925 ms  298.811 ms  301.430 ms
22  ae29.manckh-sbr2.ja.net (146.97.33.42)  300.737 ms  300.730 ms  300.655 ms
23  ae25.manckh-ban1.ja.net (146.97.35.50)  300.831 ms  300.968 ms  300.899 ms
24  lancaster-uni.ja.net (146.97.40.178)  318.275 ms  318.069 ms  318.008 ms
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Explanation:

According to the above traceroute outputs, we can see that the paths diverge from

8 et-0-0-0.pe1.a.hnl.aarnet.net.au (113.197.15.99)

for www.lancaster.ac.uk and www.ucla.edu, whereas the path diverges from

7 et-1-3-0.pe1.sxt.bkvl.nsw.aarnet.net.au (113.197.15.149)

for www.u-tokyo.ac.jp. Upon using whois, we see that these routers are under aarnet, and Australian company that provides internet and routing services.

The number of hops within a path is not directly proportional to the physical distance between my workstation and the 3 servers with the following distances respectively, 7499.0 miles (workstation to www.ucla.edu), 4908.7 miles (workstation to www.u-tokyo.ac.jp), and 10569.8 miles (workstation to www.lancaster.ac.uk). This is because there could be a concentration of hops within certain areas whereas it could take only 2 hops to cross the entire Pacific Ocean.

3. *Forward and Reverse Traceroute to and from www.speedtest.com.sg and www.telstra.net*

Forward path traceroute to 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)  0.117 ms  0.068 ms  0.045 ms
```

2 129.94.39.17 (129.94.39.17) 0.870 ms 0.862 ms 0.844 ms
 3 libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34) 39.152 ms 39.104 ms 39.127 ms
 4 ombcr1-po-6.gw.unsw.edu.au (149.171.255.169) 1.138 ms 1.139 ms 1.137 ms
 5 unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101) 1.155 ms unswbr1-te-2-13.gw.unsw.edu.au
(149.171.255.105) 1.130 ms 1.129 ms
 6 138.44.5.0 (138.44.5.0) 1.318 ms 1.251 ms 1.223 ms
 7 et-2-0-5.bdr1.sing.sin.aarnet.net.au (113.197.15.233) 92.996 ms 92.760 ms 92.745 ms
 8 ae1.bdr2.sing.sin.aarnet.net.au (113.197.15.235) 92.938 ms 92.856 ms 92.804 ms
 9 newmedia-express.sgix.sg (103.16.102.22) 93.271 ms 93.188 ms 93.183 ms
10 * * *
11 202-150-221-170.rev.ne.com.sg (202.150.221.170) 93.187 ms 93.224 ms 93.196 ms

Reverse path traceroute from www.speedtest.com.sg:

traceroute to 129.94.242.116 (129.94.242.116), 30 hops max, 60 byte packets
 1 ge2-8.r01.sin01.ne.com.sg (202.150.221.169) 0.158 ms 0.166 ms 0.180 ms
 2 10.11.34.146 (10.11.34.146) 0.441 ms 0.513 ms 0.554 ms
 3 aarnet.sgix.sg (103.16.102.67) 0.930 ms 0.959 ms 0.908 ms
 4 et-7-3-0.pe1.nsw.brwy.aarnet.net.au (113.197.15.232) 92.162 ms 92.206 ms 92.128 ms
 5 138.44.5.1 (138.44.5.1) 92.327 ms 92.406 ms 92.387 ms
 6 libcr1-te-1-5.gw.unsw.edu.au (149.171.255.102) 92.239 ms 92.250 ms 92.241 ms
 7 libudnex1-po-1.gw.unsw.edu.au (149.171.255.166) 93.306 ms 93.335 ms 93.244 ms
 8 ufw1-ae-1-3154.gw.unsw.edu.au (149.171.253.36) 93.022 ms 92.999 ms 93.086 ms
 9 129.94.39.23 (129.94.39.23) 93.063 ms 93.272 ms 93.209 ms
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Forward path traceroute to 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) 0.133 ms 0.113 ms 0.093 ms
 2 129.94.39.17 (129.94.39.17) 0.884 ms 0.868 ms 0.806 ms
 3 libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34) 1.604 ms ombudnex1-vl-3154.gw.unsw.edu.au
(149.171.253.35) 1.428 ms libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34) 1.281 ms
 4 libcr1-po-6.gw.unsw.edu.au (149.171.255.201) 1.051 ms 1.116 ms ombcr1-po-5.gw.unsw.edu.au
(149.171.255.197) 1.149 ms
 5 unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101) 1.187 ms 1.118 ms unswbr1-te-2-13.gw.unsw.edu.au
(149.171.255.105) 1.185 ms
 6 138.44.5.0 (138.44.5.0) 1.283 ms 1.232 ms 1.235 ms

7 et-1-1-0.pe1.rsby.nsw.aarnet.net.au (113.197.15.12) 2.035 ms 2.498 ms 2.581 ms
 8 xe-0-0-3.bdr1.rsby.nsw.aarnet.net.au (113.197.15.31) 1.451 ms 1.475 ms 1.460 ms
 9 HundredGigE0-1-0-4.ken-edge903.sydney.telstra.net (139.130.0.77) 2.331 ms 2.401 ms 2.692 ms
10 bundle-ether2.chw-edge903.sydney.telstra.net (203.50.11.175) 2.532 ms 2.676 ms bundle-ether17.ken-core10.sydney.telstra.net (203.50.11.172) 2.229 ms
11 bundle-ether10.win-core10.melbourne.telstra.net (203.50.11.123) 13.510 ms bundle-ether17.chw-core10.sydney.telstra.net (203.50.11.176) 3.453 ms bundle-ether10.win-core10.melbourne.telstra.net (203.50.11.123) 13.393 ms
12 bundle-ether8.exi-core10.melbourne.telstra.net (203.50.11.125) 16.551 ms bundle-ether1-2.exi-core10.melbourne.telstra.net (203.50.6.40) 15.164 ms 15.149 ms
13 203.50.11.209 (203.50.11.209) 14.950 ms 14.390 ms 14.853 ms
14 www.telstra.net (203.50.5.178) 13.607 ms 14.364 ms 14.539 ms

Reverse path traceroute from www.telstra.net:

1 gigabitethernet3-3.exi2.melbourne.telstra.net (203.50.77.53) 0.240 ms 0.214 ms 0.244 ms
 2 bundle-ether3-100.win-core10.melbourne.telstra.net (203.50.80.129) 2.623 ms 1.483 ms 2.246 ms
 3 bundle-ether12.ken-core10.sydney.telstra.net (203.50.11.122) 11.882 ms 12.119 ms 12.602 ms
 4 bundle-ether1.ken-edge903.sydney.telstra.net (203.50.11.173) 12.223 ms 12.115 ms 12.223 ms
 5 aar3533567.lnk.telstra.net (139.130.0.78) 11.608 ms 11.615 ms 11.601 ms
 6 et-7-1-0.pe1.brwy.nsw.aarnet.net.au (113.197.15.13) 11.856 ms 11.869 ms 12.970 ms
 7 138.44.5.1 (138.44.5.1) 12.102 ms 11.990 ms 12.106 ms
 8 ombcr1-te-1-5.gw.unsw.edu.au (149.171.255.106) 12.100 ms 12.112 ms 12.108 ms
 9 ombudnex1-po-2.gw.unsw.edu.au (149.171.255.170) 12.482 ms 12.365 ms 12.354 ms
10 ufw1-ae-1-3154.gw.unsw.edu.au (149.171.253.36) 12.843 ms 12.862 ms 12.732 ms
11 129.94.39.23 (129.94.39.23) 12.852 ms 12.954 ms 12.848 ms

The IP addresses of www.speedtest.com.sg and www.telstra.net are 202.150.221.170 and 203.50.5.178 respectively (using nslookup). Comparing the forward and reverse path traceroutes to and from the workstation and the servers clearly shows that the paths taken are not exactly the same for each path. Also, looking at the traceroutes of each, it is clear the common routers often have different IPs attached – this is because routers often have multiple interfaces to connect with that router and thus multiple IP addresses.

Exercise 4: Use ping to gain insights into network performance

1. Approximate physical distance and graphs

Shortest possible times:

www.uq.edu.au approx. distance from UNSW is 736 km.

T = (736 x 1000) / (3 x 10^8)

T = 2.45 ms
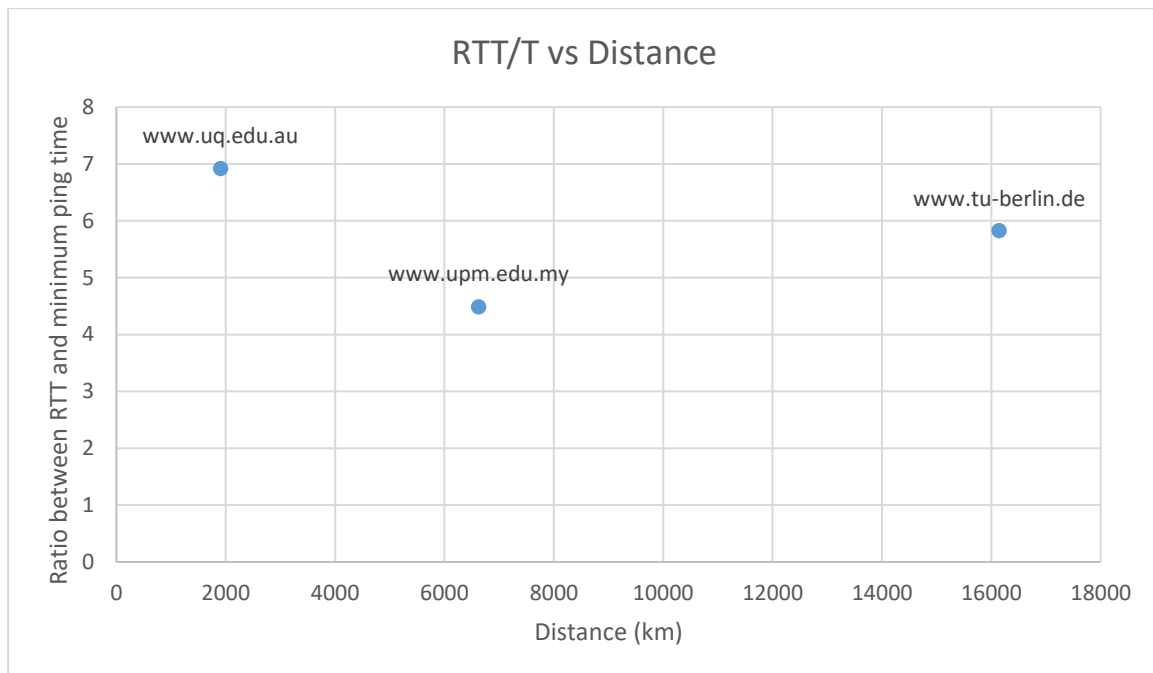

www.upm.edu.my approx. distance from UNSW is 6624 km.

T = (6624 x 1000) / (3 x 10^8)

T = 22.08 ms

www.tu-berlin.de approx. distance from UNSW is 16106 km.

T = (16106 x 1000) / (3 x 10^8)

T = 53.67 ms

As you can see, on the y-axis the ratio of RTT to minimum ping time are plotted and clearly show that all the ratios are above 2. This is because of the assumption that propagation of packets travelled at the speed of light which, in reality, does not occur within the optical fibre cables that would propagate the packets. Additionally, a combination of different mediums would be used along the chain of transmission of the packets and thus, lower speeds that the speed of light – for example copper wiring. Also queueing delay across the path to the destination would also contribute to a higher RTT than 2*T. Thus, the minimum ping time is much smaller than the actual RTT which results in the high ratio seen above.

2. *Delay to destinations*

The delay to each destination is not constant and varies over time. This is because many links along the path to each destination may experience varying degrees of congestion – affecting the queueing delay.

3. *Hosting location of www.epfl.ch*

In order to check where the website is hosted, we perform various checks:

- Ping check – very low ping RTT is exhibited.

```
PING www.epfl.ch.cdn.cloudflare.net (104.20.228.42) 56(84) bytes of data.
64 bytes from 104.20.228.42: icmp_seq=1 ttl=56 time=1.46 ms
64 bytes from 104.20.228.42: icmp_seq=2 ttl=56 time=1.48 ms
64 bytes from 104.20.228.42: icmp_seq=3 ttl=56 time=1.59 ms
64 bytes from 104.20.228.42: icmp_seq=4 ttl=56 time=1.59 ms
64 bytes from 104.20.228.42: icmp_seq=5 ttl=56 time=1.66 ms
64 bytes from 104.20.228.42: icmp_seq=6 ttl=56 time=1.55 ms
64 bytes from 104.20.228.42: icmp_seq=7 ttl=56 time=1.55 ms
64 bytes from 104.20.228.42: icmp_seq=8 ttl=56 time=1.60 ms
64 bytes from 104.20.228.42: icmp_seq=9 ttl=56 time=1.52 ms
64 bytes from 104.20.228.42: icmp_seq=10 ttl=56 time=1.51 ms
64 bytes from 104.20.228.42: icmp_seq=11 ttl=56 time=1.55 ms
64 bytes from 104.20.228.42: icmp_seq=12 ttl=56 time=1.57 ms
64 bytes from 104.20.228.42: icmp_seq=13 ttl=56 time=1.49 ms
64 bytes from 104.20.228.42: icmp_seq=14 ttl=56 time=1.55 ms
64 bytes from 104.20.228.42: icmp_seq=15 ttl=56 time=1.57 ms
64 bytes from 104.20.228.42: icmp_seq=16 ttl=56 time=1.53 ms
^C
--- www.epfl.ch.cdn.cloudflare.net ping statistics ---
16 packets transmitted, 16 received, 0% packet loss, time 15024ms
rtt min/avg/max/mdev = 1.467/1.552/1.664/0.064 ms
```

- Traceroute check – relatively short traceroute output with low RTT.

```
traceroute to www.epfl.ch (104.20.229.42), 30 hops max, 60 byte packets
 1  cserouter1-server.cse.unsw.EDU.AU (129.94.242.251)  0.073 ms  0.063 ms  0.071 ms
 2  129.94.39.17 (129.94.39.17)  0.889 ms  0.900 ms  0.870 ms
 3  libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34)  1.329 ms ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35)  1.251
 ms  1.359 ms
 4  libcr1-po-5.gw.unsw.edu.au (149.171.255.165)  1.097 ms ombcr1-po-5.gw.unsw.edu.au (149.171.255.197)  1.072 ms libcr1
-po-5.gw.unsw.edu.au (149.171.255.165)  1.080 ms
 5  unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  1.208 ms unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101)  1.217 ms
  1.148 ms
 6  138.44.5.0 (138.44.5.0)  1.260 ms  1.261 ms  1.253 ms
 7  ae2.bdr1.msc4.nsw.aarnet.net.au (113.197.15.77)  1.500 ms  1.539 ms  1.683 ms
 8  as4826.bdr1.msc4.nsw.aarnet.net.au (138.44.10.45)  3.470 ms  3.758 ms  3.456 ms
 9  be107.cor01.syd11.nsw.vocus.network (114.31.192.80)  2.133 ms be107.cor02.syd04.nsw.vocus.network (114.31.192.82)  2
.357 ms be107.cor01.syd11.nsw.vocus.network (114.31.192.80)  2.118 ms
10  be101.bdr02.syd03.nsw.vocus.network (114.31.192.37)  3.949 ms  2.352 ms be100.bdr02.syd03.nsw.vocus.network (114.31.
192.39)  2.229 ms
11  as13335.bdr02.syd03.nsw.VOCUS.net.au (175.45.124.197)  3.468 ms  3.014 ms  3.322 ms
12  104.20.229.42 (104.20.229.42)  1.547 ms  1.606 ms  1.636 ms
```

- Dig check – upon checking with dig, it's revealed that the website is actually hosted in

  Australia by cloudflare.

```
; <<>> DiG 9.9.5-9+deb8u19-Debian <<>> -x 104.20.229.42
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NXDOMAIN, id: 14481
;; flags: qr rd ra; QUERY: 1, ANSWER: 0, AUTHORITY: 1, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 4096
;; QUESTION SECTION:
;42.229.20.104.in-addr.arpa.     IN      PTR

;; AUTHORITY SECTION:
20.104.in-addr.arpa.    2009    IN      SOA     cruz.ns.cloudflare.com. dns.cloudflare.com. 2034580120 10000 2400 604800
 3600

;; Query time: 0 msec
;; SERVER: 129.94.242.45#53(129.94.242.45)
;; WHEN: Tue Mar 02 03:12:29 AEDT 2021
;; MSG SIZE  rcvd: 117
```

4. *Dependence of delay on packet size*

Out of the 4 delays, only the transmission delay is affect by the packet size. Queuing,
propagation and processing are unaffected by packet size.

Appendix – outputs and graphs

www.uq.edu.au_avg.txt
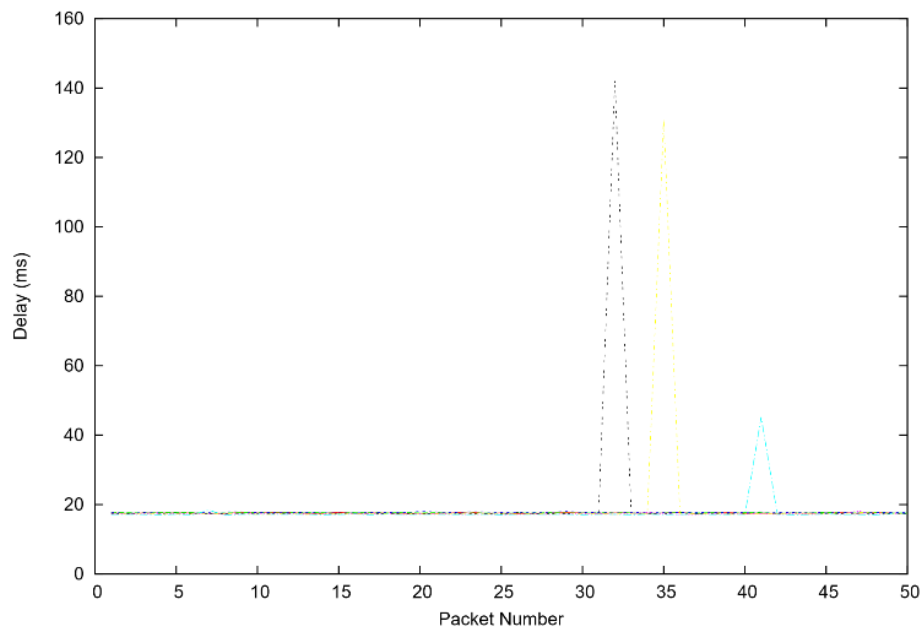
50 17.778 16.953

250 17.373 17.180

500 19.710 17.240
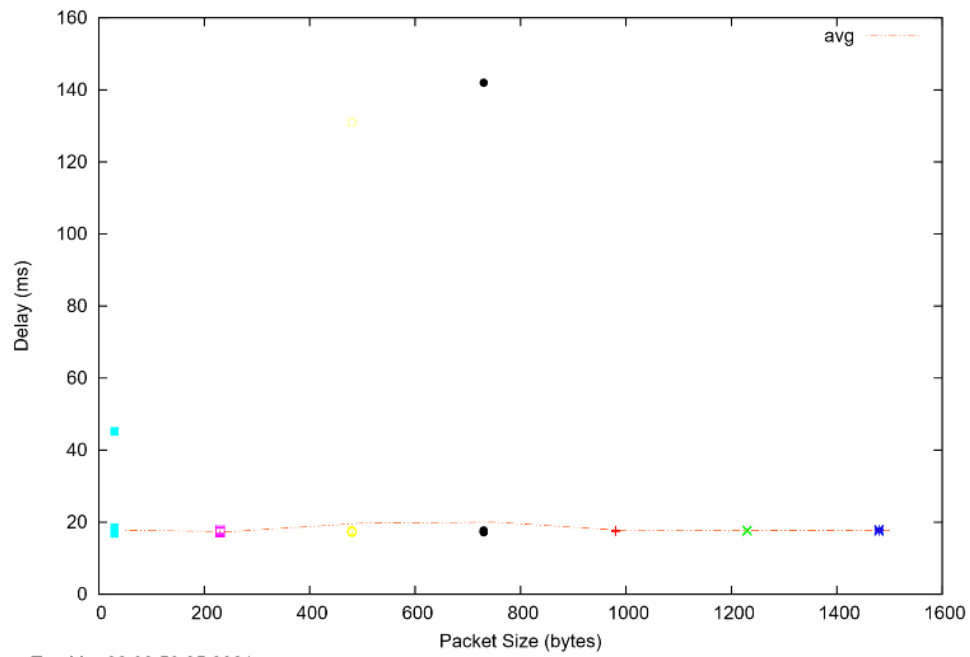
750 20.020 17.285

1000 17.626 17.455

1250 17.695 17.513

1500 17.795 17.578

www.uq.edu.au_delay.pdf

Tue Mar 02 00:58:05 2021

www.uq.edu.au_scatter.pdf

Tue Mar 02 00:58:05 2021

www.upm.edu.my_avg.txt

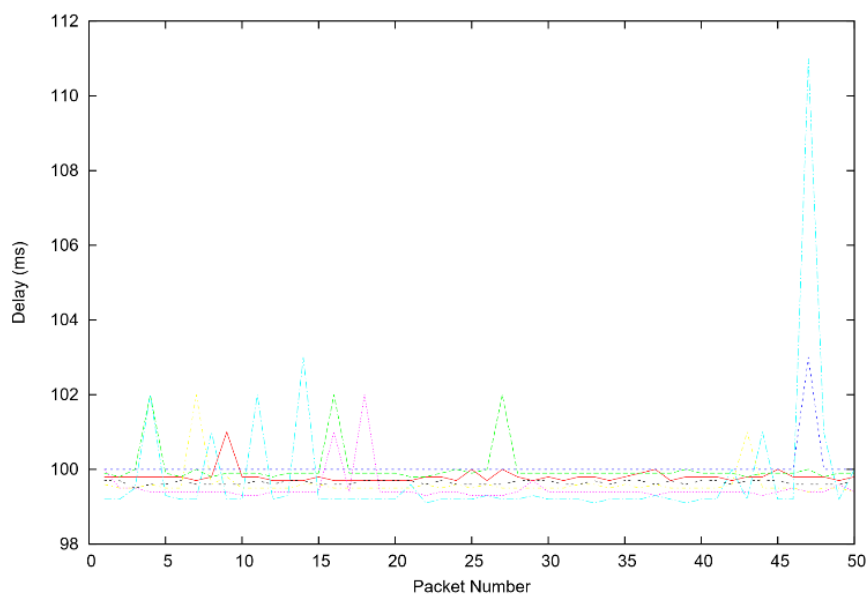50 99.909 99.147

250 99.575 99.325

500 99.677 99.446
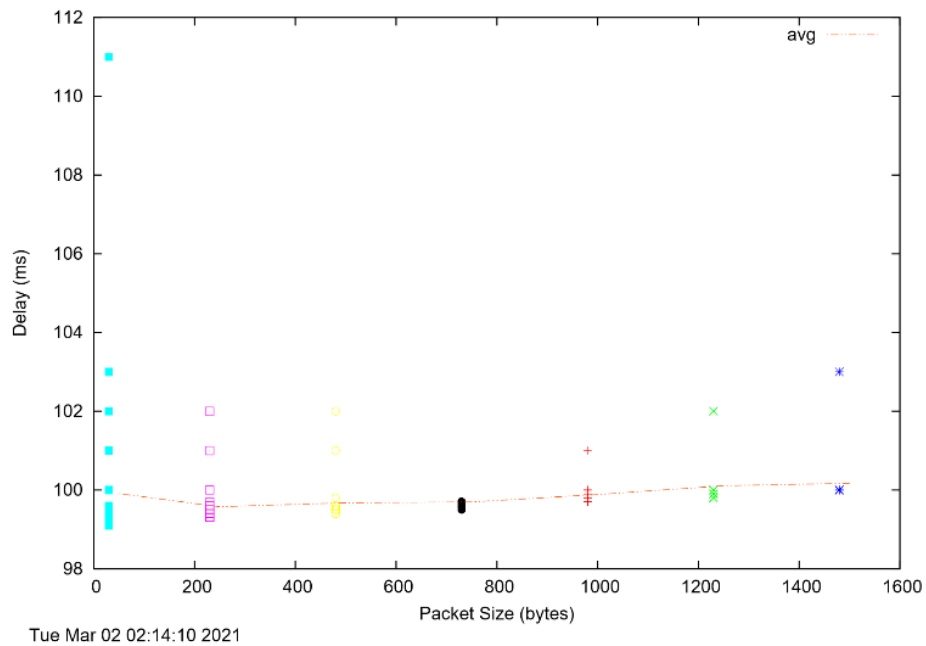
750 99.697 99.550

1000 99.885 99.724

1250 100.108 99.831

1500 100.174 100.007

www.upm.edu.my_delay.pdf

Tue Mar 02 02:14:10 2021

www.upm.edu.my_scatter.pdf

Tue Mar 02 02:14:10 2021

www.tu-berlin.de_avg.txt

50 312.828 312.702

250 312.926 312.798

500 313.070 312.926

750 313.104 312.981

1000 313.206 313.104

1250 313.334 313.213

1500 313.427 313.283

www.tu-berlin.de_delay.pdf

Tue Mar 02 00:58:44 2021

www.tu-berlin.de_scatter.pdf

Tue Mar 02 00:58:44 2021