

report.md - Grip

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Question 1

Part 1

- IP address(es) of the website www.koala.com.au : 104.18.60.21 , 104.18.61.21
- It has multiple IP addresses because it is using multiple servers (clustered servers) to balance the load better (DNS load balancing).

Part 2

- IP address 127.0.0.1 has the name "localhost". It is also referred to as the "loopback address".
- This IP address is special as it is the IP address your computer uses to refer to itself

Question 2

host	reachable (ping, web)	reason
www.unsw.edu.au	y, y	
www.getfittest.com.au	n, n	name or service not known
www.mit.edu	y, y	
www.intel.com.au	y, y	
www.tpg.com.au	y, y	
www.hola.hp	n, n	name or service not known (guessing it should be www.holahp.com)
www.amazon.com	y, y	
www.tsinghua.edu.cn	y, y	
www.kremlin.ru	n, y	ping is sometimes blocked because for security (prevent DOS)
8.8.8.8	y, n	it is the google public DNS server (no web interface/service)

Question 3

Part 1

```
$ traceroute www.columbia.edu
traceroute to www.columbia.edu (128.59.105.24), 30 hops max, 60 byte packets
 1 * * *
 2 ufw1-ae-1-3161.gw.unsw.edu.au (149.171.253.92)  2.676 ms  7.315 ms  7.314 ms
 3 libwdr1-vl-3090.gw.unsw.edu.au (149.171.253.66)  7.919 ms  7.928 ms  7.910 ms
 4 ombcr1-te-4-5.gw.unsw.edu.au (149.171.255.77)  7.893 ms  7.805 ms  7.768 ms
 5 unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  9.253 ms * *
 6 138.44.5.0 (138.44.5.0)  48.137 ms  45.743 ms  41.037 ms
 7 et-1-3-0.pe1.sxt.bkvl.nsw.aarnet.net.au (113.197.15.149)  40.909 ms  40.305 ms  40.248 ms
 8 et-0-0-0.pe1.a.hnl.aarnet.net.au (113.197.15.99)  120.516 ms  121.568 ms  121.555 ms
 9 et-2-1-0.bdr1.a.sea.aarnet.net.au (113.197.15.201)  177.054 ms  175.847 ms  158.879 ms
10 abilene-1-lo-jmb-706.sttlwa.pacificwave.net (207.231.240.8)  159.852 ms  159.837 ms  159.807 ms
11 et-4-0-0.4079.rtsw.miss2.net.internet2.edu (162.252.70.0)  160.415 ms  189.410 ms  189.381 ms
12 et-4-0-0.4079.rtsw.minn.net.internet2.edu (162.252.70.58)  189.361 ms  189.342 ms  189.324 ms
13 et-1-1-5.4079.rtsw.eqch.net.internet2.edu (162.252.70.106)  190.944 ms  194.258 ms  194.689 ms
14 ae-0.4079.rtsw3.eqch.net.internet2.edu (162.252.70.163)  192.283 ms  189.605 ms  191.005 ms
15 ae-1.4079.rtsw.clev.net.internet2.edu (162.252.70.130)  199.549 ms  206.273 ms  205.475 ms
16 buf-9208-I2-CLEV.nysernet.net (199.109.11.33)  218.302 ms  205.937 ms  210.242 ms
17 syr-9208-buf-9208.nysernet.net (199.109.7.193)  215.310 ms  223.124 ms  223.134 ms
18 nyc111-9204-syr-9208.nysernet.net (199.109.7.94)  236.115 ms  229.747 ms  229.727 ms
19 nyc-9208-nyc111-9204.nysernet.net (199.109.7.165)  229.707 ms  229.704 ms  229.667 ms
20 columbia.nyc-9208.nysernet.net (199.109.4.14)  229.650 ms  229.635 ms  229.622 ms
21 cc-core-1-x-nyser32-gw-1.net.columbia.edu (128.59.255.5)  229.608 ms  229.593 ms  229.579 ms
22 cc-conc-1-x-cc-core-1.net.columbia.edu (128.59.255.21)  317.033 ms  291.332 ms  314.293 ms
23 ci.columbia.edu (128.59.105.24)  313.894 ms  313.016 ms  325.494 ms
```

- the last one is the destination (www.columbia.edu (128.59.105.24)), so there are 22 routers between my machine and the destination server
- whois says that the first 5 routers are situated at unsw, whilst the aarnet routers 6-8 are in Kensington Perth. However, the latencies would seem to suggest that packets actually start crossing the ocean between routers 7 and 8 (significant increase in latency).

Part 2

```
$ traceroute www.ucla.edu
traceroute to www.ucla.edu (164.67.228.152), 30 hops max, 60 byte packets
 1 * * *
 2 ufw1-ae-1-3161.gw.unsw.edu.au (149.171.253.92)  4.964 ms  5.447 ms  5.431 ms
 3 libwdr1-vl-3090.gw.unsw.edu.au (149.171.253.66)  5.892 ms  5.876 ms  5.851 ms
 4 ombcr1-te-4-5.gw.unsw.edu.au (149.171.255.77)  5.322 ms  5.298 ms  5.771 ms
 5 unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  6.152 ms  6.412 ms  7.261 ms
 6 138.44.5.0 (138.44.5.0)  7.958 ms  4.540 ms  4.218 ms
 7 et-1-3-0.pe1.sxt.bkvl.nsw.aarnet.net.au (113.197.15.149)  4.690 ms  4.929 ms  4.934 ms
 8 et-0-0-0.pe1.a.hnl.aarnet.net.au (113.197.15.99)  98.432 ms  98.435 ms  98.416 ms
 9 et-2-1-0.bdr1.a.sea.aarnet.net.au (113.197.15.201)  149.561 ms  149.924 ms  150.155 ms
10 cenichpr-1-is-jmb-778.snva.pacificwave.net (207.231.245.129)  164.874 ms  165.335 ms  164.449 ms
11 hpr-lax-hpr3--svl-hpr3-100ge.cenic.net (137.164.25.73)  161.460 ms  160.750 ms  161.272 ms
12 * * *
13 bd11f1.anderson--cr00f2.csb1.ucla.net (169.232.4.4)  163.108 ms bd11f1.anderson--cr001.anderson.ucla.net (169.232.4.6)  161.874 ms :
14 cr00f1.anderson--dr00f2.csb1.ucla.net (169.232.4.55)  162.060 ms cr00f2.csb1--dr00f2.csb1.ucla.net (169.232.4.53)  161.205 ms cr00f1
15 * * *
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...
30 * * *

$ traceroute www.u-tokyo.ac.jp
traceroute to www.u-tokyo.ac.jp (210.152.243.234), 30 hops max, 60 byte packets
 1 * * *
 2 ufw1-ae-1-3161.gw.unsw.edu.au (149.171.253.92) 3.282 ms 3.593 ms 4.190 ms
 3 libwdr1-vl-3090.gw.unsw.edu.au (149.171.253.66) 4.185 ms 5.059 ms 5.042 ms
 4 libcr1-te-4-5.gw.unsw.edu.au (149.171.255.89) 5.021 ms 4.999 ms 6.003 ms
 5 unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101) 8.076 ms 8.073 ms 8.053 ms
 6 138.44.5.0 (138.44.5.0) 8.024 ms 4.902 ms 4.965 ms
 7 et-0-3-0.pe1.bkvl.nsw.aarnet.net.au (113.197.15.147) 6.065 ms 6.046 ms 7.524 ms
 8 ge-4_0_0.bb1.a.pao.aarnet.net.au (202.158.194.177) 160.449 ms 160.656 ms 161.040 ms
 9 paloalto0.iij.net (198.32.176.24) 163.669 ms 161.576 ms 161.267 ms
10 osk004bb01.IIJ.Net (58.138.88.189) 274.921 ms osk004bb00.IIJ.Net (58.138.88.185) 292.663 ms 293.366 ms
11 osk004ip57.IIJ.Net (58.138.106.162) 283.762 ms 282.162 ms osk004ip57.IIJ.Net (58.138.106.166) 273.652 ms
12 210.130.135.130 (210.130.135.130) 280.697 ms 280.163 ms 280.403 ms
13 124.83.228.58 (124.83.228.58) 300.389 ms 288.673 ms 280.064 ms
14 124.83.252.178 (124.83.252.178) 286.619 ms 295.013 ms 286.261 ms
15 158.205.134.26 (158.205.134.26) 286.515 ms 300.119 ms 277.247 ms
16 * * *
...
30 * * *

$ traceroute www.lancaster.ac.uk
traceroute to www.lancaster.ac.uk (148.88.65.80), 30 hops max, 60 byte packets
 1 * * *
 2 ufw1-ae-1-3161.gw.unsw.edu.au (149.171.253.92) 1.740 ms 1.731 ms 1.703 ms
 3 libwdr1-vl-3090.gw.unsw.edu.au (149.171.253.66) 1.977 ms 1.957 ms 1.926 ms
 4 ombcr1-te-4-5.gw.unsw.edu.au (149.171.255.77) 2.822 ms 2.810 ms 2.780 ms
 5 unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105) 2.733 ms 2.718 ms 2.675 ms
 6 138.44.5.0 (138.44.5.0) 2.648 ms 2.645 ms 2.824 ms
 7 et-2-0-5.bdr1.sing.sin.aarnet.net.au (113.197.15.233) 94.365 ms 94.050 ms 94.138 ms
 8 138.44.226.7 (138.44.226.7) 314.685 ms 313.786 ms 313.912 ms
 9 janet-gw.mx1.lon.uk.geant.net (62.40.124.198) 314.055 ms 314.525 ms 314.235 ms
10 ae29.londpg-sbr2.ja.net (146.97.33.2) 315.127 ms 314.719 ms 314.069 ms
11 ae31.erdiss-sbr2.ja.net (146.97.33.22) 314.205 ms 288.911 ms 289.007 ms
12 ae29.manckh-sbr2.ja.net (146.97.33.42) 289.228 ms 269.932 ms 263.717 ms
13 ae24.lanclu-rbr1.ja.net (146.97.38.58) 269.818 ms 295.547 ms 295.590 ms
14 lancaster-university.ja.net (194.81.46.2) 309.516 ms 309.608 ms 309.816 ms
15 is-border01.bfw01.rtr.lancs.ac.uk (148.88.253.202) 308.808 ms 308.817 ms 308.771 ms
16 bfw01.iss-servers.iss-core01.rtr.lancs.ac.uk (148.88.250.98) 308.774 ms 308.918 ms 308.944 ms
17 * * *
18 www.lancs.ac.uk (148.88.65.80) 303.117 ms !X 303.060 ms !X 303.029 ms !X

```

- Tokyo diverges from the other two at router 4 (**A**: libcr1-te-4-5.gw.unsw.edu.au (149.171.255.89) VS **B**: ombcr1-te-4-5.gw.unsw.edu.au (149.171.255.77))
- Lancaster and UCLA then diverge from each other at router 7 (**C**: et-2-0-5.bdr1.sing.sin.aarnet.net.au (113.197.15.233) VS **D**: et-1-3-0.pe1.sxt.bkvl.nsw.aarnet.net.au (113.197.15.149))
- both router A and B appear to be in the same place in Sydney (near Central)
- both router C and D appear to be located in the upper-middle of South Australia.
- UCLA distance/time relationship : the last router, router 14, took an average of 161 ms to reach and appears to be located near Long Beach, Los Angeles (~12,000km as the crow flies).
- TOKYO distance/time relationship : router 15 took an average of 288 ms to reach and appears to be located near Nagano, Japan (~8000km as the crow flies)
- LANCASTER distance/time relationship : router 18 took an average of 303 ms to reach and appears to be located near Lancaster, UK (~12,000km as the crow flies)
- This would suggest that the number of hops is kind of proportional to the distance in that with a longer distance you are more likely to get more hops BUT you can have a longer/same length path with less hops (e.g. 15 vs 18 as shown above). So just because the distance between your computer and server x is larger than server y, doesn't necessarily mean there will be more hops on the way to x (but it is more likely).

Part 3

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http://www.speedtest.com.sg/tr.php to me
traceroute to 129.94.8.96 (129.94.8.96), 30 hops max, 60 byte packets
 1 ge2-8.r01.sin01.ne.com.sg (202.150.221.169) 0.154 ms 0.174 ms 0.186 ms
 2 10.15.62.210 (10.15.62.210) 0.201 ms 0.275 ms 0.283 ms
 3 aarnet.sgix.sg (103.16.102.67) 250.672 ms 250.683 ms 250.692 ms
 4 et-7-3-0.pe1.nsw.brwy.aarnet.net.au (113.197.15.232) 209.172 ms 209.120 ms 209.139 ms
 5 138.44.5.1 (138.44.5.1) 218.799 ms 218.833 ms 218.719 ms
 6 libcr1-te-1-5.gw.unsw.edu.au (149.171.255.102) 381.874 ms 380.080 ms 378.951 ms
 7 libwdr1-te-1-1.gw.unsw.edu.au (149.171.255.90) 204.330 ms ombwdr1-te-1-1.gw.unsw.edu.au (149.171.255.94) 213.656 ms 213.778 ms
 8 cfw1-ae-1-3090.gw.unsw.edu.au (149.171.253.68) 204.945 ms 204.932 ms 204.977 ms
 9 * * *
...
30 * * *

$ traceroute 202.150.221.169
traceroute to 202.150.221.169 (202.150.221.169), 30 hops max, 60 byte packets
 1 * * *
 2 ufw1-ae-1-3161.gw.unsw.edu.au (149.171.253.92) 19.787 ms 19.775 ms 19.700 ms
 3 libwdr1-vl-3090.gw.unsw.edu.au (149.171.253.66) 19.622 ms 19.571 ms 19.564 ms
 4 libcr1-te-4-5.gw.unsw.edu.au (149.171.255.89) 19.521 ms 19.864 ms 19.853 ms
 5 unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101) 19.837 ms 19.805 ms 19.790 ms
 6 138.44.5.0 (138.44.5.0) 19.767 ms 7.818 ms 7.800 ms
 7 et-0-3-0.pe1.alxd.nsw.aarnet.net.au (113.197.15.153) 7.780 ms 9.156 ms 7.722 ms
 8 xe-0-2-7.bdr1.a.lax.aarnet.net.au (202.158.194.173) 186.938 ms 186.888 ms 186.663 ms
 9 singtel.as7473.any2ix.coresite.com (206.72.210.63) 186.619 ms 186.598 ms 186.579 ms
10 203.208.171.117 (203.208.171.117) 237.018 ms 239.096 ms 231.768 ms
11 203.208.173.73 (203.208.173.73) 256.558 ms 203.208.177.110 (203.208.177.110) 333.877 ms 333.814 ms
12 * * *
13 203.208.158.185 (203.208.158.185) 386.178 ms * *
14 * * *
...
30 * * *

https://www.telstra.net/cgi-bin/trace
 1 gigabitethernet3-3.exi2.melbourne.telstra.net (203.50.77.53) 0.298 ms 0.215 ms 0.245 ms
 2 bundle-ether3-100.win-core10.melbourne.telstra.net (203.50.80.129) 2.118 ms 1.612 ms 2.119 ms
 3 bundle-ether12.ken-core10.sydne.telstra.net (203.50.11.122) 13.006 ms 11.852 ms 12.616 ms
 4 bundle-ether1.ken-edge901.sydne.telstra.net (203.50.11.95) 11.853 ms 13.241 ms 11.978 ms
 5 aarnet6.lnk.telstra.net (139.130.0.78) 11.725 ms 11.617 ms 11.605 ms
 6 xe-5-2-2.pe1.brwy.nsw.aarnet.net.au (113.197.15.32) 11.844 ms 11.866 ms 11.854 ms

```

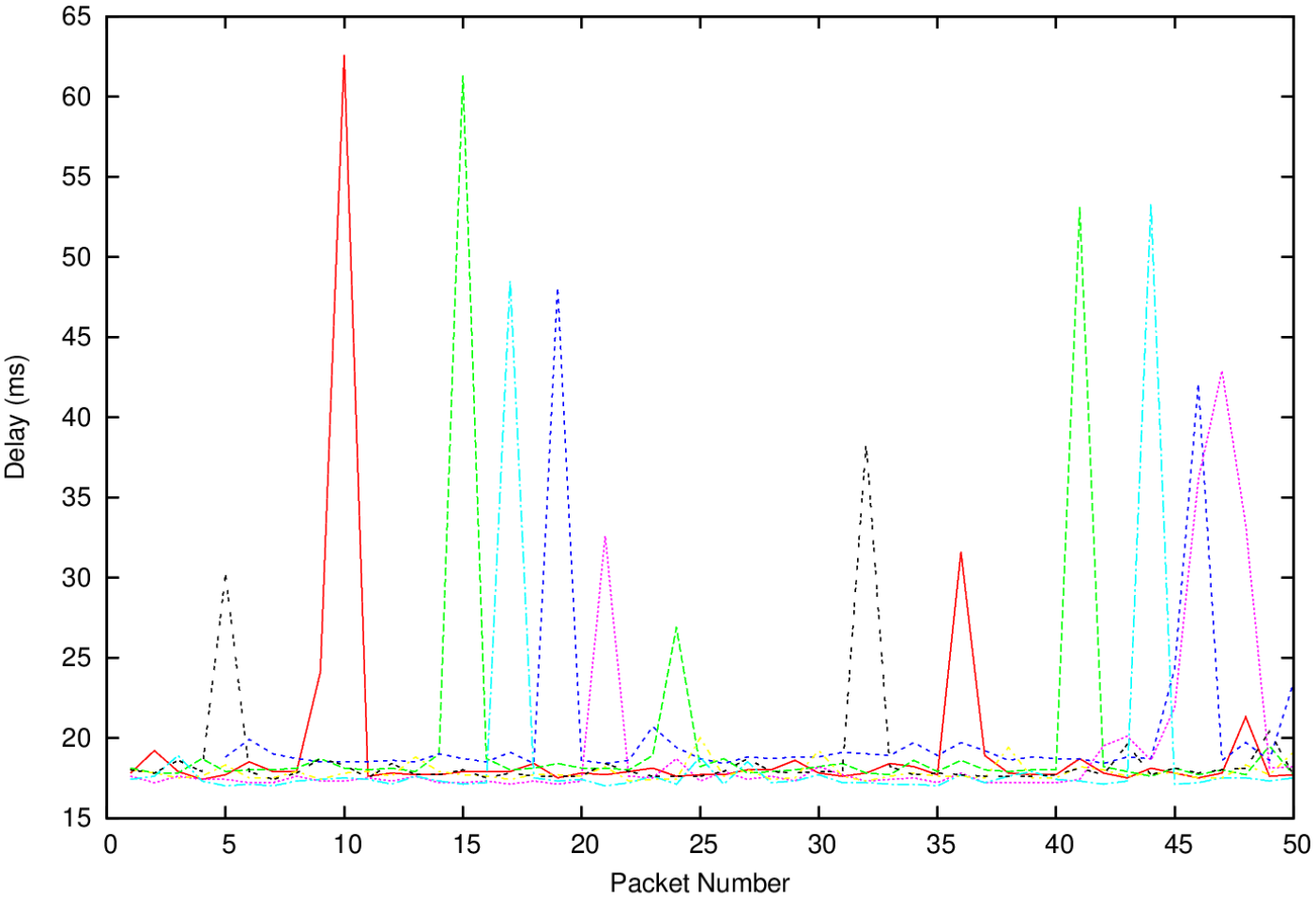
```
7 138.44.5.1 (138.44.5.1) 12.097 ms 11.994 ms 12.100 ms
8 ombcr1-te-1-5.gw.unsw.edu.au (149.171.255.106) 12.098 ms 11.987 ms 11.974 ms
9 libwdr1-te-1-2.gw.unsw.edu.au (149.171.255.78) 12.098 ms 44.674 ms 50.338 ms
10 cfw1-ae-1-3090.gw.unsw.edu.au (149.171.253.68) 12.725 ms 12.578 ms 12.724 ms

$ traceroute 203.50.77.53
traceroute to 203.50.77.53 (203.50.77.53), 30 hops max, 60 byte packets
1 * * *
2 ufw1-ae-1-3161.gw.unsw.edu.au (149.171.253.92) 9.482 ms 9.487 ms 9.459 ms
3 libwdr1-vl-3090.gw.unsw.edu.au (149.171.253.66) 9.436 ms 9.510 ms 10.306 ms
4 libcr1-te-4-5.gw.unsw.edu.au (149.171.255.89) 10.099 ms 10.427 ms 11.214 ms
5 unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101) 12.223 ms 11.807 ms 12.348 ms
6 138.44.5.0 (138.44.5.0) 12.924 ms 3.778 ms 5.741 ms
7 xe-0-0-0.bdr1.rsby.nsw.aarnet.net.au (113.197.15.33) 5.838 ms 6.428 ms 6.380 ms
8 gigabitethernet3-11.ken37.sydney.telstra.net (139.130.0.77) 5.877 ms 5.739 ms 5.540 ms
9 bundle-ether13.ken-core10.sydney.telstra.net (203.50.11.94) 5.218 ms 6.526 ms 5.546 ms
10 bundle-ether10.win-core10.melbourne.telstra.net (203.50.11.123) 15.911 ms 14.144 ms 16.584 ms
11 tengigabitethernet8-1.exi2.melbourne.telstra.net (203.50.80.154) 15.149 ms * *
```

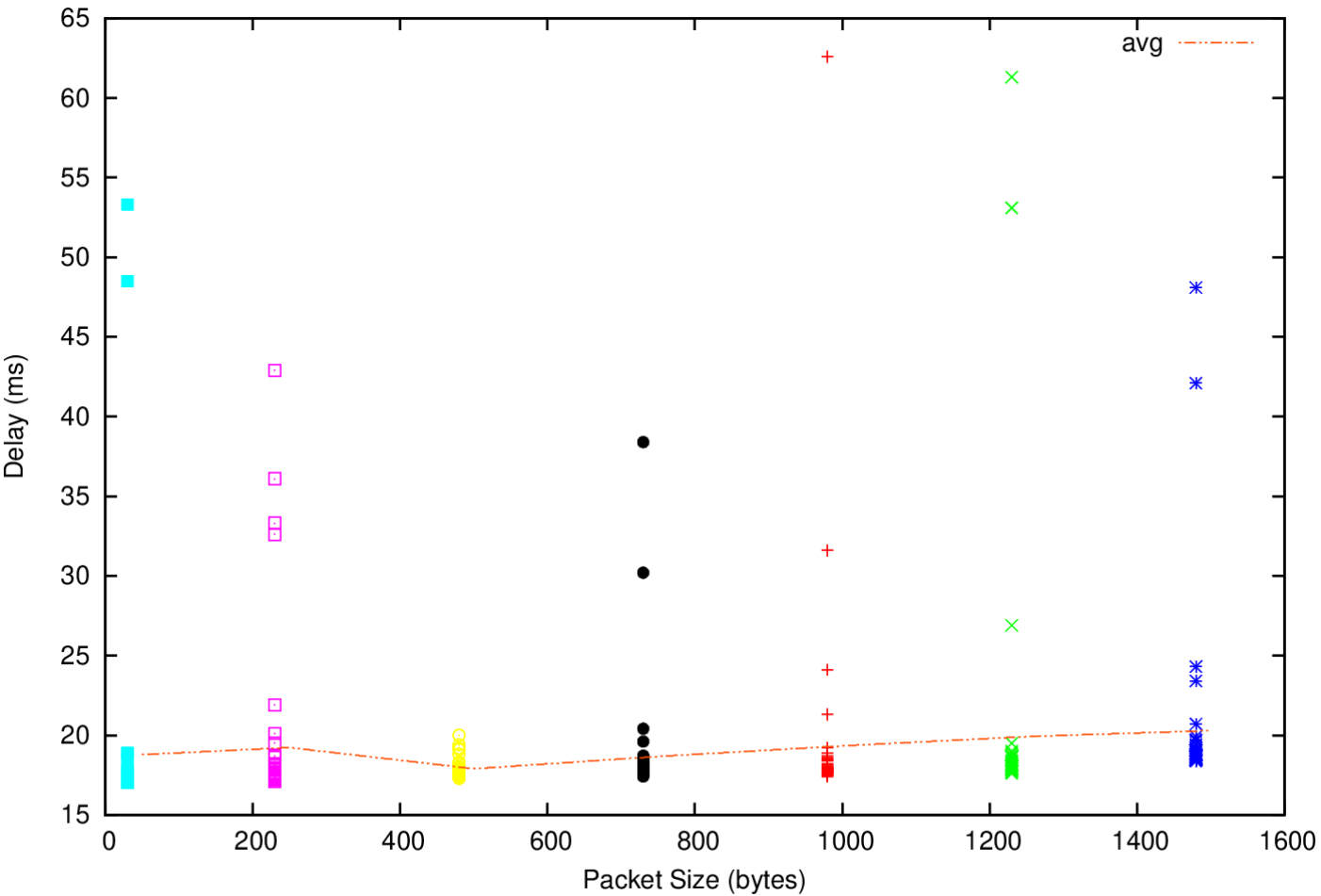
- I chose to use the two given servers, speedtest - 202.150.221.169 and telstra - 203.50.77.53
- Both go through different paths in the two directions but there do appear to be common routers e.g. the unsw library ones and also 138.44.5.0/1 which appears in both paths. The last part of the IP addresses do appear to change though, and this is perhaps because slightly different interfaces are used for handling traffic going in a specific direction.

Question 4

Brisbane script outputs



Sun Sep 29 15:56:33 2019

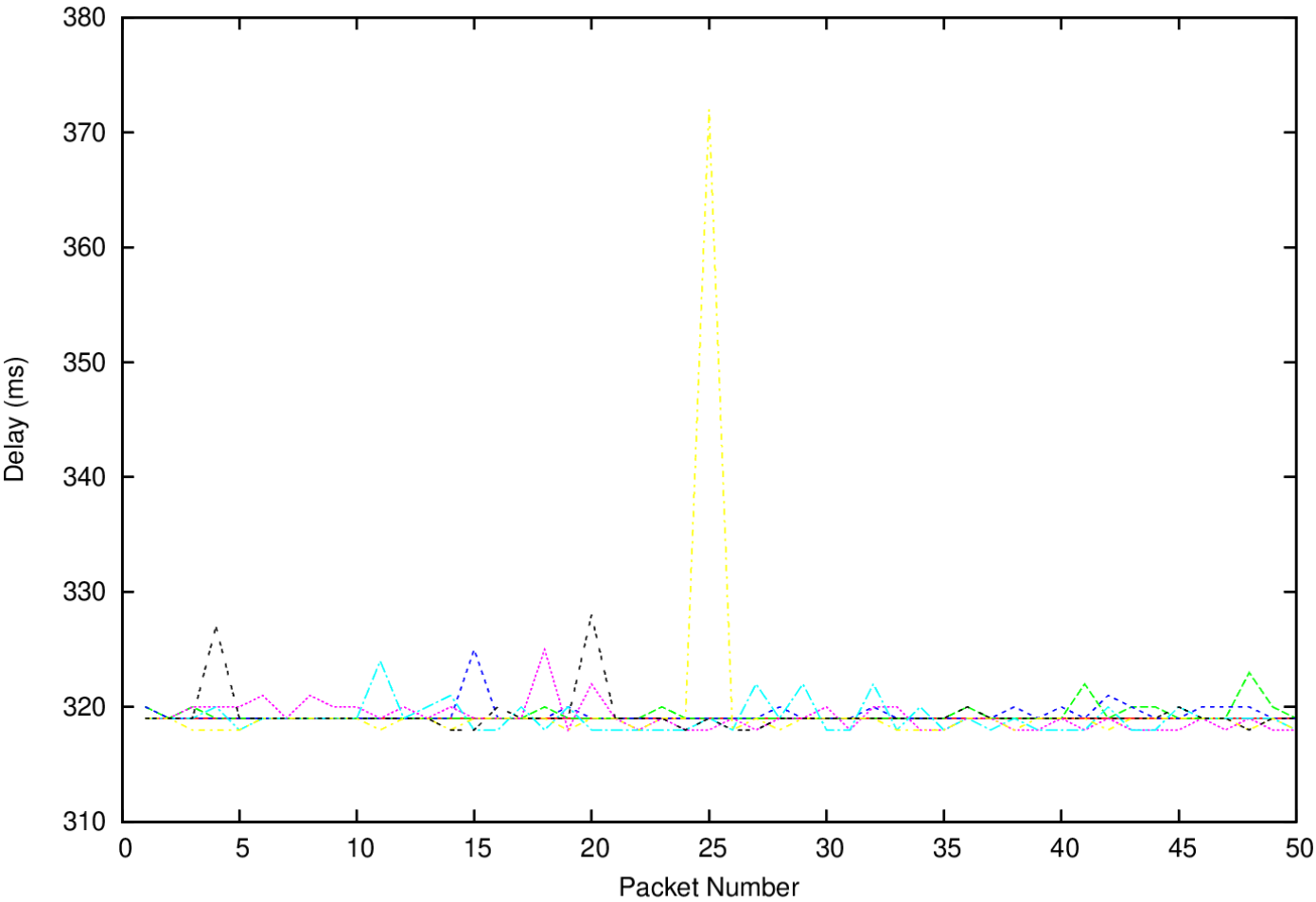


Sun Sep 29 15:56:33 2019

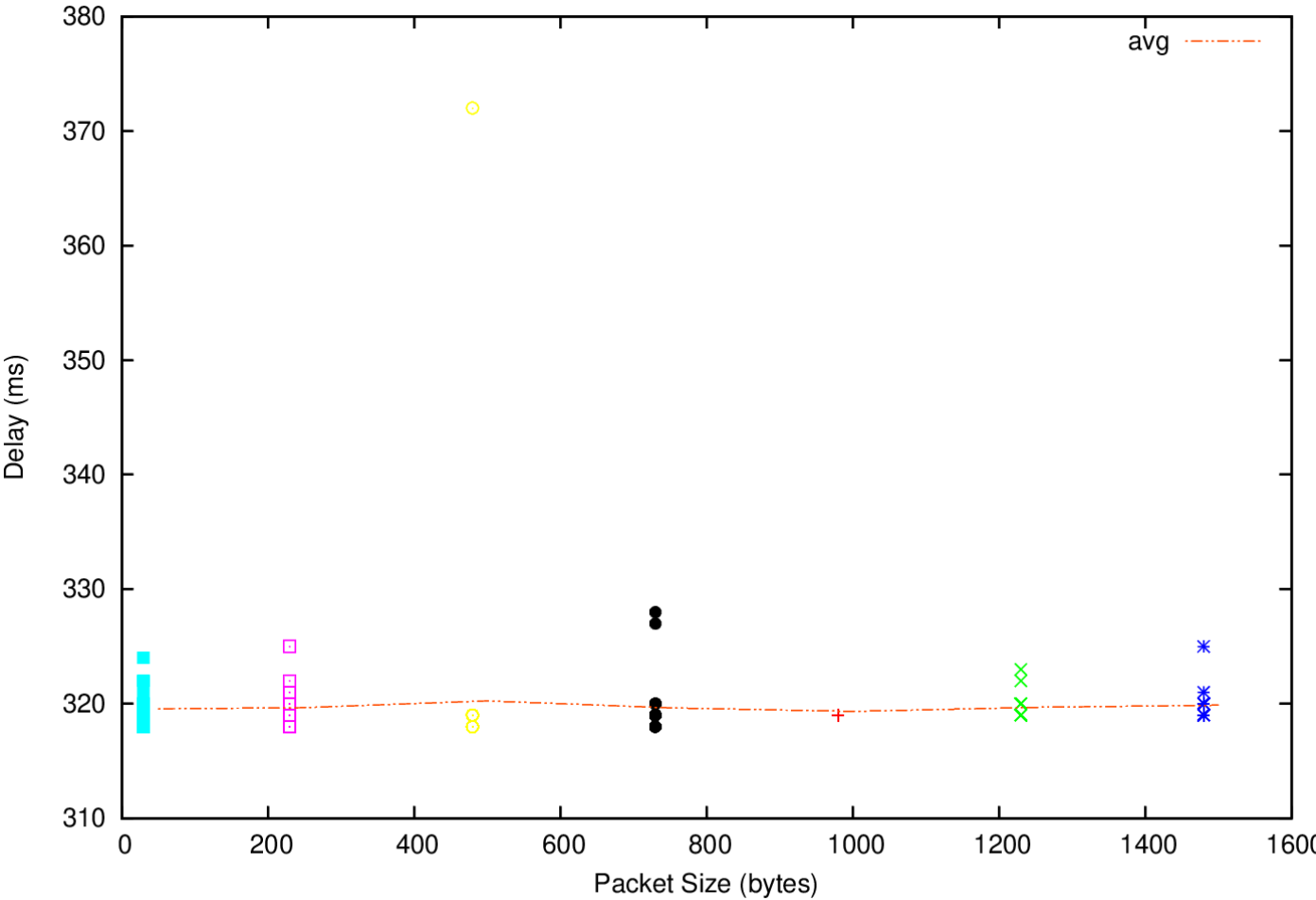
50 18.786 17.023
250 19.226 17.162
500 17.890 17.359

750 18.666 17.495
1000 19.327 17.499
1250 19.920 17.687
1500 20.283 18.457

Manila script outputs



Sun Sep 29 15:56:54 2019

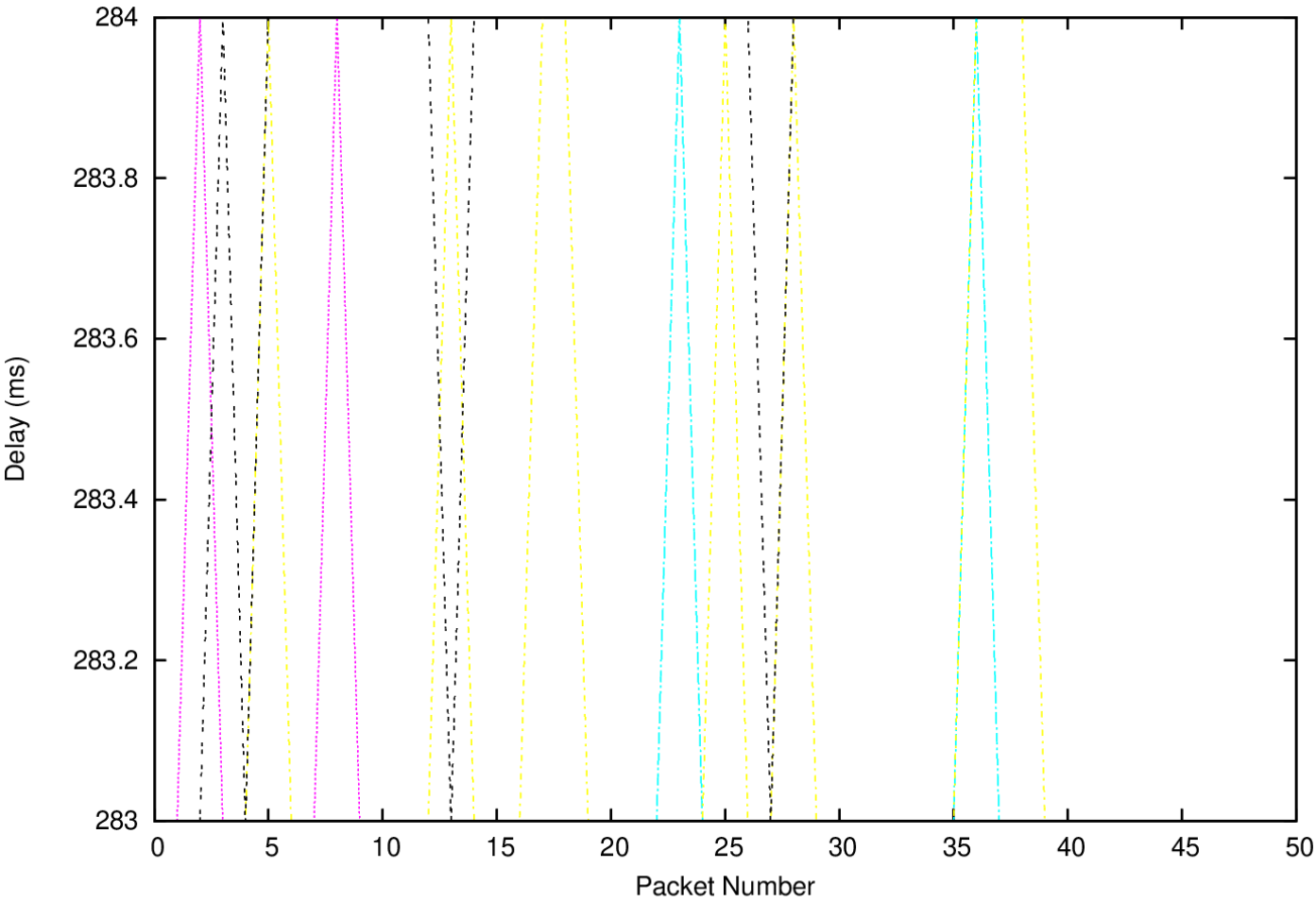


Sun Sep 29 15:56:54 2019

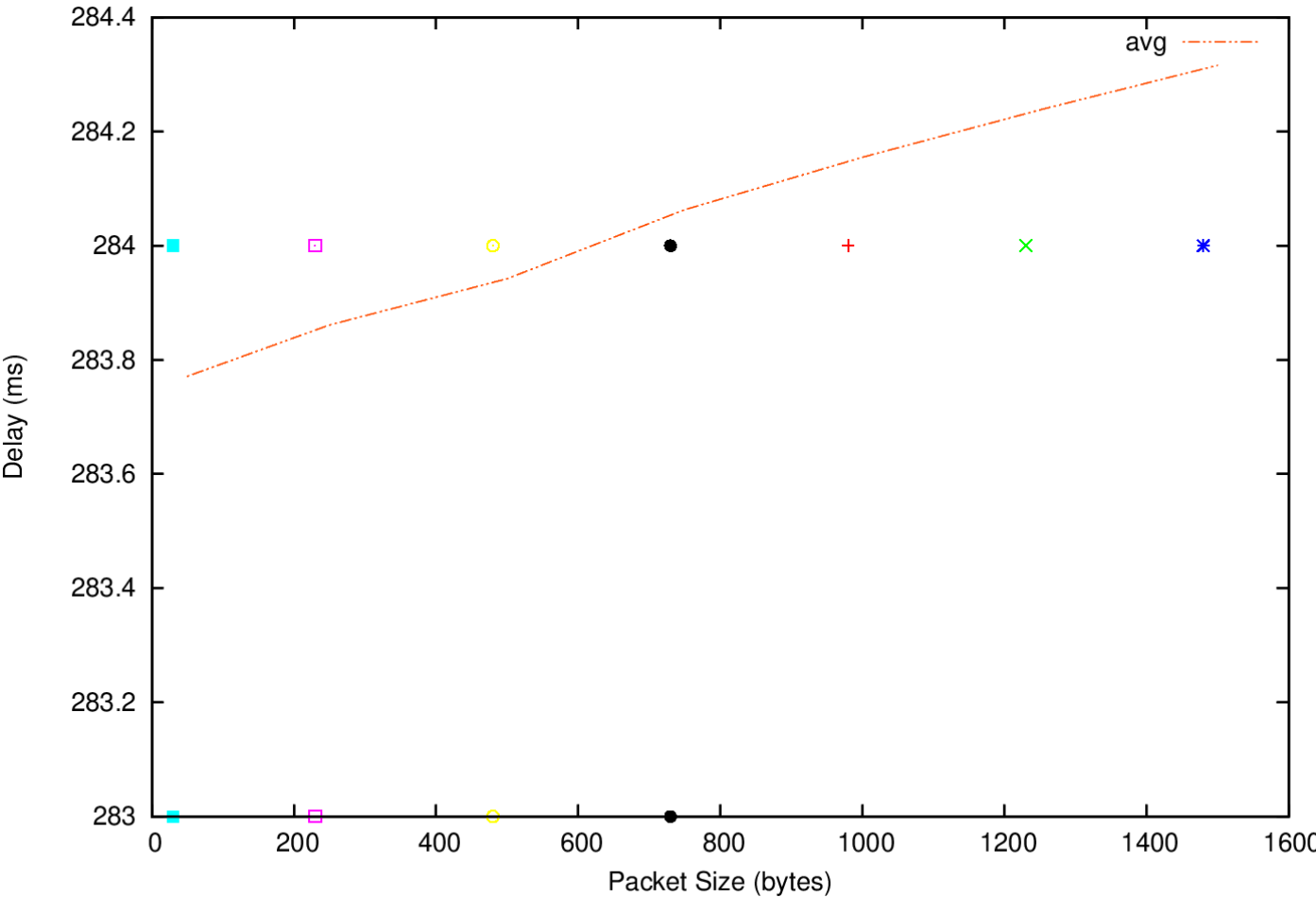
50 319.553 318.391
250 319.653 318.625
500 320.247 318.738

750 319.642 318.907
1000 319.327 319.023
1250 319.694 319.136
1500 319.879 319.260

Berlin script outputs



Sun Sep 29 15:57:06 2019



Sun Sep 29 15:57:06 2019

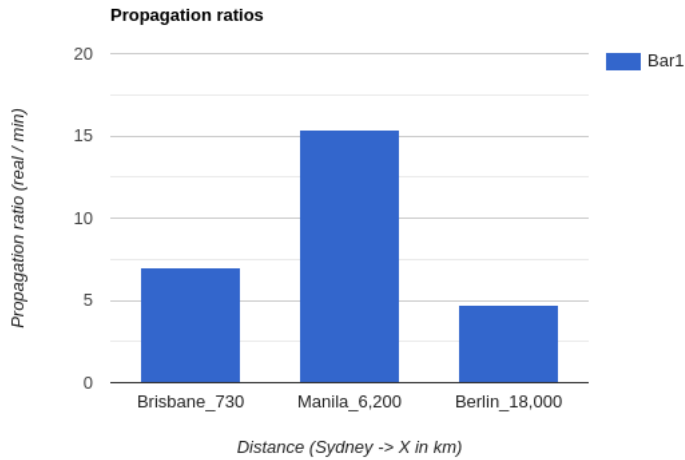
50 283.771 283.666
250 283.861 283.713
500 283.942 283.810


```

750 284.063 283.939
1000 284.155 284.039
1250 284.238 284.126
1500 284.316 284.199

```

- Sydney -> Brisbane is ~730 km, $T = 0.002433333 \text{ sec} = 2.433333 \text{ msec}$, min round-trip (MRT) = 17.023, MRT/T = 6.99
- Sydney -> Manila is ~6200 km, $T = 0.020666667 \text{ sec} = 20.666667 \text{ msec}$, MRT = 318.391, MRT/T = 15.40
- Sydney -> Berlin is ~18,000 km, $T = 0.06 \text{ sec} = 60 \text{ msec}$, MRT = 283.666, MRT/T = 4.72



- the reason the y values are much greater is because our T assumes the packet travels at the speed of light, never stopping for anything. This is obviously not how it works in reality as there are processing times (e.g. header processing and checksums), possible queueing if the network is busy, transmission delays associated with respect to bandwidth and packet size, and different propagation rates depending on the type of physical link being used (not always fibre, especially on the Aus side lol).
- delay to destinations are not constant but instead vary over time. One reason for this could be that your packet takes a different route from one day to the next. Furthermore, even if the route is the same, if there is a different number of users on the network (where the extremes i.e. just you vs more than the network is built to handle) then the RTT will change due to queueing times and possibly even packet dropping/resending as a result.
- www.epfl.ch appears to be hosted by cloudflare servers. These are a type of reverse proxy middle-man server that are designed to increase security at a low overhead. They provide a cached version of the site. whois 104.20.229.42 suggests these cloudflare servers are in San Fran. but the real server could well be in Switzerland (and likely is because that's where epfl is).
- the transmission delay is the only delay that is really effected by packet size (processing and copying into buffers for queinging would be minimal overheads even when packets are as large as the router supports). You can only fit as many bits as the link bandwidth supports onto the link at a time, meaning lower bandwidth and larger packets takes more time to send the whole packet (transmission delay). Once the bits are onto the link the propagation time is independant of the packet size.