COMP9331/3331 Lab01

Exercise 1: nslookup

Q1) Which is the IP address of the CNN website (www.cnn.com)? In your opinion, what is the reason of having several IP addresses as an output?

Server: 129.94.0.196
Address: 129.94.0.196#53

Non-authoritative answer:
Name: cnn.com
Address: 151.101.65.67
Name: cnn.com
Address: 151.101.129.67
Name: cnn.com
Address: 151.101.1.67
Name: cnn.com
Address: 151.101.193.67

The reason for having multiple IP addresses is to compensate for hosts that are down at particular moments. This prevents traffic from being exchanged at the gateway, reducing the load and allowing for greater speeds

Q2) Find out name of the IP address 127.0.0.1. What is special about this IP address?

Server: 129.94.0.196
Address: 129.94.0.196#53

1.0.0.127.in-addr.arpa name = localhost.

This IP address is the local host. 'localhost' is the internal interface of the machine so it sends a packet to itself. This is the IP of every PC which is 127.0.0.1

Exercise 2: Using ping to test host reachability

www.unsw.edu.au
- Reachable using ping

www.getfittest.com.au
- Not reached
- Server probably doesn't exist as it is unknown when checking with nslookup. Can't access on web browser either

www.mit.edu
- Reachable

www.intel.com.au
- Reachable

www.tpg.com.au
- Reachable

www.hola.hp
- Not reachable

- Server probably doesn't exist as it is unknown when checking with nslookup. Can't access on web browser either

www.amazon.com

- Reachable

www.tsinghua.edu.cn

- Reachable

www.kremlin.ru

- Requests for ping keep timing out. However, it is accessible by web browser and exists when checking through nslookup. This site could have blocked ping access at the firewall level to prevent DoS attacks. It may

8.8.8.8

- Reachable by ping

Exercise 3: Use traceroute to understand network topology

Q1) Run traceroute on your machine to www.columbia.edu . How many routers are there between your workstation andwww.columbia.edu ? How many routers along the path are part of the UNSW network? Between which two routers do packets cross the Pacific Ocean? Hint: compare the round trip times from your machine to the routers using ping.

```
weber % traceroute columbia.edu
traceroute to columbia.edu (128.59.105.24), 30 hops max, 60 byte packets
 1  cserouter1-server.cse.unsw.EDU.AU (129.94.242.251)  0.117 ms  0.102 ms  0.114 ms
 2  129.94.39.17 (129.94.39.17)  0.872 ms  0.893 ms  0.844 ms
 3  ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35)  1.607 ms  1.584 ms libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34)  1.387 ms
 4  libcr1-po-6.gw.unsw.edu.au (149.171.255.201)  1.136 ms libcr1-po-5.gw.unsw.edu.au (149.171.255.165)  1.063 ms ombcr1-po-5.gw.unsw.edu.au (149.171.255.197)  1.112 ms
 5  unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101)  1.232 ms unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  1.149 ms unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101)  1.230 ms
 6  138.44.5.0 (138.44.5.0)  1.316 ms  1.367 ms  1.362 ms
 7  et-1-3-0.pe1.sxt.bkvl.nsw.aarnet.net.au (113.197.15.149)  2.210 ms  2.295 ms  2.289 ms
 8  et-0-0-0.pe1.a.hnl.aarnet.net.au (113.197.15.99)  95.218 ms  95.223 ms  95.258 ms
 9  et-2-1-0.bdr1.a.sea.aarnet.net.au (113.197.15.201)  146.613 ms  146.782 ms  146.749 ms
10  abilene-1-lo-jmb-706.sttlwa.pacificwave.net (207.231.240.8)  146.906 ms  146.871 ms  146.947 ms
11  et-4-0-0.4079.rtsw.miss2.net.internet2.edu (162.252.70.0)  157.573 ms  157.567 ms  157.722 ms
12  et-4-0-0.4079.rtsw.minn.net.internet2.edu (162.252.70.58)  180.625 ms  180.479 ms  180.372 ms
13  et-1-1-5.4079.rtsw.eqch.net.internet2.edu (162.252.70.106)  188.366 ms  188.455 ms  188.470 ms
14  ae-0.4079.rtsw3.eqch.net.internet2.edu (162.252.70.163)  188.733 ms  188.616 ms  188.553 ms
15  ae-1.4079.rtsw.clev.net.internet2.edu (162.252.70.130)  196.969 ms  197.345 ms  198.127 ms
16  buf-9208-I2-CLEV.nysernet.net (199.109.11.33)  202.432 ms  201.992 ms  201.979 ms
17  syr-9208-buf-9208.nysernet.net (199.109.7.193)  204.743 ms  204.592 ms  204.793 ms
18  nyc-9208-syr-9208.nysernet.net (199.109.7.162)  210.124 ms  209.999 ms  209.924 ms
19  columbia.nyc-9208.nysernet.net (199.109.4.14)  209.950 ms  209.980 ms  209.950 ms
20  cc-core-1-x-nyser32-gw-1.net.columbia.edu (128.59.255.5)  210.217 ms  210.312 ms  210.175 ms
21  cc-conc-1-x-cc-core-1.net.columbia.edu (128.59.255.21)  210.273 ms  210.202 ms  210.331 ms
22  cuf.columbia.edu (128.59.105.24)  210.236 ms  210.181 ms  210.195 ms
weber %
```

As shown above, there are 22 routers between my workstation and www.columbia.edu.

There are 4 routers that contain the string 'unsw'. The second router belongs to the Australian academic and Research network which is also a part of UNSW. So there are 5 UNSW routers along the route.

The round trip times from the 7th router is about 2ms while the 8th is about 95ms. This massive jump in time is a good indicator that the packets cross the pacific ocean between routers 7 and 8

Q2) Run traceroute from your machine to the following destinations:(i) www.ucla.edu (ii) www.u-tokyo.ac.jp and (iii)www.lancaster.ac.uk . At which router do the paths from your machine to these three destinations diverge? Find out further details about this router. (HINT: You can find out more about a router by running the whois command: whois router-IP-address). Is the number of hops on each path proportional the physical distance? HINT: You can find out geographical location of a server using the following tool - http://www.yougetsignal.com/tools/network-location/

```
weber % traceroute ucla.edu
traceroute to ucla.edu (128.97.27.37), 30 hops max, 60 byte packets
 1  cserouter1-server.cse.unsw.EDU.AU (129.94.242.251)  0.124 ms  0.112 ms  0.135 ms
 2  129.94.39.17 (129.94.39.17)  0.899 ms  0.854 ms  0.900 ms
 3  libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34)  1.328 ms  1.863 ms  1.851 ms
 4  libcr1-po-5.gw.unsw.edu.au (149.171.255.165)  1.090 ms libcr1-po-6.gw.unsw.edu.au (149.171.255.201)  1.143 ms ombcr1-po-6.gw.unsw.edu.au (149.171.255.169)  14.205 ms
 5  unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  1.232 ms  1.220 ms unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101)  1.293 ms
 6  138.44.5.0 (138.44.5.0)  1.336 ms  1.362 ms  1.331 ms
 7  et-1-3-0.pe1.sxt.bkvl.nsw.aarnet.net.au (113.197.15.149)  2.035 ms  2.087 ms  2.131 ms
 8  et-0-0-0.pe1.a.hnl.aarnet.net.au (113.197.15.99)  95.195 ms  95.229 ms  95.296 ms
 9  et-2-1-0.bdr1.a.sea.aarnet.net.au (113.197.15.201)  146.799 ms  146.786 ms  146.767 ms
10  cenichpr-1-is-jmb-778.snvaca.pacificwave.net (207.231.245.129)  163.178 ms  164.150 ms  163.779 ms
11  hpr-lax-hpr3--svl-hpr3-100ge.cenic.net (137.164.25.73)  170.988 ms  170.975 ms  170.961 ms
12  * * *
13  bd11f1.anderson--cr001.anderson.ucla.net (169.232.4.6)  171.428 ms  203.644 ms bd11f1.anderson--cr00f2.csb1.ucla.net (169.232.4.4)  171.485 ms
14  cr00f1.anderson--sr02fb.jsei.ucla.net (169.232.8.53)  171.557 ms  171.445 ms cr00f2.csb1--sr02f2.csb1.ucla.net (169.232.8.7)  171.446 ms
15  128.97.27.37 (128.97.27.37)  171.460 ms !X  171.449 ms !X  171.283 ms !X
```

UCLA traceroute above

```
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)  0.217 ms  0.204 ms  0.191 ms
 2  129.94.39.17 (129.94.39.17)  1.011 ms  1.002 ms  0.986 ms
 3  libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34)  1.485 ms ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35)  1.738 ms  1.728 ms
 4  ombcr1-po-6.gw.unsw.edu.au (149.171.255.169)  1.298 ms  1.284 ms libcr1-po-5.gw.unsw.edu.au (149.171.255.165)  1.160 ms
 5  unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  1.213 ms unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101)  1.321 ms  1.311 ms
 6  138.44.5.0 (138.44.5.0)  1.510 ms  1.245 ms  1.355 ms
 7  et-0-3-0.pe1.bkvl.nsw.aarnet.net.au (113.197.15.147)  1.824 ms  1.853 ms  1.878 ms
 8  ge-4_0_0.bb1.a.pao.aarnet.net.au (202.158.194.177)  156.019 ms  156.114 ms  156.110 ms
 9  paloalto0.iij.net (198.32.176.24)  157.832 ms  157.886 ms  157.733 ms
10  osk004bb01.IIJ.Net (58.138.88.189)  270.846 ms  270.991 ms  270.880 ms
11  osk004ix51.IIJ.Net (58.138.106.126)  268.777 ms osk004ix51.IIJ.Net (58.138.106.130)  270.354 ms osk004ix51.IIJ.Net (58.138.106.126)  268.996 ms
12  210.130.135.130 (210.130.135.130)  269.658 ms  269.625 ms  269.624 ms
13  124.83.228.58 (124.83.228.58)  267.292 ms  280.223 ms  275.364 ms
14  124.83.252.178 (124.83.252.178)  273.079 ms  273.189 ms  273.014 ms
15  158.205.134.26 (158.205.134.26)  274.623 ms  274.758 ms  274.660 ms
16  * * *
17  * * *
18  * * *
19  * * *
20  * * *
21  * * *
22  * * *
23  * * *
24  * * *
25  * * *
26  * * *
27  * * *
28  * * *
29  * * *
30  * * *
```

U-tokyo traceroute above

```
traceroute to lancaster.ac.uk (148.88.65.80), 30 hops max, 60 byte packets
 1  cserouter1-server.cse.unsw.EDU.AU (129.94.242.251)  0.121 ms  0.111 ms  0.109 ms
 2  129.94.39.17 (129.94.39.17)  0.829 ms  0.840 ms  0.827 ms
 3  libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34)  1.543 ms ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35)  1.431 ms libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34)  1.313 ms
 4  libcr1-po-6.gw.unsw.edu.au (149.171.255.201)  1.136 ms ombcr1-po-6.gw.unsw.edu.au (149.171.255.169)  1.138 ms libcr1-po-5.gw.unsw.edu.au (149.171.255.165)  1.091 ms
 5  unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101)  1.246 ms  1.236 ms unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  1.230 ms
 6  138.44.5.0 (138.44.5.0)  1.278 ms  1.363 ms  1.294 ms
 7  et-1-3-0.pe1.sxt.bkvl.nsw.aarnet.net.au (113.197.15.149)  2.680 ms  2.256 ms  2.022 ms
 8  et-0-0-0.pe1.a.hnl.aarnet.net.au (113.197.15.99)  95.232 ms  95.361 ms  95.163 ms
 9  et-2-1-0.bdr1.a.sea.aarnet.net.au (113.197.15.201)  146.658 ms  146.604 ms  146.628 ms
10  abilene-1-lo-jmb-706.sttlwa.pacificwave.net (207.231.240.8)  146.711 ms  146.677 ms  146.827 ms
11  et-4-0-0.4079.rtsw.miss2.net.internet2.edu (162.252.70.0)  157.715 ms  157.724 ms  157.838 ms
12  et-4-0-0.4079.rtsw.minn.net.internet2.edu (162.252.70.58)  180.482 ms  180.328 ms  180.341 ms
13  et-1-1-5.4079.rtsw.eqch.net.internet2.edu (162.252.70.106)  188.691 ms  194.318 ms  194.386 ms
14  ae-0.4079.rtsw3.eqch.net.internet2.edu (162.252.70.163)  190.581 ms  188.505 ms  188.546 ms
15  ae-1.4079.rtsw.clev.net.internet2.edu (162.252.70.130)  197.471 ms  197.290 ms  197.459 ms
16  ae-0.4079.rtsw.ashb.net.internet2.edu (162.252.70.128)  205.163 ms  206.409 ms  206.386 ms
17  ae-2.4079.rtsw2.ashb.net.internet2.edu (162.252.70.75)  211.020 ms  210.844 ms  210.764 ms
18  ae-2.4079.rtsw.wash.net.internet2.edu (162.252.70.136)  205.773 ms  205.263 ms  206.330 ms
19  internet2.mx1.lon.uk.geant.net (62.40.124.44)  279.968 ms  279.991 ms  280.068 ms
20  janet-gw.mx1.lon.uk.geant.net (62.40.124.198)  280.167 ms  280.122 ms  279.998 ms
21  ae29.londpg-sbr2.ja.net (146.97.33.2)  280.637 ms  280.793 ms  281.817 ms
22  ae31.erdiss-sbr2.ja.net (146.97.33.22)  285.623 ms  284.406 ms  284.387 ms
23  ae29.manckh-sbr2.ja.net (146.97.33.42)  286.436 ms  286.246 ms  286.084 ms
24  ae24.lanclu-rbr1.ja.net (146.97.38.58)  288.504 ms  288.465 ms  288.392 ms
25  lancaster-university.ja.net (194.81.46.2)  308.545 ms  308.274 ms  299.554 ms
26  * * *
27  ismx-issrx.rtr.lancs.ac.uk (148.88.255.17)  290.227 ms  290.141 ms  290.106 ms
28  iss-servers.iscore01-ismx01.rtr.lancs.ac.uk (148.88.7.137)  296.334 ms  292.260 ms  292.644 ms
29  * * *
30  www.lancs.ac.uk (148.88.65.80)  290.451 ms !X  290.161 ms !X  290.127 ms !X
```

Lancaster traceroute above

The paths to the different addresses diverge on the router with the address 138.44.5.0. The router is run by the Asia Pacific Network Information Centre (APNIC).

```
weber %  whois 138.44.5.0

#
# ARIN WHOIS data and services are subject to the Terms of Use
# available at: https://www.arin.net/resources/registry/whois/tou/
#
# If you see inaccuracies in the results, please report at
# https://www.arin.net/resources/registry/whois/inaccuracy_reporting/
#
# Copyright 1997-2019, American Registry for Internet Numbers, Ltd.
#


NetRange:       138.44.0.0 - 138.44.255.255
CIDR:           138.44.0.0/16
NetName:        APNIC-ERX-138-44-0-0
NetHandle:      NET-138-44-0-0-1
Parent:         NET138 (NET-138-0-0-0-0)
NetType:        Early Registrations, Transferred to APNIC
OriginAS:
Organization:   Asia Pacific Network Information Centre (APNIC)
RegDate:        2003-12-11
Updated:        2009-10-08
Comment:        This IP address range is not registered in the ARIN database.
Comment:        This range was transferred to the APNIC Whois Database as
Comment:        part of the ERX (Early Registration Transfer) project.
Comment:        For details, refer to the APNIC Whois Database via
Comment:        WHOIS.APNIC.NET or http://wq.apnic.net/apnic-bin/whois.pl
Comment:
Comment:        ** IMPORTANT NOTE: APNIC is the Regional Internet Registry
Comment:        for the Asia Pacific region.  APNIC does not operate networks
Comment:        using this IP address range and is not able to investigate
Comment:        spam or abuse reports relating to these addresses.  For more
Comment:        help, refer to http://www.apnic.net/apnic-info/whois_search2/abuse-and-spamming
Ref:            https://rdap.arin.net/registry/ip/138.44.0.0

ResourceLink:  http://wq.apnic.net/whois-search/static/search.html
ResourceLink:  whois.apnic.net


OrgName:        Asia Pacific Network Information Centre
OrgId:          APNIC
Address:        PO Box 3646
City:           South Brisbane
StateProv:      QLD
PostalCode:     4101
Country:        AU
RegDate:
Updated:        2012-01-24
Ref:            https://rdap.arin.net/registry/entity/APNIC
```

The distance to www.ucla.edu is about **7499.00 miles** and there are 15 hops
The distance to www.u-tokyo.ac.jp is about **5558.0 miles** and there are 15 hops
The distance to www.lancaster.ac.uk is about **5797.1 miles** and there are 26 hops
Therefore it can be concluded that the number of hops is not proportional to physical distance

Q3) Several servers distributed around the world provide a web interface from which you can perform a traceroute to any other host in the Internet. Here are two examples: (i) http://www.speedtest.com.sg/tr.php and (ii) https://www.telstra.net/cgi-bin/trace . Run traceroute from both these servers towards your machine and in the reverse direction (i.e. from your machine to these servers). You may also try other traceroute servers from the list at www.traceroute.org . What are the IP addresses of the two servers that you have chosen. Does the reverse path go through the same routers as the forward path? If you observe common routers between the forward and the reverse path, do you also observe the same IP addresses? Why or why not?

```
weber % traceroute 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)  0.097 ms  0.085 ms  0.086 ms
 2  129.94.39.17 (129.94.39.17)  0.848 ms  0.847 ms  0.869 ms
 3  libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34)  2.003 ms  2.040 ms  1.948 ms
 4  ombcr1-po-5.gw.unsw.edu.au (149.171.255.197)  1.078 ms ombcr1-po-6.gw.unsw.edu.au (149.171.255.169)  1.127 ms libcr1-po-5.gw.unsw.edu.au (149.171.255.165)  1.066 ms
 5  unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101)  1.120 ms  1.192 ms  1.118 ms
 6  138.44.5.0 (138.44.5.0)  1.387 ms  1.687 ms  1.621 ms
 7  et-0-3-0.pe1.alxd.nsw.aarnet.net.au (113.197.15.153)  1.694 ms  1.790 ms  1.709 ms
 8  xe-0-0-3.pe1.wnpa.akl.aarnet.net.au (113.197.15.67)  24.151 ms  24.169 ms  24.156 ms
 9  et-0-1-0.200.pe1.tkpa.akl.aarnet.net.au (113.197.15.69)  24.505 ms  24.548 ms  24.502 ms
10  xe-0-2-6.bdr1.a.lax.aarnet.net.au (202.158.194.173)  147.831 ms  147.871 ms  147.794 ms
11  singtel.as7473.any2ix.coresite.com (206.72.210.63)  147.875 ms  147.943 ms  147.930 ms
12  203.208.171.117 (203.208.171.117)  150.569 ms 203.208.172.153 (203.208.172.153)  328.652 ms 203.208.154.45 (203.208.154.45)  328.869 ms
13  203.208.177.110 (203.208.177.110)  332.265 ms  320.221 ms 203.208.151.233 (203.208.151.233)  265.851 ms
14  * * *
15  202-150-221-170.rev.ne.com.sg (202.150.221.170)  237.770 ms  233.840 ms 203.208.177.110 (203.208.177.110)  335.318 ms
```

```
traceroute to 129.94.242.53 (129.94.242.53), 30 hops max, 60 byte packets
 1  ge2-8.r01.sin01.ne.com.sg (202.150.221.169)  0.155 ms  0.148 ms  0.146 ms
 2  10.15.62.210 (10.15.62.210)  0.268 ms  0.369 ms  0.366 ms
 3  aarnet.sgix.sg (103.16.102.67)  223.661 ms  223.649 ms  223.771 ms
 4  xe-3-0-3.pe1.brwy.nsw.aarnet.net.au (113.197.15.206)  232.204 ms  232.317 ms  232.317 ms
 5  138.44.5.1 (138.44.5.1)  239.045 ms  239.051 ms  239.159 ms
 6  libcr1-te-1-5.gw.unsw.edu.au (149.171.255.102)  239.045 ms  239.160 ms  239.027 ms
 7  ombudnex1-po-1.gw.unsw.edu.au (149.171.255.202)  237.761 ms libudnex1-po-1.gw.unsw.edu.au (149.171.255.166)  236.302 m
 8  ufw1-ae-1-3154.gw.unsw.edu.au (149.171.253.36)  237.567 ms  237.687 ms  237.556 ms
 9  129.94.39.23 (129.94.39.23)  236.485 ms  236.515 ms  236.476 ms
```

Above are the traceroute results between my IP and speedtest.com.sg
The IP address of speedtest.com is 202.150.221.170.

```
weber % traceroute 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)  0.162 ms  0.149 ms  0.135 ms
 2  129.94.39.17 (129.94.39.17)  0.871 ms  0.841 ms  0.896 ms
 3  libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34)  1.706 ms  1.825 ms  1.816 ms
 4  libcr1-po-6.gw.unsw.edu.au (149.171.255.201)  1.121 ms  1.205 ms  1.194 ms
 5  unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101)  1.171 ms unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  1.221 ms unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101)  1.289 ms
 6  138.44.5.0 (138.44.5.0)  1.569 ms  1.492 ms  1.474 ms
 7  et-0-3-0.pe1.alxd.nsw.aarnet.net.au (113.197.15.153)  1.596 ms  1.502 ms  1.507 ms
 8  ae9.bb1.b.syd.aarnet.net.au (113.197.15.65)  1.836 ms  1.824 ms  1.867 ms
 9  gigabitethernet1-1.pe1.b.syd.aarnet.net.au (202.158.202.18)  1.942 ms  2.004 ms  1.985 ms
10  gigabitethernet3-11.ken37.sydney.telstra.net (139.130.0.77)  2.441 ms  2.579 ms  2.670 ms
11  bundle-ether2.chw-edge901.sydney.telstra.net (203.50.11.103)  2.567 ms bundle-ether13.ken-core10.sydney.telstra.net (203.50.11.94)  3.725 ms bundle-ether2.chw-edge901.sydney.telstra.net (203.50.11.103)  2.488 ms
12  bundle-ether10.win-core10.melbourne.telstra.net (203.50.11.123)  14.562 ms bundle-ether13.chw-core10.sydney.telstra.net (203.50.11.98)  3.854 ms bundle-ether10.win-core10.melbourne.telstra.net (203.50.11.123)  14.524 ms
13  bundle-ether8.exi-core10.melbourne.telstra.net (203.50.11.125)  16.925 ms  16.920 ms 203.50.6.40 (203.50.6.40)  15.199 ms
14  bundle-ether2.exi-ncprouter101.melbourne.telstra.net (203.50.11.209)  15.239 ms  15.417 ms  14.857 ms
15  www.telstra.net (203.50.5.178)  14.940 ms  14.304 ms  14.917 ms
```

```
 1  gigabitethernet3-3.exi2.melbourne.telstra.net (203.50.77.53)  0.368 ms  0.200 ms  0.241 ms
 2  bundle-ether3-100.win-core10.melbourne.telstra.net (203.50.80.129)  2.614 ms  1.602 ms  1.992 ms
 3  bundle-ether12.ken-core10.sydney.telstra.net (203.50.11.122)  13.359 ms  12.221 ms  12.860 ms
 4  bundle-ether1.ken-edge901.sydney.telstra.net (203.50.11.95)  11.983 ms  11.974 ms  11.861 ms
 5  aarnet6.lnk.telstra.net (139.130.0.78)  11.612 ms  11.600 ms  11.613 ms
 6  ge-6-0-0.bb1.a.syd.aarnet.net.au (202.158.202.17)  11.859 ms  11.844 ms  11.734 ms
 7  ae9.pe2.brwy.nsw.aarnet.net.au (113.197.15.56)  12.107 ms  12.099 ms  12.110 ms
 8  et-3-1-0.pe1.brwy.nsw.aarnet.net.au (113.197.15.146)  12.106 ms  12.099 ms  12.110 ms
 9  138.44.5.1 (138.44.5.1)  12.356 ms  12.353 ms  12.359 ms
10  libcr1-te-1-5.gw.unsw.edu.au (149.171.255.102)  12.359 ms  12.348 ms  12.362 ms
11  ombudnex1-po-1.gw.unsw.edu.au (149.171.255.202)  12.731 ms  12.850 ms  12.610 ms
12  ufw1-ae-1-3154.gw.unsw.edu.au (149.171.253.36)  12.855 ms  12.851 ms  12.858 ms
13  129.94.39.23 (129.94.39.23)  12.983 ms  12.976 ms  12.985 ms
```

Above are the traceroute results between my IP and telstra.net
The IP of telstra.net is 203.50.5.178

For both cases, the paths between the two servers are NOT the same. However, the path between telstra is quite similar. There are common routers but they have different IP addresses. This is because they have different interfaces. So traffic going from A→B will use a different interface from traffic moving from B→A. This results in the same routers giving different IP addresses.

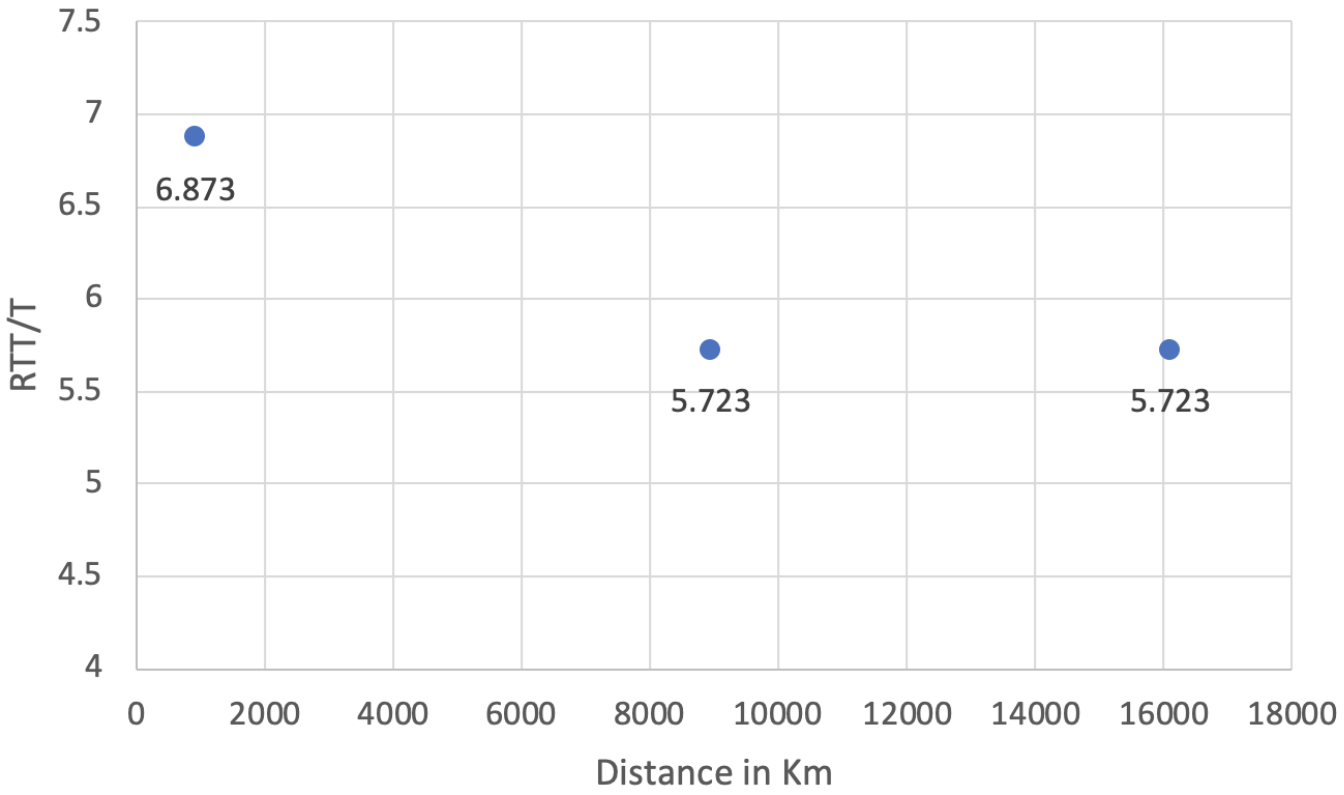
Exercise 4: Use ping to gain insights into network performance

Q1)

The approximate distance between UNSW and UQ is about 733km. Therefore, the shortest possible time T is T = 933km / 3 x 10^8 = 2.443ms. The value of the y-axis is 16.723 / 2.443 = 6.873

The approximate distance between UNSW and Beijing(Tsinghua University) is 8948km. Therefore, the shortest possible time T is T = 8948km / 3 x 10^8 = 29.826ms. The value of the y-axis is 274.64 / 29.826 = 5.723

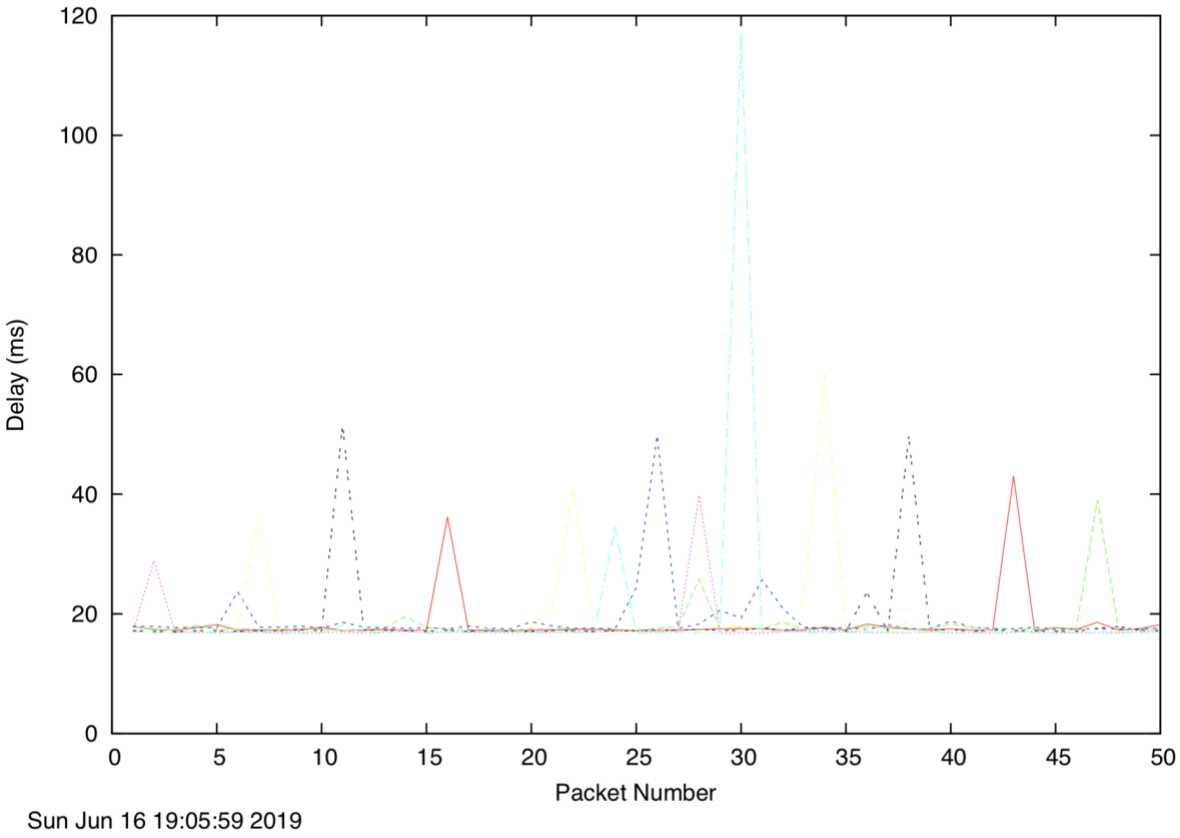
The approximate distance between UNSW and Berlin is 16117km. Therefore, the shortest possible time T is T = 16117km / 3 x 10^8 = 53.723ms. The value of the y-axis is 307.488 / 53.723 = 5.723

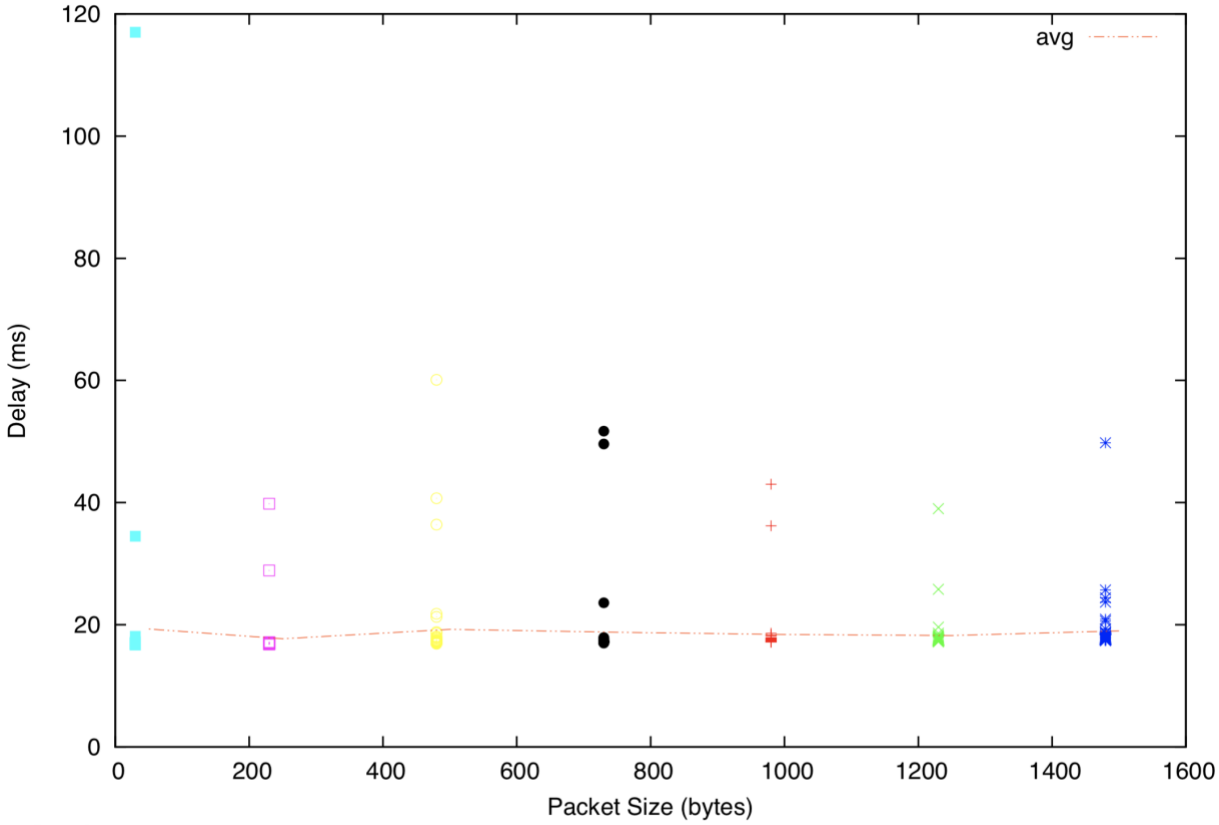


The RTT/T ratio being greater than 2 can be attributed to a variety of reasons. Some of these can be due to congestion or interference along the route between my computer and the destination server. It should also be noted that most long distance internet cables cannot carry signals at the speed of light due to refraction, meaning it will be unable to match the minimum time T which assumes light speed travel.

Q2) Is the delay to the destinations constant or does it vary over time? Explain why.

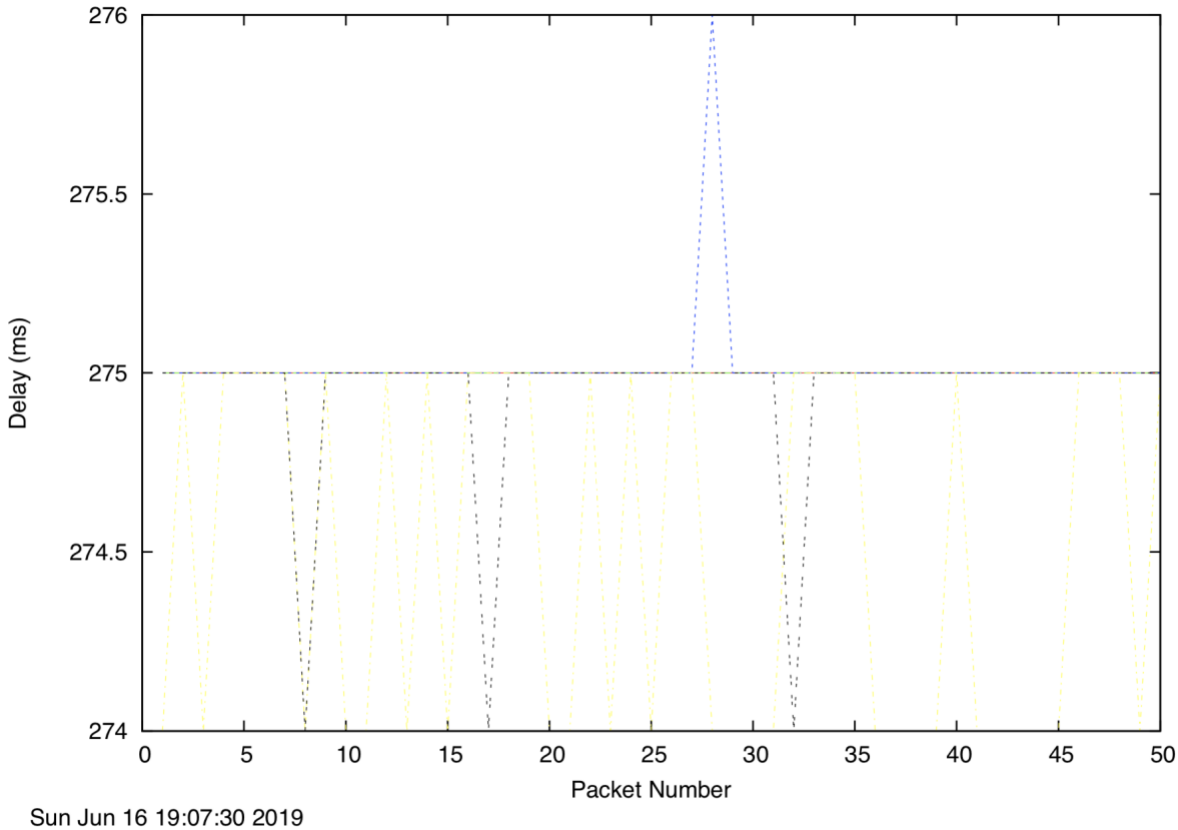
www.uq.com



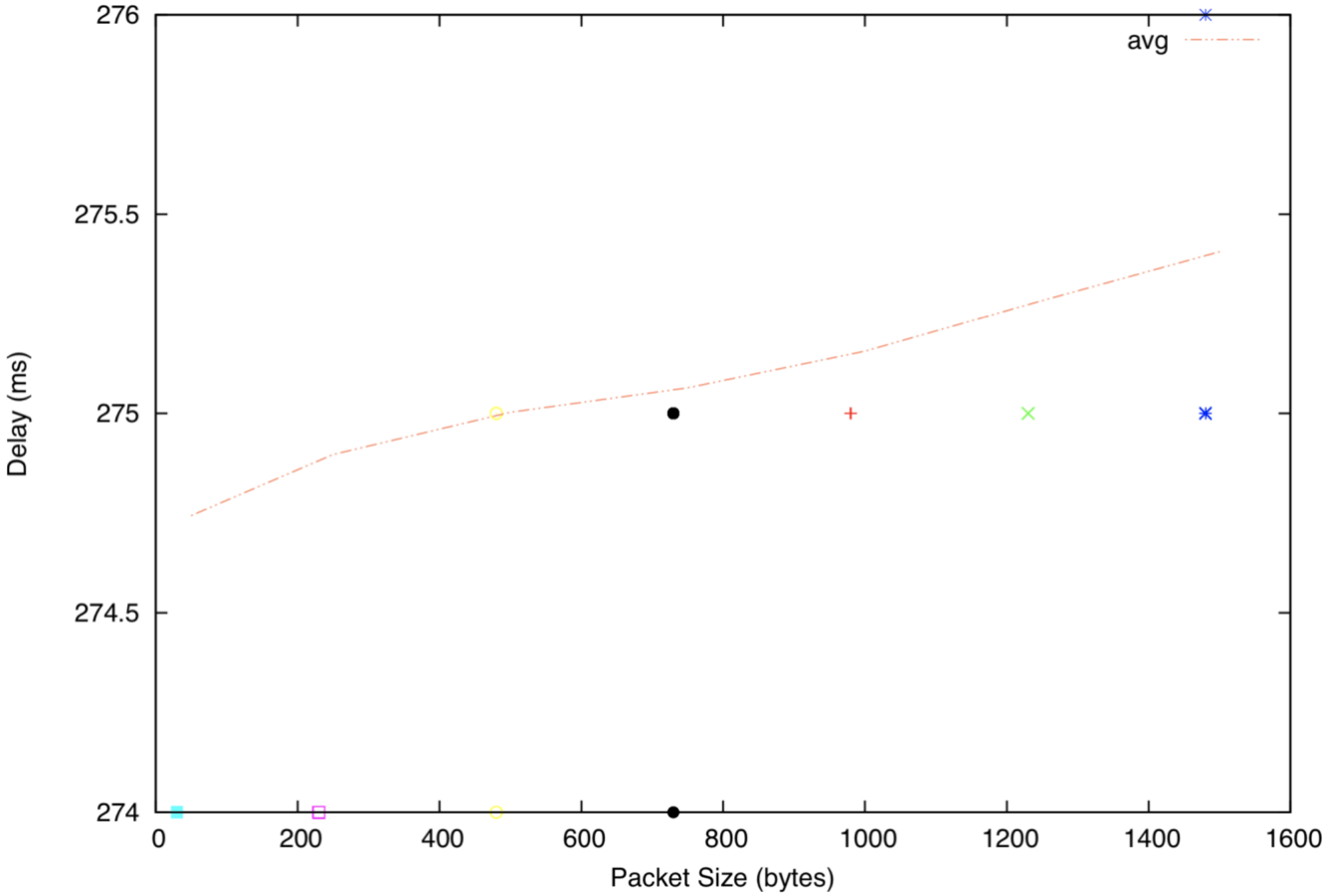


Sun Jun 16 19:05:59 2019

www.tsinghua.edu.cn

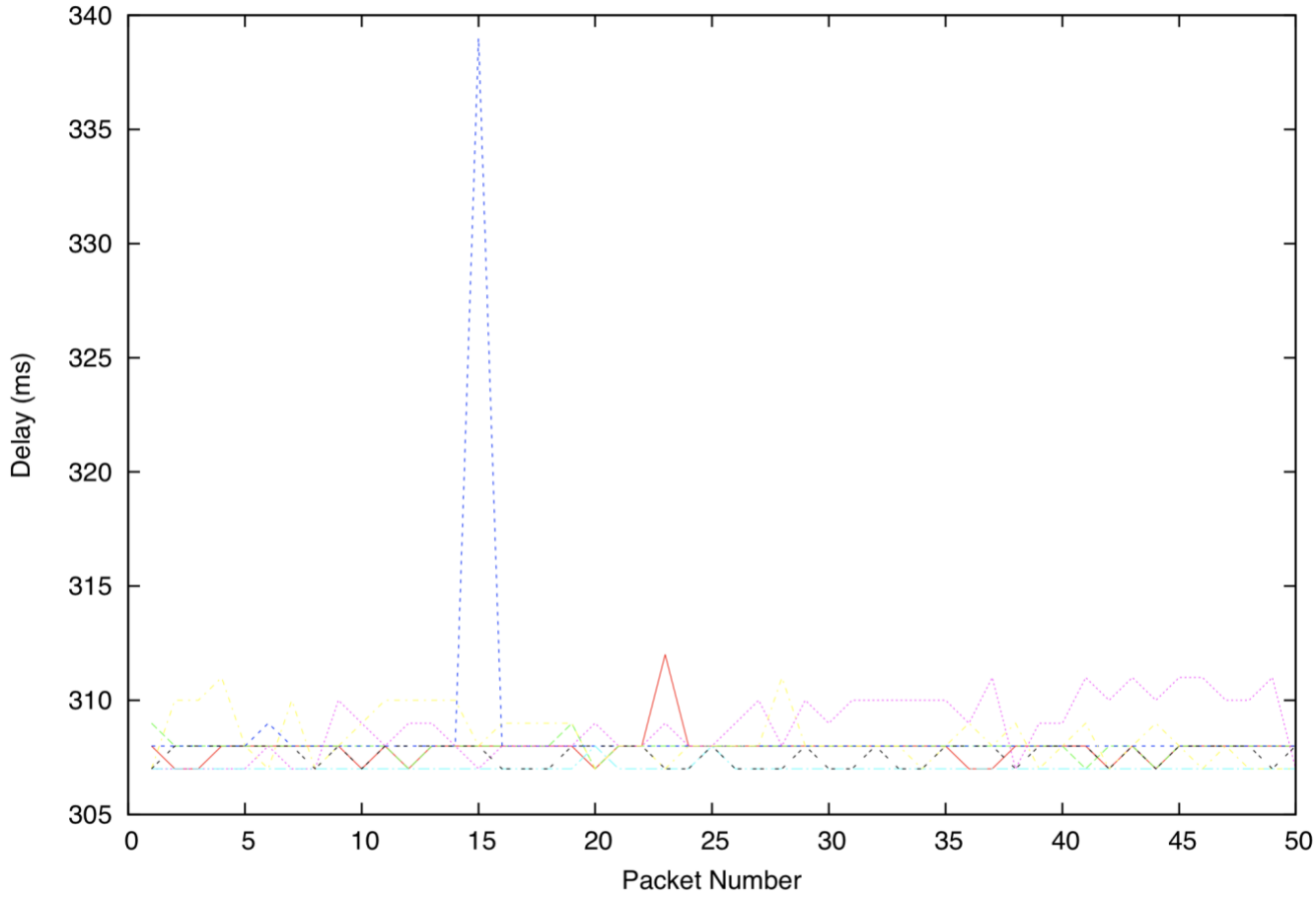


Sun Jun 16 19:07:30 2019

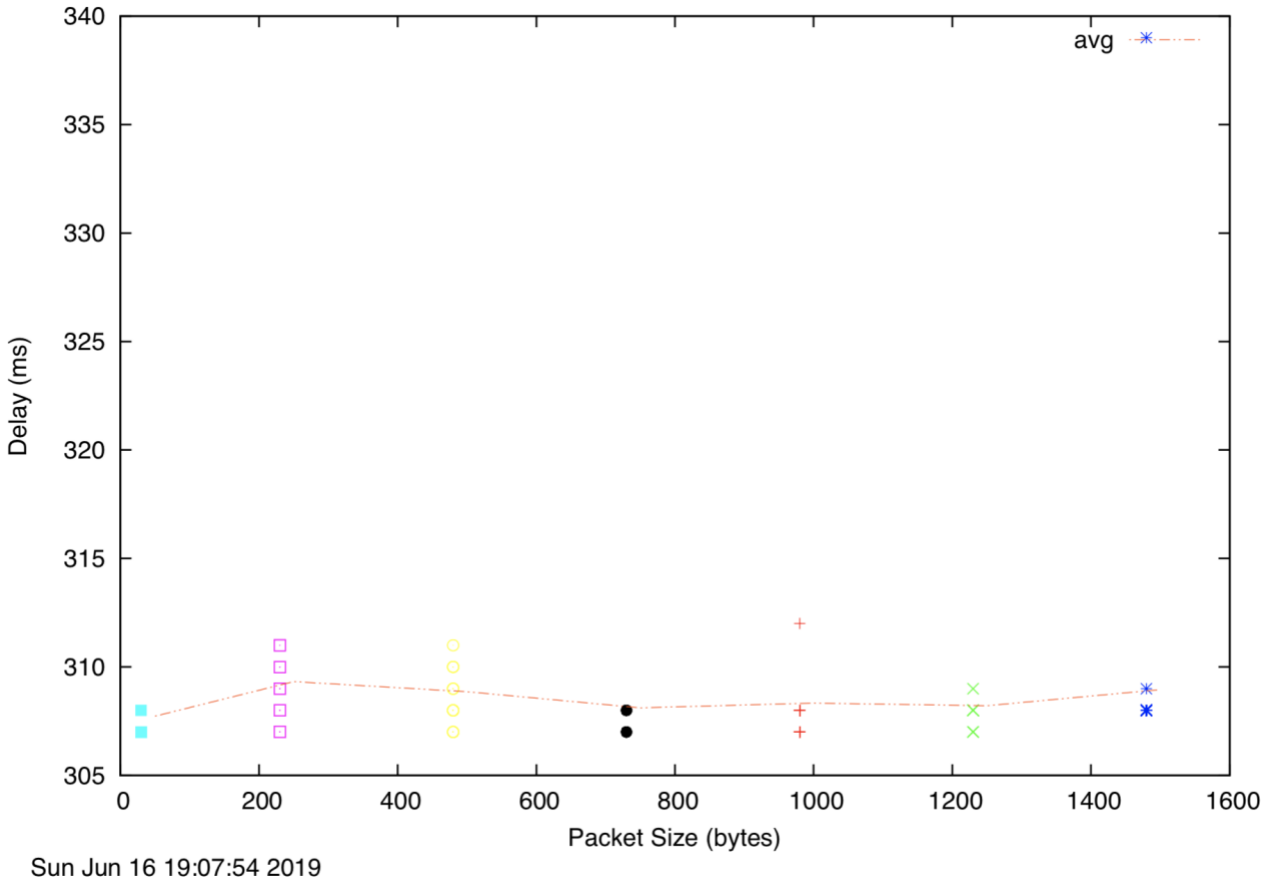


Sun Jun 16 19:07:30 2019

www.tu-berlin.de



Sun Jun 16 19:07:54 2019



According to the graphs above, delay to the destinations tend to be constant over time, with the exception of a few bursts of delay every now and then. This is due to the use of Packet switching, resulting in resource flow to be dynamically allocated. Therefore, no overloading occurs

Q3) Explore where the website for www.epfl.ch is hosted. Is it in Switzerland?

epfl.ch is hosted on **SWITCH**

- **Datacenter:** Ecole Polytechnique Federale de Lausanne
- **Server IP:** 128.178.222.108
- **Location:** Switzerland, Swiss Confederation
- **City:** Lausanne
- **Domain Who Is:** Click Here
- **Nameservers:** stisun1.epfl.ch, stisun2.epfl.ch

VISIT SWITCH

It appears that epfl.ch is indeed hosted in Switzerland.

Q4) The measured delay (i.e., the delay you can see in the graphs) is composed of propagation delay, transmission delay, processing delay and queuing delay. Which of these delays depend on the packet size and which do not?

Only **Transmission Delay** depends on packet size. It is the amount of time required to transmit an entire packet of a certain size. The formula to calculate Transmission delay is L/R, where L = packet size and R = Bandwidth.

None of the other delays depend on packet size. Propagation depends on the length of the physical link (i.e. distance). Processing delay is the time it takes routers to process the packet header. Queuing delay is the amount of time that the packet has to wait at the output link.