

Exercise 1: nslookup

Use the nslookup command from the "Tools of the Trade" and answer the following questions:

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

Answer:

1. The IP address of the website www.koala.com.au is 104.18.60.21 and 104.18.61.21.



```
uxterm
z5185842@vx2:/tmp_amd/reed/export/reed/2/z5185842/Desktop$ 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: 104.18.60.21
Name:   www.koala.com.au
Address: 104.18.61.21
```

In my opinion, website using [DNS load balancing technology](#) is the reason of having several IP addresses as an output. As each core part of the existing network increases with the increase of business volume and the rapid growth of traffic and data flow, its processing capacity and computing intensity also increase accordingly, making it impossible for a single server device to undertake. Thus, DNS load balancing technology configures multiple IP addresses for the same host name in the DNS server. Allowing different clients to access different servers for load balancing technology.

2. The name of the IP address 127.0.0.1 is local host. Local host is a hostname that means this computer. It is used to access the network services that are running on the host via the loopback network interface. Using the loopback interface bypasses any local network interface hardware.



```
z5185842@vx2:/tmp_amd/reed/export/reed/2/z5185842/Desktop$ nslookup 127.0.0.1
Server:      129.94.242.2
Address:     129.94.242.2#53

1.0.0.127.in-addr.arpa name = localhost.
```

Exercise 2: Use ping to test host reachability

Are the following hosts reachable from your machine by using ping:

- www.unsw.edu.au
- www.getfittest.com.au
- www.mit.edu
- www.intel.com.au
- www.tpg.com.au
- www.hola.hp
- www.amazon.com
- www.tsinghua.edu.cn
- www.kremlin.ru
- 8.8.8.8

If you observe that some hosts are not reachable, then can you explain why? Check if the addresses unreachable by the ping command are reachable from the Web browser.

Answer:

website		approximately
www.unsw.edu.au	reachable	22.6~22.9ms
www.getfittest.com.au	unreachable	
www.mit.edu	reachable	13.7~14.2ms
www.intel.com.au	reachable	13.7~14.0ms
www.tpg.com.au	reachable	29.7~29.9ms
www.hola.hp	unreachable	
www.amazon.com	reachable	13.0~13.2ms
www.tsinghua.edu.cn	reachable	164ms
www.kremlin.ru	unreachable	
8.8.8.8	reachable	1.50~1.91ms

www.getfittest.com.au and www.hola.hp does not exist.

www.kremlin.ru exists and it could access through browser, but it cannot access through ping because the owners of website have banned this way which could be a security measure.

Exercise 3: Use traceroute to understand network topology

Note: Include all traceroute outputs in your report.

1. Run traceroute on your machine to www.columbia.edu. How many routers are there between your workstation and www.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.

2. 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/>

3. 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?

Answer:

1.

```
uxterm
z5185842@vx3:/tmp_amd/reed/export/reed/2/z5185842/Desktop$ 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) 0.126 ms 0.100 ms 0.084 ms
 2 129.94.39.17 (129.94.39.17) 0.853 ms 0.869 ms 0.819 ms
 3 libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34) 1.598 ms 1.415 ms ombudnex1-vl-3154.gw.unsw.edu.au
   (149.171.253.35) 1.356 ms
 4 ombcr1-po-5.gw.unsw.edu.au (149.171.255.197) 1.193 ms ombcr1-po-6.gw.unsw.edu.au (149.171.255.169) 1
   .156 ms ombcr1-po-5.gw.unsw.edu.au (149.171.255.197) 1.179 ms
 5 unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101) 1.181 ms unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.
 105) 1.169 ms 1.170 ms
 6 138.44.5.0 (138.44.5.0) 1.762 ms 1.325 ms 1.318 ms
 7 et-1-3-0.pe1.sxt.bkvl.nsw.aarnet.net.au (113.197.15.149) 2.086 ms 2.279 ms 2.264 ms
 8 et-0-0-0.pe1.a.hnl.aarnet.net.au (113.197.15.99) 95.117 ms 95.053 ms 94.958 ms
 9 et-2-1-0.bdri.a.sea.aarnet.net.au (113.197.15.201) 146.560 ms 146.553 ms 146.537 ms
10 abilene-1-lo-jmb-706.sttlwa.pacificwave.net (207.231.240.8) 146.680 ms 146.642 ms 146.709 ms
11 et-4-0-0.4079.rtsw.miss2.net.internet2.edu (162.252.70.0) 157.349 ms 157.496 ms 157.322 ms
12 et-4-0-0.4079.rtsw.minn.net.internet2.edu (162.252.70.58) 180.443 ms 180.476 ms 180.439 ms
13 et-1-1-5.4079.rtsw.eqch.net.internet2.edu (162.252.70.106) 188.423 ms 188.464 ms 188.420 ms
14 ae-0.4079.rtsw3.eqch.net.internet2.edu (162.252.70.163) 192.137 ms 189.321 ms 189.309 ms
15 ae-1.4079.rtsw.clev.net.internet2.edu (162.252.70.130) 197.076 ms 196.971 ms 197.030 ms
16 buf-9208-I2-CLEV.nysernet.net (199.109.11.33) 201.294 ms 201.285 ms 201.324 ms
17 syr-9208-buf-9208.nysernet.net (199.109.7.193) 214.904 ms 204.731 ms 204.597 ms
18 nyc111-9204-syr-9208.nysernet.net (199.109.7.94) 213.865 ms 213.852 ms 213.634 ms
19 nyc-9208-nyc111-9204.nysernet.net (199.109.7.165) 213.816 ms 213.783 ms 220.562 ms
20 columbia,nyc-9208.nysernet.net (199.109.4.14) 213.678 ms 213.706 ms 213.876 ms
21 cc-core-1-x-nyser32-gw-1.net.columbia.edu (128.59.255.5) 214.228 ms 214.043 ms 214.444 ms
22 cc-conc-1-x-cc-core-1.net.columbia.edu (128.59.255.21) 214.189 ms 214.184 ms 214.204 ms
23 childpolicy.org (128.59.105.24) 213.864 ms 213.942 ms 213.924 ms
```

There are 22 routes between my workstation and www.columbia.edu. (There are 23 hops but the last one is the target website.) Based on the name of the outputs, there are 5 routers along the path that are part of the UNSW network, from the first to the fifth. Between the 7th and 9th routers, the package crosses the Pacific Ocean because the time delay between the two routers increases dramatically.

2. www.ucla.edu

```
tracert 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) 0.112 ms 0.096 ms 0.080 ms
 2 129.94.39.17 (129.94.39.17) 0.889 ms 0.886 ms 0.930 ms
 3 libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34) 1.388 ms libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35) 1.5
57 ms 1.551 ms
 4 ombcr1-po-5.gw.unsw.edu.au (149.171.255.197) 1.117 ms libcr1-po-6.gw.unsw.edu.au (149.171.255.201) 1.087 ms libc
r1-po-5.gw.unsw.edu.au (149.171.255.165) 1.104 ms
 5 unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101) 1.114 ms unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105) 1.156
ms unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101) 1.163 ms
 6 138.44.5.0 (138.44.5.0) 1.356 ms 1.365 ms 1.323 ms
 7 et-1-3-0.pe1.sxt.bkvl.nsw.aarnet.net.au (113.197.15.149) 1.984 ms 2.082 ms 2.097 ms
 8 et-0-0-0.pe1.a.hnl.aarnet.net.au (113.197.15.99) 95.213 ms 95.282 ms 95.189 ms
 9 et-2-1-0.bdr1.a.sea.aarnet.net.au (113.197.15.201) 146.615 ms 146.615 ms 146.610 ms
10 cenichpr-1-is-jmb-778.snvaca.pacificwave.net (207.231.245.129) 163.211 ms 163.908 ms 163.875 ms
11 hpr-lax-hpr3-svl-hpr3-100ge.cenic.net (137.164.25.73) 170.978 ms 171.583 ms 171.055 ms
12 ***
13 bd11f1.anderson--cr001.anderson.ucla.net (169.232.4.6) 172.740 ms 172.004 ms 172.686 ms
14 cr00f1.anderson--dr00f2.csbl.ucla.net (169.232.4.55) 188.111 ms cr00f2.csbl--dr00f2.csbl1.ucla.net (169.232.4.53)
172.181 ms cr00f1.anderson--dr00f2.csbl.ucla.net (169.232.4.55) 172.798 ms
15 ***
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```

www.u-tokyo.ac.jp

```
tracert 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) 0.148 ms 0.123 ms 0.101 ms
 2 129.94.39.17 (129.94.39.17) 0.888 ms 0.867 ms 0.815 ms
 3 libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34) 1.172 ms libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35) 1.62
0 ms 1.610 ms
 4 libcr1-po-6.gw.unsw.edu.au (149.171.255.201) 1.065 ms libcr1-po-5.gw.unsw.edu.au (149.171.255.165) 1.130 ms libcr
1-po-6.gw.unsw.edu.au (149.171.255.201) 1.083 ms
 5 unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105) 1.190 ms unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101) 1.107 m
s 1.100 ms
 6 138.44.5.0 (138.44.5.0) 1.256 ms 1.269 ms 1.264 ms
 7 et-0-3-0.pe1.bkvl.nsw.aarnet.net.au (113.197.15.147) 1.735 ms 1.806 ms 1.783 ms
 8 ge-4-0-0.bb1.a.pao.aarnet.net.au (202.158.194.177) 156.044 ms 156.048 ms 156.047 ms
 9 paloalto0.iij.net (198.32.176.24) 157.483 ms 157.422 ms 157.497 ms
10 osk004bb00.iij.net (58.138.88.185) 267.340 ms osk004bb01.iij.net (58.138.88.189) 270.442 ms osk004bb00.iij.net (5
8.138.88.185) 267.312 ms
11 osk004ip57.iij.net (58.138.106.166) 270.533 ms 270.515 ms osk004ip57.iij.net (58.138.106.162) 268.877 ms
12 210.130.135.130 (210.130.135.130) 268.932 ms 268.924 ms 270.430 ms
13 124.83.228.58 (124.83.228.58) 269.199 ms 267.651 ms 269.029 ms
14 124.83.252.178 (124.83.252.178) 275.025 ms 276.654 ms 274.916 ms
15 158.205.134.26 (158.205.134.26) 273.206 ms 274.845 ms 273.261 ms
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```

www.lancaster.ac.uk

```
tracert 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) 0.099 ms 0.076 ms 0.079 ms
 2 129.94.39.17 (129.94.39.17) 0.881 ms 0.869 ms 0.851 ms
 3 ombudnxi-vl-3154.gw.unsw.edu.au (149.171.253.35) 1.658 ms 1.684 ms 1.623 ms
 4 ombcr1-po-6.gw.unsw.edu.au (149.171.255.169) 1.024 ms libcr1-po-5.gw.unsw.edu.au (149.171.255.165) 1.079 ms libcr
1-po-6.gw.unsw.edu.au (149.171.255.201) 1.065 ms
 5 unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101) 1.115 ms 1.103 ms unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105
) 1.136 ms
 6 138.44.5.0 (138.44.5.0) 2.875 ms 2.229 ms 2.200 ms
 7 et-2-0-5.bdr1.sing.sin.aarnet.net.au (113.197.15.233) 92.731 ms 92.742 ms 92.722 ms
 8 138.44.226.7 (138.44.226.7) 256.240 ms 256.094 ms 256.096 ms
 9 janet-gw.mx1.lon.uk.geant.net (62.40.124.198) 256.235 ms 256.186 ms 256.237 ms
10 ae29.londpg-sbr2.ja.net (146.97.33.2) 256.839 ms 256.800 ms 256.788 ms
11 ae31.erdiss-sbr2.ja.net (146.97.33.22) 260.471 ms 260.447 ms 260.427 ms
12 ae29.manckh-sbr2.ja.net (146.97.33.42) 262.408 ms 262.492 ms 262.416 ms
13 ae24.lanclu-rbr1.ja.net (146.97.38.58) 264.660 ms 264.700 ms 264.630 ms
14 lancaster-university.ja.net (194.81.46.2) 278.493 ms 278.447 ms 278.435 ms
15 is-border01.bfw01.rtr.lancs.ac.uk (148.88.253.202) 265.117 ms 265.009 ms 265.023 ms
16 bfw01.iss-servers.is-core01.rtr.lancs.ac.uk (148.88.250.98) 270.324 ms 266.938 ms 266.677 ms
17 * * *
18 www.lancs.ac.uk (148.88.65.80) 265.108 ms !X 265.119 ms !X 265.217 ms !X
```

As these three pictures, we could find that when we traceroute these websites, the 6th router(138.44.5.0) is the reason that do the paths from my machine to these three destinations diverge.

whois 138.44.5.0

```
z5185842@vx3:/tmp_amd/reed/export/reed/2/z5185842/Desktop$ 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
```

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

OrgTechHandle: AWC12-ARIN
OrgTechName: APNIC Whois Contact
OrgTechPhone: +61 7 3858 3188
OrgTechEmail: search-apnic-not-arin@apnic.net
OrgTechRef: https://rdap.arin.net/registry/entity/AWC12-ARIN

OrgAbuseHandle: AWC12-ARIN
OrgAbuseName: APNIC Whois Contact
OrgAbusePhone: +61 7 3858 3188
OrgAbuseEmail: search-apnic-not-arin@apnic.net
OrgAbuseRef: https://rdap.arin.net/registry/entity/AWC12-ARIN

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/

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#

Found a referral to whois.apnic.net.

% [whois.apnic.net]
% Whois data copyright terms http://www.apnic.net/db/dbcopyright.html

% Information related to '138.44.0.0 - 138.44.255.255'

% Abuse contact for '138.44.0.0 - 138.44.255.255' is 'abuse@aarnet.edu.au'

inetnum: 138.44.0.0 - 138.44.255.255
netname: AARNET
descr: Australian Academic and Research Network
descr: Building 9
descr: Banks Street
country: AU
org: ORG-AAAR1-AP
admin-c: SM6-AP
tech-c: ANOC-AP
notify: irrcontact@aarnet.edu.au
mnt-by: APNIC-HM
mnt-lower: MAINT-AARNET-AP
mnt-routes: MAINT-AARNET-AP
mnt-irt: IRT-AARNET-AU
status: ALLOCATED PORTABLE
remarks: +-----+
remarks: This object can only be updated by APNIC hostmasters.

remarks: hostmasters and include your organisation's account
 remarks: name in the subject line.
 remarks: -----
 last-modified: 2017-10-09T13:02:43Z
 source: APNIC

irt: IRT-AARNET-AU
 address: AARNet Pty Ltd
 address: 26 Dick Perry Avenue
 address: Kensington, Western Australia
 address: Australia
 e-mail: abuse@aarnet.edu.au
 abuse-mailbox: abuse@aarnet.edu.au
 admin-c: SM6-AP
 tech-c: ANOC-AP
 auth: # Filtered
 mnt-by: MAINT-AARNET-AP
 last-modified: 2010-11-08T08:02:43Z
 source: APNIC

organisation: ORG-AAAR1-AP
 org-name: Australian Academic and Research Network
 country: AU
 address: Building 9
 address: Banks Street
 phone: +61-2-6222-3530
 fax-no: +61-2-6222-3535
 e-mail: irrcontact@aarnet.edu.au
 mnt-ref: APNIC-HM
 mnt-by: APNIC-HM
 last-modified: 2017-10-09T12:56:36Z
 source: APNIC

role: AARNet Network Operations Centre
 remarks:
 address: AARNet Pty Ltd
 address: GPO Box 1559
 address: Canberra
 address: ACT 2601
 country: AU
 phone: +61 1300 275 662
 phone: +61 2 6222 3555
 remarks:
 e-mail: noc@aarnet.edu.au
 remarks:
 remarks: Send abuse reports to abuse@aarnet.edu.au
 remarks: Please include timestamps and offset to UTC in logs
 remarks: Peering requests to peering@aarnet.edu.au
 remarks:
 admin-c: SM6-AP
 tech-c: BM-AP
 nic-hdl: ANOC-AP
 mnt-by: MAINT-AARNET-AP
 last-modified: 2010-06-30T13:16:48Z


```

-----
source:      APNIC

person:      Steve Maddocks
remarks:     Director Operations
address:     AARNet Pty Ltd
address:     26 Dick Perry Avenue
address:     Kensington
address:     Perth
address:     WA 6151
country:     AU
phone:       +61-8-9289-2210
fax-no:      +61-2-6222-7509
e-mail:      steve.maddocks@aarnet.edu.au
nic-hdl:     SM6-AP
mnt-by:      MAINT-AARNET-AP
last-modified: 2011-02-01T08:37:06Z
source:      APNIC

% Information related to '138.44.5.0/24AS7575'

route:       138.44.5.0/24
origin:      AS7575
descr:       Australian Academic and Research Network
             Building 9
             Banks Street
mnt-by:      MAINT-AARNET-AP
last-modified: 2019-04-03T03:55:51Z
source:      APNIC

% This query was served by the APNIC Whois Service version 1.88.15-46 (WHOIS-NODE3)

```

The information getting from these pictures, we know that:

www.ucla.edu	164.67.228.152	9339.8 miles	14 routers
www.u-tokyo.ac.jp	210.152.243.234	5558.0 miles	15 routers
www.lancaster.ac.uk	148.88.65.80	5797.1 miles	18 routers

Thus, the number of hops on each path is not proportional the physical distance.

3.

My IP is 129.94.242.117

www.speedtest.com.sg IP address is 202.150.221.170

www.telstra.net IP address is 203.50.5.178

From www.speedtest.com.sg/tr.php to my machine:

```
tracert to 129.94.242.117 (129.94.242.117), 30 hops max, 60 byte packets
 1  ge2-8.r01.sin01.ne.com.sg (202.150.221.169)  0.192 ms  0.211 ms  0.228 ms
 2  10.15.62.210 (10.15.62.210)  0.243 ms  0.299 ms  0.309 ms
 3  aarnet.sgix.sg (103.16.102.67)  209.135 ms  209.112 ms  209.153 ms
 4  et-7-3-0.pe1.nsw.brwy.aarnet.net.au (113.197.15.232)  212.351 ms  212.325 ms  212.333 ms
 5  138.44.5.1 (138.44.5.1)  208.384 ms  208.265 ms  208.394 ms
 6  ombcr1-te-1-5.gw.unsw.edu.au (149.171.255.106)  201.823 ms  201.938 ms  201.912 ms
 7  libudnex1-po-2.gw.unsw.edu.au (149.171.255.198)  212.417 ms  212.323 ms  212.360 ms
 8  ufw1-ae-1-3154.gw.unsw.edu.au (149.171.253.36)  202.412 ms  202.443 ms  202.439 ms
 9  129.94.39.23 (129.94.39.23)  207.506 ms  207.627 ms  207.491 ms
10  * * *
11  * * *
12  * * *
13  * * *
14  * * *
15  * * *
16  * * *
17  * * *
18  * * *
19  * * *
20  * * *
21  * * *
22  * * *
23  * * *
24  * * *
25  * * *
26  * * *
27  * * *
28  * * *
29  * * *
30  * * *
```

Traceroute Completed.

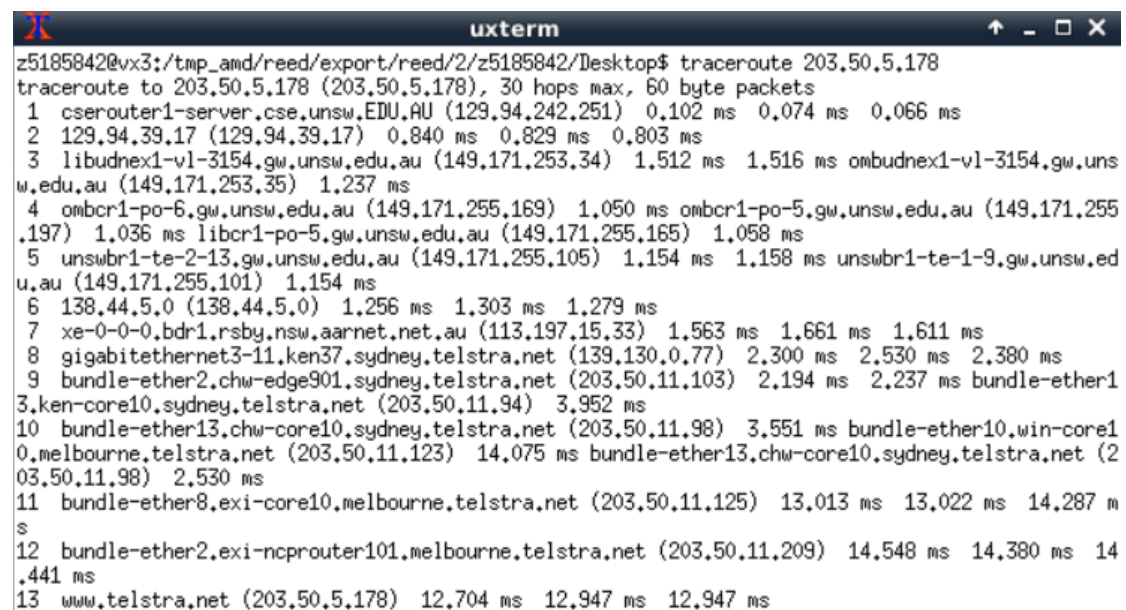
From my machine to www.speedtest.com.sg/tr.php:

```
z5185842@vx4:/tmp/and/reed/export/reed/2/z5185842/Desktop$ traceroute 202.150.221.170
tracert to 202.150.221.170 (202.150.221.170), 30 hops max, 60 byte packets
 1  cserouter1-server.cse.unsw.EDU.AU (129.94.242.251)  0.099 ms  0.078 ms  0.059 ms
 2  129.94.39.17 (129.94.39.17)  0.883 ms  0.875 ms  0.877 ms
 3  libudnex1-v1-3154.gw.unsw.edu.au (149.171.253.34)  1.512 ms  ombudnex1-v1-3154.gw.unsw.edu.au (149.171.253.35)  3
.920 ms  3.903 ms
 4  ombcr1-po-6.gw.unsw.edu.au (149.171.255.169)  1.139 ms  1.134 ms  ombcr1-po-5.gw.unsw.edu.au (149.171.255.197)  1
.218 ms
 5  unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101)  1.622 ms  unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  1.67
4 ms  1.626 ms
 6  138.44.5.0 (138.44.5.0)  1.344 ms  1.318 ms  1.216 ms
 7  et-0-3-0.pe1.alxd.nsw.aarnet.net.au (113.197.15.153)  1.717 ms  1.680 ms  1.623 ms
 8  xe-0-2-7.bdri1.a.lax.aarnet.net.au (202.158.194.173)  147.638 ms  147.636 ms  147.618 ms
 9  singtel.as7473.any2ix.coresite.com (206.72.210.63)  147.638 ms  147.602 ms  147.618 ms
10  203.208.182.153 (203.208.182.153)  334.314 ms  203.208.171.9 (203.208.171.9)  328.104 ms  203.208.178.185 (203.208
.178.185)  324.181 ms
11  203.208.177.110 (203.208.177.110)  325.296 ms  203.208.173.73 (203.208.173.73)  250.779 ms  203.208.172.145 (203.2
08.172.145)  245.037 ms
12  203.208.182.253 (203.208.182.253)  333.320 ms  * *
13  203.208.177.110 (203.208.177.110)  327.660 ms  202-150-221-170.rev.ne.com.sg (202.150.221.170)  208.973 ms  203.20
8.158.185 (203.208.158.185)  321.927 ms
```

From www.telstra.net/cgi-bin/trace to my machine:

```
1 gigabitethernet3-3.exi2.melbourne.telstra.net (203.50.77.53) 0.288 ms 0.201 ms 0.242 ms
2 bundle-ether3-100.win-core10.melbourne.telstra.net (203.50.80.129) 1.490 ms 1.477 ms 2.240 ms
3 bundle-ether12.ken-core10.sydney.telstra.net (203.50.11.122) 13.863 ms 12.598 ms 12.611 ms
4 bundle-ether1.ken-edge901.sydney.telstra.net (203.50.11.95) 12.109 ms 11.847 ms 11.862 ms
5 aarnet6.lnk.telstra.net (139.130.0.78) 11.608 ms 11.724 ms 11.610 ms
6 xe-5-2-2.pe1.brwy.nsw.aarnet.net.au (113.197.15.32) 11.862 ms 11.848 ms 11.860 ms
7 138.44.5.1 (138.44.5.1) 12.111 ms 11.972 ms 12.235 ms
8 libcr1-te-1-5.gw.unsw.edu.au (149.171.255.102) 11.985 ms 11.976 ms 11.983 ms
9 ombudnex1-po-1.gw.unsw.edu.au (149.171.255.202) 12.358 ms
10 ufw1-ae-1-3154.gw.unsw.edu.au (149.171.253.36) 12.610 ms 12.600 ms 12.733 ms
11 129.94.39.23 (129.94.39.23) 12.733 ms 12.850 ms 12.862 ms
```

From my machine to www.telstra.net/cgi-bin/trace :



```
uxterm
z5185842@vx3:/tmp_amd/reed/export/reed/2/z5185842/Desktop$ traceroute 203.50.5.178
traceroute to 203.50.5.178 (203.50.5.178), 30 hops max, 60 byte packets
 1 cserouter1-server.cse.unsw.EDU.AU (129.94.242.251) 0.102 ms 0.074 ms 0.066 ms
 2 129.94.39.17 (129.94.39.17) 0.840 ms 0.829 ms 0.803 ms
 3 libudnex1-v1-3154.gw.unsw.edu.au (149.171.253.34) 1.512 ms 1.516 ms ombudnex1-v1-3154.gw.uns
w.edu.au (149.171.253.35) 1.237 ms
 4 ombcr1-po-6.gw.unsw.edu.au (149.171.255.169) 1.050 ms ombcr1-po-5.gw.unsw.edu.au (149.171.255
.197) 1.036 ms libcr1-po-5.gw.unsw.edu.au (149.171.255.165) 1.058 ms
 5 unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105) 1.154 ms 1.158 ms unswbr1-te-1-9.gw.unsw.ed
u.au (149.171.255.101) 1.154 ms
 6 138.44.5.0 (138.44.5.0) 1.256 ms 1.303 ms 1.279 ms
 7 xe-0-0-0.bdri.rsby.nsw.aarnet.net.au (113.197.15.33) 1.563 ms 1.661 ms 1.611 ms
 8 gigabitethernet3-11.ken37.sydney.telstra.net (139.130.0.77) 2.300 ms 2.530 ms 2.380 ms
 9 bundle-ether2.chw-edge901.sydney.telstra.net (203.50.11.103) 2.194 ms 2.237 ms bundle-ether1
3.ken-core10.sydney.telstra.net (203.50.11.94) 3.952 ms
10 bundle-ether13.chw-core10.sydney.telstra.net (203.50.11.98) 3.551 ms bundle-ether10.win-core1
0.melbourne.telstra.net (203.50.11.123) 14.075 ms bundle-ether13.chw-core10.sydney.telstra.net (2
03.50.11.98) 2.530 ms
11 bundle-ether8.exi-core10.melbourne.telstra.net (203.50.11.125) 13.013 ms 13.022 ms 14.287 m
s
12 bundle-ether2.exi-ncprouter101.melbourne.telstra.net (203.50.11.209) 14.548 ms 14.380 ms 14
.441 ms
13 www.telstra.net (203.50.5.178) 12.704 ms 12.947 ms 12.947 ms
```

My IP is 129.94.242.117

www.speedtest.com.sg IP address is 202.150.221.170

www.telstra.net IP address is 203.50.5.178

As the results of the exercise, the reverse path is not as same as the forward path. For example, IP address in the two paths(reverse and forward), my machine to www.speedtest.com.sg is 202.150.221.170, but www.speedtest.com.sg to my machine is 202.150.221.169. Meanwhile, the names of the routers are same, because using DNS load balancing Technology makes some of the routers have several IP addresses.

In general, routes on the Internet do not need to be symmetric. For example, an administrative entity may choose to employ separate routers to handle ingoing and outgoing connections, to achieve better load balancing. Nevertheless, even when both the forward and the reverse path cross the same router, it is possible that different IP addresses are observed. The reason behind this is that the names we see in the traceroute output are the names of the router interfaces and not of routers.

Exercise 4: Use ping to gain insights into network performance

Answer:

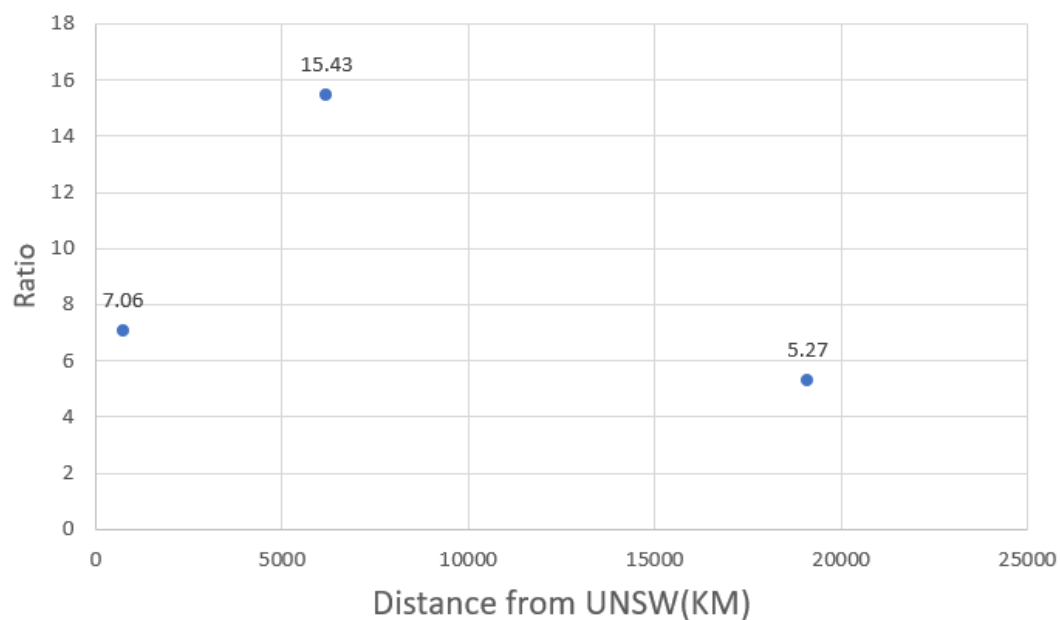
1.

(1) www.uq.edu.au is in Brisbane

(2) www.dlsu.edu.ph is in Manila

(3) www.tu-berlin.de is in Berlin

	Distance(km)	T(ms)	RTT(ms)	Ratio
Brisbane	735	2.45	17.3	7.06
Manila	6200	20.67	319	15.43
Berlin	16100	53.67	283	5.27

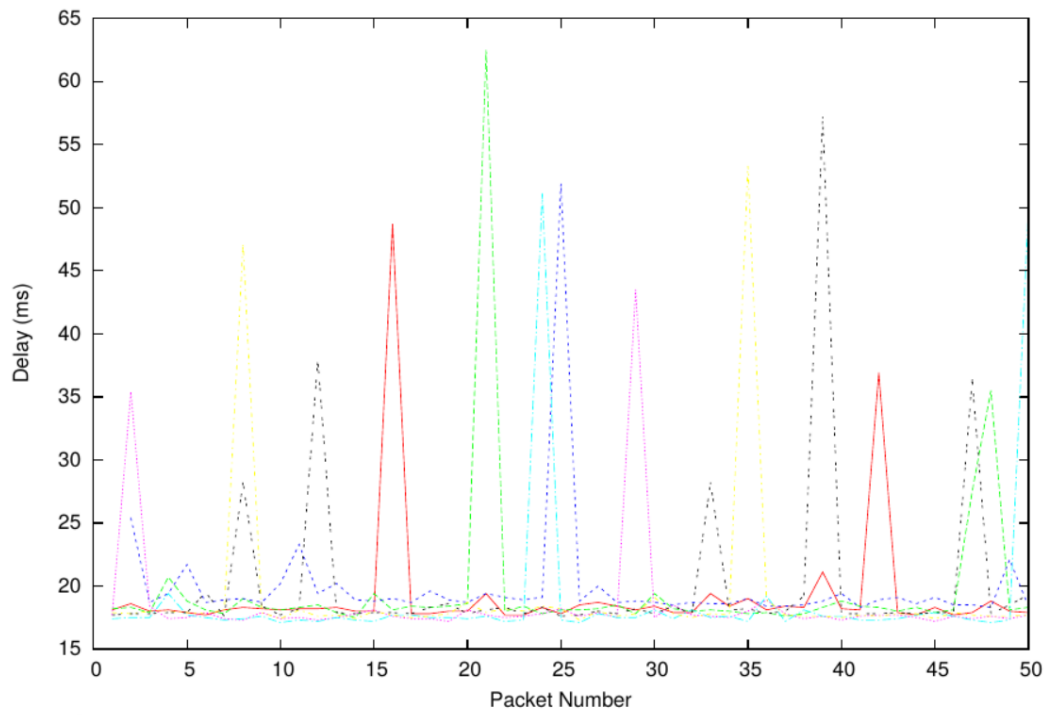


The ratio is much greater than 2. The possible reasons are below:

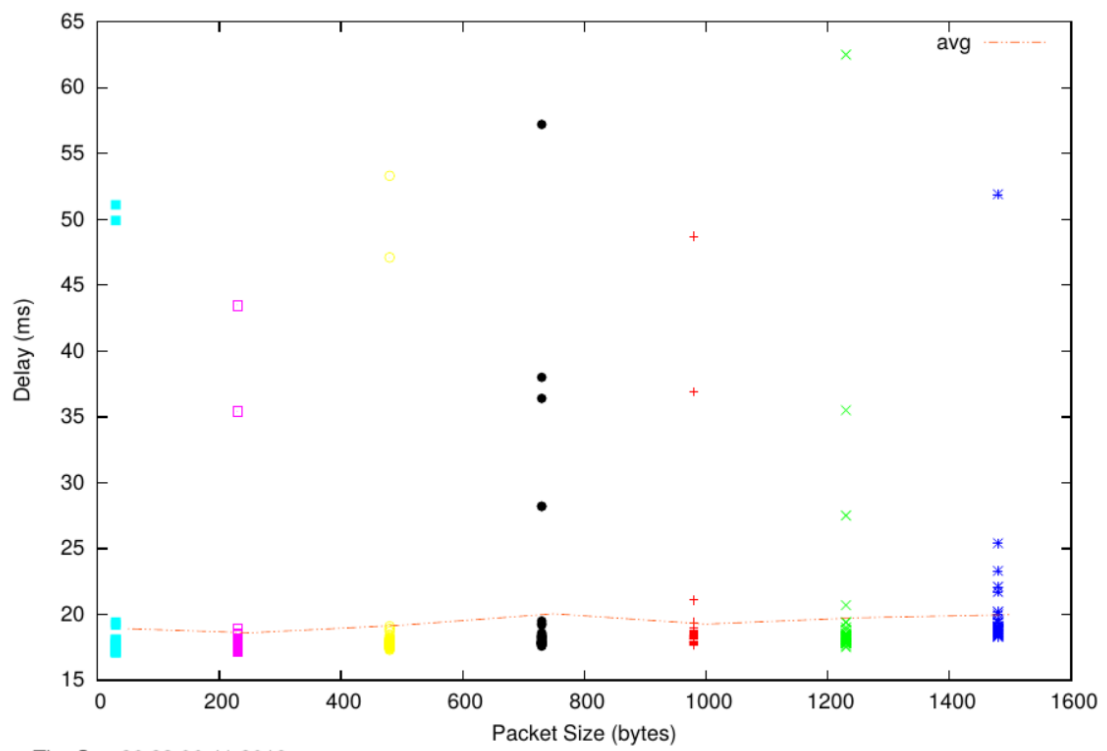
- (a) The transmission speed is less than the speed of light in the fiber.
- (b) The physical distance is also not the actual cable length, and the cable length may be much longer than the theoretical distance.
- (c) The presence of interference in the circuit.

2.

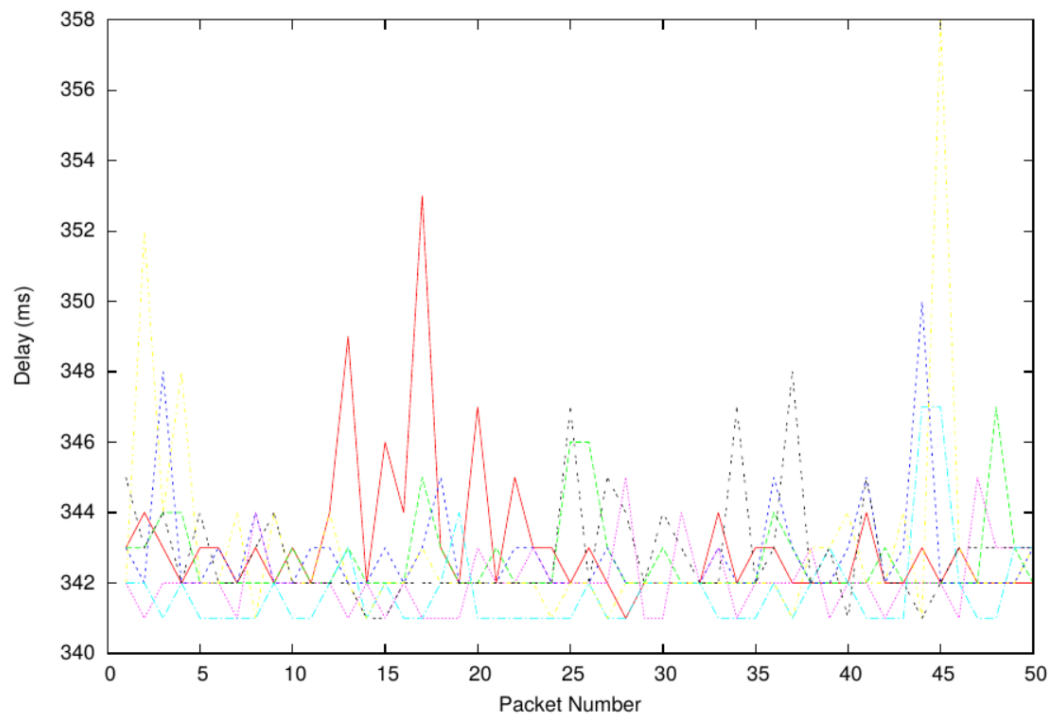
www.uq.edu.au



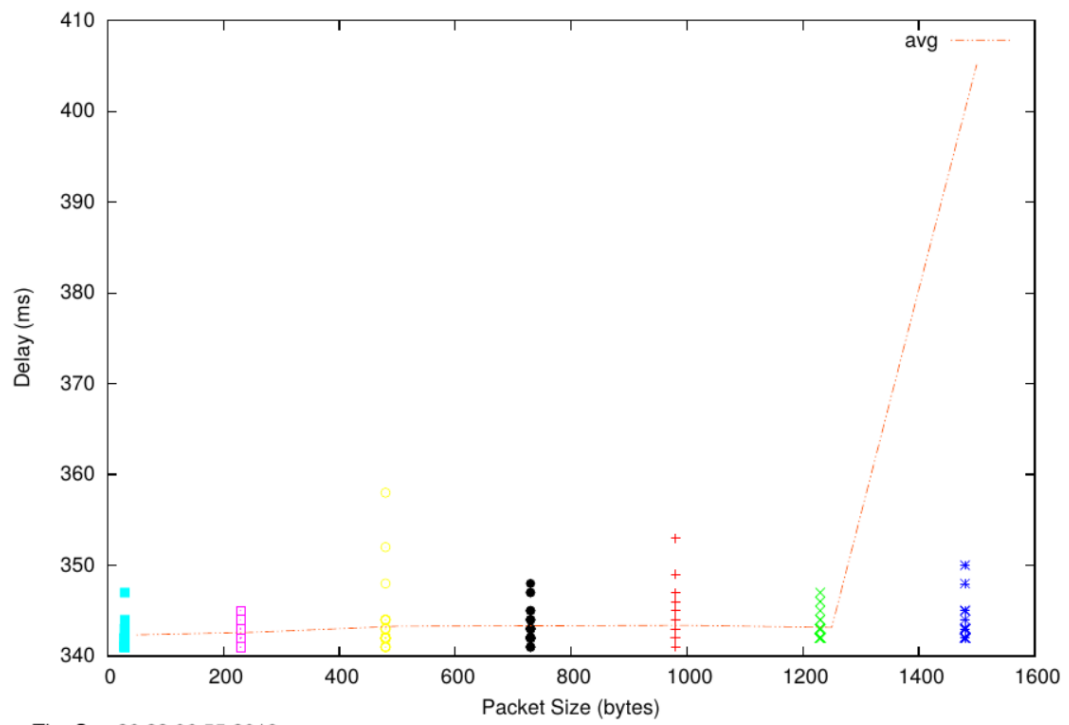
Thu Sep 26 23:06:41 2019



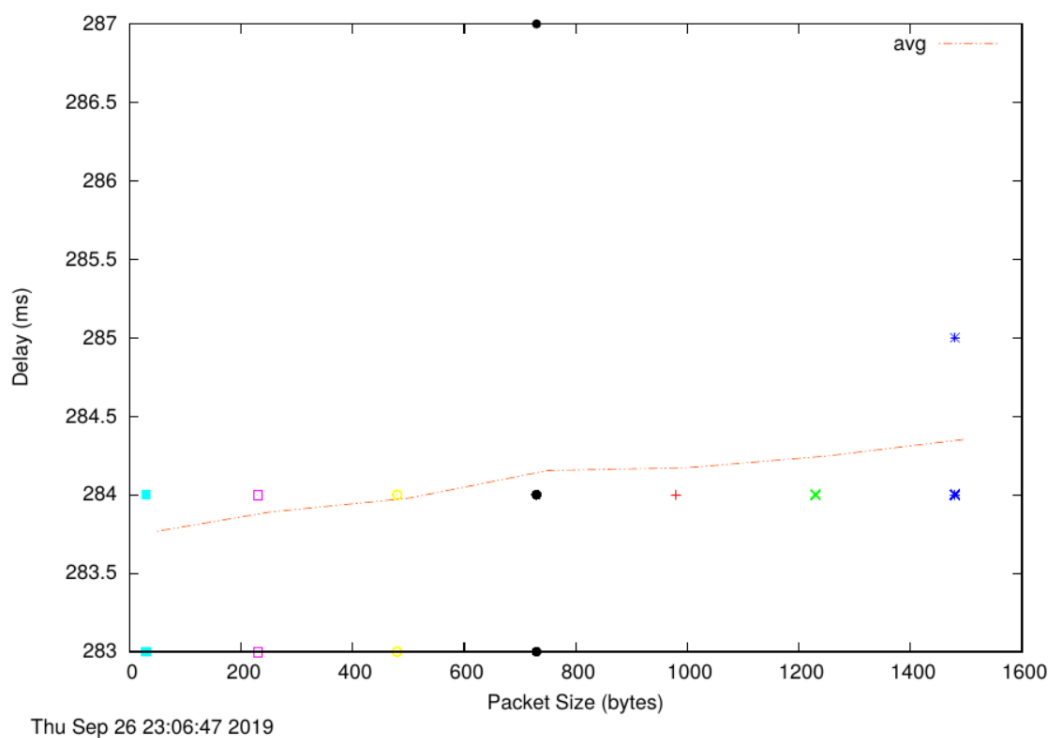
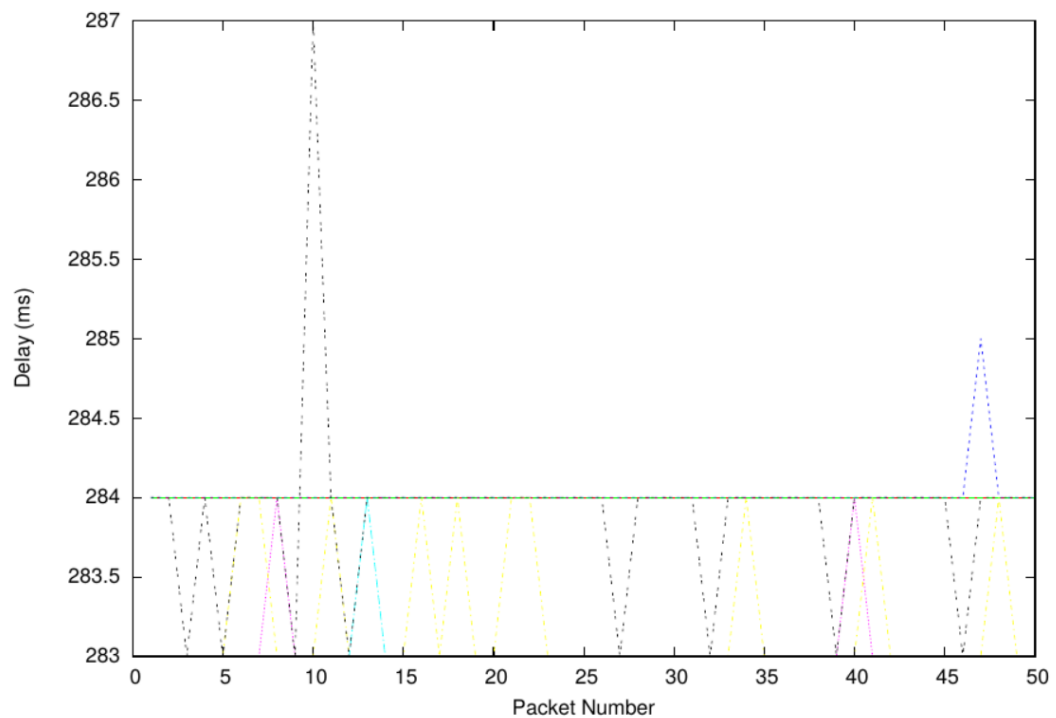
Thu Sep 26 23:06:41 2019



Thu Sep 26 23:06:55 2019



Thu Sep 26 23:06:55 2019



From the graphs of delay and packet number, they show that the delay varies over time and delay has no relation with the packet number or physical distance. However, the delay increases quickly several time in each graph, which indicate the variability of processing and queuing may influence the delay.

From the graphs of delay and packet number, the graph(Berlin) show that while the size of packet increase, delay also increase, however, in other graphs, the increased trend is not obvious. It may be the reason that other delay is much higher than transmission delay (relate to the size of packet).

Over all, The degree of this change does not depend on the physical distance and the number of routers ,but on the size of the packet.

3.NO, the website for www.epfl.ch is hosted in San Francisco of US.

```

uxterm
z5185842@vx2:/tmp_and/reed/export/reed/2/z5185842/Desktop$ traceroute www.epfl.ch
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) 0.078 ms 0.062 ms 0.063 ms
 2 129.94.39.17 (129.94.39.17) 0.854 ms 0.852 ms 0.795 ms
 3 ombudnex1-v1-3154.gw.unsw.edu.au (149.171.253.35) 1.573 ms libudnex1-v1-3154.gw.unsw.edu.au (149.171.253.34) 1.459 ms ombudnex1-v1-3154.gw.unsw.edu.au (149.171.253.35) 1.302 ms
 4 ombcr1-po-6.gw.unsw.edu.au (149.171.255.169) 1.156 ms ombcr1-po-5.gw.unsw.edu.au (149.171.255.197) 1.160 ms 1.118 ms
 5 unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105) 1.134 ms unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101) 1.145 ms unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105) 1.146 ms
 6 138.44.5.0 (138.44.5.0) 1.222 ms 1.196 ms 1.247 ms
 7 113.197.15.101 (113.197.15.101) 1.330 ms 1.326 ms 1.319 ms
 8 as4826.sydnet.megaopt.com (103.26.68.248) 2.326 ms 2.196 ms 3.462 ms
 9 BE-110.cor02.syd04.nsw.VOCUS.net.au (175.45.72.30) 1.696 ms be-111.cor01.syd11.nsw.vocus.net.au (175.45.72.32) 1.764 ms
10 BE-110.cor02.syd04.nsw.VOCUS.net.au (175.45.72.30) 1.801 ms
11 as13335.bdr02.syd03.nsw.VOCUS.net.au (114.31.192.37) 11.985 ms 12.294 ms 12.475 ms
12 104.20.229.42 (104.20.229.42) 1.416 ms 1.488 ms 1.444 ms

```

```

OrgName:      Cloudflare, Inc.
OrgId:        CLOUD14
Address:      101 Townsend Street
City:         San Francisco
StateProv:    CA
PostalCode:   94107
Country:      US
RegDate:      2010-07-09
Updated:      2019-09-25
Ref:          https://rdap.arin.net/registry/entity/CLOUD14

```

4.

Propagation delay is the amount of time it takes for the head of the signal to travel from the sender to the receiver. It can be computed as the ratio between the link length and the propagation speed over the specific medium. It does not depend on the packet size. It's related to the link(length of the link and medium) and, in general, does not vary (except if the link varies: cable, satellite, etc.).

Transmission delay is a delay based on how long it takes to send the signal down the transmission line. It depends on the size of packet. The transmission delay is almost proportional to the packet size; for a fixed packet size, it is constant.

Processing delay is the delay based on how long it takes the router to figure out where to send the packet. It depends on the size of packet.

Queuing delay is a delay based on how long the packet has to sit around in the router. The queuing delay only depends on the congestion in the network. It does not depend on packet size.

Over all, propagation delay and queuing delay do not depend on the size of packet, transmission delay and processing delay depend on it.