

COMP9331-21T2-Lab exercise 1

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Exercise 1: nslookup

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

Q1.

```
wagner % 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: 172.67.219.46
Name:   www.koala.com.au
Address: 104.21.45.210
```

The IP address of the web www.koala.com.au are “172.67.219.46” and “104.21.45.210”.

The website www.koala.com.au has multiple IP addresses, first this operation allows each server running on a different end system, and each has a different IP address. Also, this allows for Load balancing, and one of its important roles is to use multiple servers to provide a single service.

And, having multiple IP addresses can avoid single point failure.

Q2.

```
wagner % 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.
```

The name is “localhost”.

Specially, the IP address 127.0.0.1 here is Loop back Address, which is the data we send from host to the IP address starting with 127 will be received by host itself, and cannot be transmitted outside, and also the external device cannot access the machine through the Loopback Address.

And meanwhile, the name “localhost” is a domain name actually. Here, the localhost points to “127.0.0.1”

Exercise2. Use ping to test host reachability

(i) Reachable webs are as follows:

www.unsw.edu.au

www.mit.edu ,
www.intel.com.au ,
www.tpg.com.au
www.amazon.com
www.tsinghua.edu.cn

8.8.8.8

(ii)The non-existent webs are as follows:

www.getfittest.com.au ,
www.hola.hp

(iii) Not reachable web:

www.kremlin.ru

This web address unreachable by the ping command but is reachable from the web browser. The main possible reason is that this website are in a security factor to disable the ICMP protocol or enable ICMP packet filtering.

Exercise3. Use traceroute to understand network topology

1. Run traceroute on machine to www.columbia.edu .

The output of traceroute is,

```
wagner ~ 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)  0.186 ms  0.163 ms  0.177 ms
 2 129.94.39.17 (129.94.39.17)  1.019 ms  1.010 ms  0.918 ms
 3 libudnrex1-vl-3154.gw.unsw.edu.au (149.171.253.34)  1.587 ms  1.539 ms libudnrex1-vl-3154.gw.unsw.edu.au (149.171.253.35)  1.294 ms
 4 ombrcl-po-5.gw.unsw.edu.au (149.171.255.197)  1.097 ms libcrcl-po-5.gw.unsw.edu.au (149.171.255.165)  1.107 ms  1.087 ms
 5 unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.101)  1.164 ms unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  1.280 ms  1.255 ms
 6 138.44.5.0 (138.44.5.0)  1.392 ms  1.304 ms  1.332 ms
 7 et-1-3-0.pel.sxt.bkvl.nsw.aarnet.net.au (113.197.15.149)  2.143 ms  2.225 ms  2.098 ms
 8 et-0-0-0.pel.a.hnl.aarnet.net.au (113.197.15.99)  95.393 ms  95.368 ms  95.380 ms
 9 et-2-1-0.bdrl.a.sea.aarnet.net.au (113.197.15.201)  147.060 ms  147.033 ms  147.027 ms
10 abilene-1-0-jmb-706.sttlw.pacificwave.net (207.231.240.8)  207.443 ms  177.542 ms
11 ae-1.4079.rtsw.minn.net.internet2.edu (162.252.70.173)  202.306 ms  202.281 ms  202.328 ms
12 ae-1.4079.rtsw.eqch.net.internet2.edu (162.252.70.106)  207.630 ms  207.446 ms  207.420 ms
13 ae-0.4079.rtsw3.eqch.net.internet2.edu (162.252.70.163)  207.070 ms  213.216 ms  213.209 ms
14 ae-1.4079.rtsw.clev.net.internet2.edu (162.252.70.130)  212.994 ms  212.963 ms  212.941 ms
15 buf-9208.I2-CLEV.nysernet.net (199.109.11.33)  216.360 ms  216.489 ms  216.396 ms
16 syr-55al-buf-9208.nysernet.net (199.109.7.213)  219.945 ms  220.003 ms  219.977 ms
17 nyc32-55al-syr-55al.nysernet.net (199.109.7.206)  225.164 ms  225.183 ms  225.142 ms
18 nyc32-9208-nyc32-55al.nysernet.net (199.109.7.201)  225.119 ms  225.080 ms  224.993 ms
19 columbia.nyc-9208.nysernet.net (199.109.4.14)  224.881 ms  224.858 ms  224.819 ms
20 cc-core-1-x-nyser32-gw-1.net.columbia.edu (128.59.255.5)  225.113 ms  225.237 ms  225.254 ms
21 cc-conc-1-x-cc-core-1.net.columbia.edu (128.59.255.21)  226.053 ms  225.310 ms  225.388 ms
22 exeads.org (128.59.105.24)  227.786 ms  225.138 ms  225.108 ms
```

1) The output after tracrerooute command shows there are 22 hops, and then there are

21 routers between my workstation and www.columbia.edu .

2) There are 5 routers are part of the UNSW networks based on their hostnames.

```
weaver ~ 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]  0.070 ms  0.072 ms  0.060 ms
 2 129.94.39.17 [129.94.39.17]  0.869 ms  0.873 ms  0.882 ms
 3 libudnrex1-vl-3154.gw.unsw.edu.au [149.171.253.35]  1.095 ms libudnrex1-vl-3154.gw.unsw.edu.au (149.171.253.34)  1.410 ms libudnrex1-vl-3154.gw.unsw.edu.au (149.171.253.35)
 4 libcrcl-po-5.gw.unsw.edu.au [149.171.255.197]  1.221 ms ombrcl-po-5.gw.unsw.edu.au (149.171.255.165)  1.134 ms  1.134 ms
 5 unswbr1-te-1-9.gw.unsw.edu.au [149.171.255.101]  1.220 ms  1.230 ms unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.105)  1.271 ms
 6 138.44.5.0 (138.44.5.0)  1.357 ms  1.281 ms  1.288 ms
 7 et-1-3-0.pel.sxt.bkvl.nsw.aarnet.net.au [113.197.15.149]  1.976 ms  2.064 ms  2.161 ms
 8 et-0-0-0.pel.a.hnl.aarnet.net.au [113.197.15.99]  95.150 ms  95.125 ms  95.192 ms
 9 et-2-1-0.bdrl.a.sea.aarnet.net.au [113.197.15.201]  146.159 ms  146.225 ms  146.749 ms
10 abilene-1-0-jmb-706.sttlw.pacificwave.net (207.231.240.8)  177.423 ms  177.393 ms  177.412 ms
11 ae-1.4079.rtsw.minn.net.internet2.edu (162.252.70.173)  202.166 ms  202.200 ms  201.302 ms
12 ae-1.4079.rtsw.eqch.net.internet2.edu (162.252.70.106)  207.215 ms  207.377 ms  207.259 ms
```

```

; <>> DiG 9.9.5-9+deb8u19-Debian <>> -x 129.94.39.17
;; global options: +cmd
;; Got answer:
;; ->>HEADER<- opcode: QUERY, status: NXDOMAIN, id: 59498
;; flags: qr rd ra; QUERY: 1, ANSWER: 0, AUTHORITY: 1, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 4096
;; QUESTION SECTION:
;17.39.94.129.in-addr.arpa. IN PTR
;; AUTHORITY SECTION:
39.94.129.in-addr.arpa. 810 IN SOA ddi-member.net.unsw.edu.au. hostmaster.unsw.edu.au. 2012042316 10800 3600 2419200 900
;; Query time: 0 msec
;; SERVER: 129.94.242.2#53(129.94.242.2)
;; WHEN: Mon Jun 14 23:34:50 AEST 2021
;; MSG SIZE rcvd: 128

weaver % dig -x 138.44.5.0

; <>> DiG 9.9.5-9+deb8u19-Debian <>> -x 138.44.5.0
;; global options: +cmd
;; Got answer:
;; ->>HEADER<- opcode: QUERY, status: NXDOMAIN, id: 17883
;; flags: qr rd ra; QUERY: 1, ANSWER: 0, AUTHORITY: 1, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 4096
;; QUESTION SECTION:
;0.5.44.138.in-addr.arpa. IN PTR
;; AUTHORITY SECTION:
5.44.138.in-addr.arpa. 683 IN SOA ns1.aarnet.net.au. hostmaster.aarnet.edu.au. 2017121509 10800 600 1209600 3600
;; Query time: 0 msec
;; SERVER: 129.94.242.2#53(129.94.242.2)
;; WHEN: Mon Jun 14 23:29:19 AEST 2021
;; MSG SIZE rcvd: 127

```

To be more specific, a reverse DNS query on 2th hop router indicates that this router is part of UNSW network. And also, a reverse DNS query on 6th hop router above shows that this router is part of the AARNet domain. Therefore, there are 5 routers are part of UNSW network.

3)

From the specific information below:

```

1 cserouter1-server.cse.unsw.EDU.AU (129.94.242.251) 0.070 ms 0.072 ms 0.060 ms
2 129.94.39.17 (129.94.39.17) 0.869 ms 0.873 ms 0.882 ms
3 ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35) 1.305 ms libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34) 1.410 ms ombudn
9.171.253.35) 1.583 ms
4 libcr1-po-6.gw.unsw.edu.au (149.171.255.201) 1.121 ms ombrcl-po-6.gw.unsw.edu.au (149.171.255.169) 1.134 ms 1.134 ms
5 unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101) 1.220 ms 1.230 ms unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105) 1.271 ms
6 138.44.5.0 (138.44.5.0) 1.357 ms 1.281 ms 1.289 ms
7 et-1-3-0.pe1.sxt.bkvl.nsw.aarnet.net.au (113.197.15.149) 1.976 ms 2.064 ms 2.161 ms
8 et-0-0-0.pe1.a.hnl.aarnet.net.au (113.197.15.99) 95.160 ms 95.191 ms 95.192 ms
9 et-2-1-0.bdrl1.a.sea.aarnet.net.au (113.197.15.201) 146.758 ms 146.725 ms 146.749 ms
10 abilene-1-lo-jmb-706.sttlwa.pacificwave.net (207.231.240.8) 177.423 ms 177.389 ms 177.412 ms
11 ae-1.4079.rtsw.minn.net.internet2.edu (162.252.70.173) 202.166 ms 202.200 ms 201.902 ms
12 ae-1.4079.rtsw.eqch.net.internet2.edu (162.252.70.106) 207.215 ms 207.377 ms 207.259 ms
13 ae-0.4079.rtsw3.eqch.net.internet2.edu (162.252.70.163) 207.047 ms 212.467 ms 210.206 ms
14 ae-1.4079.rtsw.clev.net.internet2.edu (162.252.70.130) 232.356 ms 212.950 ms 212.949 ms
15 buf-9208-I2-CLEV.nysernet.net (199.109.11.33) 216.328 ms 216.861 ms 216.897 ms
16 syr-55al-buf-9208.nysernet.net (199.109.7.213) 220.076 ms 219.846 ms 219.777 ms
17 nyc32-55al-syr-55al.nysernet.net (199.109.7.206) 225.323 ms 225.199 ms 225.010 ms
18 nyc32-9208-nyc32-55al.nysernet.net (199.109.7.201) 224.884 ms 224.873 ms 224.870 ms
19 columbia.nyc-9208.nysernet.net (199.109.4.14) 224.741 ms 224.784 ms 224.811 ms
20 cc-core-1-x-nysernet3-gw-1.net.columbia.edu (128.59.255.5) 225.054 ms 225.255 ms 225.107 ms
21 cc-conc-1-x-cc-core-1.net.columbia.edu (128.59.255.21) 252.996 ms 249.372 ms 226.177 ms
22 columbiav university.net (128.59.105.24) 225.096 ms 225.129 ms 225.043 ms
weaver % dig -x 138.44.5.0

```

Hop 7-8 and 8-9 have a huge time jump. This suggests that this is where the path crosses the Pacific Ocean.

Also, from the information of 10th hop router, which is part of Pacificave network, it can roughly be known that the network before 7th hop and after 9th hop are located spans the Pacific Ocean.

2. Run traceroute from your machine to the following destinations:

- (i) Run traceroute on machine to www.ucla.edu

```

weber % traceroute www.ucla.edu
traceroute to www.ucla.edu (164.67.228.152), 30 hops max, 60 byte packets
 1 cserouterl-server.cse.unsw.EDU.AU (129.94.242.251) 0.090 ms 0.086 ms 0.071 ms
 2 129.94.39.17 (129.94.39.17) 1.212 ms 1.218 ms 1.146 ms
 3 libudnexl-vl-3154.gw.unsw.edu.au (149.171.255.169) 1.393 ms 2.079 ms 2.041 ms 2.070 ms
 4 ombrcl-po-5.gw.unsw.edu.au (149.171.255.197) 1.393 ms 2.079 ms 2.041 ms 2.070 ms
 5 unswhrl-te-2-9.gw.unsw.edu.au (149.171.255.101) 1.436 ms unswhrl-te-2-13.gw.unsw.edu.au (149.171.255.105) 1.501 ms unswhrl-te-1-9.gw.unsw.edu.au (149.171.255.101) 1.451 ms
 6 138.44.5.0 (138.44.5.0) 1.851 ms 1.564 ms 1.445 ms
 7 et-1-3-0.pel.sxt.bkv1.nsw.aarnet.net.au (113.197.15.149) 2.007 ms 1.843 ms 1.819 ms
 8 et-0-0-0.pel.a.hnl.aarnet.net.au (113.197.15.99) 95.284 ms 95.282 ms 95.336 ms
 9 et-2-1-0.bdr1.a.ser.aarnet.net.au (113.197.15.201) 146.800 ms 146.820 ms 146.781 ms
10 cenichpr-1-is-jmb-778.envacpacificwave.net (202.231.245.129) 164.289 ms 164.058 ms 163.190 ms
11 svl-aggl0-hn---svl-hpr100g.comc.net (137.21.22.106) 180.203 ms 165.142 ms 165.112 ms
12 svl-aggl0-hn---svl-hpr100g.comc.net (137.164.25.73) 160.864 ms 160.821 ms 160.777 ms
13 * * *
14 bd1f1.anderson--cr001.anderson.ultra.net (169.232.4.6) 160.384 ms 161.173 ms 161.184 ms
15 cr00f2.csbl--rrt1lf4.mathsci.ucla.net (169.232.8.181) 160.525 ms 160.550 ms cr00f1.anderson--rrt1lf4.mathsci.ucla.net (169.232.8.185) 160.640 ms
16 * * *
17 * * *
18 * * *
19 * * *
20 * * *
21 * * *
22 * * *
23 * * *
24 * * *
25 * * *
26 * * *
27 * * *
28 * * *
29 * * *
30 * * *

```

(ii) Run traceroute on machine to www.u-tokyo.ac.jp

```

traceroute to www.u-tokyo.ac.jp (210.152.243.234), 30 hops max, 60 byte packets
 1 cserouterl-server.cse.unsw.EDU.AU (129.94.242.251) 0.085 ms 0.070 ms 0.073 ms
 2 129.94.39.17 (129.94.39.17) 0.398 ms 1.065 ms 1.042 ms
 3 libudnexl-vl-3154.gw.unsw.edu.au (149.171.253.34) 1.768 ms 1.768 ms 1.806 ms
 4 librcl-po-5.gw.unsw.edu.au (149.171.255.165) 1.181 ms ombrcl-po-5.gw.unsw.edu.au (149.171.255.197) 1.255 ms librcl-po-6.gw.unsw.edu.au (149.171.255.201) 1.197 ms
 5 unswhrl-te-2-13.gw.unsw.edu.au (149.171.255.105) 1.348 ms 1.239 ms unswhrl-te-1-9.gw.unsw.edu.au (149.171.255.101) 1.260 ms
 6 138.44.5.0 (138.44.5.0) 1.581 ms 1.354 ms 1.352 ms
 7 et-0-3-0.pel.bkv1.nsw.aarnet.net.au (113.197.15.147) 1.725 ms 1.872 ms 1.794 ms
 8 ge-4_0_0.bbl.a.pao.aarnet.net.au (202.158.194.177) 155.144 ms 155.146 ms 155.143 ms
 9 palalito0.ijj.Net (198.32.176.24) 156.578 ms 156.698 ms 156.706 ms
10 osk004bb01.IIJ.Net (58.138.88.189) 266.743 ms osk004bb00.IIJ.Net (58.138.88.185) 287.157 ms 287.127 ms
11 osk004ip57.IIJ.Net (58.138.106.166) 277.150 ms osk004ip57.IIJ.Net (58.138.106.162) 276.730 ms osk004ip57.IIJ.Net (58.138.106.166) 277.003 ms
12 210.130.135.130 (210.130.135.130) 277.026 ms 287.217 ms 288.522 ms
13 124.83.228.58 (124.83.228.58) 277.237 ms 288.162 ms 288.130 ms
14 124.83.252.178 (124.83.252.178) 283.038 ms 282.823 ms 282.800 ms
15 158.205.134.26 (158.205.134.26) 282.812 ms 272.680 ms 272.619 ms
16 * * *
17 * * *
18 * * *
19 * * *
20 * * *
21 * * *
22 * * *
23 * * *
24 * * *
25 * * *
26 * * *
27 * * *
28 * * *
29 * * *
30 * * *

```

(iii) Run traceroute on machine to www.lancaster.ac.uk

```

weber % traceroute www.lancaster.ac.uk
traceroute to www.lancaster.ac.uk (108.88.65.80), 30 hops max, 60 byte packets
 1 cserouterl-server.cse.unsw.EDU.AU (129.94.242.251) 0.117 ms 0.146 ms 0.102 ms
 2 129.94.39.17 (129.94.39.17) 1.253 ms 1.248 ms 1.229 ms
 3 libudnexl-vl-3154.gw.unsw.edu.au (149.171.253.35) 58.309 ms 58.420 ms libudnexl-vl-3154.gw.unsw.edu.au (149.171.253.34) 1.443 ms
 4 librcl-po-6.gw.unsw.edu.au (149.171.255.201) 1.190 ms ombrcl-po-5.gw.unsw.edu.au (149.171.255.197) 1.643 ms ombrcl-po-6.gw.unsw.edu.au (149.171.255.169) 1.625 ms
 5 unswhrl-te-1-9.gw.unsw.edu.au (149.171.255.101) 1.360 ms 1.350 ms unswhrl-te-2-13.gw.unsw.edu.au (149.171.255.105) 1.590 ms
 6 138.44.5.0 (138.44.5.0) 1.574 ms 1.697 ms 1.685 ms
 7 et-2-0-5.bdr1.sing.sin.aarnet.net.au (113.197.15.233) 92.682 ms 92.878 ms 92.840 ms
 8 138.44.226.7 (138.44.226.7) 255.951 ms 255.922 ms 255.945 ms
 9 janet-gw.mxl.lon.uk.geant.net (62.40.124.198) 256.071 ms 256.122 ms 256.024 ms
10 ae29.londpg-sbr2.ja.net (146.97.33.40) 256.93 ms 256.00 ms 256.00 ms
11 ae29.londpg-sbr2.ja.net (146.97.33.22) 263.500 ms 261.162 ms 260.316 ms
12 ae29.manch-sbr2.ja.net (146.97.33.42) 262.06 ms 270.492 ms 265.387 ms
13 ae29.manch-sbr2.ja.net (146.97.35.50) 262.157 ms 262.188 ms 262.238 ms
14 lancaster-uni.ja.net (146.97.40.178) 280.879 ms 280.878 ms 280.882 ms
15 * * *
16 * * *
17 * * *
18 * * *
19 * * *
20 * * *
21 * * *
22 * * *
23 * * *
24 * * *
25 * * *
26 * * *
27 * * *
28 * * *
29 * * *
30 * * *

```

Specially, from the three outputs above, the first 6 hops are same, and then from 7th hop, the IP addresses are different. Therefore, the divergent router is 6th router, and the IP is 138.44.5.0.

The detail of this IP address 138.44.5.0. is as follows:

```

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 1997-2021, 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-138-44-0-0-0
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/
#
# Copyright 1997-2021, American Registry for Internet Numbers, Ltd.
#

```

```
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
abuse-c:          AA1638-AP
status:           ALLOCATED PORTABLE
remarks:          This object can only be updated by APNIC hostmasters.
remarks:          To update this object, please contact APNIC
remarks:          hostmasters and include your organisation's account
remarks:          name in the subject line.
notify:           irrcontact@aarnet.edu.au
mnt-by:           APNIC-HM
mnt-lower:        MAINT-AARNET-AP
mnt-routes:       MAINT-AARNET-AP
mnt-irt:          IRT-AARNET-AU
last-modified:    2020-06-22T05:22:11Z
source:           APNIC

irt:              IRT-AARNET-AU
address:          AARNet Pty Ltd
e-mail:           abuse@aarnet.edu.au
abuse-mailbox:   abuse@aarnet.edu.au
admin-c:          SM6-AP
tech-c:           ANOC-AP
auth:             # Filtered
remarks:          abuse@aarnet.edu.au was validated on 2020-12-23
mnt-by:           MAINT-AARNET-AP
last-modified:    2020-12-23T04:53:48Z
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:             ABUSE AARNETAU
address:          AARNet Pty Ltd
country:          ZZ
phone:            +000000000
e-mail:           abuse@aarnet.edu.au
admin-c:          SM6-AP
tech-c:           ANOC-AP
nic-hdl:          AA1638-AP
remarks:          Generated from irt object IRT-AARNET-AU
abuse-mailbox:   abuse@aarnet.edu.au
mnt-by:           APNIC-ABUSE
last-modified:    2020-12-02T07:30:52Z
source:           APNIC

role:             AARNet Network Operations Centre
remarks:
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:
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
e-mail:           noc@aarnet.edu.au
admin-c:          ANOC-AP
tech-c:           ANOC-AP
nic-hdl:          ANOC-AP
mnt-by:           MAINT-AARNET-AP
last-modified:    2020-12-02T07:35:01Z
source:           APNIC
```

```

role:          AARNet Network Operations Centre
remarks:
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:
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
e-mail:       noc@aarnet.edu.au
admin-c:      ANOC-AP
tech-c:       ANOC-AP
nic-hdl:     ANOC-AP
mnt-by:      MAINT-AARNET-AP
last-modified: 2020-12-02T07:35:01Z
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-SNAPSHOT (WHOIS-AU1)

```

No, the number of hops on each path is not proportional the physical distance.

The specific reason is,

the physical distance from AU to UK (15196 km) is much greater than the distance from AU to JP (6848km),

however, access www.u-tokyo.ac.jp experienced 15 hops, but access www.lancaster.ac.uk experienced 14 hops.

3. Several servers distributed around the world: (i) <http://www.speedtest.com.sg/tr.php> and (ii) <https://www.telstra.net/cgi-bin/trace> .

Check my IP address first through the command /sbin/ifconfig is 129.94.242.55.

```
weaver % /sbin/ifconfig
eth0      Link encap:Ethernet HWaddr 00:50:56:91:39:58
          inet addr:129.94.242.55 Bcast:129.94.242.255 Mask:255.255.255.0
          inet6 addr: fe80::250:56ff:fe91:3958/64 Scope:Link
            UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
            RX packets:2704593373 errors:0 dropped:45661 overruns:0 frame:0
            TX packets:1734019650 errors:0 dropped:0 overruns:0 carrier:0
            collisions:0 txqueuelen:1000
            RX bytes:1192627313125 (1.0 TiB)  TX bytes:1150476122777 (1.0 TiB)
```

1) Run traceroute from servers towards local machine. (Reversed path)

www.speedtest.com.sg

```
Traceroute Result:
traceroute to 129.94.242.55 (129.94.242.55), 30 hops max, 60 byte packets
1 ge2-8.r01.sin01.ne.com.sg (202.150.221.169) 0.131 ms 0.151 ms 0.157 ms
2 10.11.34.146 (10.11.34.146) 0.393 ms 0.465 ms 0.532 ms
3 aarnet.sgix.sg (103.16.102.67) 209.103 ms 209.126 ms 209.135 ms
4 et-7-3-0.pel.nsw.brwy.aarnet.net.au (113.197.15.232) 209.276 ms 209.198 ms 209.176 ms
5 138.44.5.1 (138.44.5.1) 204.568 ms 204.593 ms 204.658 ms
6 ombcrl-te-1-5.gw.unsw.edu.au (149.171.255.106) 215.082 ms 215.335 ms 214.950 ms
7 libudnrex1-po-2.gw.unsw.edu.au (149.171.255.170) 205.179 ms 205.132 ms 205.098 ms
8 ufw1-ae-1-3154.gw.unsw.edu.au (149.171.253.36) 215.652 ms 215.594 ms 215.636 ms
9 129.94.39.23 (129.94.39.23) 200.603 ms 200.550 ms 200.559 ms
10 * * *
11 * * *
12 * * *
13 * * *
14 * * *
15 * * *
16 * * *
17 * * *
18 * * *
19 * * *
20 * * *
21 * * *
22 * * *
23 * * *
24 * * *
25 * * *
26 * * *
27 * * *
28 * * *
29 * * *
30 * * *
```

Traceroute Completed.

www.telstra.net

```
1 gigabitethernet3-3.exi2.melbourne.telstra.net (203.50.77.53) 0.350 ms 0.224 ms 0.243 ms
2 bundle-ether3-100.win-core10.melbourne.telstra.net (203.50.80.129) 2.743 ms 1.737 ms 2.120 ms
3 bundle-ether12.ken-core10.sydney.telstra.net (203.50.11.122) 13.861 ms 12.355 ms 12.737 ms
4 bundle-ether1.ken-edge903.sydney.telstra.net (203.50.11.173) 11.987 ms 11.981 ms 11.988 ms
5 aar3533567.lnk.telstra.net (139.130.0.78) 105.808 ms 155.279 ms 12.231 ms
6 et-7-1-0.pel.brwy.nsw.aarnet.net.au (113.197.15.13) 11.862 ms 11.855 ms 11.862 ms
7 138.44.5.1 (138.44.5.1) 12.111 ms 11.982 ms 11.986 ms
8 ombcrl-te-1-5.gw.unsw.edu.au (149.171.255.106) 12.112 ms 12.106 ms 17.609 ms
9 libudnrex1-po-2.gw.unsw.edu.au (149.171.255.198) 12.360 ms 12.356 ms 12.361 ms
10 ufw1-ae-1-3154.gw.unsw.edu.au (149.171.253.36) 12.738 ms 12.859 ms 12.858 ms
11 129.94.39.23 (129.94.39.23) 12.986 ms 12.982 ms 12.986 ms
```

2) Run traceroute from my machine towards servers. (Forward path)

www.speedtest.com.sg (IP address is 202.150.221.170)

```
weaver % traceroute www.speedtest.com.sg
traceroute to www.speedtest.com.sg (202.150.221.170), 30 hops max, 60 byte packets
  cserouterl-server.cse.unsw.EDU.AU (129.94.242.251) 0.081 ms 0.080 ms 0.080 ms
  2 129.94.39.17 (129.94.39.17) 0.880 ms 0.899 ms 0.907 ms
  3 libudnrex1-vl-3154.gw.unsw.edu.au (149.171.253.34) 1.782 ms 2.049 ms 1.779 ms
  4 libcrl-po-6.gw.unsw.edu.au (149.171.255.165) 1.176 ms libcrl-po-5.gw.unsw.edu.au (149.171.255.197)
  1.197 ms
  5 unswvrl-te-1-9.gw.unsw.edu.au (149.171.255.101) 1.415 ms 1.399 ms 1.409 ms
  6 138.44.5.0 (138.44.5.0) 1.423 ms 1.296 ms 1.301 ms
  7 eth0-3-0.pel.alternate.aarnet.net.au (113.197.15.153) 1.700 ms 1.765 ms 1.750 ms
  8 xe-0-2-7.bdrl.a1.lax.aarnet.net.au (202.158.194.173) 148.157 ms 148.163 ms 148.161 ms
  9 singtel.as7473.any2ix.coresite.com (206.72.210.63) 147.769 ms 147.768 ms 147.715 ms
  10 203.208.171.117 (203.208.171.117) 147.993 ms 203.208.172.165 (203.208.172.165) 325.774 ms 203.208.171.117 (203.208.171.117) 147.884 ms
  11 203.208.177.110 (203.208.177.110) 308.396 ms 203.208.172.145 (203.208.172.145) 243.644 ms 203.208.177.110 (203.208.177.110) 320.059 ms
  12 * * 203.208.158.17 (203.208.158.17) 327.041 ms
  13 203.208.158.185 (203.208.158.185) 326.884 ms 202-150-221-170.rev.ne.com.sg (202.150.221.170) 212.398 ms 200.816 ms
weaver %
```

www.telstra.net (IP address is 203.208.5.178)

```

traceroute to www.telstra.net (203.50.5.178), 30 hops max, 60 byte packets
1 cserouter.unsw.edu.au (129.94.242.251) 0.090 ms 0.098 ms 0.100 ms
2 129.94.39.17 (129.94.39.17) 0.80 ms 0.925 ms 0.893 ms
3 core1-0-4.unsw.edu.au (129.94.39.13) 1.03 ms 1.06 ms 1.04 ms
4 libcore1-te-5.gw.unsw.edu.au (149.171.255.145) 1.187 ms libcore1-po-5.gw.unsw.edu.au (149.171.255.197) 1.202 ms libcore1-te-6.gw.unsw.edu.au (149.171.255.201) 1.212 ms
5 unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105) 1.384 ms unswbr1-te-1-3.gw.unsw.edu.au (149.171.255.101) 1.442 ms unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105) 1.378 ms
6 139.44.5.9 (139.44.5.9) 1.393 ms 1.391 ms 1.343 ms
7 139.44.5.1 (139.44.5.1) 1.391 ms 1.391 ms 1.343 ms
8 xe-0-0-3.bdr1.ruby.nav.sarnet.net.au (113.197.15.31) 1.442 ms 1.503 ms 1.446 ms
9 139.44.5.1 (139.44.5.1) 1.442 ms 1.503 ms 1.446 ms
10 libcore1-te-1-17.libcore1-0-4.ken-edge903.sydney.telstra.net (139.130.0.77) 2.358 ms 2.324 ms 2.307 ms
11 libcore1-te-1-17.libcore1-0-4.ken-edge903.sydney.telstra.net (139.130.0.77) 2.358 ms 2.324 ms 2.307 ms
12 bundle-ether-2-exi-correl0.melbourne.telstra.net (203.50.6.40) 14.324 ms bundle-ether1-exi-correl0.melbourne.telstra.net (203.50.11.125) 16.131 ms bundle-ether1-2-exi-correl0.melbourne.telstra.net (203.50.6.40) 15.772 ms
13 www.telstra.net (203.50.5.178) 14.391 ms 13.696 ms 14.286 ms

```

According to the results of forward path and reversed path, it can be found that they are not go through the same routers. Because in the process of router routing, the network topology is continuous changing (there may be router corruption, or router congestion, or other factors.). Hence, forward path and reverse path do not choose the same routers often. And meanwhile, because of the problem of load balancing, the same router will have multiple IP addresses.

Exercise 4. Use ping to gain insights into network performance

Q1.

The distance,

UNSW (Sydney) to Brisbane by air, 754km

UNSW (Sydney) to Serdang by air, 6243km

UNSW (Sydney) to Berlin by air, 16,093km

(Data from google)

Assuming the propagation speed is $3 \times 10^8 \text{ m/s}$,

Then, the shortest (theoretically) possible time that a packet will take to reach the 3 locations from UNSW are:

$$T_{Brisbane} = \frac{754\text{km}}{3 \times 10^8 \text{ m/s}} \approx 2.51\text{ms}$$

$$T_{Serdang} = \frac{6243\text{km}}{3 \times 10^8 \text{ m/s}} = 20.81\text{ms}$$

$$T_{Berlin} = \frac{16,093\text{km}}{3 \times 10^8 \text{ m/s}} \approx 53.64\text{ms}$$

And from the corresponding *avg.txt files, the minimum RTT (for 50 byte packets) to these 3 destinations are,

$$\min RTT_{Brisbane} = 16.985\text{ms}$$

$$\min RTT_{Serdang} = 101.934\text{ms}$$

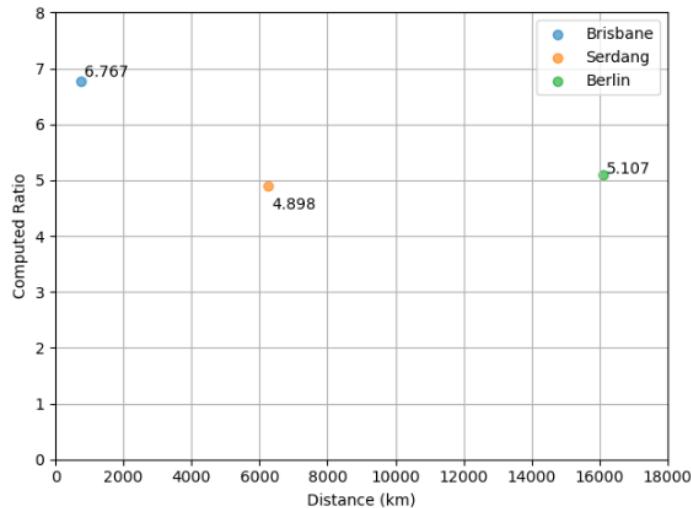
$$\min RTT_{Berlin} = 273.942\text{ms}$$

Therefore, the ratios are:

$$R_{Brisbane} = \frac{16.985\text{ms}}{2.51\text{ms}} = 6.767$$

$$R_{Serdang} = \frac{101.934\text{ms}}{20.81\text{ms}} = 4.898$$

$$R_{Berlin} = \frac{273.942\text{ms}}{53.64\text{ms}} = 5.107$$



The values of y-axis are greater than 2.

The possible reasons are as follows,

- The speed is lost in the pipeline network transmission process, which is lower than the theoretical speed ($3 \times 10^8 \text{ m/s}$).
- The distance in the transmission process is not a perfect straight-line distance, but the actual transmission distance is much higher than the two-point direct straight-line distance.
- There is an unnegligible delay between each router.

Q2.

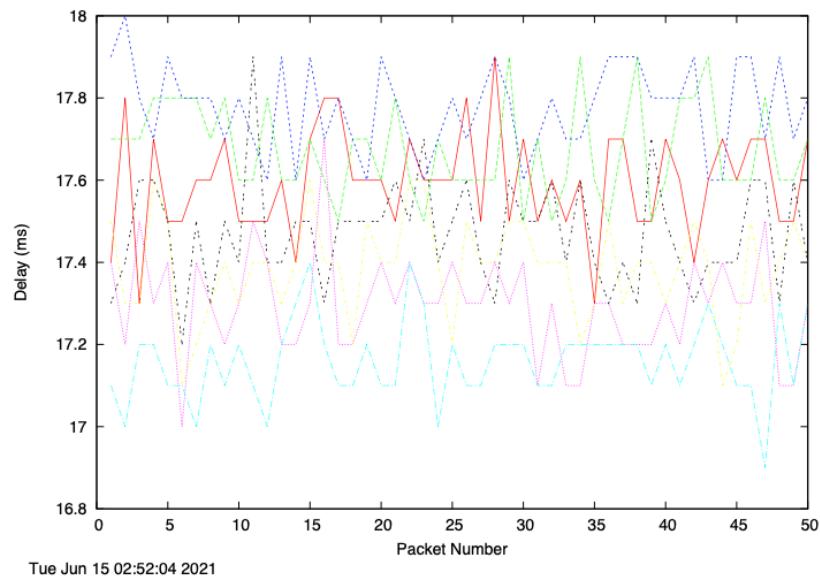
The delay to the destinations varies over time.

From the graphs of delay and scatter below, it is found that the horizontal coordinates of these graph are packet size (the number of packets). As time goes on, the number of packets (the amount of data) increases gradually. The overall graphs below shows that as the number of packet increases, the delay time increases (changes). Therefore, the delay to the destination varies over time.

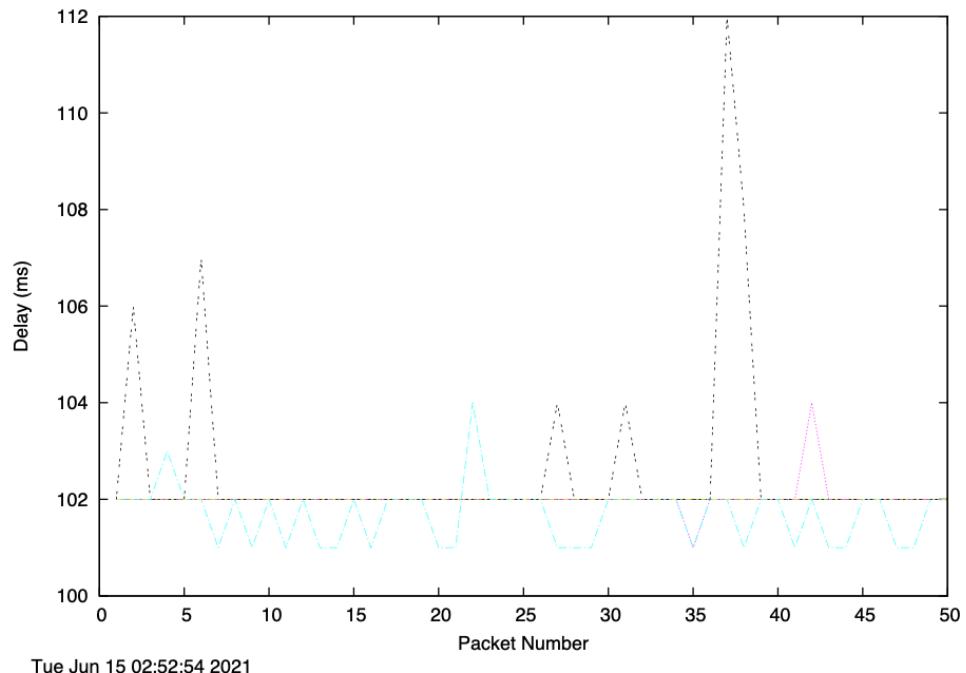
(i)

Each of the following plots (destination_delay.pdf) indicates the delay of consecutive packets of same size, for different packet sizes:

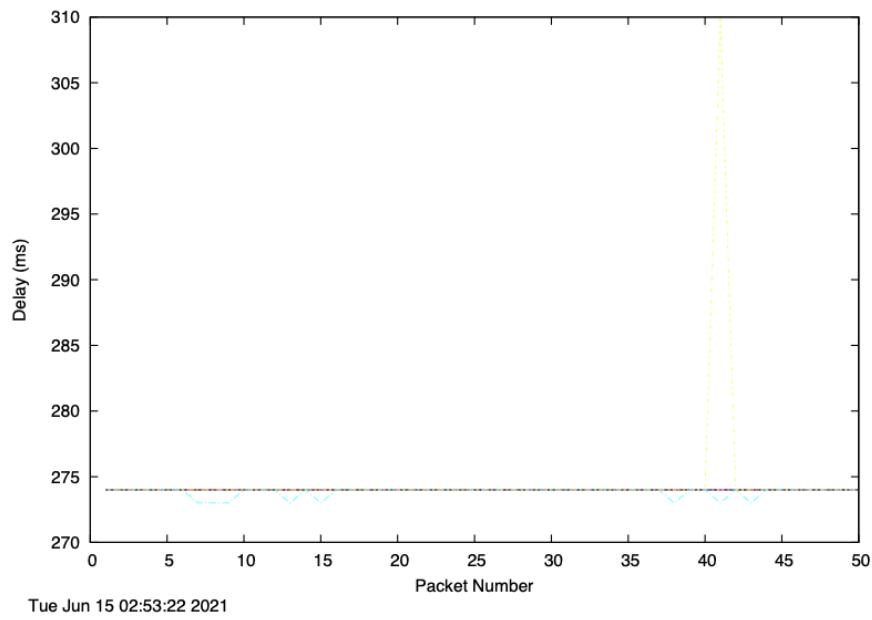
- 1) www.uq.edu.au



2) www.upm.edu.my



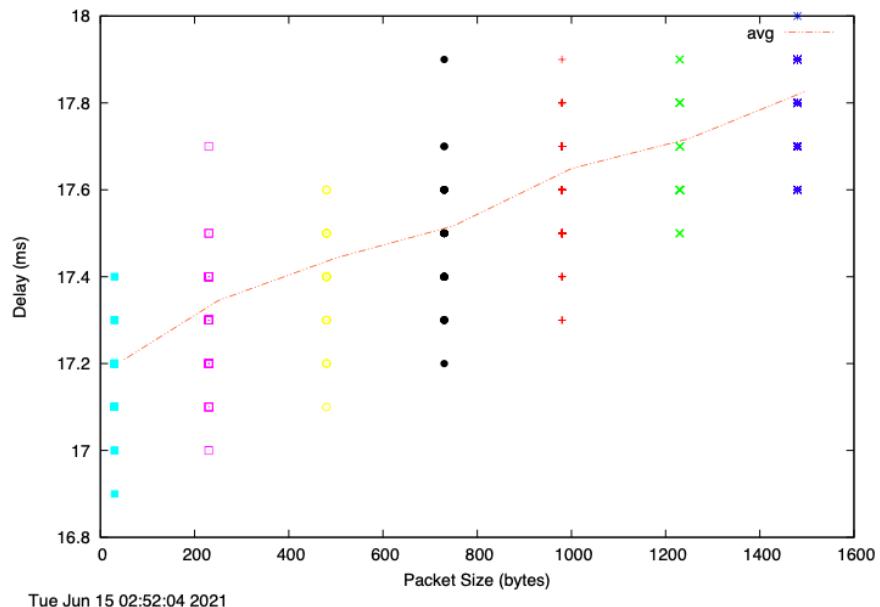
3) www.tu-berlin.de



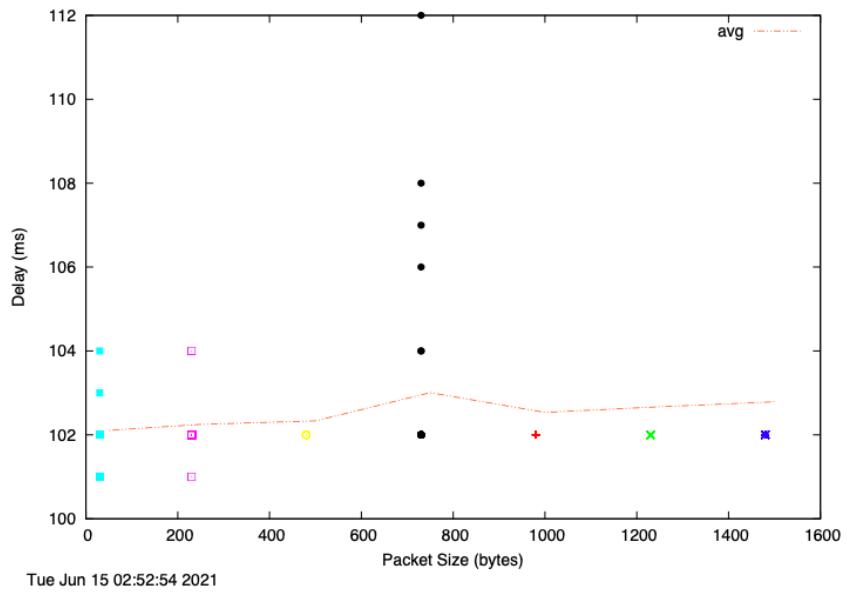
(ii)

The following plots (destination_scatter.pdf) depict the various measurements of delay as a scatter plot for different packet sizes.

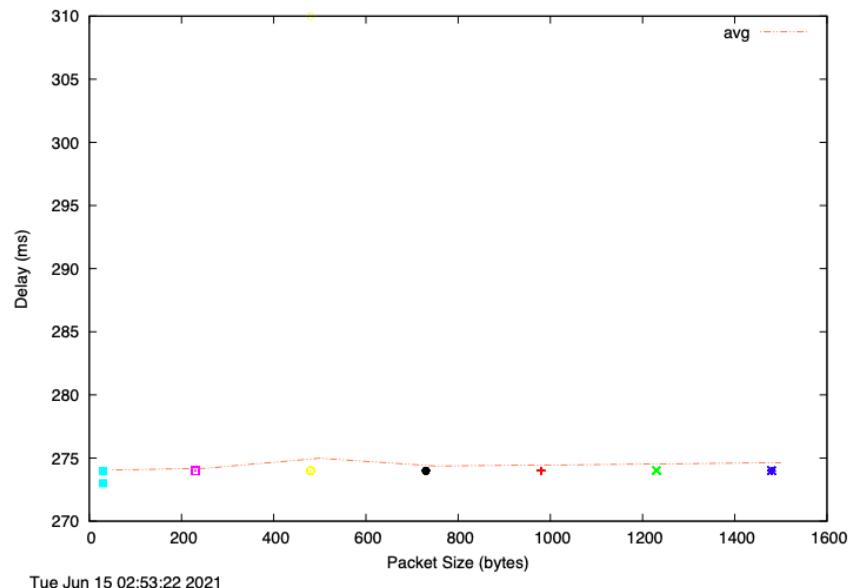
1) www.uq.edu.au



2) www.upm.edu.my



3) www.tu-berlin.de



Q3.

The website www.epfl.ch is not hosted in Switzerland.

By the nslookup command, the real(canonical) name of this web is
www.epfl.ch.cdn.cloudflare.net.

```

weaver * nslookup www.epfl.ch
Server:      129.94.242.2
Address:     129.94.242.2#53

Non-authoritative answer:
www.epfl.ch      canonical name = www.epfl.ch.cdn.cloudflare.net.
Name: www.epfl.ch.cdn.cloudflare.net
Address: 104.20.228.42
Name: www.epfl.ch.cdn.cloudflare.net
Address: 104.20.229.42
Name: www.epfl.ch.cdn.cloudflare.net
Address: 172.67.2.106

```

Then, by the whois command, we can find that this web hosted in the US.

```

weaver * whois 104.20.228.42

#
# 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 1997-2021, American Registry for Internet Numbers, Ltd.
#


NetRange:      104.16.0.0 - 104.31.255.255
CIDR:          104.16.0.0/12
NetName:       CLOUDFLARENET
NetHandle:     NET-104-16-0-0-1
Parent:        NET104 (NET-104-0-0-0-0)
NetType:       Direct Allocation
OriginAS:     AS13335
Organization: Cloudflare, Inc. (CLOUD14)
RegDate:      2014-03-28
Updated:       2021-05-26
Comment:       All Cloudflare abuse reporting can be done via https://www.cloudflare.com/abuse
Ref:          https://rdap.arin.net/registry/ip/104.16.0.0


OrgName:       Cloudflare, Inc.
OrgId:         CLOUD14
Address:       101 Townsend Street
City:          San Francisco
StateProv:    CA
PostalCode:   94107
Country:       US
RegDate:      2010-07-09
Updated:       2021-01-11
Ref:          https://rdap.arin.net/registry/entity/CLOUD14


OrgTechHandle: ADMIN2521-ARIN
OrgTechName:   Admin
OrgTechPhone: +1-650-319-8930
OrgTechEmail:  rir@cloudflare.com
OrgTechRef:   https://rdap.arin.net/registry/entity/ADMIN2521-ARIN

OrgAbuseHandle: ABUSE2916-ARIN
OrgAbuseName:  Abuse
OrgAbusePhone: +1-650-319-8930
OrgAbuseEmail: abuse@cloudflare.com
OrgAbuseRef:   https://rdap.arin.net/registry/entity/ABUSE2916-ARIN

OrgNOCHandle: NOC11962-ARIN
OrgNOCName:   NOC
OrgNOCPhone: +1-650-319-8930
OrgNOCEmail:  noc@cloudflare.com
OrgNOCRef:   https://rdap.arin.net/registry/entity/NOC11962-ARIN

RTechHandle: ADMIN2521-ARIN
RTechName:   Admin
RTechPhone: +1-650-319-8930
RTechEmail:  rir@cloudflare.com
RTechRef:   https://rdap.arin.net/registry/entity/ADMIN2521-ARIN

RNOCHandle: NOC11962-ARIN
RNOCName:   NOC
RNOCPhone: +1-650-319-8930
RNOCEmail:  noc@cloudflare.com
RNOCRef:   https://rdap.arin.net/registry/entity/NOC11962-ARIN

```

Q4.

- a) Propagation delay depends on the distance of channel and the speed. It has nothing to do with packet size.
- b) Transmission delay depends on packet size because $d_{trans} = \frac{L}{R}$ (where, $L = \frac{\text{packet size}}{n}$, $R = \text{link bandwidth}$).
- c) Node processing delay, it need to process packets, hence it depend on packet size.
- d) Queuing delay, it is related to data inflow speed, outflow speed and buffer size, and so it does depend on the packet size.

Therefore, transmission delay, processing delay and queuing delay are depend on packet size.