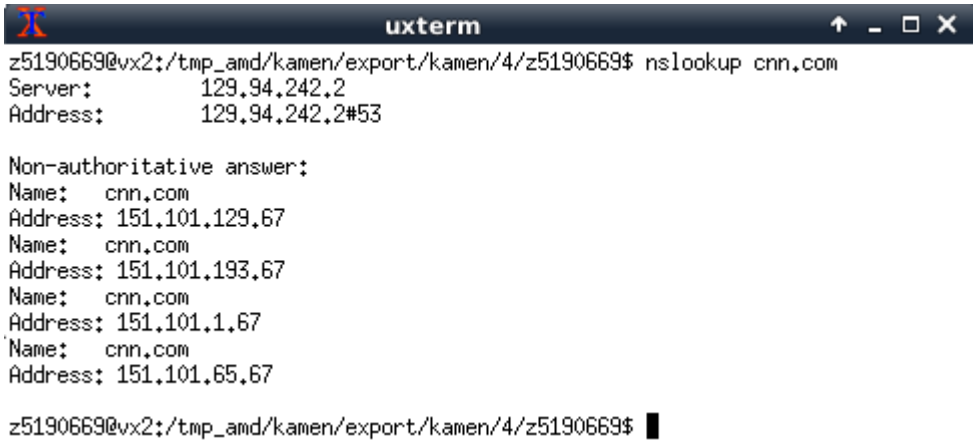
Lab 1

Exercise 1: nslookup

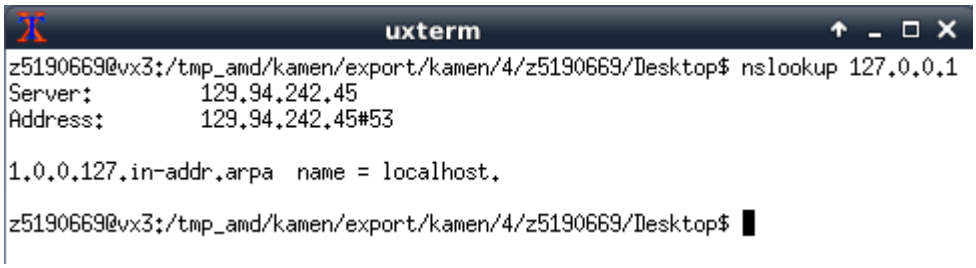
Question 1:



I used vlab to access the cse computer, there are several IP addresses of cnn.com.

A website can have serval different IP addresses since it can be replicated on different servers, and those servers can run on different end systems and different end systems corresponding to different IP addresses.

Question 2:



127.0.0.1 is the loopback address, also called “localhost” which refers to the internal interface used by the machine to send a packet to itself. “localhost” is the name used by TCP/IP to refer to the local machine, it means TCP/IP will not send message through the network but send to itself when seeing “localhost”, often used for testing purpose.

Exercise 2: Use ping to test host reachability

1. www.unsw.edu.au reachable
2. www.getfittest.com.au unreachable
3. www.mit.edu reachable
4. www.intel.com.au reachable
5. www.tpg.com.au reachable
6. www.hola.hp unreachable
7. www.amazon.com reachable

8. www.tsinghua.edu.cn reachable
9. www.kremlin.ru unreachable
10. 8.8.8.8 reachable

www.getfittest.com.au and www.hola.hp are not reachable and can't open by the web browser,they may not exist.
www.kremlin.ru is not reachable but it can be accessed by the web browser. Maybe this website set up an firewall and refuse to respond to the ping command.

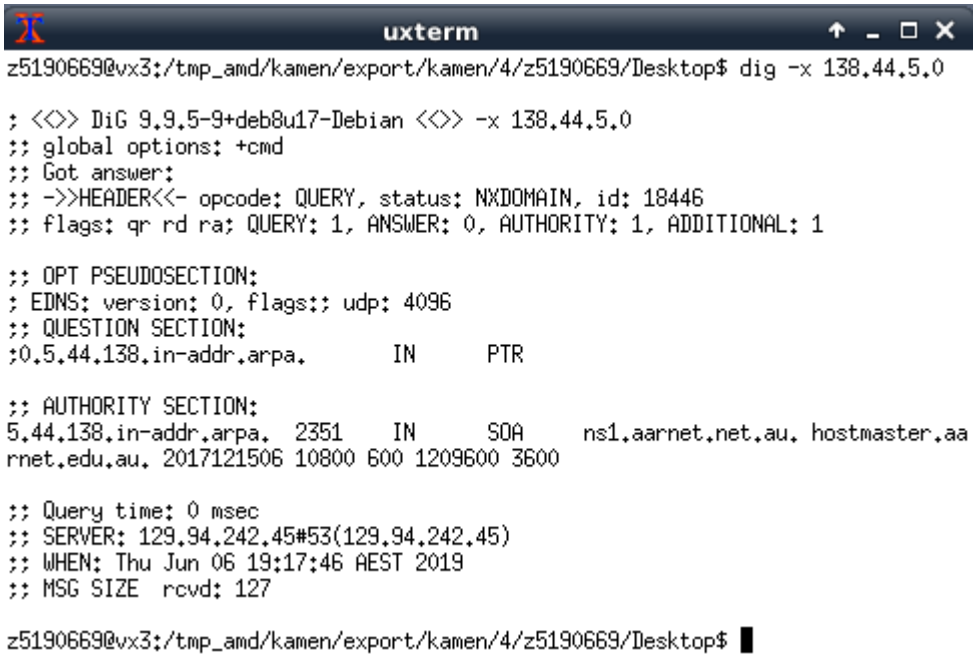
Exercise 3: Use traceroute to understand network topology

Question 1:

```
z5190669@vx3:/tmp_amd/kamen/export/kamen/4/z5190669/Desktop$ traceroute www.colu
mbia.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)  0.072 ms  0.050 ms  0.07
5 ms
 2  129.94.39.17 (129.94.39.17)  0.794 ms  0.787 ms  0.761 ms
 3  ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35)  1.871 ms  1.388 ms  1.838
 ms
 4  ombcr1-po-6.gw.unsw.edu.au (149.171.255.169)  1.092 ms ombcr1-po-5.gw.unsw.e
du.au (149.171.255.197)  1.058 ms libcr1-po-5.gw.unsw.edu.au (149.171.255.165)
1.014 ms
 5  unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  1.153 ms  1.185 ms  1.169
ms
 6  138.44.5.0 (138.44.5.0)  1.200 ms  1.162 ms  1.161 ms
 7  et-1-3-0.pe1.sxt.bkvl.nsw.aarnet.net.au (113.197.15.149)  2.154 ms  2.110 ms
  2.127 ms
 8  et-0-0-0.pe1.a.hnl.aarnet.net.au (113.197.15.99)  95.079 ms  95.120 ms  95.1
15 ms
 9  et-2-1-0.bdr1.a.sea.aarnet.net.au (113.197.15.201)  146.484 ms  146.503 ms
146.472 ms
10  abilene-1-lo-jmb-706.sttlwa.pacificwave.net (207.231.240.8)  146.700 ms  146
.709 ms  146.646 ms
11  et-4-0-0.4079.rtsw.miss2.net.internet2.edu (162.252.70.0)  160.591 ms  159.9
07 ms  159.786 ms
12  et-4-0-0.4079.rtsw.minn.net.internet2.edu (162.252.70.58)  180.421 ms  180.4
01 ms  180.439 ms
13  et-1-1-5.4079.rtsw.eqch.net.internet2.edu (162.252.70.106)  188.522 ms  188.
724 ms  188.583 ms
14  ae-0.4079.rtsw3.eqch.net.internet2.edu (162.252.70.163)  190.868 ms  188.360
 ms  188.411 ms
15  ae-1.4079.rtsw.clev.net.internet2.edu (162.252.70.130)  197.144 ms  197.344
ms  197.304 ms
16  buf-9208-I2-CLEV.nysernet.net (199.109.11.33)  201.551 ms  201.341 ms  201.3
30 ms
17  syr-9208-buf-9208.nysernet.net (199.109.7.193)  204.558 ms  204.980 ms  204.
741 ms
18  nyc-9208-syr-9208.nysernet.net (199.109.7.162)  213.748 ms  213.871 ms  234.
196 ms
19  columbia.nyc-9208.nysernet.net (199.109.4.14)  213.956 ms  213.709 ms  213.5
40 ms
20  cc-core-1-x-nyser32-gw-1.net.columbia.edu (128.59.255.5)  213.897 ms  213.95
7 ms  214.255 ms
21  cc-conc-1-x-cc-core-1.net.columbia.edu (128.59.255.210)  214.081 ms  214.114
 ms  214.079 ms
22  columbiauniversity.org (128.59.105.24)  213.865 ms  214.081 ms  213.793 ms
z5190669@vx3:/tmp_amd/kamen/export/kamen/4/z5190669/Desktop$
```

There are 21 routers between my machine and www.columbia.edu.
The first five routers are part of the UNSW network according to their hostnames.
I used dig command to check the DNS information for the 6th router,here is the result I

got:



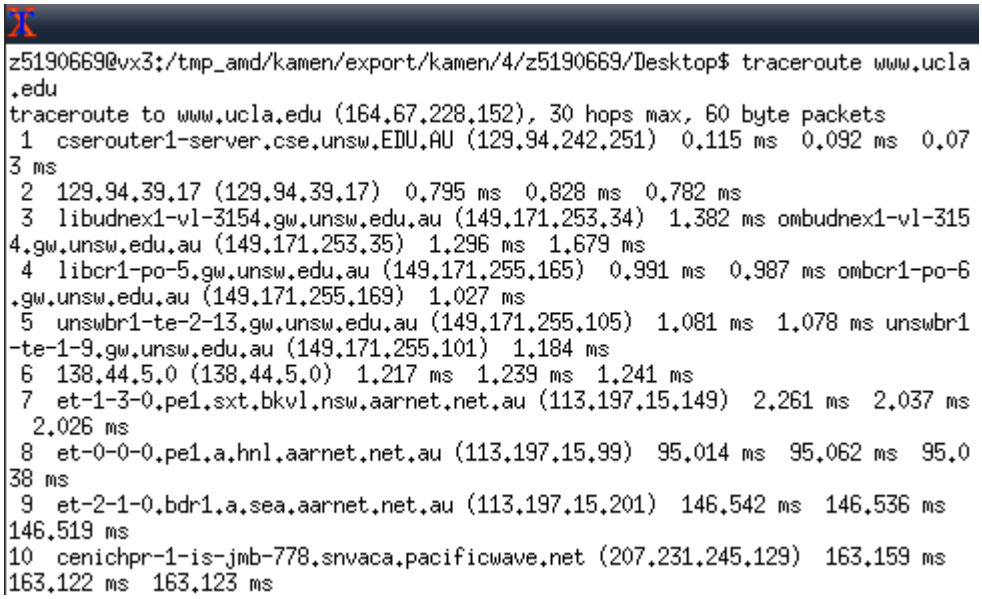
This router is part of the AARNET domain. Hence, only the first five routers are part of the UNSW network.

The RRts from the 7th router is around 2.1ms, however the RRts from the 8th router is around 95.1ms,which is a huge difference with no other routers between them. And the RRTs from the 9th router is around 146.5ms which is also very different from the previous router. And part of the hostnames for these 3 routers are nsw, hnl, sea respectively. We can know that these 3 routers are physically located in nsw, Honolulu and Seattle.

Hence, between the 7th router and 9th router, packets cross the Pacific Ocean,where the 8th router is some how “in” the Pacific Ocean.

Question 2:

Traceroute from my machine to www.ucla.edu:

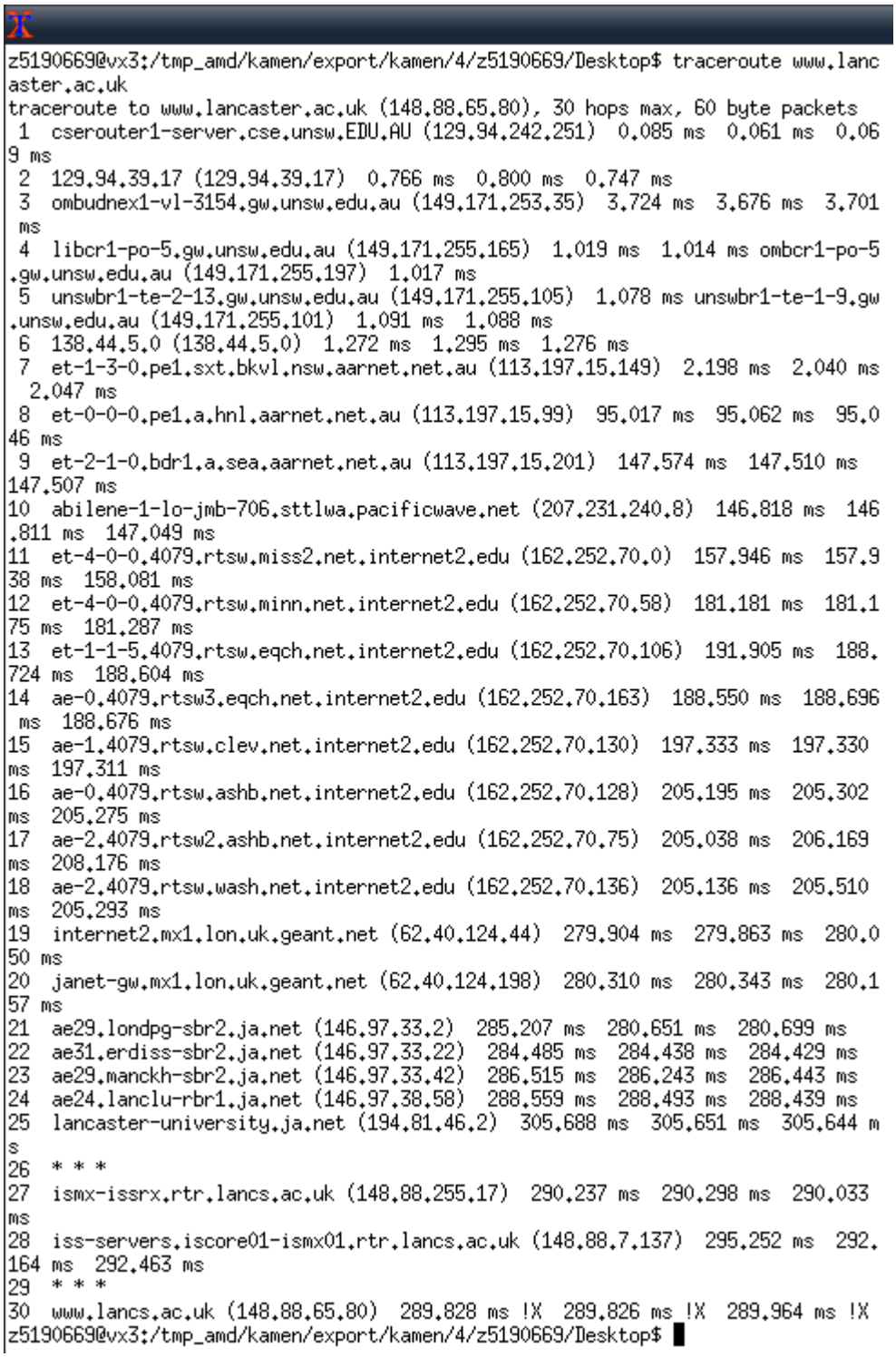


```
11  hpr-lax-hpr3--svl-hpr3-100ge.cenic.net (137.164.25.73)  170.902 ms  170.933
ms  170.830 ms
12  * * *
13  bd11f1.anderson--cr001.anderson.ucla.net (169.232.4.6)  171.249 ms  171.465
ms  171.422 ms
14  cr00f2.csb1--dr00f2.csb1.ucla.net (169.232.4.53)  171.429 ms cr00f1.anderson
--dr00f2.csb1.ucla.net (169.232.4.55)  171.343 ms cr00f2.csb1--dr00f2.csb1.ucla.
net (169.232.4.53)  171.367 ms
15  * * *
16  * * *
17  * * *
18  * * *
19  * * *
20  * * *
21  * * *
22  * * *
23  * * *
24  * * *
25  * * *
26  * * *
27  * * *
28  * * *
29  * * *
30  * * *
z5190669@vx3:/tmp_amd/kamen/export/kamen/4/z5190669/Desktop$
```

Traceroute from my machine to www.u-tokyo.ac.jp:

```
z5190669@vx3:/tmp_amd/kamen/export/kamen/4/z5190669/Desktop$ traceroute www.u-to
kyo.ac.jp
traceroute to www.u-tokyo.ac.jp (210.152.243.234), 30 hops max, 60 byte packets
 1  cserouter1-server.cse.unsw.EDU.AU (129.94.242.251)  0.148 ms  0.123 ms  0.10
3 ms
 2  129.94.39.17 (129.94.39.17)  0.857 ms  0.881 ms  0.834 ms
 3  ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35)  29.461 ms libudnex1-vl-31
54.gw.unsw.edu.au (149.171.253.34)  1.466 ms ombudnex1-vl-3154.gw.unsw.edu.au (1
49.171.253.35)  29.002 ms
 4  libcr1-po-5.gw.unsw.edu.au (149.171.255.165)  1.081 ms libcr1-po-6.gw.unsw.e
du.au (149.171.255.201)  1.120 ms libcr1-po-5.gw.unsw.edu.au (149.171.255.165)
1.121 ms
 5  unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101)  1.122 ms unswbr1-te-2-13.gw
.unsw.edu.au (149.171.255.105)  1.141 ms unswbr1-te-1-9.gw.unsw.edu.au (149.171.
255.101)  1.137 ms
 6  138.44.5.0 (138.44.5.0)  1.285 ms  1.292 ms  1.242 ms
 7  et-0-3-0.pe1.bkvl.nsw.aarnet.net.au (113.197.15.147)  1.731 ms  1.757 ms  1.
743 ms
 8  ge-4_0_0.bb1.a.pao.aarnet.net.au (202.158.194.177)  155.996 ms  155.971 ms
155.996 ms
 9  paloalto0.iij.net (198.32.176.24)  157.425 ms  157.493 ms  157.522 ms
10  osk004bb00.IIJ.Net (58.138.88.185)  288.150 ms  288.190 ms osk004bb01.IIJ.Ne
t (58.138.88.189)  270.710 ms
11  osk004ix51.IIJ.Net (58.138.106.130)  270.376 ms  270.366 ms  270.414 ms
12  210.130.135.130 (210.130.135.130)  279.247 ms  270.651 ms  279.286 ms
13  124.83.228.58 (124.83.228.58)  270.653 ms  270.592 ms  270.573 ms
14  124.83.252.178 (124.83.252.178)  276.448 ms  276.448 ms  285.397 ms
15  158.205.134.26 (158.205.134.26)  293.778 ms  293.850 ms  293.874 ms
16  * * *
17  * * *
18  * * *
19  * * *
20  * * *
21  * * *
22  * * *
23  * * *
24  * * *
25  * * *
26  * * *
27  * * *
28  * * *
29  * * *
30  * * *
z5190669@vx3:/tmp_amd/kamen/export/kamen/4/z5190669/Desktop$
```

Traceroute from my machine to www.lancaster.ac.uk:



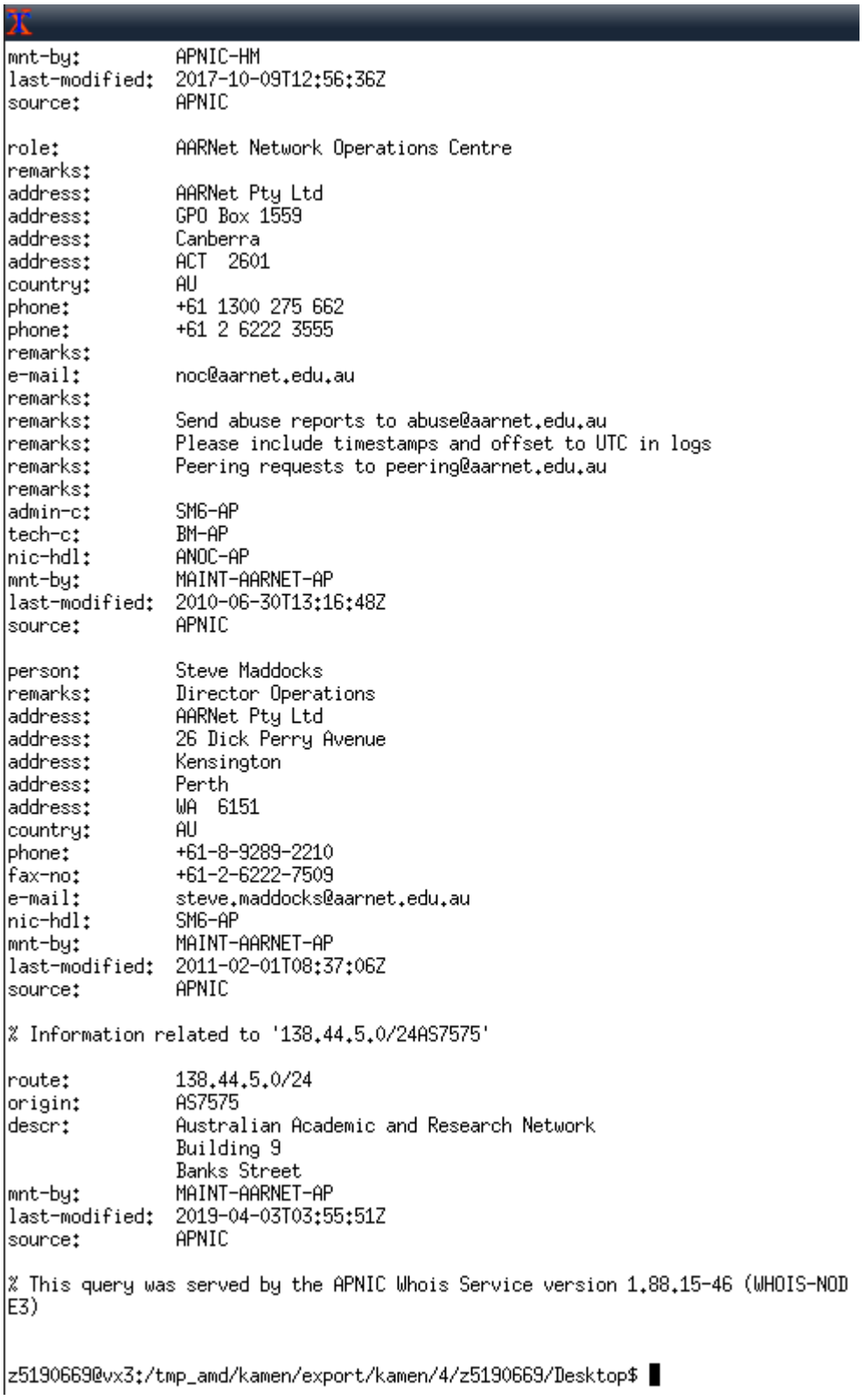
```
z5190669@vx3:/tmp_amd/kamen/export/kamen/4/z5190669/Desktop$ traceroute www.lanc
aster.ac.uk
traceroute to www.lancaster.ac.uk (148.88.65.80), 30 hops max, 60 byte packets
 1  cserouter1-server.cse.unsw.EDU.AU (129.94.242.251)  0.085 ms  0.061 ms  0.06
9 ms
 2  129.94.39.17 (129.94.39.17)  0.766 ms  0.800 ms  0.747 ms
 3  ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35)  3.724 ms  3.676 ms  3.701
 ms
 4  libcr1-po-5.gw.unsw.edu.au (149.171.255.165)  1.019 ms  1.014 ms ombcr1-po-5
.gw.unsw.edu.au (149.171.255.197)  1.017 ms
 5  unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  1.078 ms unswbr1-te-1-9.gw
.unsw.edu.au (149.171.255.101)  1.091 ms  1.088 ms
 6  138.44.5.0 (138.44.5.0)  1.272 ms  1.295 ms  1.276 ms
 7  et-1-3-0.pe1.sxt.bkvl.nsw.aarnet.net.au (113.197.15.149)  2.198 ms  2.040 ms
  2.047 ms
 8  et-0-0-0.pe1.a.hnl.aarnet.net.au (113.197.15.99)  95.017 ms  95.062 ms  95.0
46 ms
 9  et-2-1-0.bdr1.a.sea.aarnet.net.au (113.197.15.201)  147.574 ms  147.510 ms
147.507 ms
10  abilene-1-lo-jmb-706.sttlwa.pacificwave.net (207.231.240.8)  146.818 ms  146
.811 ms  147.049 ms
11  et-4-0-0.4079.rtsw.miss2.net.internet2.edu (162.252.70.0)  157.946 ms  157.9
38 ms  158.081 ms
12  et-4-0-0.4079.rtsw.minn.net.internet2.edu (162.252.70.58)  181.181 ms  181.1
75 ms  181.287 ms
13  et-1-1-5.4079.rtsw.eqch.net.internet2.edu (162.252.70.106)  191.905 ms  188.
724 ms  188.604 ms
14  ae-0.4079.rtsw3.eqch.net.internet2.edu (162.252.70.163)  188.550 ms  188.696
 ms  188.676 ms
15  ae-1.4079.rtsw.clev.net.internet2.edu (162.252.70.130)  197.333 ms  197.330
ms  197.311 ms
16  ae-0.4079.rtsw.ashb.net.internet2.edu (162.252.70.128)  205.195 ms  205.302
ms  205.275 ms
17  ae-2.4079.rtsw2.ashb.net.internet2.edu (162.252.70.75)  205.038 ms  206.169
ms  208.176 ms
18  ae-2.4079.rtsw.wash.net.internet2.edu (162.252.70.136)  205.136 ms  205.510
ms  205.293 ms
19  internet2.mx1.lon.uk.geant.net (62.40.124.44)  279.904 ms  279.863 ms  280.0
50 ms
20  janet-gw.mx1.lon.uk.geant.net (62.40.124.198)  280.310 ms  280.343 ms  280.1
57 ms
21  ae29.londpg-sbr2.ja.net (146.97.33.2)  285.207 ms  280.651 ms  280.699 ms
22  ae31.erdiss-sbr2.ja.net (146.97.33.22)  284.485 ms  284.438 ms  284.429 ms
23  ae29.manckh-sbr2.ja.net (146.97.33.42)  286.515 ms  286.243 ms  286.443 ms
24  ae24.lanclu-rbr1.ja.net (146.97.38.58)  288.559 ms  288.493 ms  288.439 ms
25  lancaster-university.ja.net (194.81.46.2)  305.688 ms  305.651 ms  305.644 m
s
26  * * *
27  ismx-issrx.rtr.lancs.ac.uk (148.88.255.17)  290.237 ms  290.298 ms  290.033
ms
28  iss-servers.iscore01-ismx01.rtr.lancs.ac.uk (148.88.7.137)  295.252 ms  292.
164 ms  292.463 ms
29  * * *
30  www.lancs.ac.uk (148.88.65.80)  289.828 ms !X  289.826 ms !X  289.964 ms !X
z5190669@vx3:/tmp_amd/kamen/export/kamen/4/z5190669/Desktop$
```

The first 6 hops are identical on all 3 paths. At router 138.44.5.0, paths from my machine to these three destinations diverge.

The detail information about this router is as follows:

```
z5190669@vx3:/tmp_amd/kamen/export/kamen/4/z5190669/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/abu
se-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
```

```
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 1997-2019, 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
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:        To update this object, please contact APNIC
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
```



The number of hops is not proportional to the physical distance. It takes 14 routers to visit www.ucla.edu and 15 routers to visit www.u-tokyo.ac.jp, however the physical distance between Sydney to LA and Sydney to Tokyo is quite large.

Question 3:

IP address of my machine: 129.94.242.45, IP address of www.speedtest.com.sg: 202.150.221.170

Traceroute from my machine to www.speedtest.com.sg:

```
z5190669@vx3:/tmp_amd/kamen/export/kamen/4/z5190669/Desktop$ 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)  0.085 ms  0.063 ms  0.071 ms
 2  129.94.39.17 (129.94.39.17)  0.862 ms  0.855 ms  0.786 ms
 3  libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34)  1.248 ms ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35)  1.443 ms libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34)  1.457 ms
 4  libcr1-po-5.gw.unsw.edu.au (149.171.255.165)  1.061 ms  1.050 ms ombcr1-po-6.gw.unsw.edu.au (149.171.255.169)  1.277 ms
 5  unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101)  1.075 ms unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  1.090 ms unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101)  1.103 ms
 6  138.44.5.0 (138.44.5.0)  1.229 ms  1.322 ms  1.304 ms
 7  et-0-3-0.pe1.alxd.nsw.aarnet.net.au (113.197.15.153)  1.687 ms  1.771 ms  1.752 ms
 8  xe-0-0-3.pe1.wnpa.akl.aarnet.net.au (113.197.15.67)  24.257 ms xe-0-2-1-204.pe1.wnpa.alxd.aarnet.net.au (113.197.15.183)  24.187 ms  24.178 ms
 9  et-0-1-0.200.pe1.tkpa.akl.aarnet.net.au (113.197.15.69)  24.571 ms  24.513 ms  24.503 ms
10  xe-0-2-6.bdr1.a.lax.aarnet.net.au (202.158.194.173)  147.914 ms  147.897 ms  147.881 ms
11  singtel.as7473.any2ix.coresite.com (206.72.210.63)  148.024 ms  148.021 ms  148.026 ms
12  203.208.172.165 (203.208.172.165)  328.497 ms 203.208.171.117 (203.208.171.117)  148.117 ms 203.208.151.181 (203.208.151.181)  312.401 ms
13  203.208.171.85 (203.208.171.85)  272.932 ms 203.208.177.110 (203.208.177.110)  328.508 ms  325.204 ms
14  * 203.208.182.253 (203.208.182.253)  336.375 ms  328.169 ms
15  203.208.177.110 (203.208.177.110)  316.591 ms 202-150-221-170.rev.ne.com.sg (202.150.221.170)  237.801 ms 203.208.177.110 (203.208.177.110)  330.269 ms
z5190669@vx3:/tmp_amd/kamen/export/kamen/4/z5190669/Desktop$
```

Traceroute from www.speedtest.com.sg to my machine:

Traceroute Result:

```
traceroute to 129.94.242.45 (129.94.242.45), 30 hops max, 60 byte packets
 1  ge2-8.r01.sin01.ne.com.sg (202.150.221.169)  0.165 ms  0.187 ms  0.197 ms
 2  10.15.62.210 (10.15.62.210)  1.723 ms  1.799 ms  1.808 ms
 3  aarnet.sgix.sg (103.16.102.67)  223.636 ms  223.667 ms  223.680 ms
 4  xe-3-0-3.pe1.brwy.nsw.aarnet.net.au (113.197.15.206)  237.376 ms  237.385 ms  237.390 ms
 5  138.44.5.1 (138.44.5.1)  230.935 ms  230.958 ms  231.038 ms
 6  libcr1-te-1-5.gw.unsw.edu.au (149.171.255.102)  230.886 ms  231.141 ms  231.077 ms
 7  libudnex1-po-1.gw.unsw.edu.au (149.171.255.166)  231.606 ms ombudnex1-po-1.gw.unsw.edu.au (149.171.255.202)  231.302 ms libudnex1-po-1.gw.unsw.
 8  ufw1-ae-1-3154.gw.unsw.edu.au (149.171.253.36)  224.576 ms  224.357 ms  224.408 ms
 9  129.94.39.23 (129.94.39.23)  238.499 ms  238.430 ms  238.504 ms
10  * * *
11  * * *
12  * * *
13  * * *
14  * * *
15  * * *
16  * * *
17  * * *
18  * * *
19  * * *
20  * * *
21  * * *
22  * * *
23  * * *
24  * * *
25  * * *
26  * * *
27  * * *
28  * * *
29  * * *
30  * * *
```

Traceroute Completed.

IP address of my machine: 129.94.242.45, IP address of www.telstra.net: 203.50.5.178
Traceroute from my machine to www.telstra.net:

```
z5190669@vx3:/tmp_amd/kamen/export/kamen/4/z5190669/Desktop$ traceroute www.tels
tra.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)  0.088 ms  0.063 ms  0.06
4 ms
 2  129.94.39.17 (129.94.39.17)  0.865 ms  0.826 ms  0.819 ms
 3  ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35)  1.847 ms  1.794 ms  1.830
 ms
 4  libcr1-po-6.gw.unsw.edu.au (149.171.255.201)  1.057 ms ombcr1-po-5.gw.unsw.e
du.au (149.171.255.197)  1.112 ms ombcr1-po-6.gw.unsw.edu.au (149.171.255.169)
1.142 ms
 5  unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101)  1.133 ms unswbr1-te-2-13.gw
.unsw.edu.au (149.171.255.105)  2.833 ms unswbr1-te-1-9.gw.unsw.edu.au (149.171.
255.101)  1.101 ms
 6  138.44.5.0 (138.44.5.0)  1.274 ms  3.180 ms  3.124 ms
 7  et-0-3-0.pe1.alxd.nsw.aarnet.net.au (113.197.15.153)  3.162 ms  3.944 ms  3.
888 ms
 8  ae9.bb1.b.syd.aarnet.net.au (113.197.15.65)  3.541 ms  3.661 ms  1.743 ms
 9  gigabitethernet1-1.pe1.b.syd.aarnet.net.au (202.158.202.18)  3.735 ms  3.811
 ms  3.813 ms
10  gigabitethernet3-11.ken37.sydney.telstra.net (139.130.0.77)  4.345 ms  4.223
 ms  2.428 ms
11  bundle-ether13.ken-core10.sydney.telstra.net (203.50.11.94)  6.433 ms  4.288
 ms  3.085 ms
12  bundle-ether10.win-core10.melbourne.telstra.net (203.50.11.123)  15.285 ms
15.240 ms bundle-ether13.chw-core10.sydney.telstra.net (203.50.11.98)  3.757 ms
13  bundle-ether8.exi-core10.melbourne.telstra.net (203.50.11.125)  14.097 ms 20
3.50.6.40 (203.50.6.40)  13.893 ms  15.936 ms
14  bundle-ether2.exi-ncprouter101.melbourne.telstra.net (203.50.11.209)  13.666
 ms  13.772 ms  15.532 ms
15  www.telstra.net (203.50.5.178)  14.854 ms  13.038 ms  13.268 ms
z5190669@vx3:/tmp_amd/kamen/export/kamen/4/z5190669/Desktop$
```

Traceroute from www.telstra.net to my machine:

```
 1  gigabitethernet3-3.exi2.melbourne.telstra.net (203.50.77.53)  0.267 ms  0.203 ms  0.240 ms
 2  bundle-ether3-100.win-core10.melbourne.telstra.net (203.50.80.129)  1.239 ms  1.227 ms  2.242 ms
 3  bundle-ether12.ken-core10.sydney.telstra.net (203.50.11.122)  13.234 ms  12.223 ms  12.739 ms
 4  bundle-ether1.ken-edge901.sydney.telstra.net (203.50.11.95)  11.979 ms  12.099 ms  11.860 ms
 5  aarnet6.lnk.telstra.net (139.130.0.78)  11.610 ms  11.598 ms  11.611 ms
 6  ge-6-0-0.bb1.a.syd.aarnet.net.au (202.158.202.17)  11.861 ms  11.849 ms  11.735 ms
 7  ae9.pe2.brwy.nsw.aarnet.net.au (113.197.15.56)  12.104 ms  12.096 ms  12.113 ms
 8  et-3-1-0.pe1.brwy.nsw.aarnet.net.au (113.197.15.146)  12.110 ms  15.597 ms  12.112 ms
 9  138.44.5.1 (138.44.5.1)  12.360 ms  12.349 ms  52.462 ms
10  ombcr1-te-1-5.gw.unsw.edu.au (149.171.255.106)  12.360 ms  12.349 ms  12.362 ms
11  ombudnex1-po-2.gw.unsw.edu.au (149.171.255.170)  12.609 ms  12.599 ms  12.609 ms
12  ufw1-ae-1-3154.gw.unsw.edu.au (149.171.253.36)  12.864 ms  12.885 ms  12.852 ms
13  129.94.39.23 (129.94.39.23)  12.981 ms  13.097 ms  13.110 ms
```

There are other traceroute sites listed here.

The traceroute CGI source can be found via:
carpeNet

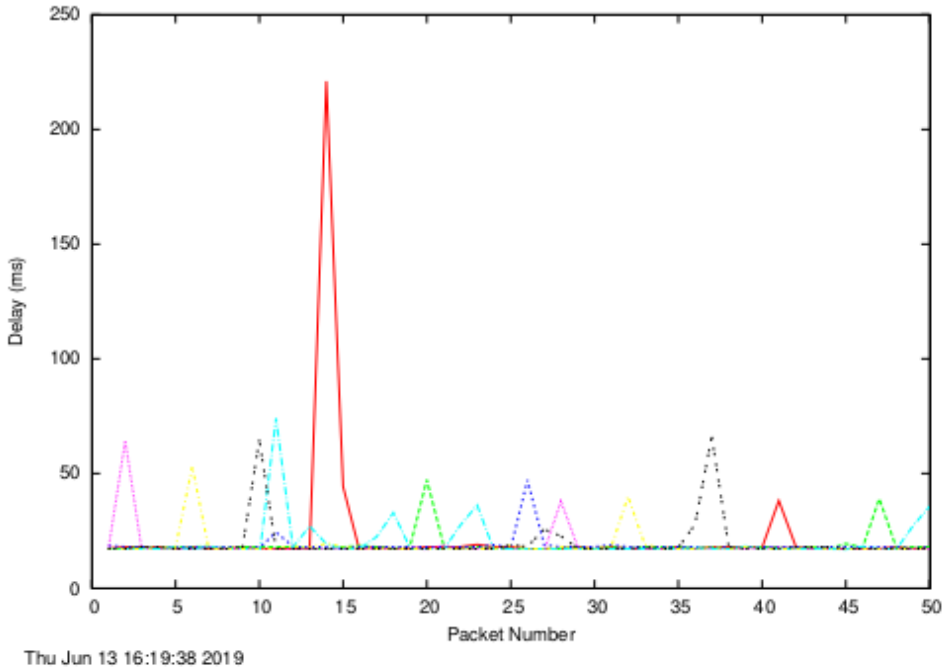
In both cases, the reverse path does not go through the same routers as the forward path, there are some common routers have the same hostnames along the path but they have different IP addresses.
The reason is routes do not necessary to be symmetric on the Internet, sometimes choose different routers to handle ingoing and outgoing connections can achieve better load balancing. Actually, even if both the forward and the reverse path go

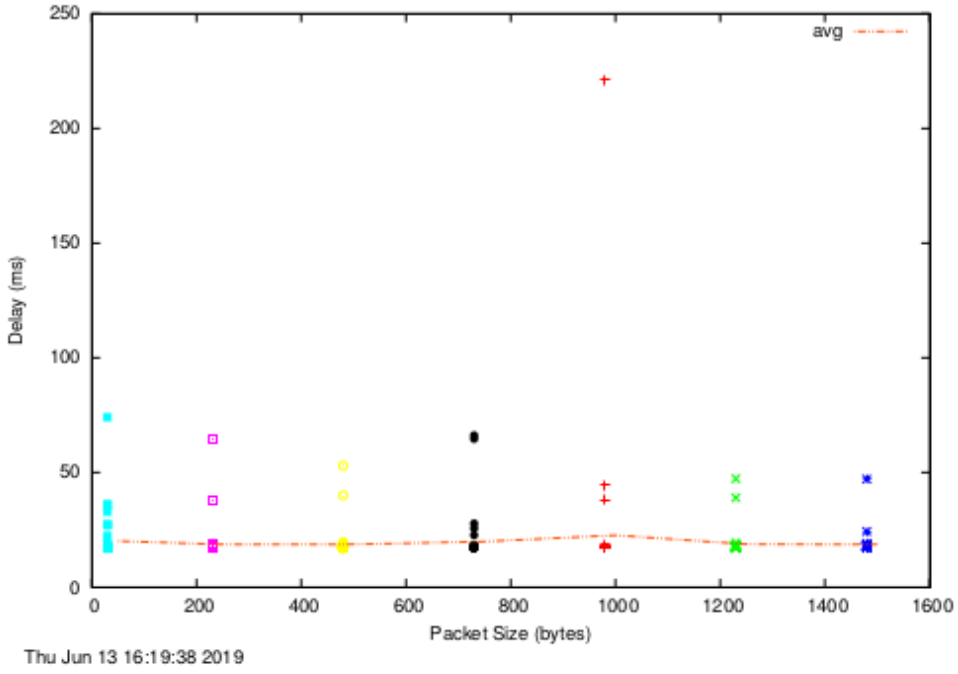
through the same router, the IP address can be different, this is because that one router can have many different interfaces. Those interfaces have different IP addresses but they all belong to the same router.

Exercise 4: Use ping to gain insights into network performance

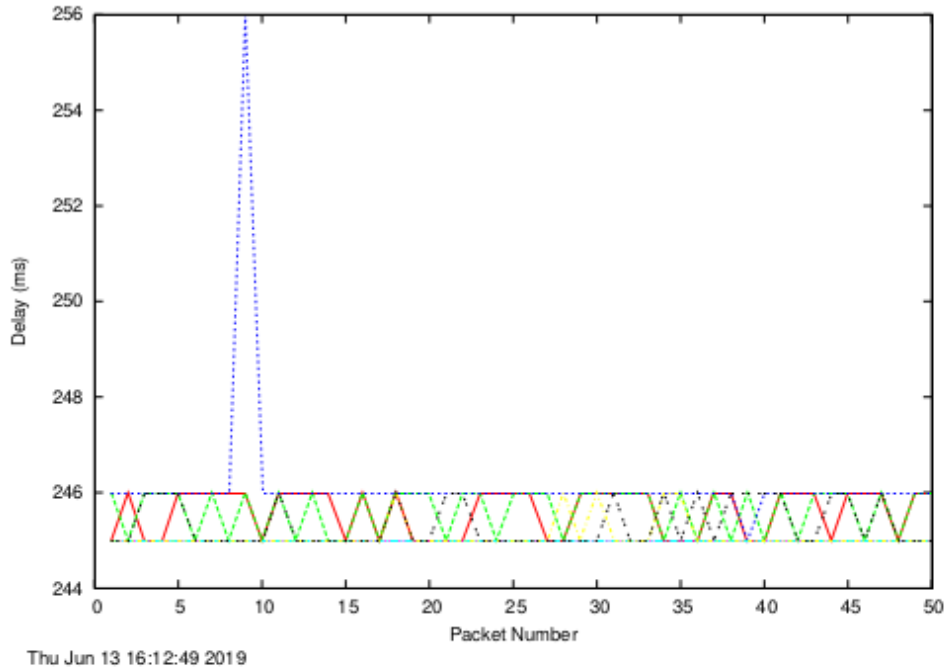
I chose www.uq.edu.au(Australia), www.kyoto-u.ac.jp(Asia), www.tu-berlin.de(Europe) as destinations.

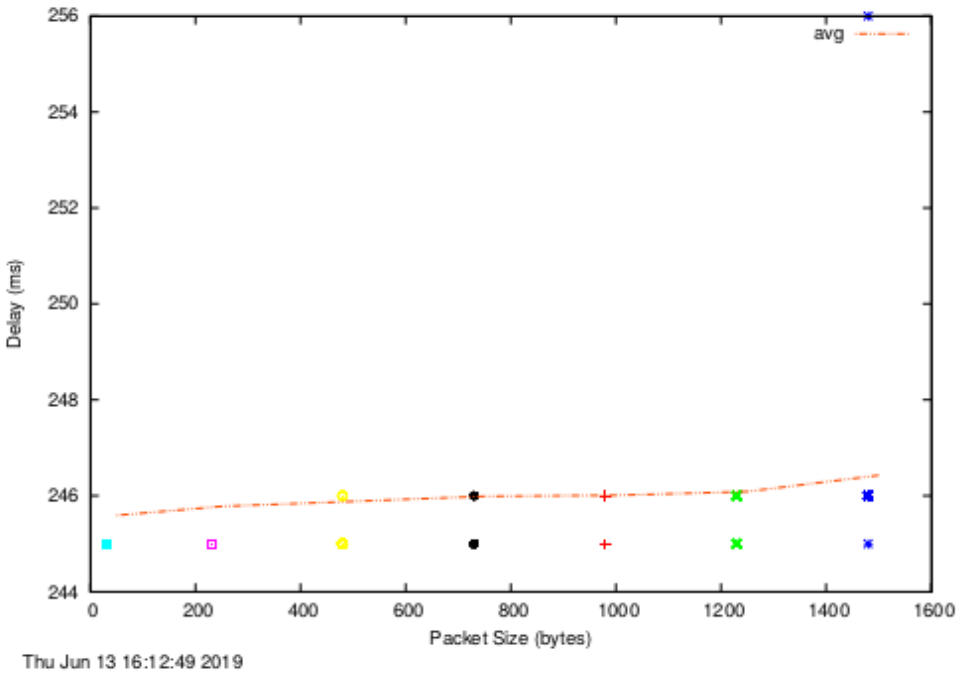
www.uq.edu.au



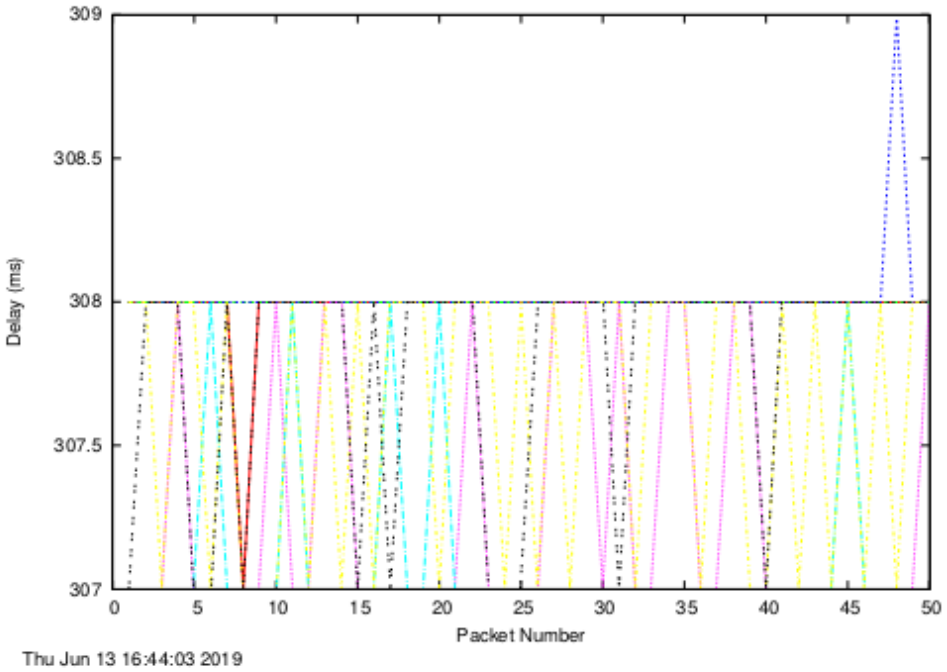


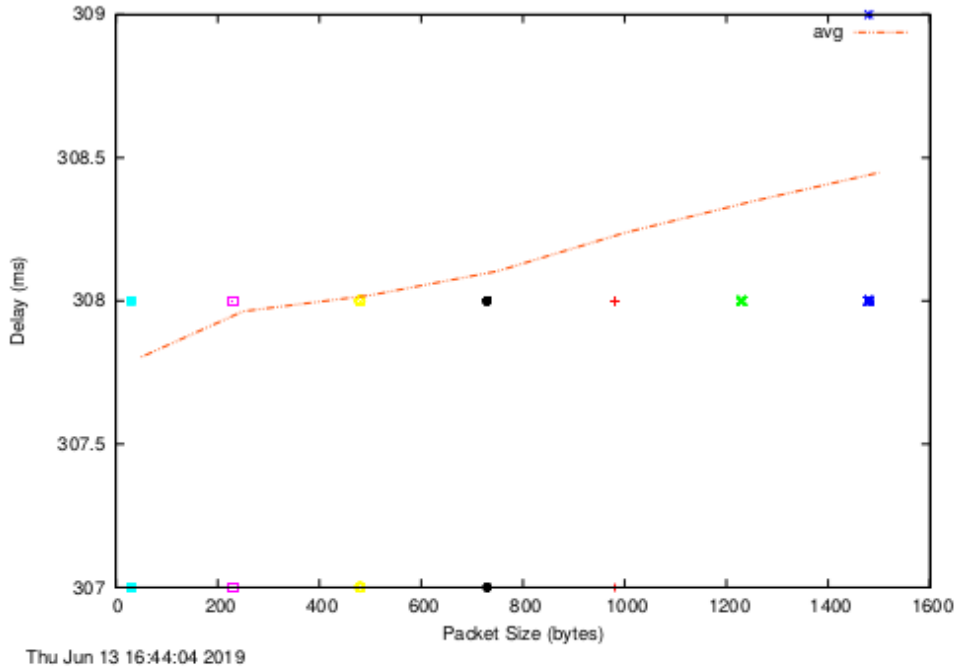
www.kyoto-u.ac.jp





www.tu-berlin.de





Question 1:
Distance between Sydney and the 3 destinations(based on flight path between them) are:
Brisbane: 733km, Kyoto: 7929km, Berlin: 16094km

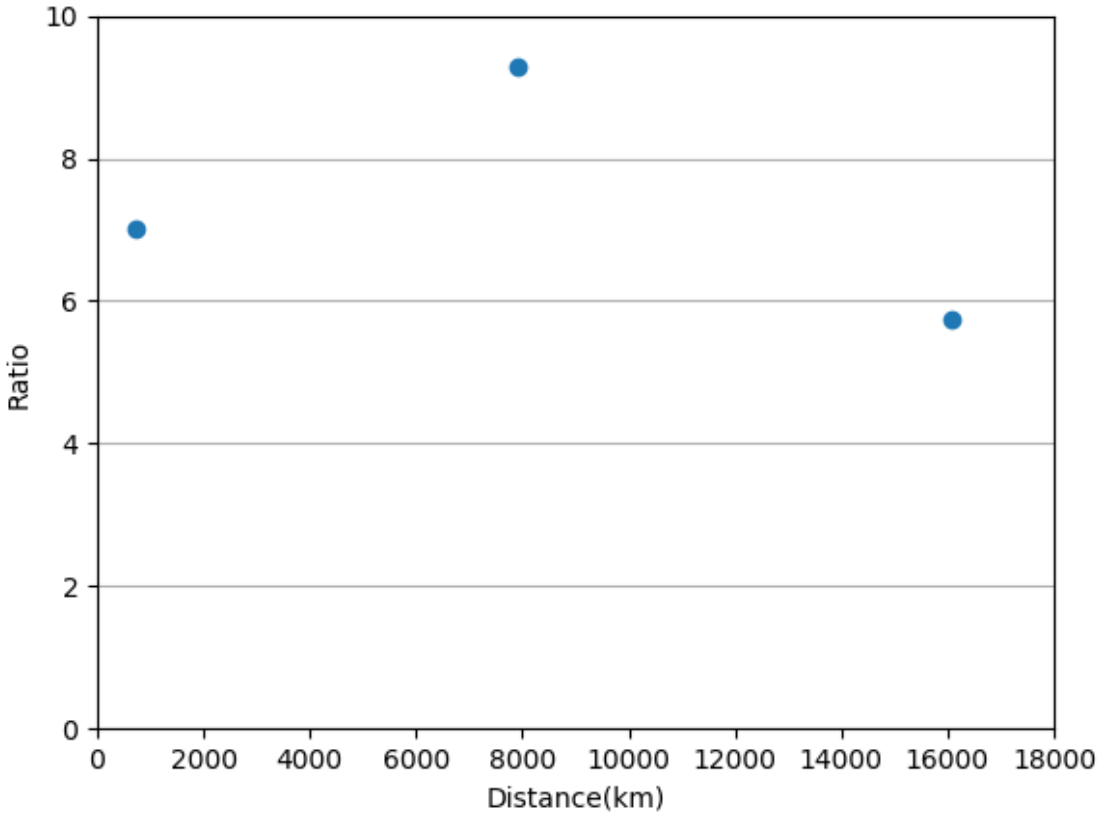
Assuming packet moves at the speed of light, $3x10^8$m/s, then the shortest possible

time that a packet will take to reach these 3 destinations are:
Brisbane: 2.4ms, Kyoto: 26.4ms, Berlin: 53.6ms

The minimum RTT(for 50 byte packets) to these 3 destinations are:
Brisbane: 16.841ms, Kyoto: 245.33ms, Berlin: 307.554ms

The ratios of the minimum RTT to the minimum propagation delay for these 3 destinations are:
Brisbane: 7.02, Kyoto: 9.29, Berlin: 5.74

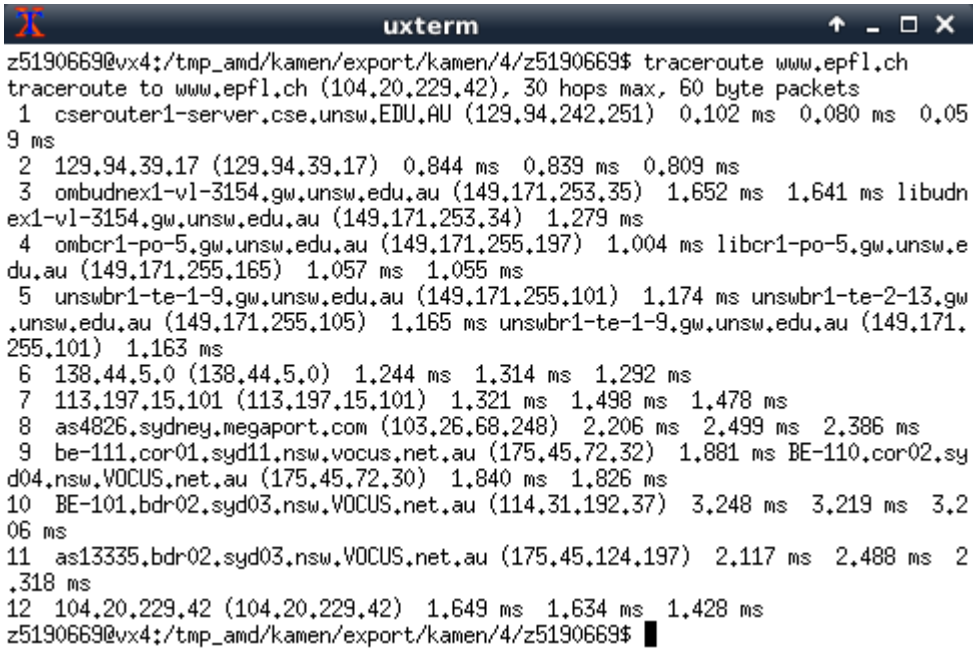
The following plot shows this ratio as a function of distance:



Reasons y-axis values are greater than 2:
1. Light of speed is only a theoretical value, packet actually don't travel that fast.
2. Some links may have low bandwidth, causing more transmit delay.
3. There are many routers between Sydney and these 3 destinations, RTT not only contain propagation delay but also contain processing delay and queuing delay.

Question 2:
The delay to the destinations vary over time since there are many different end-to-end paths, packets could go through different routers and switches which may cause different degrees of processing and queueing delays.

Question 3:



www.epfl.ch is not host in Switzerland since the RTT is very small(under 2ms), it is probably hosted in NSW.

Question 4:
Transmission delay is proportional to the packet size.
Processing delay can depand on the packet size, but to a much smaller degree than transmission delay.
Queuing delay only depands on the congestion in the nertwork.
Propagation delay only depands on the link.

In conclusion, only transmission delay and processing delay depand on the packet size.