Lab1/ z5146286

Exercise 1: nslookup

1. Which is the IP address of the Google site (www.google.com)? In your opinion, what is the reason of having several IP addresses as an output?

   Answer 1: The IP address of The Google site is 216.58.198.132.

   Answer 2: As the most famous search engine, google must deal with a huge number of DNS queries every second, and the round robin DNS is used to balance the load of request. The most appropriate server can response the end user according to user location. Thus, the IP address always changes.

```
zhangpeideMacBook-Pro:~ zhangpei$ nslookup www.google.com
Server:         129.94.0.196
Address:        129.94.0.196#53

Non-authoritative answer:
Name:   www.google.com
Address: 216.58.196.132
```

```
zhangpeideMacBook-Pro:~ zhangpei$ nslookup 216.58.196.132
Server:         129.94.0.196
Address:        129.94.0.196#53

Non-authoritative answer:
132.196.58.216.in-addr.arpa     name = syd15s04-in-f4.1e100.net.

Authoritative answers can be found from:
196.58.216.in-addr.arpa nameserver = ns2.google.com.
196.58.216.in-addr.arpa nameserver = ns4.google.com.
196.58.216.in-addr.arpa nameserver = ns1.google.com.
196.58.216.in-addr.arpa nameserver = ns3.google.com.
ns2.google.com  internet address = 216.239.34.10
ns2.google.com  has AAAA address 2001:4860:4802:34::a
ns3.google.com  internet address = 216.239.36.10
ns3.google.com  has AAAA address 2001:4860:4802:36::a
ns1.google.com  internet address = 216.239.32.10
ns1.google.com  has AAAA address 2001:4860:4802:32::a
ns4.google.com  internet address = 216.239.38.10
ns4.google.com  has AAAA address 2001:4860:4802:38::a
```

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

Answer: the name of: the IP address 127.0.0.1 is 'Local host'. All computer uses this address as their own address. Other user cannot visit this computer by the address.

```
Server:         129.94.0.196
Address:        129.94.0.196#53

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

Exercise 2: Use ping to test host reachability

Answer:

1. www.cse.unsw.edu.au Reachable
```
PING www.cse.unsw.edu.au (129.94.242.51): 56 data bytes
64 bytes from 129.94.242.51: icmp_seq=0 ttl=57 time=5.507 ms
64 bytes from 129.94.242.51: icmp_seq=1 ttl=57 time=9.053 ms
```
2. www.getfittest.com.au Not reachable
```
ping: cannot resolve www.getfittest.com.au: Unknown host
```
3. www.mit.edu Reachable
```
PING e9566.dscb.akamaiedge.net (104.74.27.200): 56 data bytes
64 bytes from 104.74.27.200: icmp_seq=0 ttl=56 time=2.846 ms
64 bytes from 104.74.27.200: icmp_seq=1 ttl=56 time=9.294 ms
```
4. www.intel.com.au Reachable
```
PING e117.b.akamaiedge.net (104.74.39.239): 56 data bytes
64 bytes from 104.74.39.239: icmp_seq=0 ttl=56 time=3.698 ms
64 bytes from 104.74.39.239: icmp_seq=1 ttl=56 time=9.415 ms
```
5. www.tpg.com.au Reachable
```
PING www.tpg.com.au (203.26.27.38): 56 data bytes
64 bytes from 203.26.27.38: icmp_seq=0 ttl=118 time=31.839 ms
64 bytes from 203.26.27.38: icmp_seq=1 ttl=118 time=38.082 ms
```
6. www.hola.hp Not reachable
```
ping: cannot resolve www.hola.hp: Unknown host
```
7. www.amazon.com Reachable
```
PING d3ag4hukkh62yn.cloudfront.net (13.35.149.151): 56 data bytes
64 bytes from 13.35.149.151: icmp_seq=0 ttl=244 time=2.228 ms
64 bytes from 13.35.149.151: icmp_seq=1 ttl=244 time=2.572 ms
```
8. www.tsinghua.edu.cn Reachable
```
PING www.d.tsinghua.edu.cn (166.111.4.100): 56 data bytes
64 bytes from 166.111.4.100: icmp_seq=0 ttl=235 time=312.450 ms
64 bytes from 166.111.4.100: icmp_seq=1 ttl=235 time=355.994 ms
```

9. www.kremlin.ru Not Reachable

```
PING www.kremlin.ru (95.173.136.70): 56 data bytes
Request timeout for icmp_seq 0
Request timeout for icmp_seq 1
```

10. 8.8.8.8 Reachable

```
PING 8.8.8.8 (8.8.8.8): 56 data bytes
64 bytes from 8.8.8.8: icmp_seq=0 ttl=53 time=11.022 ms
64 bytes from 8.8.8.8: icmp_seq=1 ttl=53 time=5.897 ms
```

"www.getfittest.com.au" and "www.hola.hp" are not existing domain name.

"www.kremlin.ru" is not reachable by ping command, but is reachable from the Web browser. Ping actually operates by sending ICMP echo request packets to the target host and waiting for an ICMP echo reply. But some servers set a principle to control and restrict ICMP echo reply. Thus, these address cannot be reachable by ping.

Exercise 3: Use traceroute to understand network topology.

1. Run traceroute on your machine to www.columbia.edu . How many routers are there between your workstation andwww.columbia.edu ? How many routers along the path are part of the UNSW network? Between which two routers do packets cross the Pacific Ocean?

Answer 1: 23 Routers are there between my workstation and www.columbia.edu.

```
traceroute to www.wwwr53.cc.columbia.edu (128.59.105.24), 64 hops max, 52 byte packets
 1  * * *
 2  ufw1-ae-1-3161.gw.unsw.edu.au (149.171.253.92)  8.407 ms  3.295 ms  2.987 ms
 3  libwdr1-vl-3090.gw.unsw.edu.au (149.171.253.66)  3.158 ms  3.455 ms  2.992 ms
 4  ombcr1-te-4-5.gw.unsw.edu.au (149.171.255.77)  3.369 ms  3.474 ms  3.216 ms
 5  unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  3.223 ms  3.447 ms  3.433 ms
 6  138.44.5.0 (138.44.5.0)  3.398 ms  4.529 ms  3.364 ms
 7  et-1-3-0.pe1.sxt.bkvl.nsw.aarnet.net.au (113.197.15.149)  4.443 ms  4.475 ms  4.421 ms
 8  et-0-0-0.pe1.a.hnl.aarnet.net.au (113.197.15.99)  97.490 ms  97.756 ms  97.332 ms
 9  et-2-1-0.bdr1.a.sea.aarnet.net.au (113.197.15.201)  149.017 ms  148.951 ms  149.060 ms
10  abilene-1-lo-jmb-706.sttlwa.pacificwave.net (207.231.240.8)  149.187 ms  149.143 ms  149.281 ms
11  et-4-0-0.4079.rtsw.miss2.net.internet2.edu (162.252.70.0)  159.910 ms  159.875 ms  160.027 ms
12  et-4-0-0.4079.rtsw.minn.net.internet2.edu (162.252.70.58)  182.764 ms  182.822 ms  183.381 ms
13  et-1-1-5.4079.rtsw.eqch.net.internet2.edu (162.252.70.106)  190.844 ms  191.444 ms  191.648 ms
14  162.252.70.163 (162.252.70.163)  194.173 ms  292.161 ms  190.996 ms
15  ae-1.4079.rtsw.clev.net.internet2.edu (162.252.70.130)  199.773 ms  199.752 ms  199.512 ms
16  buf-9208-i2-clev.nysernet.net (199.109.11.33)  203.909 ms  203.853 ms  203.924 ms
17  syr-9208-buf-9208.nysernet.net (199.109.7.193)  207.607 ms  207.010 ms  258.536 ms
18  nyc-9208-syr-9208.nysernet.net (199.109.7.162)  326.560 ms  291.266 ms  316.478 ms
19  columbia.nyc-9208.nysernet.net (199.109.4.14)  311.044 ms  309.448 ms  212.678 ms
20  nyser111-gw-1-x-nyser32-gw-1.net.columbia.edu (128.59.255.10)  306.740 ms  251.429 ms  315.834 ms
21  phi-core-1-x-nyser111-gw-1.net.columbia.edu (128.59.255.13)  310.445 ms  251.282 ms  316.460 ms
22  cc-conc-1-x-phi-core-1.net.columbia.edu (128.59.255.214)  313.333 ms  313.028 ms  312.147 ms
23  ci.columbia.edu (128.59.105.24)  312.640 ms  212.159 ms  309.294 ms
```

Answer 2: 4 routers are part of the UNSW network.

```
 2  ufw1-ae-1-3161.gw.unsw.edu.au (149.171.253.92)  8.407 ms  3.295 ms  2.987 ms
 3  libwdr1-vl-3090.gw.unsw.edu.au (149.171.253.66)  3.158 ms  3.455 ms  2.992 ms
 4  ombcr1-te-4-5.gw.unsw.edu.au (149.171.255.77)  3.369 ms  3.474 ms  3.216 ms
 5  unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  3.223 ms  3.447 ms  3.433 ms
```

Answer 3: Between router 9 and router 10 packet cross the Pacific Ocean.

IP Address	Country	Region	City
113.197.15.149	Australia	Victoria	Melbourne

IP Address	Country	Region	City
113.197.15.149	Australia	Victoria	Melbourne

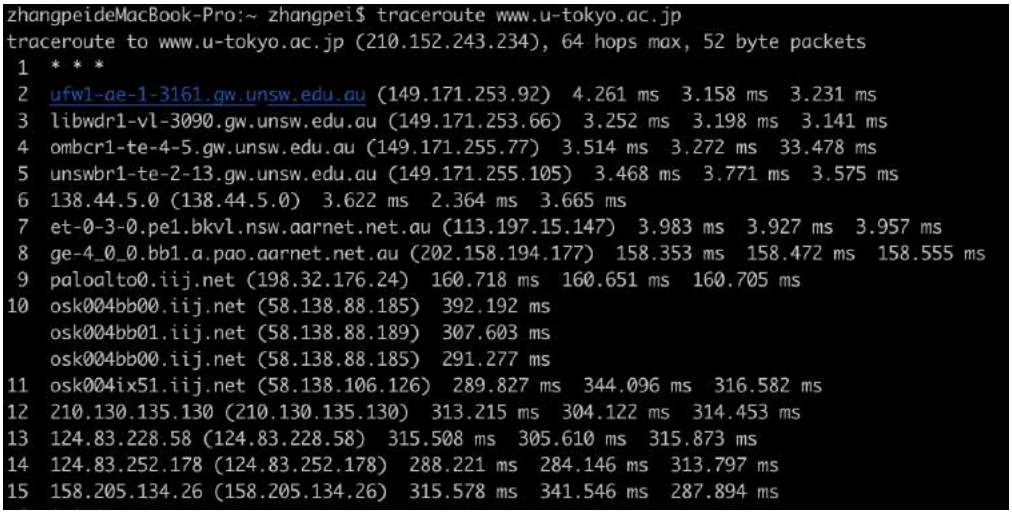
2. Run traceroute from your machine to the following destinations. (i) www.ucla.edu (ii) www.u-tokyo.ac.jp and (iii)www.lancaster.ac.uk. At which router do the paths from your machine to these three destinations diverge? Find out further details about this router. (HINT: You can find out more about a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

Answer :

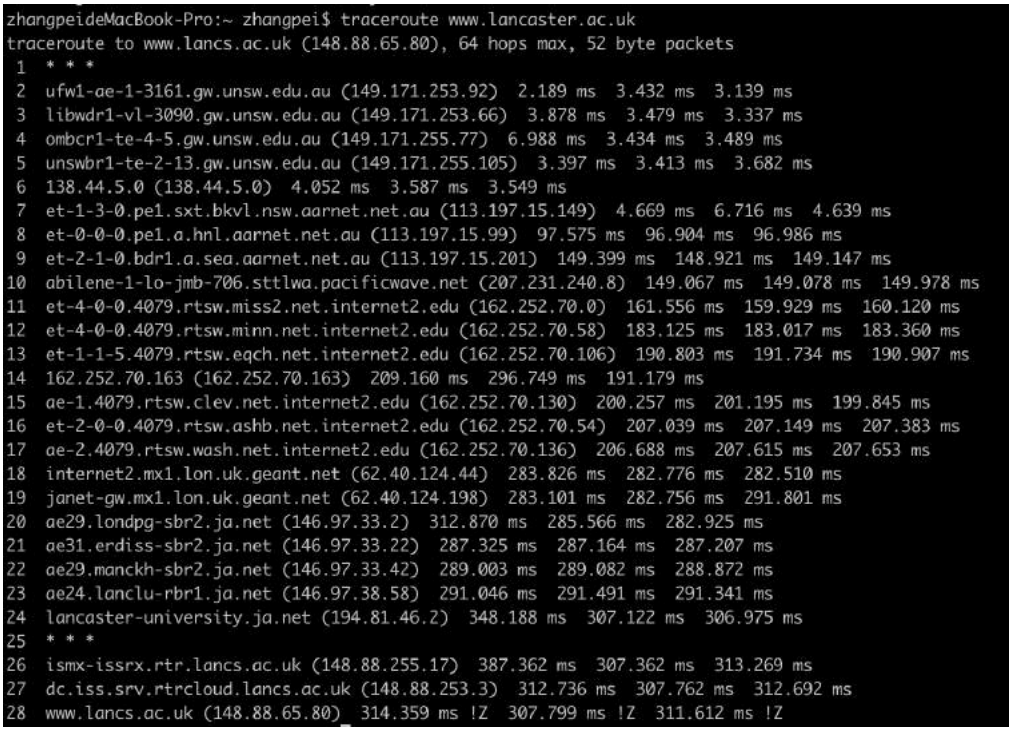
www.ucla.edu

```
zhangpeideMacBook-Pro:~ zhangpei$ traceroute www.ucla.edu
traceroute to gateway.lb.it.ucla.edu (164.67.228.152), 64 hops max, 52 byte packets
 1  * * *
 2  ufw1-ae-1-3161.gw.unsw.edu.au (149.171.253.92)  8.283 ms  3.151 ms  3.155 ms
 3  libwdr1-vl-3090.gw.unsw.edu.au (149.171.253.66)  3.364 ms  3.450 ms  3.128 ms
 4  libcr1-te-4-5.gw.unsw.edu.au (149.171.255.89)  3.197 ms  3.191 ms  3.296 ms
 5  unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101)  3.421 ms  3.423 ms  3.251 ms
 6  138.44.5.0 (138.44.5.0)  3.406 ms  3.477 ms  3.388 ms
 7  et-1-3-0.pe1.sxt.bkvl.nsw.aarnet.net.au (113.197.15.149)  4.196 ms  4.432 ms  4.195 ms
 8  et-0-0-0.pe1.a.hnl.aarnet.net.au (113.197.15.99)  106.774 ms  97.697 ms  97.775 ms
 9  et-2-1-0.bdr1.a.sea.aarnet.net.au (113.197.15.201)  149.734 ms  148.198 ms  148.949 ms
10  cenichpr-1-is-jmb-778.snvaca.pacificwave.net (207.231.245.129)  166.073 ms  164.580 ms  165.671 ms
11  hpr-lax-hpr3--svl-hpr3-100ge.cenic.net (137.164.25.73)  173.682 ms  172.190 ms  173.770 ms
12  * * *
13  bd11f1.anderson--cr00f2.csb1.ucla.net (169.232.4.4)  179.103 ms  173.234 ms
    bd11f1.anderson--cr001.anderson.ucla.net (169.232.4.6)  173.732 ms
14  cr00f2.csb1--dr00f2.csb1.ucla.net (169.232.4.53)  172.676 ms
    cr00f1.anderson--dr00f2.csb1.ucla.net (169.232.4.55)  173.790 ms
    cr00f2.csb1--dr00f2.csb1.ucla.net (169.232.4.53)  173.795 ms
```

www.u_tokyo.ac.jp



www.lancs.ac.uk



Q1: After router 6(138.44.5.0) the path to “www.u_tokyo.ac.jp” diverges from the others destination. After router 9(113.197.15.201) the path diverges from my machine to “www.lancs.ac.uk” and “www.ucla.edu”.

Q2: Detail of router 6:

```
zhangpeideMacBook-Pro:~ zhangpei$ whois 138.44.5.0
% IANA WHOIS server
% for more information on IANA, visit http://www.iana.org
% This query returned 1 object

refer:        whois.arin.net

inetnum:      138.0.0.0 - 138.255.255.255
organisation: Administered by ARIN
status:       LEGACY

whois:        whois.arin.net

changed:      1993-05
source:       IANA


#
# 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.
#
```

```
#
# Query terms are ambiguous.  The query is assumed to be:
#     "n + 138.44.5.0"
#
# Use "?" to get help.
#

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
```

```
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
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

% This query was served by the APNIC Whois Service version 1.88.15-46 (WHOIS-NODE2)
```

Q3: www.ucla.edu 14 hops;
www.u-tokyo.ac.jp 15 hops;
www.lancaster.ac.uk 28 hops

The physical distance is showed below:

network information	network information	network information
IP Address **169.232.4.53**	IP Address **158.205.134.26**	IP Address **148.88.65.80**
Base Domain **ucla.net**	Base Domain **158.205.134.26**	Base Domain **ac.uk**
Country **United States**	Country **Japan**	Country **United Kingdom**
Region **CA**	Region **Unknown**	Region **H2**
City **Los Angeles**	City **Unknown**	City **Lancaster**
Latitude **33.7866**	Latitude **36**	Latitude **54.0667**
Longitude **-118.2987**	Longitude **138**	Longitude **-2.8333**
Area Code **310**	Area Code **Unknown**	Area Code **Unknown**
Postal Code **90095**	Postal Code **Unknown**	Postal Code **Unknown**
Distance from Last (as the crow flies) **7499.0 miles**	Distance from Last (as the crow flies) **4908.7 miles**	Distance from Last (as the crow flies) **10569.8 miles**
Source **MaxMind**	Source **MaxMind**	Source **MaxMind**

Obviously, the number of hops is not proportional the phydical distance.

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：

Q1: Traceroute from my machine to “www.speedtest.com.sg/tr.php”

```
traceroute to www.speedtest.com.sg (202.150.221.170), 64 hops max, 52 byte packets
 1  * * *
 2  ufw1-ae-1-3161.gw.unsw.edu.au (149.171.253.92)  8.475 ms  6.362 ms  4.440 ms
 3  libwdr1-vl-3090.gw.unsw.edu.au (149.171.253.66)  9.810 ms  5.821 ms  16.513 ms
 4  ombcr1-te-4-5.gw.unsw.edu.au (149.171.255.77)  3.444 ms  3.412 ms  3.508 ms
 5  unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  3.769 ms  5.183 ms  3.346 ms
 6  138.44.5.0 (138.44.5.0)  3.594 ms  7.654 ms  4.374 ms
 7  et-0-3-0.pe1.alxd.nsw.aarnet.net.au (113.197.15.153)  4.164 ms  4.229 ms  4.355 ms
 8  xe-0-2-1-204.pe1.wnpa.alxd.aarnet.net.au (113.197.15.183)  29.890 ms
    xe-0-0-3.pe1.wnpa.akl.aarnet.net.au (113.197.15.67)  26.865 ms  26.817 ms
 9  et-0-1-0.200.pe1.tkpa.akl.aarnet.net.au (113.197.15.69)  44.382 ms  28.682 ms  27.134 ms
10  xe-0-2-6.bdr1.a.lax.aarnet.net.au (202.158.194.173)  150.479 ms  150.560 ms  150.326 ms
11  singtel.as7473.any2ix.coresite.com (206.72.210.63)  151.094 ms  152.231 ms  150.760 ms
12  203.208.172.173 (203.208.172.173)  165.260 ms
    203.208.182.153 (203.208.182.153)  410.386 ms
    203.208.172.173 (203.208.172.173)  151.534 ms
13  203.208.177.110 (203.208.177.110)  256.295 ms  227.733 ms
    203.208.182.125 (203.208.182.125)  340.048 ms
14  202-150-221-170.rev.ne.com.sg (202.150.221.170)  323.364 ms *  693.022 ms
```

Traceroute from “www.speedtest.com.sg/tr.php” to my machine.

```
Traceroute Result:

traceroute to 129.94.8.201 (129.94.8.201), 30 hops max, 60 byte packets
 1  ge2-8.r01.sin01.ne.com.sg (202.150.221.169)  0.163 ms  0.193 ms  0.206 ms
 2  10.11.33.30 (10.11.33.30)  0.248 ms  0.262 ms  0.276 ms
 3  10.11.33.74 (10.11.33.74)  0.743 ms  0.762 ms  0.774 ms
 4  aarnet.sgix.sg (103.16.102.67)  225.643 ms  225.603 ms  225.653 ms
 5  xe-3-0-3.pe1.brwy.nsw.aarnet.net.au (113.197.15.206)  232.830 ms  232.849 ms  232.864 ms
 6  138.44.5.1 (138.44.5.1)  225.833 ms  225.836 ms  225.921 ms
 7  ombcr1-te-1-5.gw.unsw.edu.au (149.171.255.106)  235.675 ms  235.791 ms  235.802 ms
 8  ombwdr1-te-1-2.gw.unsw.edu.au (149.171.255.82)  290.180 ms  289.374 ms  289.271 ms
 9  cfw1-ae-1-3090.gw.unsw.edu.au (149.171.253.68)  226.562 ms  226.591 ms  226.554 ms
10  libwdr1-vl-3090.gw.unsw.edu.au (149.171.253.66)  231.555 ms  231.632 ms  231.607 ms
11  cfw1-ae-1-3090.gw.unsw.edu.au (149.171.253.68)  226.712 ms  226.749 ms  226.731 ms
12  libwdr1-vl-3090.gw.unsw.edu.au (149.171.253.66)  231.768 ms  231.846 ms  231.797 ms
13  cfw1-ae-1-3090.gw.unsw.edu.au (149.171.253.68)  226.942 ms  226.973 ms  226.953 ms
14  libwdr1-vl-3090.gw.unsw.edu.au (149.171.253.66)  232.085 ms  232.056 ms  232.095 ms
15  cfw1-ae-1-3090.gw.unsw.edu.au (149.171.253.68)  227.141 ms  227.319 ms  227.277 ms
16  libwdr1-vl-3090.gw.unsw.edu.au (149.171.253.66)  232.335 ms  232.290 ms  232.231 ms
```

Traceroute from my machine to “www.telstra.net/cgi-bin/trace”

```
zhangpeideMacBook-Pro:~ zhangpei$ traceroute www.telstra.net
traceroute to www.telstra.net (203.50.5.178), 64 hops max, 52 byte packets
 1  * * *
 2  ufw1-ae-1-3161.gw.unsw.edu.au (149.171.253.92)  8.609 ms  2.187 ms  3.166 ms
 3  libwdr1-vl-3090.gw.unsw.edu.au (149.171.253.66)  5.373 ms  3.387 ms  3.424 ms
 4  libcr1-te-4-5.gw.unsw.edu.au (149.171.255.89)  328.724 ms  3.856 ms  4.253 ms
 5  unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101)  3.498 ms  3.595 ms  4.462 ms
 6  138.44.5.0 (138.44.5.0)  3.637 ms  2.445 ms  4.314 ms
 7  et-0-3-0.pe1.alxd.nsw.aarnet.net.au (113.197.15.153)  3.719 ms  4.578 ms  4.411 ms
 8  ae9.bb1.b.syd.aarnet.net.au (113.197.15.65)  4.341 ms  5.086 ms  3.901 ms
 9  gigabitethernet1-1.pe1.b.syd.aarnet.net.au (202.158.202.18)  4.696 ms  4.403 ms  4.282 ms
10  gigabitethernet3-11.ken37.sydney.telstra.net (139.130.0.77)  4.774 ms  4.995 ms  5.331 ms
11  bundle-ether13.ken-core10.sydney.telstra.net (203.50.11.94)  7.428 ms  6.378 ms  4.898 ms
12  bundle-ether13.chw-core10.sydney.telstra.net (203.50.11.98)  6.654 ms
    bundle-ether10.win-core10.melbourne.telstra.net (203.50.11.123)  16.441 ms  17.849 ms
13  203.50.6.40 (203.50.6.40)  18.099 ms
    bundle-ether8.exi-core10.melbourne.telstra.net (203.50.11.125)  18.798 ms  19.745 ms
14  bundle-ether2.exi-ncprouter101.melbourne.telstra.net (203.50.11.209)  17.740 ms  17.852 ms  17.260 ms
15  www.telstra.net (203.50.5.178)  16.704 ms  18.445 ms  18.022 ms
```

Traceroute from “www.telstra.net/cgi-bin/trace” to my machine.

```
 1  gigabitethernet3-3.exi2.melbourne.telstra.net (203.50.77.53)  0.338 ms  0.205 ms  0.366 ms
 2  bundle-ether3-100.win-core10.melbourne.telstra.net (203.50.80.129)  2.111 ms  1.478 ms  2.241 ms
 3  bundle-ether12.ken-core10.sydney.telstra.net (203.50.11.122)  13.110 ms  12.470 ms  12.611 ms
 4  bundle-ether1.ken-edge901.sydney.telstra.net (203.50.11.95)  12.108 ms  11.974 ms  11.985 ms
 5  aarnet6.lnk.telstra.net (139.130.0.78)  11.610 ms  11.598 ms  11.612 ms
 6  ge-6-0-0.bb1.a.syd.aarnet.net.au (202.158.202.17)  11.734 ms  11.849 ms  11.736 ms
 7  ae9.pe2.brwy.nsw.aarnet.net.au (113.197.15.56)  12.109 ms  12.098 ms  11.987 ms
 8  et-3-1-0.pe1.brwy.nsw.aarnet.net.au (113.197.15.146)  12.107 ms  12.096 ms  12.110 ms
 9  138.44.5.1 (138.44.5.1)  12.358 ms  12.348 ms  12.361 ms
10  libcr1-te-1-5.gw.unsw.edu.au (149.171.255.102)  12.361 ms  12.348 ms  12.360 ms
11  ombwdr1-te-1-1.gw.unsw.edu.au (149.171.255.94)  12.359 ms
12  cfw1-ae-1-3090.gw.unsw.edu.au (149.171.253.68)  12.860 ms  12.850 ms  12.860 ms
13  libwdr1-vl-3090.gw.unsw.edu.au (149.171.253.66)  12.859 ms  12.847 ms  12.862 ms
14  cfw1-ae-1-3090.gw.unsw.edu.au (149.171.253.68)  13.233 ms  13.097 ms  13.112 ms
15  libwdr1-vl-3090.gw.unsw.edu.au (149.171.253.66)  13.106 ms  13.098 ms  13.110 ms
16  cfw1-ae-1-3090.gw.unsw.edu.au (149.171.253.68)  13.358 ms  13.349 ms  13.360 ms
17  libwdr1-vl-3090.gw.unsw.edu.au (149.171.253.66)  13.358 ms  13.472 ms  13.482 ms
18  cfw1-ae-1-3090.gw.unsw.edu.au (149.171.253.68)  14.481 ms  14.596 ms  14.484 ms
19  libwdr1-vl-3090.gw.unsw.edu.au (149.171.253.66)  14.608 ms  14.599 ms  14.482 ms
```

Q2:I chosen two serves “www.speedtest.com.sg”and “www.telstra.net” . Obviously, the reverse path does not go through the same path as forward path.

Exercise 4: Use ping to gain insights into network performance.

Q1: Computing the shortest possible time from UNSW to these locations:

www.uq.edu.au (130.102.131.123, Brisbane)

Approximate physical distance from UNSW to Brisbane: 731.1 km

T = 731.1km / 3 * 10^8m/s = 2.4 ms

www.nus.edu.sg (137.132.21.27, Singapore)

Approximate physical distance from UNSW to Singapore: 6317.5 km

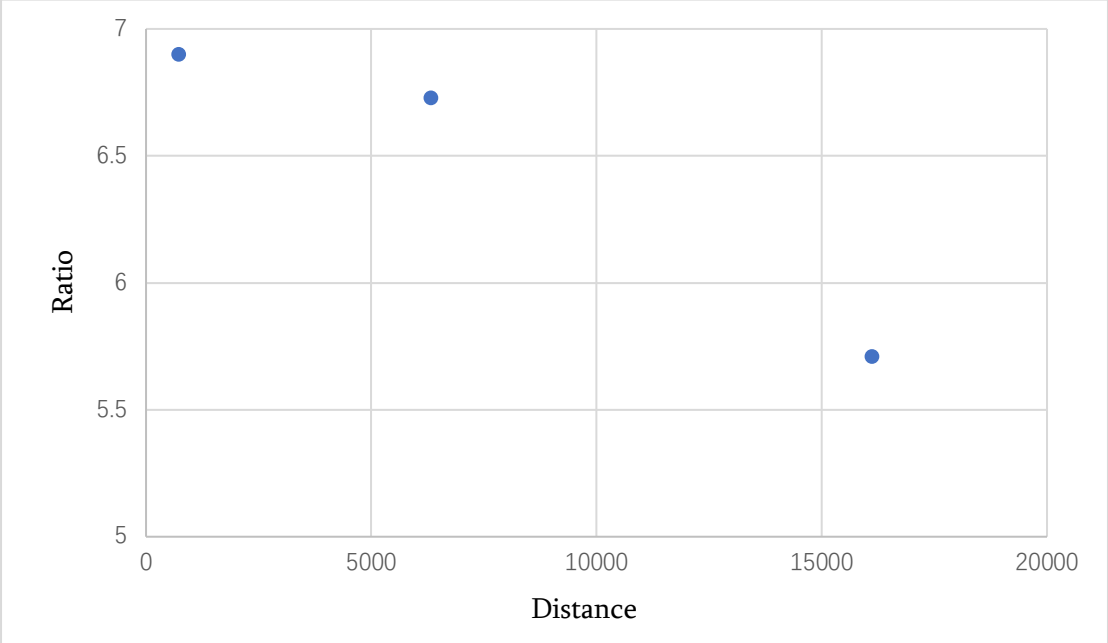
T = 6317.5km / 3 * 10^8m/s = 21.1 ms

www.tu-berlin.de (130.149.7.201, Berlin)

Approximate physical distance from UNSW to Berlin: 16114.5 km

T = 16114.5km / 3 * 10^8m/s = 53.7 ms

Location	Distance	The short possible time	Minimum delay	Ratio
Brisbane	731.1km	2.4 ms	16.563 ms	6.90
Singapore	6317.5 km	21.1 ms	141.968 ms	6.73
Berlin	16114.5 km	53.7 ms	306.985ms	5.71



The reasons why the radio are greater than 2 :

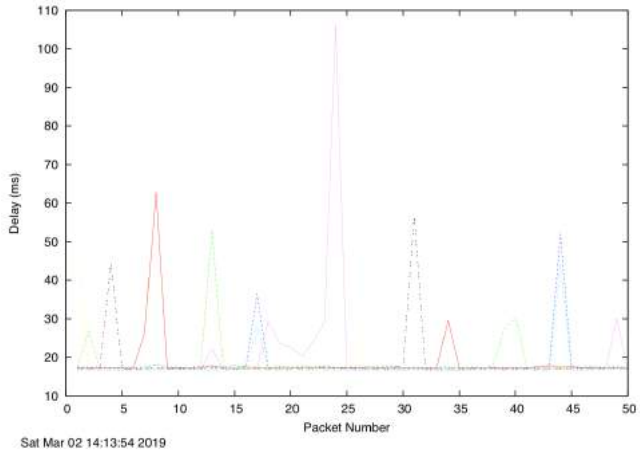
- The router path may not the shortest path.
- Devices should check bits error and determine output link , this may cause processing delay.

- Queueing delay may be contributed by packet waiting at queue for transmission.

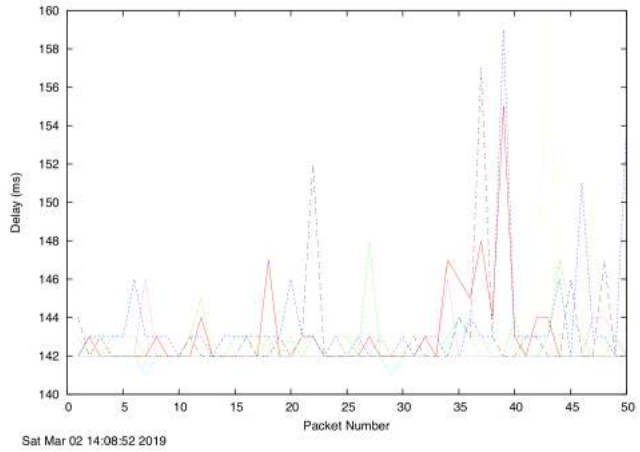
Q2. Is the delay to the destinations constant or does it vary over time? Explain why.

There are destination_delay.pdf for three serves (different colors correspond to different packet sizes) :

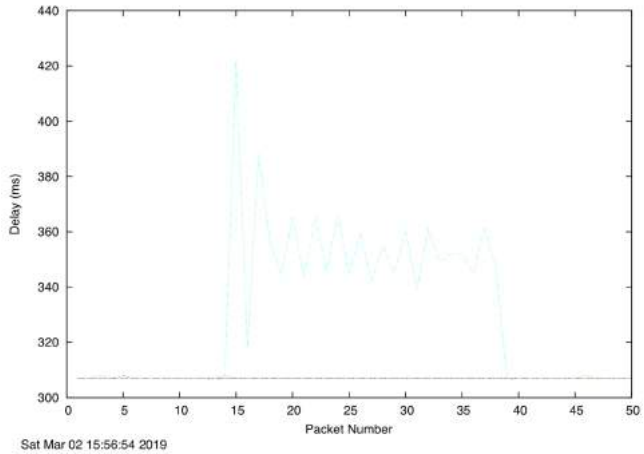
www.uq.edu.au



www.nus.edu.sg



www.tu-berlin.de



Obviously, the delay varies over time.

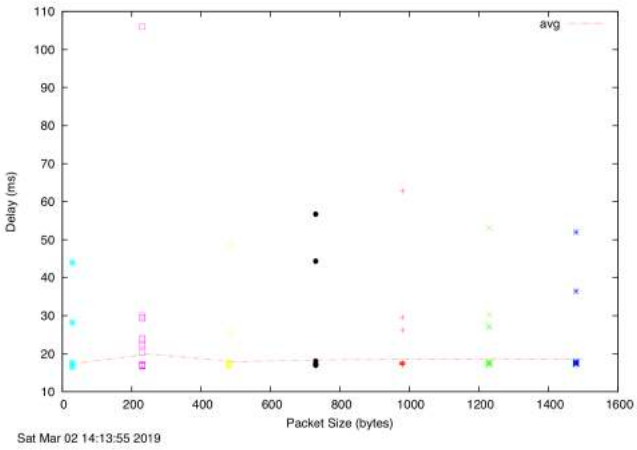
The situation of link and router changes at every moment. For example, the number of packets waiting at queue may be different at different moment in one device.

Q3. The measured delay (i.e., the delay you can see in the graphs) is composed of propagation delay, transmission delay, processing delay and queuing delay. Which of these delays depend on the packet size and which do not?

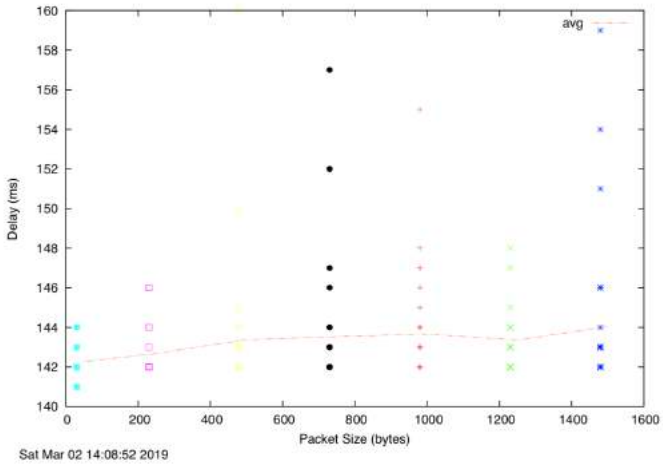
Transmission delay is affected by packet size.
Propagation delay is affected by length of physical link and propagation speed.
Processing delay is almost same for different packet size.
Queueing delay is affected by congestion level of router.

There are destination_scatter.pdf below that shows delay vs. packet size below:

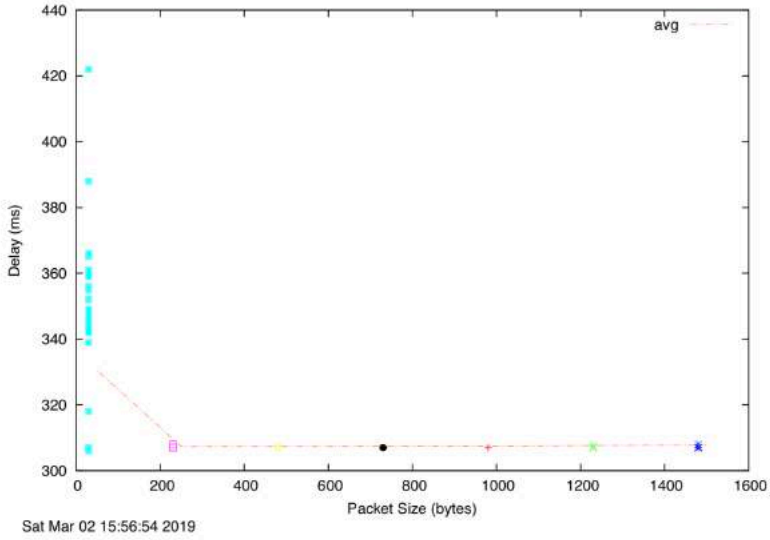
www.uq.edu.au



www.nus.edu.sg



www.tu-berlin.de


avg
Delay (ms)
Packet Size (bytes)
440
420
400
380
360
340
320
300
0
200
400
600
800
1000
1200
1400
1600
Sat Mar 02 15:56:54 2019