Exercise 1: nslookup

1. Answer:

IP address: 216.58.196.132

```
'z5187292@vx2:/tmp_amd/reed/export/reed/1/z5187292/comp9331$ nslookup www.google.'
com
Server:         129.94.242.2
Address:        129.94.242.2#53

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

In my opinion, multiple IP addresses

1. can avoid firewalls or to avoid being blacklisted in SPAM filters
2. compensate for a host that's down at that moment by adding its IP address to another one
3. In order to load balancing

2. Answer:

name of the IP address 127.0.0.1 is localhost

```
z5187292@vx1:/tmp_amd/reed/export/reed/1/z5187292$ nslookup 127.0.0.1
Server:         129.94.242.45
Address:        129.94.242.45#53

1.0.0.127.in-addr.arpa  name = localhost.

z5187292@vx1:/tmp_amd/reed/export/reed/1/z5187292$
```

127.0.0.1 is the loopback Internet protocol (IP) address. The address is used to establish an IP connection to the same machine or computer being used by the end-user.

Exercise 2: Use ping to test host reachability

Answer:

In testing, www.getfittest.com.au and www.hola.hp do not exist. www.kremlin.ru is unreachable because this website ban ICMP protocol in order to enhance security. The rest websites can reachable. The test is below,

www.kremlin.ru

```
z5187292@vx1:/tmp_amd/reed/export/reed/1/z5187292$ ping -c 10  www.kremlin.ru
PING www.kremlin.ru (95.173.136.72) 56(84) bytes of data.

--- www.kremlin.ru ping statistics ---
10 packets transmitted, 0 received, 100% packet loss, time 9197ms
```

www.hola.hp

```
z5187292@vx1:/tmp_amd/reed/export/reed/1/z5187292$ ping www.hola.hp
ping: unknown host www.hola.hp
```

www.getfittest.com.au

```
z5187292@vx1:/tmp_amd/reed/export/reed/1/z5187292$ ping www.getfittest.com.au
ping: unknown host www.getfittest.com.au
```

www.amazon.com

```
z5187292@vx1:/tmp_amd/reed/export/reed/1/z5187292$ ping -c 1 www.amazon.com
PING e15316.ci.akamaiedge.net (104.97.231.172) 56(84) bytes of data.
64 bytes from a104-97-231-172.deploy.static.akamaitechnologies.com (104.97.231.1
72): icmp_req=1 ttl=56 time=13.6 ms

--- e15316.ci.akamaiedge.net ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 13.605/13.605/13.605/0.000 ms
```

www.tsinghua.edu.cn

```
z5187292@vx1:/tmp_amd/reed/export/reed/1/z5187292$ ping -c 1 www.tsinghua.edu.cn
PING www.d.tsinghua.edu.cn (166.111.4.100) 56(84) bytes of data.
64 bytes from www.tsinghua.edu.cn (166.111.4.100): icmp_req=1 ttl=235 time=211 m
s

--- www.d.tsinghua.edu.cn ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 211.164/211.164/211.164/0.000 ms
```

8.8.8.8

```
z5187292@vx1:/tmp_amd/reed/export/reed/1/z5187292$ ping -c 1 8.8.8.8
PING 8.8.8.8 (8.8.8.8) 56(84) bytes of data.
64 bytes from 8.8.8.8: icmp_req=1 ttl=120 time=1.64 ms

--- 8.8.8.8 ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 1.646/1.646/1.646/0.000 ms
```

www.cse.unsw.edu.au

```
z5187292@vx1:/tmp_amd/reed/export/reed/1/z5187292$ ping -c 1 www.cse.unsw.edu.au
PING www.cse.unsw.edu.au (129.94.242.51) 56(84) bytes of data.
64 bytes from albeniz.orchestra.cse.unsw.EDU.AU (129.94.242.51): icmp_req=1 ttl=
64 time=0.155 ms

--- www.cse.unsw.edu.au ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 0.155/0.155/0.155/0.000 ms
```

www.mit.edu

```
z5187292@vx1:/tmp_amd/reed/export/reed/1/z5187292$ ping -c 1 www.mit.edu
PING e9566.dscb.akamaiedge.net (23.77.138.76) 56(84) bytes of data.
64 bytes from a23-77-138-76.deploy.static.akamaitechnologies.com (23.77.138.76):
 icmp_req=1 ttl=56 time=1.41 ms

--- e9566.dscb.akamaiedge.net ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 1.410/1.410/1.410/0.000 ms
```

www.intel.com.au

```
z5187292@vx1:/tmp_amd/reed/export/reed/1/z5187292$ ping -c 1 www.intel.com.au
PING e117.b.akamaiedge.net (23.77.147.47) 56(84) bytes of data.
64 bytes from a23-77-147-47.deploy.static.akamaitechnologies.com (23.77.147.47):
 icmp_req=1 ttl=56 time=1.51 ms

--- e117.b.akamaiedge.net ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 1.517/1.517/1.517/0.000 ms
```

www.tpg.com.au

```
z5187292@vx1:/tmp_amd/reed/export/reed/1/z5187292$ ping -c 1 www.tpg.com.au
PING www.tpg.com.au (203.26.27.38) 56(84) bytes of data.
64 bytes from www.tpg.com.au (203.26.27.38): icmp_req=1 ttl=118 time=29.7 ms

--- www.tpg.com.au ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 29.700/29.700/29.700/0.000 ms
```

Exercise 3: Use traceroute to understand network topology

1. Answer:

```
z5187292@vx1:/tmp_amd/reed/export/reed/1/z5187292$ 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)  0.107 ms  0.089 ms  0.07
3 ms
 2  129.94.39.17 (129.94.39.17)  0.962 ms  0.960 ms  0.937 ms
 3  ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35)  1.617 ms libudnex1-vl-315
4.gw.unsw.edu.au (149.171.253.34)  1.641 ms  1.646 ms
 4  ombcr1-po-6.gw.unsw.edu.au (149.171.255.169)  1.285 ms  1.283 ms ombcr1-po-5
.gw.unsw.edu.au (149.171.255.197)  1.276 ms
 5  unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101)  1.256 ms  1.223 ms  1.298 m
s
 6  138.44.5.0 (138.44.5.0)  1.379 ms  1.420 ms  1.409 ms
 7  et-1-3-0.pe1.sxt.bkvl.nsw.aarnet.net.au (113.197.15.149)  2.310 ms  2.041 ms
  2.060 ms
 8  et-0-0-0.pe1.a.hnl.aarnet.net.au (113.197.15.99)  95.148 ms  95.226 ms  95.1
89 ms
 9  et-2-1-0.bdr1.a.sea.aarnet.net.au (113.197.15.201)  157.572 ms  157.548 ms
157.517 ms
10  abilene-1-lo-jmb-706.sttlwa.pacificwave.net (207.231.240.8)  146.878 ms  146
.889 ms  146.868 ms
11  et-4-0-0.4079.rtsw.miss2.net.internet2.edu (162.252.70.0)  157.608 ms  157.5
45 ms  157.535 ms
12  et-4-0-0.4079.rtsw.minn.net.internet2.edu (162.252.70.58)  185.378 ms  185.3
31 ms  185.227 ms
13  et-1-1-5.4079.rtsw.eqch.net.internet2.edu (162.252.70.106)  188.513 ms  188.
766 ms  188.646 ms
14  162.252.70.163 (162.252.70.163)  189.168 ms  189.229 ms  189.219 ms
15  ae-1.4079.rtsw.clev.net.internet2.edu (162.252.70.130)  197.131 ms  197.286
ms  197.311 ms
16  buf-9208-I2-CLEV.nysernet.net (199.109.11.33)  201.391 ms  201.432 ms  201.4
81 ms
17  syr-9208-buf-9208.nysernet.net (199.109.7.193)  204.608 ms  204.857 ms  204.
837 ms
18  nyc-9208-syr-9208.nysernet.net (199.109.7.162)  210.541 ms  210.419 ms  210.
755 ms
19  columbia.nyc-9208.nysernet.net (199.109.4.14)  210.619 ms  210.415 ms  210.5
07 ms
20  nyser111-gw-1-x-nyser32-gw-1.net.columbia.edu (128.59.255.10)  372.994 ms  3
64.541 ms  353.168 ms
21  phi-core-1-x-nyser111-gw-1.net.columbia.edu (128.59.255.13)  211.256 ms  211
.019 ms  211.762 ms
22  cc-conc-1-x-phi-core-1.net.columbia.edu (128.59.255.214)  211.205 ms  210.99
4 ms  211.808 ms
23  ctv.columbia.edu (128.59.105.24)  211.060 ms  211.191 ms  211.121 ms
```

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

5 routers are part of UNSW network, because top five routers belong to UNSW(can see .unsw.edu.au) and the sixth we can use dig -x 138.44.5.0 like below to check it does not belong to UNSW,

```
z5187292@vx1:/tmp_amd/reed/export/reed/1/z5187292$ dig -x 138.44.5.0

; <<>> DiG 9.7.3 <<>> -x 138.44.5.0
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NXDOMAIN, id: 34093
;; flags: qr rd ra; QUERY: 1, ANSWER: 0, AUTHORITY: 1, ADDITIONAL: 0

;; QUESTION SECTION:
;0.5.44.138.in-addr.arpa.       IN      PTR

;; AUTHORITY SECTION:
5.44.138.in-addr.arpa.  941     IN      SOA     ns1.aarnet.net.au. hostmaster.aa
rnet.edu.au. 2017121506 10800 600 1209600 3600

;; Query time: 3 msec
;; SERVER: 129.94.242.45#53(129.94.242.45)
;; WHEN: Mon Feb 25 15:28:17 2019
;; MSG SIZE  rcvd: 116

z5187292@vx1:/tmp_amd/reed/export/reed/1/z5187292$
```

9th and 10th routers do packets cross the Pacific Ocean. Because 8th and 9th still belong to .aarnet.net.au, but 10th router is part of pacificwave.net.

2. Answer:

UNSW CSE

Student ID:z5187292 Student Name: Ran Bai

<i> www.ucla.edu

```
z5187292@vx1:/tmp_amd/reed/export/reed/1/z5187292$ traceroute www.ucla.edu
traceroute 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)  0.081 ms  0.068 ms  0.065 ms
 2  129.94.39.17 (129.94.39.17)  1.016 ms  0.962 ms  0.925 ms
 3  ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35)  13.817 ms  13.774 ms  13.734 ms
 4  libcr1-po-5.gw.unsw.edu.au (149.171.255.165)  1.254 ms  1.239 ms  1.302 ms
 5  unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  1.198 ms unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101)  1.302 ms unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)
 6  138.44.5.0 (138.44.5.0)  1.355 ms  1.529 ms  1.485 ms
 7  et-1-3-0.pe1.sxt.bkvl.nsw.aarnet.net.au (113.197.15.149)  2.485 ms  2.330 ms  2.173 ms
 8  et-0-0-0.pe1.a.hnl.aarnet.net.au (113.197.15.99)  95.203 ms  95.393 ms  95.350 ms
 9  et-2-1-0.bdr1.a.sea.aarnet.net.au (113.197.15.201)  146.804 ms  146.778 ms  146.714 ms
10  cenichpr-1-is-jmb-778.snvaca.pacificwave.net (207.231.245.129)  163.275 ms  163.218 ms  163.171 ms
11  hpr-lax-hpr3--svl-hpr3-100ge.cenic.net (137.164.25.73)  171.176 ms  171.037 ms  171.024 ms

12  * * *
13  bd11f1.anderson--cr00f2.csb1.ucla.net (169.232.4.4)  171.684 ms  171.616 ms  171.522 ms
14  cr00f2.csb1--dr00f2.csb1.ucla.net (169.232.4.53)  171.498 ms cr00f1.anderson--dr00f2.csb1.ucla.net (169.232.4.55)  171.666 ms  171.623 ms
15  * * *
16  * * *
17  * * *
18  * * *
19  * * *
20  * * *
21  * * *
22  * * *
23  * * *
24  * * *
25  * * *
26  * * *
27  * * *
28  * * *
29  * * *
30  * * *
```

Network Location Tool

approximate geophysical location

network information

IP Address
164.67.228.152

Base Domain
ucla.edu

Country
United States

Region
CA

City
Los Angeles

Latitude
33.7866

Longitude
-118.2987

Area Code
310

Postal Code
90095

Distance from Last (as the crow flies)
7499.0 miles

Source
MaxMind

locate a network

Remote Address 164.67.228.152 Locate

Use Current IP

Source ◉ MaxMind ○ Hostip.info

<ii> www.u-tokyo.ac.jp

```
z5187292@vx1:/tmp_amd/reed/export/reed/1/z5187292$ traceroute www.u-tokyo.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)  0.084 ms  0.070 ms  0.055 ms
 2  129.94.39.17 (129.94.39.17)  0.991 ms  0.988 ms  0.963 ms
 3  libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34)  1.797 ms ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35)  1.435 ms libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34)  1
 4  ombcr1-po-5.gw.unsw.edu.au (149.171.255.197)  1.183 ms ombcr1-po-6.gw.unsw.edu.au (149.171.255.169)  1.229 ms libcr1-po-6.gw.unsw.edu.au (149.171.255.201)  1.201 ms
 5  unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  1.346 ms unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101)  1.303 ms  1.361 ms
 6  138.44.5.0 (138.44.5.0)  3.574 ms  3.058 ms  3.037 ms
 7  et-0-3-0.pe1.bkvl.nsw.aarnet.net.au (113.197.15.147)  2.441 ms  1.902 ms  1.839 ms
 8  ge-4_0_0.bb1.a.pao.aarnet.net.au (202.158.194.177)  156.929 ms  156.903 ms  156.910 ms
 9  paloalto0.iij.net (198.32.176.24)  158.069 ms  158.234 ms  158.306 ms
10  osk004bb00.IIJ.Net (58.138.88.185)  288.671 ms osk004bb01.IIJ.Net (58.138.88.189)  271.545 ms osk004bb00.IIJ.Net (58.138.88.185)  288.709 ms
11  osk004ix51.IIJ.Net (58.138.106.130)  279.802 ms  279.729 ms  279.723 ms
12  210.130.135.130 (210.130.135.130)  288.616 ms  288.575 ms  288.578 ms
13  124.83.228.58 (124.83.228.58)  279.688 ms  271.111 ms  280.006 ms
14  124.83.252.178 (124.83.252.178)  294.489 ms  285.734 ms  294.507 ms
15  158.205.134.26 (158.205.134.26)  277.098 ms  276.955 ms  285.711 ms
16  * * *
17  * * *
18  * * *
19  * * *
20  * * *
21  * * *
22  * * *
23  * * *
24  * * *
25  * * *
26  * * *
27  * * *
28  * * *
29  * * *
30  * * *
```

Network Location Tool

approximate geophysical location

network information

IP Address
210.152.243.234
Base Domain
idcfcloud.com
Country
Japan
Region
Unknown
City
Unknown
Latitude
36
Longitude
138
Area Code
Unknown
Postal Code
Unknown
Distance from Last (as the crow flies)
4908.7 miles
Source
MaxMind

locate a network

Remote Address 210.152.243.234 Locate
Use Current IP
Source MaxMind Hostip.info

<iii> www.lancaster.ac.uk

```
z5187292@vx4:/tmp_amd/reed/export/reed/1/z5187292$ traceroute www.lancaster.ac.u
k
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  0.062 ms  0.07
5 ms
 2  129.94.39.17 (129.94.39.17)  1.065 ms  1.061 ms  1.038 ms
 3  ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35)  4.114 ms  4.108 ms  4.075
 ms
 4  libcr1-po-5.gw.unsw.edu.au (149.171.255.165)  1.256 ms ombcr1-po-6.gw.unsw.e
du.au (149.171.255.169)  1.267 ms libcr1-po-6.gw.unsw.edu.au (149.171.255.201)
1.271 ms
 5  unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105)  1.303 ms  1.262 ms  1.324
ms
 6  138.44.5.0 (138.44.5.0)  1.498 ms  1.448 ms  1.404 ms
 7  et-1-3-0.pe1.sxt.bkvl.nsw.aarnet.net.au (113.197.15.149)  2.250 ms  2.126 ms
  2.102 ms
 8  et-0-0-0.pe1.a.hnl.aarnet.net.au (113.197.15.99)  95.300 ms  95.398 ms  95.2
92 ms
 9  et-2-1-0.bdr1.a.sea.aarnet.net.au (113.197.15.201)  146.727 ms  146.691 ms
146.689 ms
10  abilene-1-lo-jmb-706.sttlwa.pacificwave.net (207.231.240.8)  146.792 ms  146
.798 ms  146.862 ms
11  et-4-0-0.4079.rtsw.miss2.net.internet2.edu (162.252.70.0)  157.635 ms  157.6
31 ms  157.661 ms
12  et-4-0-0.4079.rtsw.minn.net.internet2.edu (162.252.70.58)  180.673 ms  180.7
20 ms  180.781 ms
13  et-1-1-5.4079.rtsw.eqch.net.internet2.edu (162.252.70.106)  188.530 ms  188.
703 ms  188.651 ms
14  162.252.70.163 (162.252.70.163)  188.807 ms  188.602 ms  188.617 ms
15  ae-1.4079.rtsw.clev.net.internet2.edu (162.252.70.130)  197.439 ms  197.590
ms  197.531 ms
16  et-2-0-0.4079.rtsw.ashb.net.internet2.edu (162.252.70.54)  205.038 ms  204.9
93 ms  204.980 ms
17  ae-2.4079.rtsw.wash.net.internet2.edu (162.252.70.136)  205.328 ms  205.384
ms  205.301 ms
18  internet2-gw.mx1.lon.uk.geant.net (62.40.124.44)  280.368 ms  280.370 ms  28
0.723 ms
19  janet-gw.mx1.lon.uk.geant.net (62.40.124.198)  280.521 ms  280.592 ms  280.6
65 ms
20  ae29.londpg-sbr2.ja.net (146.97.33.2)  281.210 ms  281.198 ms  281.160 ms
21  ae31.erdiss-sbr2.ja.net (146.97.33.22)  284.816 ms  284.759 ms  284.866 ms
22  ae29.manckh-sbr2.ja.net (146.97.33.42)  286.962 ms  286.960 ms  286.947 ms
23  ae24.lanclu-rbr1.ja.net (146.97.38.58)  288.887 ms  288.915 ms  288.922 ms
24  lancaster-university.ja.net (194.81.46.2)  306.908 ms  306.249 ms  304.575 m
s
25  * * *
26  ismx-issrx.rtr.lancs.ac.uk (148.88.255.17)  290.472 ms  290.493 ms  290.494
ms
27  dc.iss.srv.rtrcloud.lancs.ac.uk (148.88.253.3)  305.712 ms  303.589 ms  303.
579 ms
28  www.lancs.ac.uk (148.88.65.80)  290.659 ms !X  290.288 ms !X  290.274 ms !X
```

Network Location Tool

approximate geophysical location

network information

IP Address
148.88.65.80
Base Domain
ac.uk
Country
United Kingdom
Region
H2
City
Lancaster
Latitude
54.0667
Longitude
-2.8333
Area Code
Unknown
Postal Code
Unknown
Distance from Last (as the crow flies)
10569.8 miles
Source
MaxMind

locate a network

Remote Address 148.88.65.80 Locate
Use Current IP
Source MaxMind Hostip.info

The first 2 hops are identical on all 3 paths. Lancaster and ucla paths have a common 9th hop router (113.197.15.201).
No, the number of hops is not proportional to the physical distance. Because the path to Tokyo (which is more closer to Sydney than LA) have 15 hops, while LA have 14 hops.

3. Answer:

IP address of my machine: 129.94.242.117
IP address of www.telstra.net: 203.50.5.178
Ip address of www.speedtest.com.sg: 202.150.221.170

```
z5187292@vx4:/tmp_amd/reed/export/reed/1/z5187292$ /sbin/ifconfig
eth0      Link encap:Ethernet  HWaddr 18:66:da:7b:a6:51
          inet addr:129.94.242.117  Bcast:129.94.242.255  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:10235069 errors:0 dropped:0 overruns:0 frame:0
          TX packets:9743528 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:2262305970 (2.1 GiB)  TX bytes:7752552575 (7.2 GiB)
          Interrupt:93 Memory:95000000-957fffff

lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          UP LOOPBACK RUNNING  MTU:65536  Metric:1
          RX packets:34886613 errors:0 dropped:0 overruns:0 frame:0
          TX packets:34886613 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1
          RX bytes:93691640681 (87.2 GiB)  TX bytes:93691640681 (87.2 GiB)

z5187292@vx4:/tmp_amd/reed/export/reed/1/z5187292$ nslookup www.telstra.net
Server:         129.94.242.2
Address:        129.94.242.2#53

Non-authoritative answer:
Name:   www.telstra.net
Address: 203.50.5.178
```

```
z5187292@vx4:/tmp_amd/reed/export/reed/1/z5187292$ nslookup www.speedtest.com.sg
Server:         129.94.242.2
Address:        129.94.242.2#53

Non-authoritative answer:
Name:   www.speedtest.com.sg
Address: 202.150.221.170
```

Traceroute from www.telstra.net to my machine:

```
 1  gigabitethernet3-3.exi2.melbourne.telstra.net (203.50.77.53)  0.367 ms  0.222 ms  0.244 ms
 2  bundle-ether3-100.win-core10.melbourne.telstra.net (203.50.80.129)  2.743 ms  1.611 ms  2.119 ms
 3  bundle-ether12.ken-core10.sydney.telstra.net (203.50.11.122)  13.113 ms  12.231 ms  12.864 ms
 4  bundle-ether1.ken-edge901.sydney.telstra.net (203.50.11.95)  12.236 ms  11.981 ms  11.864 ms
 5  aarnet6.lnk.telstra.net (139.130.0.78)  11.613 ms  11.607 ms  11.613 ms
 6  ge-6-0-0.bb1.a.syd.aarnet.net.au (202.158.202.17)  11.863 ms  11.732 ms  11.737 ms
 7  ae9.pe2.brwy.nsw.aarnet.net.au (113.197.15.56)  11.987 ms  11.982 ms  11.988 ms
 8  et-3-1-0.pe1.brwy.nsw.aarnet.net.au (113.197.15.146)  12.114 ms  12.105 ms  12.113 ms
 9  138.44.5.1 (138.44.5.1)  12.363 ms  12.234 ms  12.361 ms
10  libcr1-te-1-5.gw.unsw.edu.au (149.171.255.102)  12.364 ms  12.356 ms  12.239 ms
11  ombudnex1-po-1.gw.unsw.edu.au (149.171.255.202)  12.863 ms
12  ufw1-ae-1-3154.gw.unsw.edu.au (149.171.253.36)  13.108 ms  13.104 ms  13.112 ms
13  129.94.39.23 (129.94.39.23)  13.237 ms  13.230 ms  13.238 ms
```

There are other traceroute sites listed here.

The traceroute CGI source can be found via:

carpeNet

Traceroute from my machine to www.telstra.net:

```
z5187292@vx4:/tmp_amd/reed/export/reed/1/z5187292$ traceroute www.telstra.net
traceroute to www.telstra.net (203.50.5.178), 30 hops max, 60 byte packets
 1  cserouter1-server.cse.unsw.EDU.AU (129.94.242.251)  0.087 ms  0.068 ms  0.136 ms
 2  129.94.39.17 (129.94.39.17)  1.142 ms  1.101 ms  1.097 ms
 3  ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35)  2.119 ms  2.087 ms libudnex1-vl-3154.gw.unsw.edu.a
u (149.171.253.34)  2.022 ms
 4  ombcr1-po-5.gw.unsw.edu.au (149.171.255.197)  1.334 ms  1.337 ms ombcr1-po-6.gw.unsw.edu.au (149.171.
255.169)  1.946 ms
 5  unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101)  1.927 ms  1.904 ms unswbr1-te-2-13.gw.unsw.edu.au (1
49.171.255.105)  1.974 ms
 6  138.44.5.0 (138.44.5.0)  1.957 ms  1.846 ms  1.842 ms
 7  et-0-3-0.pe1.alxd.nsw.aarnet.net.au (113.197.15.153)  16.026 ms  15.794 ms  16.007 ms
 8  ae9.bb1.b.syd.aarnet.net.au (113.197.15.65)  2.240 ms  2.208 ms  2.168 ms
 9  gigabitethernet1-1.pe1.b.syd.aarnet.net.au (202.158.202.18)  2.239 ms  2.292 ms  2.207 ms
10  gigabitethernet3-11.ken37.sydney.telstra.net (139.130.0.77)  2.767 ms  2.598 ms  2.674 ms
11  bundle-ether2.chw-edge901.sydney.telstra.net (203.50.11.103)  2.767 ms  2.795 ms bundle-ether13.ken-c
ore10.sydney.telstra.net (203.50.11.94)  4.083 ms
12  bundle-ether10.win-core10.melbourne.telstra.net (203.50.11.123)  14.723 ms bundle-ether13.chw-core10.
sydney.telstra.net (203.50.11.98)  4.019 ms bundle-ether10.win-core10.melbourne.telstra.net (203.50.11.12
3)  14.680 ms
13  203.50.6.40 (203.50.6.40)  15.812 ms  15.777 ms bundle-ether8.exi-core10.melbourne.telstra.net (203.5
0.11.125)  16.904 ms
14  bundle-ether2.exi-ncprouter101.melbourne.telstra.net (203.50.11.209)  14.907 ms  15.670 ms  14.697 ms
15  www.telstra.net (203.50.5.178)  15.121 ms  15.157 ms  14.203 ms
z5187292@vx4:/tmp_amd/reed/export/reed/1/z5187292$
```

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

```
z5187292@vx4:/tmp_amd/reed/export/reed/1/z5187292$ 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)  0.083 ms  0.066 ms  0.078 ms
 2  129.94.39.17 (129.94.39.17)  1.031 ms  1.050 ms  1.057 ms
 3  ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35)  1.425 ms libudnex1-vl-3154.gw.unsw.edu.au (149.171
.253.34)  1.459 ms  1.740 ms
 4  libcr1-po-5.gw.unsw.edu.au (149.171.255.165)  1.324 ms ombcr1-po-6.gw.unsw.edu.au (149.171.255.169)
1.270 ms libcr1-po-5.gw.unsw.edu.au (149.171.255.165)  1.251 ms
 5  unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101)  1.220 ms unswbr1-te-2-13.gw.unsw.edu.au (149.171.255
.105)  1.291 ms unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101)  1.378 ms
 6  138.44.5.0 (138.44.5.0)  1.486 ms  1.514 ms  1.477 ms
 7  et-0-3-0.pe1.alxd.nsw.aarnet.net.au (113.197.15.153)  1.821 ms  1.937 ms  1.874 ms
 8  xe-0-0-3.pe1.wnpa.akl.aarnet.net.au (113.197.15.67)  24.484 ms  24.453 ms xe-0-2-1-204.pe1.wnpa.alxd.
aarnet.net.au (113.197.15.183)  24.460 ms
 9  et-0-1-0.200.pe1.tkpa.akl.aarnet.net.au (113.197.15.69)  24.629 ms  24.600 ms  24.645 ms
10  xe-0-2-6.bdr1.a.lax.aarnet.net.au (202.158.194.173)  147.995 ms  147.964 ms  147.991 ms
11  singtel.as7473.any2ix.coresite.com (206.72.210.63)  148.132 ms  148.100 ms  148.096 ms
12  203.208.182.153 (203.208.182.153)  322.138 ms 203.208.178.185 (203.208.178.185)  329.347 ms 203.208.1
72.173 (203.208.172.173)  148.237 ms
13  203.208.171.85 (203.208.171.85)  314.965 ms 203.208.177.110 (203.208.177.110)  236.831 ms  224.805 ms
14  203.208.182.45 (203.208.182.45)  323.156 ms 202-150-221-170.rev.ne.com.sg (202.150.221.170)  236.609
ms  238.604 ms
```

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

```
traceroute 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)  0.378 ms  0.398 ms  0.406 ms
 2  10.11.33.30 (10.11.33.30)  0.515 ms  0.536 ms  0.546 ms
 3  10.11.33.74 (10.11.33.74)  1.175 ms  1.280 ms  1.293 ms
 4  aarnet.sgix.sg (103.16.102.67)  225.908 ms  225.927 ms  225.773 ms
 5  xe-3-0-3.pe1.brwy.nsw.aarnet.net.au (113.197.15.206)  233.206 ms  233.222 ms  233.231 ms
 6  138.44.5.1 (138.44.5.1)  226.074 ms  225.927 ms  225.918 ms
 7  ombcr1-te-1-5.gw.unsw.edu.au (149.171.255.106)  235.753 ms  235.866 ms  235.880 ms
 8  libudnex1-po-2.gw.unsw.edu.au (149.171.255.198)  226.710 ms  226.739 ms  226.757 ms
 9  ufw1-ae-1-3154.gw.unsw.edu.au (149.171.253.36)  236.476 ms  236.418 ms  236.420 ms
10  129.94.39.23 (129.94.39.23)  224.728 ms  224.764 ms  224.664 ms
```

According to above, the forward and reverse path are different. This is because Internet environment is randomly, and the routing is not unique and uncertainly when the packet is transmitted. If have common routers between the forward and the reverse path, the IP addresses may be different because one router may have many interface. The interface the packet is sent from is determined by the router's algorithm influenced by congestion of networks. So the IP address may be different. But in my tracerouting process, there are not traveling by same routers between forward and the reverse path.

Exercise 4: Use ping to gain insights into network performance

1. Answer:

Distance between Sydney and the 3 destinations (based on flight path between them) are:

Brisbane:731.12 km,

Singapore: 6317.48km,

Berlin: 16114.52km.

Assuming propagation speed of 3 x 10^8 m/s, the shortest possible time that a packet will take to reach these 3 destinations are:(c = 3 * 10^8 m/s)

Brisbane: 731.12 * 10^3 / c = 2.44ms,

Singapore:6317.48 * 10^3 / c = 21.06ms,

Berlin: 16114.52 * 10^3 / c = 53.71ms.

The minimum RTT (for 50 byte packets) to these 3 destinations from the

corresponding *avg.txt files are:

Brisbane: 17.306ms,

Singapore: 142.992ms,

Berlin: 307.602ms.

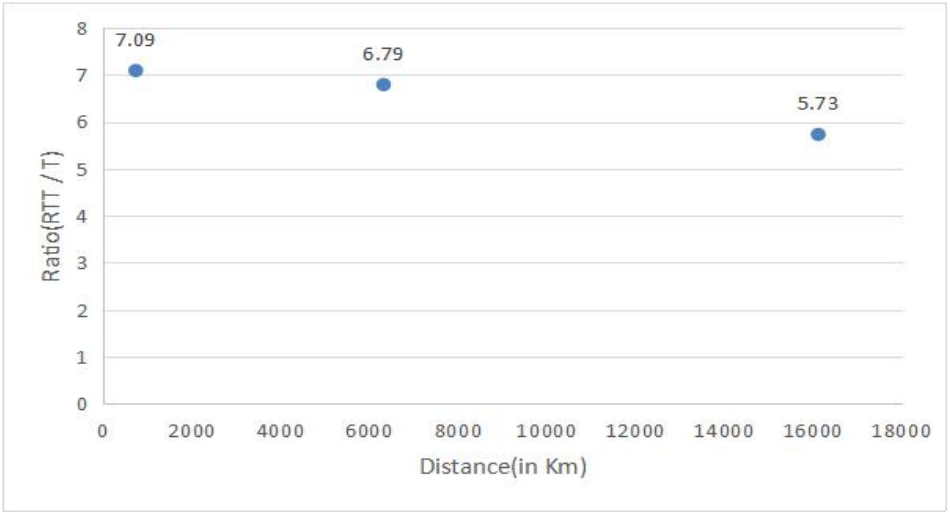
As such, the ratios of the minimum RTT to the minimum propagation delay for these 3 destinations are:

Brisbane: 7.09,

Singapore: 6.79,

Berlin: 5.73.

The following plot illustrates this ratio as a function of distance.



There are several reasons that this ratio is always > 2. Here are some:
<i> The link distance from Sydney to these three locations is not equal to the straight line distance found on Google Maps.

<ii>Signal transmission speed is only theoretically equal to the speed of light. Actually, the speed is lower than light speed.

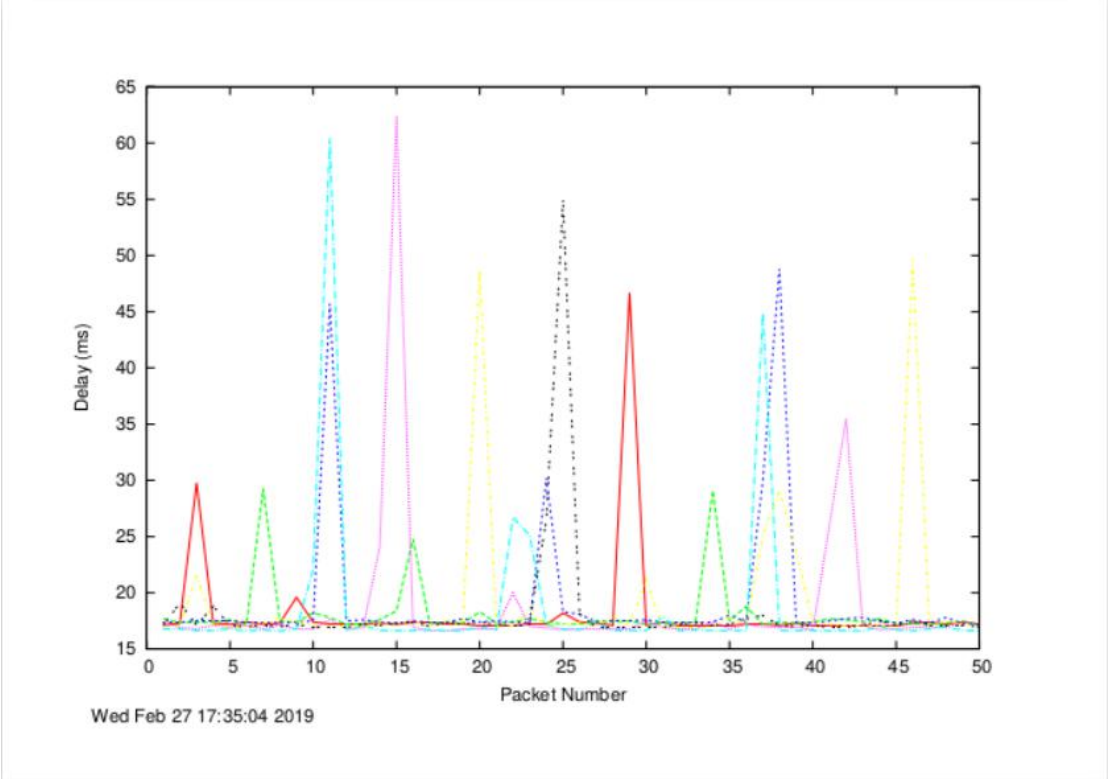
<iii>There are many routers between Sydney and these three locations on wire. So RTT is not only contain propagation delay, but also contain queuing delay, processing delay on routers or switchers.

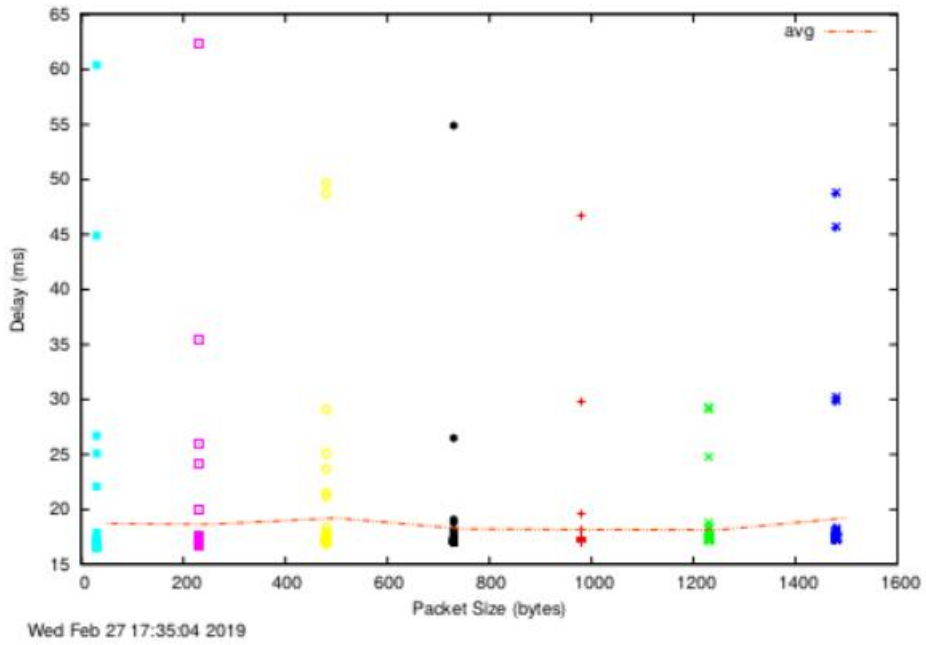
2. Answer:

The delay to the destinations varies over time because there are lots of different network points on the Internet. The routers in the process of packet transmission may choose different network nodes for data forwarding. The length of the transmission path is uncertain, so we cannot ensure that the time to destination is constant.

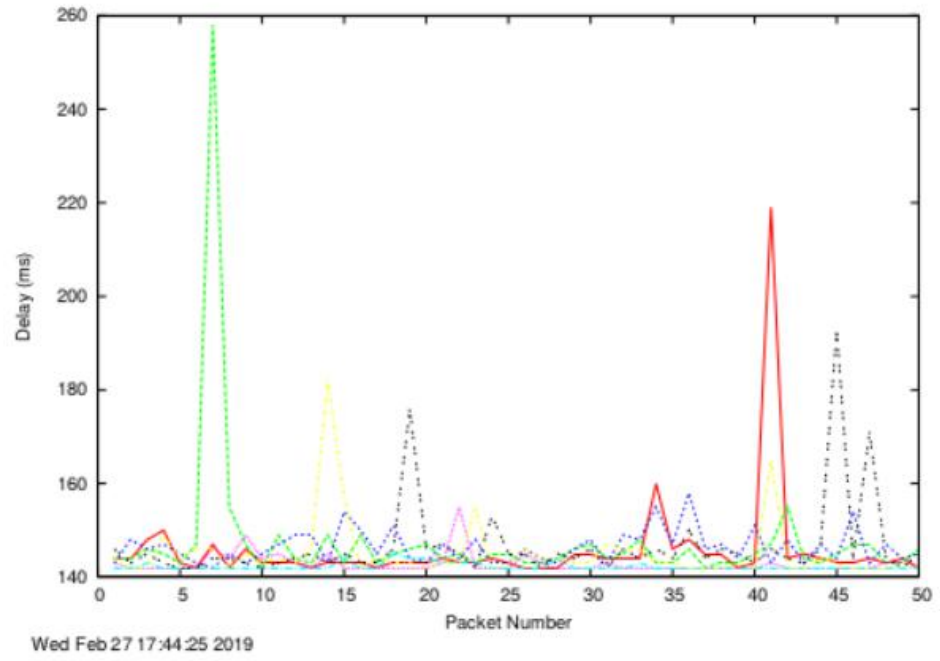
Each of the following plots depicts the delay of consecutive packets of same size (every line), for different packet sizes (six different lines):

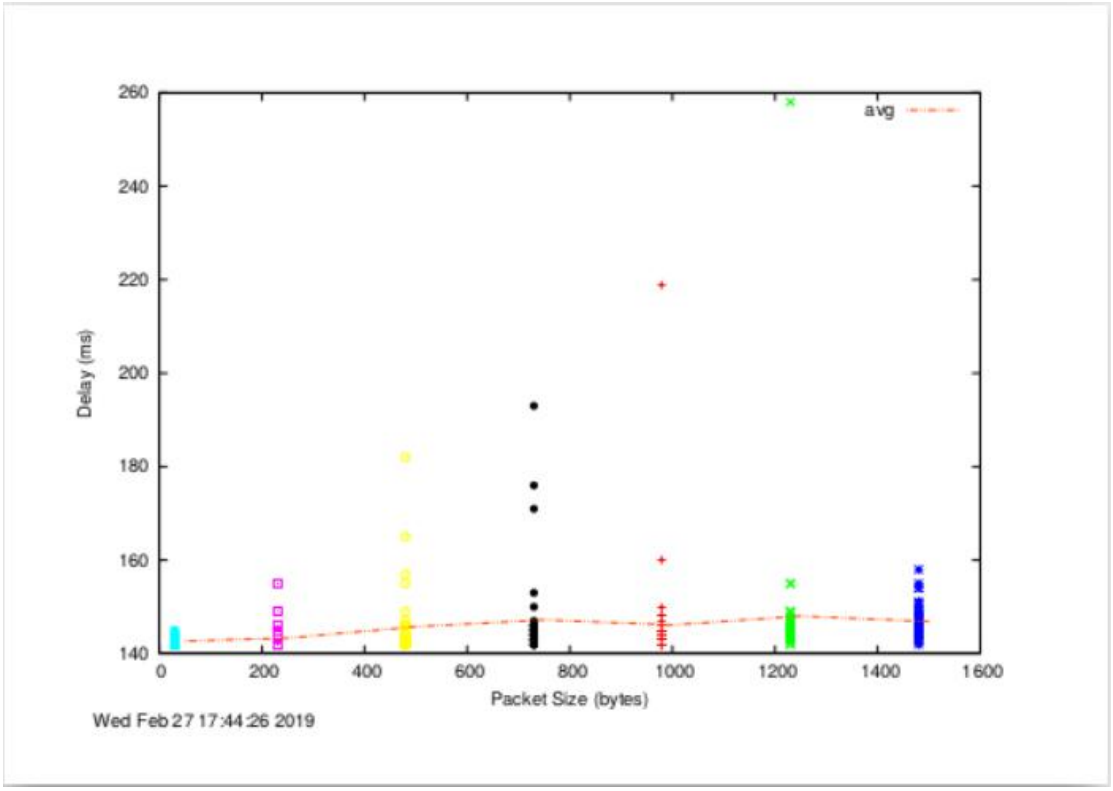
www.uq.edu.au



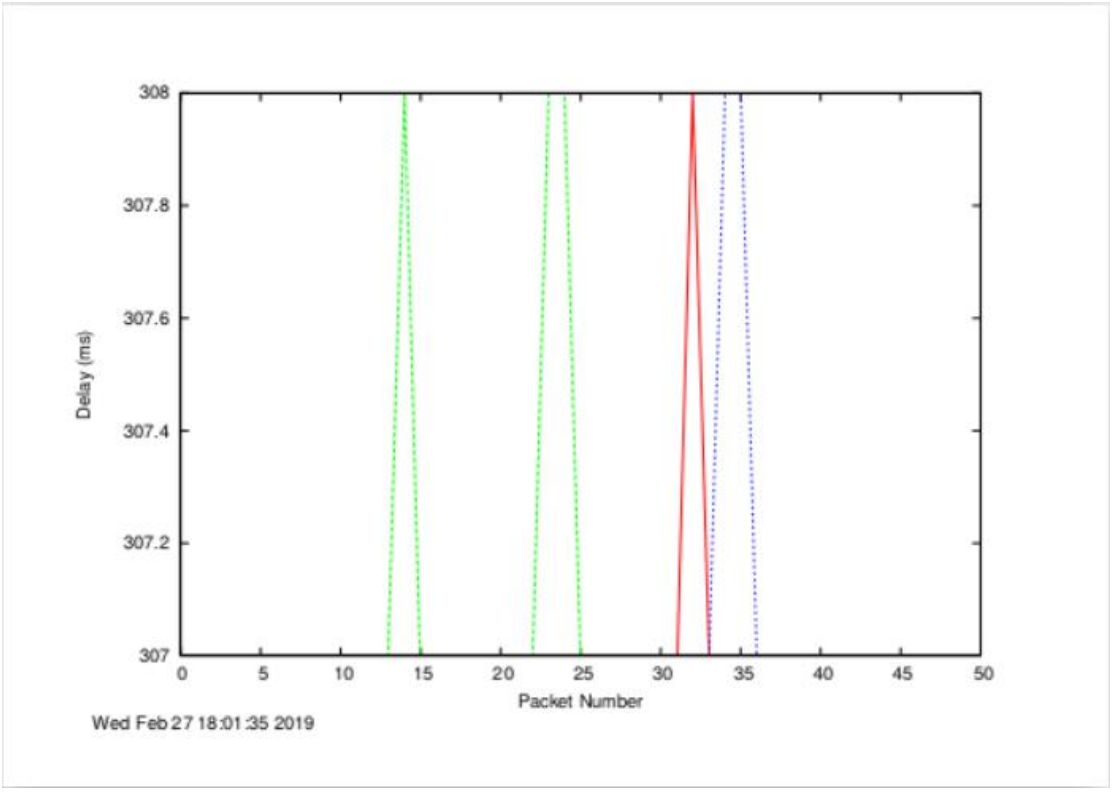


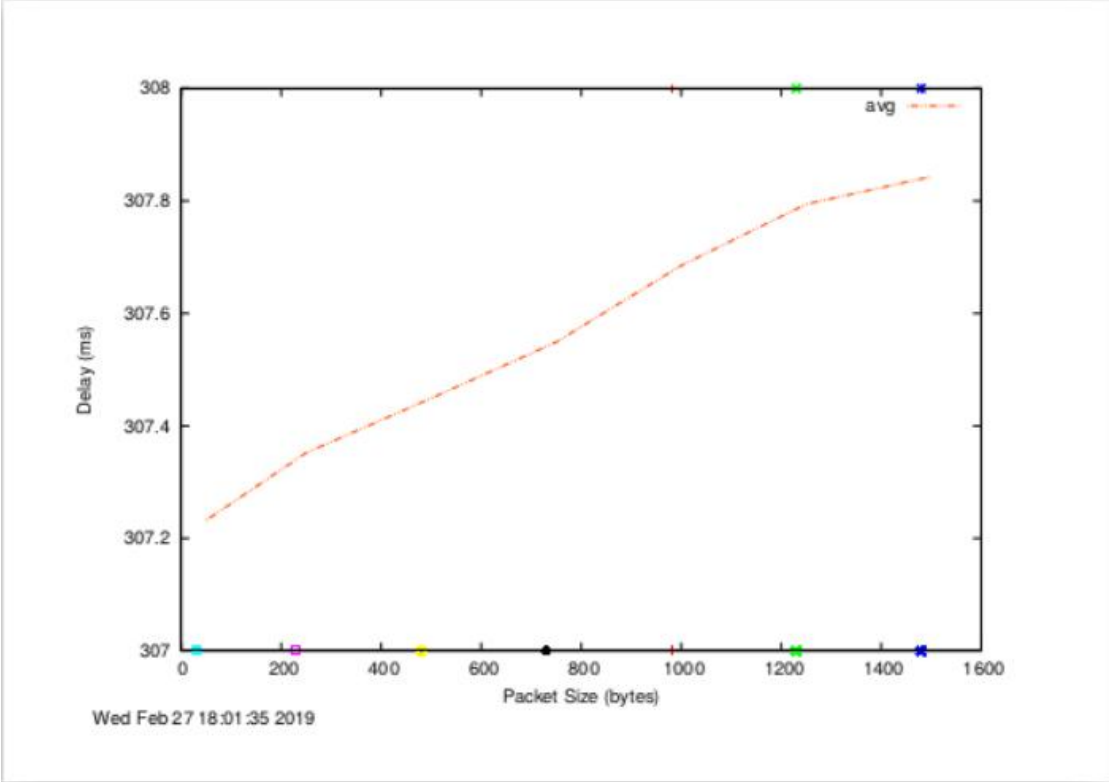
www.nus.edu.sg





www.tu-berlin.de





3. Answer:

<i> The propagation delay do not depend on the packet size, because propagation delay = length of link / speed of transmission.
<ii> The transmission delay depend on the packet size, because transmission delay = packet size / transmission rate.
<iii> The processing delay can depend on the packet size, because processing delay = packet size / processing rate.
<iv> The queuing delay do not depend on the packet size, because it only related to workload of network.