

Question 1

1. The IP address of www.koala.com.au is 172.67.219.46 and 104.21.45.210. It has multiple IP addresses because it has multiple servers to run the same website, use a technique called round-robin DNS to achieve load distribution and load balancing.

```
weber % 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
```

2. localhost. 127.0.0.1 is the first assignable IP address in the subnet, and it is always used to establish connection with the same machine being used by the end-user.

```
weber % 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.
```

Question 2

Unreachable address:

- www.getfittest.com.au
- www.hola.hp

www.getfittest.com and www.hola.com exist, however they are not in domain “au” and “hp”. We try to find them in the wrong domain; therefore, they are not reachable.

www.kremlin.ru is reachable, however when running ping www.kremlin.ru all the packets are lost. The possible reason is ping packets use the ICMP protocol, whereas on the same level web pages use the TCP protocol. Both go over the IP protocol, but they are different types of packets. This means that some routers or firewalls may just block pings between UNSW to www.kremlin.ru.

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weber % ping www.unsw.edu.au
PING cdn.prod65.unsw.adobeqcms.net (13.35.145.116) 56(84) bytes of data.
64 bytes from server-13-35-145-116.syd1.r.cloudfront.net (13.35.145.116): icmp_seq=1 ttl=244 time=1.20 ms
64 bytes from server-13-35-145-116.syd1.r.cloudfront.net (13.35.145.116): icmp_seq=2 ttl=244 time=1.23 ms
64 bytes from server-13-35-145-116.syd1.r.cloudfront.net (13.35.145.116): icmp_seq=3 ttl=244 time=1.27 ms
^C
--- cdn.prod65.unsw.adobeqcms.net ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2002ms
rtt min/avg/max/mdev = 1.209/1.240/1.274/0.039 ms
weber % ping www.getfittest.com.au
ping: www.getfittest.com.au: unknown host
weber % ping www.mit.edu
PING e9566.dscb.akamaiedge.net (23.77.146.209) 56(84) bytes of data.
64 bytes from a23-77-146-209.deploy.static.akamaitechnologies.com (23.77.146.209): icmp_seq=1 ttl=56 time=1.24 ms
64 bytes from a23-77-146-209.deploy.static.akamaitechnologies.com (23.77.146.209): icmp_seq=2 ttl=56 time=1.30 ms
64 bytes from a23-77-146-209.deploy.static.akamaitechnologies.com (23.77.146.209): icmp_seq=3 ttl=56 time=1.26 ms
^C
--- e9566.dscb.akamaiedge.net ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2003ms
rtt min/avg/max/mdev = 1.249/1.274/1.308/0.038 ms
weber % ping www.intel.com.au
PING e19235.dsca.akamaiedge.net (104.98.21.56) 56(84) bytes of data.
64 bytes from a104-98-21-56.deploy.static.akamaitechnologies.com (104.98.21.56): icmp_seq=1 ttl=56 time=1.23 ms
64 bytes from a104-98-21-56.deploy.static.akamaitechnologies.com (104.98.21.56): icmp_seq=2 ttl=56 time=1.27 ms
64 bytes from a104-98-21-56.deploy.static.akamaitechnologies.com (104.98.21.56): icmp_seq=3 ttl=56 time=1.24 ms
64 bytes from a104-98-21-56.deploy.static.akamaitechnologies.com (104.98.21.56): icmp_seq=4 ttl=56 time=1.22 ms
^C
--- e19235.dsca.akamaiedge.net ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3003ms
rtt min/avg/max/mdev = 1.228/1.247/1.279/0.047 ms
weber % ping 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_seq=1 ttl=119 time=1.86 ms
64 bytes from www.tpg.com.au (203.26.27.38): icmp_seq=2 ttl=119 time=1.72 ms
64 bytes from www.tpg.com.au (203.26.27.38): icmp_seq=3 ttl=119 time=1.64 ms
^C
--- www.tpg.com.au ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2003ms
rtt min/avg/max/mdev = 1.641/1.745/1.865/0.092 ms
weber % ping www.hola.hp
ping: www.hola.hp: unknown host
weber % ping www.amazon.com
PING d3ag4hukkh62yn.cloudfront.net (99.84.91.236) 56(84) bytes of data.
64 bytes from server-99-84-91-236.muc50.r.cloudfront.net (99.84.91.236): icmp_seq=1 ttl=218 time=296 ms
64 bytes from server-99-84-91-236.muc50.r.cloudfront.net (99.84.91.236): icmp_seq=2 ttl=218 time=296 ms
64 bytes from server-99-84-91-236.muc50.r.cloudfront.net (99.84.91.236): icmp_seq=3 ttl=218 time=296 ms
^C
--- d3ag4hukkh62yn.cloudfront.net ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2000ms
rtt min/avg/max/mdev = 296.684/296.705/296.737/0.445 ms
weber % █

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weber % ping www.amazon.comPING d3ag4hukkh62yn.cloudfront.net (13.35.146.169) 56(84) bytes of data.
64 bytes from server-13-35-146-169.syd1.r.cloudfront.net (13.35.146.169): icmp_seq=1 ttl=244 time=1.05 ms
64 bytes from server-13-35-146-169.syd1.r.cloudfront.net (13.35.146.169): icmp_seq=2 ttl=244 time=1.04 ms
64 bytes from server-13-35-146-169.syd1.r.cloudfront.net (13.35.146.169): icmp_seq=3 ttl=244 time=1.06 ms
^C
--- d3ag4hukkh62yn.cloudfront.net ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2001ms
rtt min/avg/max/mdev = 1.044/1.057/1.069/0.028 ms
weber % ping www.tsinghua.edu.cn
PING www.tsinghua.edu.cn (166.111.4.100) 56(84) bytes of data.
64 bytes from www.tsinghua.edu.cn (166.111.4.100): icmp_seq=1 ttl=44 time=158 ms
64 bytes from www.tsinghua.edu.cn (166.111.4.100): icmp_seq=2 ttl=44 time=162 ms
64 bytes from www.tsinghua.edu.cn (166.111.4.100): icmp_seq=3 ttl=44 time=159 ms
^C
--- www.tsinghua.edu.cn ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2002ms
rtt min/avg/max/mdev = 158.767/160.259/162.248/1.463 ms
weber % ping www.kremlin.ru
PING www.kremlin.ru (95.173.136.72) 56(84) bytes of data.
^C
--- www.kremlin.ru ping statistics ---
8 packets transmitted, 0 received, 100% packet loss, time 7146ms

weber % ping 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_seq=1 ttl=115 time=1.28 ms
64 bytes from 8.8.8.8: icmp_seq=2 ttl=115 time=1.32 ms
64 bytes from 8.8.8.8: icmp_seq=3 ttl=115 time=1.25 ms
64 bytes from 8.8.8.8: icmp_seq=4 ttl=115 time=1.31 ms
^C
--- 8.8.8.8 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3004ms
rtt min/avg/max/mdev = 1.257/1.292/1.321/0.050 ms
weber % █

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Question 3

- 22 routers between my workstation and www.columbia.edu, 5 of them are part of UNSW network, between 113.197.15.201(AU) and 207.231.240.8(Seattle, US), the packets cross the pacific ocean.

```
weber % 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) 0.127 ms 0.126 ms 0.101 ms
 2 129.94.39.17 (129.94.39.17) 0.856 ms 0.931 ms 1.027 ms
 3 libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34) 2.090 ms 2.122 ms 2.085 ms
 4 libcr1-po-6.gw.unsw.edu.au (149.171.255.201) 1.174 ms ombcr1-po-5.gw.unsw.edu.au (149.171.255.197) 1.205 ms libcr1-po-6.gw.unsw.edu.au (149.171.255.201) 1.173 ms
 5 unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105) 1.227 ms unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101) 1.247 ms 1.278 ms
 6 138.44.5.0 (138.44.5.0) 1.513 ms 1.300 ms 1.306 ms
 7 et-1-3-0.pe1.sxt.bkvl.nsw.aarnet.net.au (113.197.15.149) 2.097 ms 1.960 ms 1.968 ms
 8 et-0-0-0.pe1.a.hnl.aarnet.net.au (113.197.15.99) 95.285 ms 95.292 ms 95.353 ms
 9 et-2-1-0.bdr1.a.sea.aarnet.net.au (113.197.15.201) 146.766 ms 146.802 ms 146.767 ms
10 ablene-1-lo-jmb-706.sttlwa.pacificwave.net (207.231.240.8) 177.374 ms 177.246 ms 177.272 ms
11 ae-1.4079.rtsw.minn.net.internet2.edu (162.252.70.173) 202.202 ms 202.210 ms 202.298 ms
12 ae-1.4079.rtsw.eqch.net.internet2.edu (162.252.70.108) 206.700 ms 211.640 ms 211.656 ms
13 ae-0.4079.rtsw5.eqch.net.internet2.edu (162.252.70.163) 207.470 ms 209.573 ms 209.628 ms
14 ae-1.4079.rtsw.clev.net.internet2.edu (162.252.70.130) 212.996 ms 212.969 ms 212.882 ms
15 buf-9208-12-CLEV.nysernet.net (199.109.11.33) 219.865 ms 216.296 ms 216.326 ms
16 syr-55a1-buf-9208.nysernet.net (199.109.7.213) 220.027 ms 219.833 ms 219.839 ms
17 nyc32-55a1-syr-55a1.nysernet.net (199.109.7.206) 225.393 ms 225.480 ms 225.232 ms
18 nyc32-9208-nyc32-55a1.nysernet.net (199.109.7.201) 224.993 ms 224.950 ms 224.981 ms
19 columbia.nyc-9208.nysernet.net (199.109.4.14) 224.071 ms 224.076 ms 224.022 ms
20 cc-core-1-x-nyser32-gw-1.net.columbia.edu (128.59.255.5) 225.149 ms 225.001 ms 225.337 ms
21 cc-conc-1-x-cc-core-1.net.columbia.edu (128.59.255.21) 225.347 ms 225.346 ms 225.354 ms
22 columbiauniversity.org (128.59.105.24) 225.192 ms 225.219 ms 225.145 ms
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- After 149.171.253.34, the three paths diverge. This router is Asia Pacific Network Information Centre, at South Brisbane. The number of hops on each path is proportional the physical distance.

```
weber % 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) 0.125 ms 0.119 ms 0.122 ms
 2 129.94.39.17 (129.94.39.17) 0.872 ms 0.918 ms 0.937 ms
 3 libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34) 1.412 ms libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35) 1.412 ms libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34) 1.412 ms
34 1.688 ms
 4 libcr1-po-6.gw.unsw.edu.au (149.171.255.201) 1.238 ms ombcr1-po-6.gw.unsw.edu.au (149.171.255.169) 1.196 ms ombcr1-po-5.gw.unsw.edu.au (149.171.255.197) 1.233 ms
 5 unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105) 1.302 ms unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101) 1.338 ms 1.351 ms
 6 138.44.5.0 (138.44.5.0) 1.461 ms 1.268 ms 1.270 ms
 7 et-1-3-0.pe1.sxt.bkvl.nsw.aarnet.net.au (113.197.15.149) 1.920 ms 1.935 ms 2.056 ms
 8 et-0-0-0.pe1.a.hnl.aarnet.net.au (113.197.15.99) 95.497 ms 95.394 ms 95.330 ms
 9 et-2-1-0.bdr1.a.sea.aarnet.net.au (113.197.15.201) 146.837 ms 146.839 ms 146.858 ms
10 cenichpr-1-is-jmb-778.snvaca.pacificwave.net (207.231.245.129) 163.239 ms 163.946 ms 164.026 ms
11 svl-agg10-hpr-svl-hpr3-100g.cenic.net (137.164.25.166) 164.167 ms 164.176 ms 164.897 ms
12 hpr-lax-agg10-svl-agg10-100g.cenic.net (137.164.25.73) 160.658 ms 160.636 ms 160.752 ms
13 * * *
14 bd11f1.anderson-cr001.anderson.ucla.net (169.232.4.6) 160.301 ms bd11f1.anderson-cr00f2.csbl.ucla.net (169.232.4.4) 161.125 ms bd11f1.anderson-cr001.anderson.ucl
a.net (169.232.4.6) 161.157 ms
15 cr00f2.csbl-rtr11f4.mathsci.ucla.net (169.232.8.181) 160.638 ms cr00f1.anderson-rtr11f4.mathsci.ucla.net (169.232.8.185) 161.275 ms cr00f2.csbl-rtr11f4.mathsci.u
cla.net (169.232.8.181) 161.406 ms
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weber % 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) 0.082 ms 0.081 ms 0.080 ms
 2 129.94.39.17 (129.94.39.17) 1.063 ms 1.068 ms 1.078 ms
 3 ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35) 2.649 ms libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34) 1.803 ms ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35) 2.636 ms
35 2.636 ms
 4 ombcr1-po-5.gw.unsw.edu.au (149.171.255.197) 1.462 ms libcr1-po-6.gw.unsw.edu.au (149.171.255.201) 1.660 ms 1.665 ms
 5 unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105) 1.498 ms unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101) 1.659 ms 1.670 ms
 6 138.44.5.0 (138.44.5.0) 1.573 ms 2.191 ms 2.186 ms
 7 et-0-3-0.pe1.bkvl.nsw.aarnet.net.au (113.197.15.147) 2.004 ms 2.037 ms 2.470 ms
 8 ge-1-0-0.bb1.a.pao.aarnet.net.au (202.158.194.177) 155.798 ms 155.769 ms 155.608 ms
 9 paloalto0.iiij.net (198.32.176.24) 156.925 ms 156.085 ms 157.028 ms
10 osk004bb00.IIJ.Net (58.138.88.185) 287.687 ms osk004bb01.IIJ.Net (58.138.88.189) 267.260 ms osk004bb00.IIJ.Net (58.138.88.185) 287.652 ms
11 osk004ip57.IIJ.Net (58.138.106.166) 277.418 ms osk004ip57.IIJ.Net (58.138.106.194) 287.618 ms osk004ip57.IIJ.Net (58.138.106.162) 277.107 ms
12 210.130.135.130 (210.130.135.130) 287.276 ms 287.271 ms 287.282 ms
13 124.83.228.58 (124.83.228.58) 287.251 ms 287.182 ms 287.171 ms
14 124.83.252.178 (124.83.252.178) 282.763 ms 272.682 ms 282.834 ms
15 158.205.134.26 (158.205.134.26) 272.680 ms 273.088 ms 282.883 ms
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weber % traceroute www.lancaster.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) 0.090 ms 0.081 ms 0.061 ms
 2 129.94.39.17 (129.94.39.17) 0.855 ms 0.934 ms 0.933 ms
 3 libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34) 1.723 ms ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35) 1.662 ms 1.667 ms
 4 libcr1-po-5.gw.unsw.edu.au (149.171.255.165) 1.180 ms 1.238 ms ombcr1-po-5.gw.unsw.edu.au (149.171.255.197) 1.198 ms
 5 unswbr1-te-1-9.gw.unsw.edu.au (149.171.255.101) 1.311 ms 1.326 ms 1.631 ms
 6 138.44.5.0 (138.44.5.0) 1.681 ms 1.441 ms 1.398 ms
 7 et-2-0-5.bdr1.sing.sin.aarnet.net.au (113.197.15.233) 92.633 ms 92.690 ms 92.658 ms
 8 138.44.226.7 (138.44.226.7) 262.083 ms 262.020 ms 262.045 ms
 9 janet-gw.mx1.lon.uk.geant.net (62.40.124.198) 260.013 ms 259.951 ms 259.954 ms
10 ae29.londpg-sbr2.ja.net (146.97.33.2) 260.339 ms 260.301 ms 260.070 ms
11 ae31.erdiss-sbr2.ja.net (146.97.33.22) 263.954 ms 263.868 ms 263.888 ms
12 ae29.manckh-sbr2.ja.net (146.97.33.42) 267.634 ms 265.799 ms 265.787 ms
13 ae25.manckh-ban1.ja.net (146.97.35.50) 265.796 ms 265.925 ms 265.919 ms
14 lancaster-uni.ja.net (146.97.40.178) 279.026 ms 289.523 ms 289.509 ms
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- I choose www.speedtest.com.sg and www.telstra.net. The reverse path doesn't go through the same routers as forward path. This is each router takes its own decision about the next-hop and doesn't care about the path another packet in the same conversation took.

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traceroute to cse.unsw.edu.au (129.94.242.53), 30 hops max, 60 byte packets
 1 ge2-8.r01.sin01.ne.com.sg (202.150.221.169) 0.142 ms 0.170 ms 0.185 ms
 2 10.11.34.146 (10.11.34.146) 0.713 ms 0.790 ms 0.815 ms
 3 aarnet.sgix.sg (103.16.102.67) 213.560 ms 213.614 ms 213.630 ms
 4 et-7-3-0.pel.nsw.brwy.aarnet.net.au (113.197.15.232) 208.298 ms 208.270 ms 208.212 ms
 5 138.44.5.1 (138.44.5.1) 214.969 ms 215.075 ms 215.018 ms
 6 ombcr1-te-1-5.gw.unsw.edu.au (149.171.255.106) 232.807 ms 231.649 ms 231.650 ms
 7 ombudnex1-po-2.gw.unsw.edu.au (149.171.255.170) 212.662 ms 211.609 ms 211.575 ms
 8 ufw1-ae-1-3154.gw.unsw.edu.au (149.171.253.36) 209.970 ms 209.970 ms 210.017 ms
 9 129.94.39.23 (129.94.39.23) 210.254 ms 210.104 ms 210.175 ms
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weber % 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) 0.092 ms 0.079 ms 0.065 ms
 2 129.94.39.17 (129.94.39.17) 0.960 ms 0.956 ms 0.897 ms
 3 ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35) 1.510 ms libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34) 1.570 ms ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35) 1.598 ms
 4 libcr1-po-5.gw.unsw.edu.au (149.171.255.165) 1.287 ms libcr1-po-6.gw.unsw.edu.au (149.171.255.201) 1.194 ms ombcr1-po-6.gw.unsw.edu.au (149.171.255.169) 1.228 ms
 5 unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.105) 1.285 ms 1.349 ms 1.353 ms
 6 138.44.5.0 (138.44.5.0) 1.468 ms 1.246 ms 1.318 ms
 7 et-0-3-0.pel.alxd.nsw.aarnet.net.au (113.197.15.153) 1.670 ms 1.769 ms 1.787 ms
 8 xe-0-2-7.bdr1.a.lax.aarnet.net.au (202.158.194.173) 147.703 ms 147.672 ms 147.686 ms
 9 singtel.as7473.any2ix.coresite.com (206.72.210.63) 147.703 ms 147.713 ms 147.821 ms
10 203.208.158.29 (203.208.158.29) 328.254 ms 203.208.171.117 (203.208.171.117) 147.927 ms 203.208.151.181 (203.208.151.181) 323.413 ms
11 203.208.177.110 (203.208.177.110) 317.562 ms 203.208.173.73 (203.208.173.73) 250.643 ms 203.208.177.110 (203.208.177.110) 325.989 ms
12 * 203.208.158.17 (203.208.158.17) 328.155 ms *
13 203.208.158.185 (203.208.158.185) 365.544 ms 202-150-221-170.rev.ne.com.sg (202.150.221.170) 212.389 ms 209.275 ms

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1 gigabitethernet3-3.exi2.melbourne.telstra.net (203.50.77.53) 0.260 ms 0.222 ms 0.247 ms
2 bundle-ether3-100.win-core10.melbourne.telstra.net (203.50.80.129) 2.367 ms 1.737 ms 2.119 ms
3 bundle-ether12.ken-core10.sydney.telstra.net (203.50.11.122) 13.363 ms 12.107 ms 12.864 ms
4 bundle-ether1.ken-edge903.sydney.telstra.net (203.50.11.173) 12.114 ms 11.981 ms 12.114 ms
5 aar3533567.lnk.telstra.net (139.130.0.78) 11.613 ms 11.731 ms 11.739 ms
6 et-7-1-0.pel.brwy.nsw.aarnet.net.au (113.197.15.13) 11.740 ms 11.855 ms 11.865 ms
7 138.44.5.1 (138.44.5.1) 11.987 ms 11.982 ms 12.112 ms
8 ombcr1-te-1-5.gw.unsw.edu.au (149.171.255.106) 12.113 ms 12.106 ms 11.988 ms
9 libudnex1-po-2.gw.unsw.edu.au (149.171.255.198) 12.489 ms 12.481 ms 12.363 ms
10 ufw1-ae-1-3154.gw.unsw.edu.au (149.171.253.36) 12.863 ms 12.981 ms 12.863 ms
11 129.94.39.23 (129.94.39.23) 12.987 ms 12.982 ms 12.863 ms

```

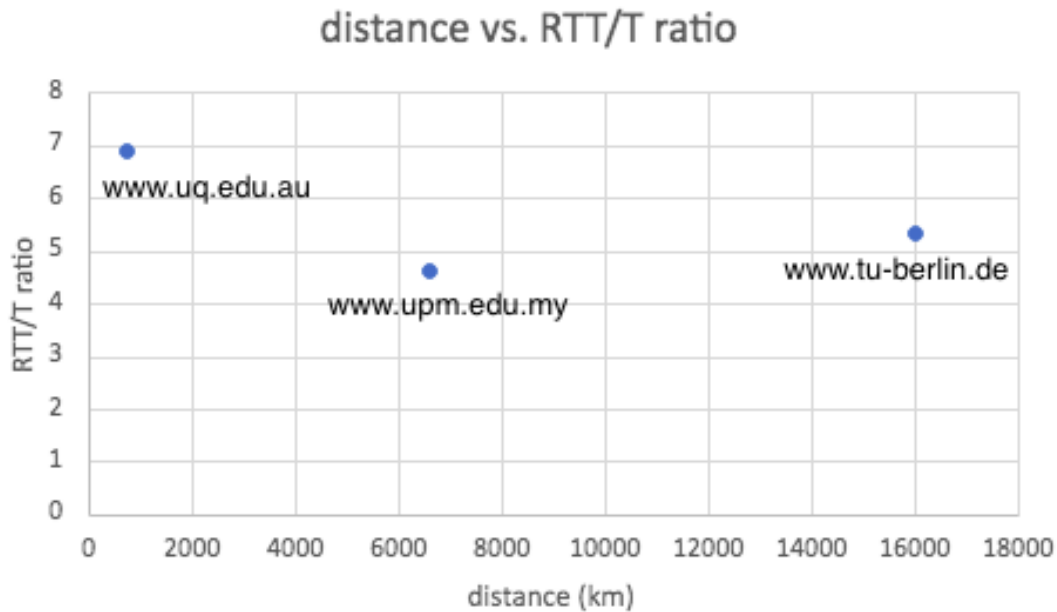
```

weber % 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) 0.077 ms 0.101 ms 0.062 ms
2 129.94.39.17 (129.94.39.17) 0.882 ms 0.884 ms 0.885 ms
3 ombudnex1-vl-3154.gw.unsw.edu.au (149.171.253.35) 1.197 ms libudnex1-vl-3154.gw.unsw.edu.au (149.171.253.34) 1.445 ms 1.458 ms
4 ombcr1-po-5.gw.unsw.edu.au (149.171.255.197) 1.198 ms ombcr1-po-6.gw.unsw.edu.au (149.171.255.169) 1.111 ms ombcr1-po-5.gw.unsw.edu.au (149.171.255.197) 1.194 ms
5 unswbr1-te-2-13.gw.unsw.edu.au (149.171.255.185) 39.918 ms 39.917 ms 39.927 ms
6 138.44.5.0 (138.44.5.0) 1.364 ms 1.318 ms 1.313 ms
7 et-1-1-0.pel.rsby.nsw.aarnet.net.au (113.197.15.12) 1.669 ms 1.719 ms 2.060 ms
8 xe-0-0-3.bdr1.rsby.nsw.aarnet.net.au (113.197.15.31) 1.905 ms 1.846 ms 1.800 ms
9 HundredGigE0-1-0-4.ken-edge903.sydney.telstra.net (139.130.0.77) 2.437 ms 2.435 ms 2.540 ms
10 bundle-ether2.chw-edge903.sydney.telstra.net (203.50.11.175) 2.355 ms bundle-ether17.ken-core10.sydney.telstra.net (203.50.11.172) 2.685 ms bundle-ether2.chw-edge903.sydney.telstra.net (203.50.11.175) 2.596 ms
11 bundle-ether10.win-core10.melbourne.telstra.net (203.50.11.123) 14.644 ms bundle-ether17.chw-core10.sydney.telstra.net (203.50.11.176) 2.719 ms 2.635 ms
12 bundle-ether8.exi-core10.melbourne.telstra.net (203.50.11.125) 16.155 ms 16.107 ms bundle-ether1-2.exi-core10.melbourne.telstra.net (203.50.6.40) 15.055 ms
13 203.50.11.209 (203.50.11.209) 15.095 ms 15.016 ms 15.082 ms
14 www.telstra.net (203.50.5.178) 13.663 ms 14.320 ms 14.383 ms

```

Question 4

- Let T be the time for light to travel the certain distance.
 - www.uq.edu.au is approximately 740km from UNSW
 - $T = 7.4 \times 10^5 / (3 \times 10^8) = 2.5\text{ms}$
 - RTT = 17.3ms
 - Ratio = 6.9
 - www.upm.edu.my is approximately 6600km from UNSW
 - $T = 6.6 \times 10^6 / (3 \times 10^8) = 22\text{ms}$
 - RTT = 102ms
 - Ratio = $102/22 = 4.6$
 - www.tu-berlin.de is approximately 16000km from UNSW
 - $T = 1.6 \times 10^7 / (3 \times 10^8) = 53\text{ms}$
 - RTT = 281ms
 - Ratio = $281/53 = 5.3$



Possible reasons that y-axis is greater than 2:

- The RTT is at least $2T$ since the packets need to reach the destination from UNSW and get back
 - There are 4 types of delays, transmission delay, queuing delay, propagation delay, and processing delay, and T only accounts for propagation delay.
 - Therefore RTT is more than 2 times larger than T , hence the ratios are all greater than 2.
2. It slightly varies over time. One possible reason is uncertainty in queuing delay. The router can process one packet at a time. When the package arrives at the router, there could be some packets waiting in queue to be transmitted, or the queue could be empty, depending on if there are other hosts or routers send packet to the current router or our packet in. Therefore the total delay is randomly varying over time.
 3. It is NOT in Switzerland, it's in San Francisco.
 4. Transmission delay is time that a packet takes to be placed in the link, therefore it depends on the size of the packet. All the other delays are irrelevant to the packet size.