**Exercise 1: nslookup**

1. There are three IP addresses for [www.koala.com.au](http://www.koala.com.au). For example, if one IP address stands on one server, we can get the service of this website is running on three servers at the same time from the result given below. This can reduce the workload of different servers. This is because using different servers can separate the users who want to visit this website. Furthermore, reducing the workload can also improve security and make servers more stable. If these three servers are running in different networks, it can speed up the process of doing ISP routing. This can improve the speed for users using different kinds of the network to visit this website.

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2. From the result, we can find that the name of 127.0.0.1 is the localhost. Localhost means the local computer itself. The address 127.0.0.1, also the localhost, is called the loopback address. This is because for any network using this address to send data package will finally back to the local computer(machine) itself. This address is often used to do some local tests. For example, setting up a local website, we can use the localhost to check whether the website is right or not.

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**Exercise 2: Using ping to test host reachability**

1. Reachable address:

a. [www.unsw.edu.au](http://www.unsw.edu.au): 32.6ms

b. [www.mit.edu](http://www.mit.edu): 100.7ms

c. [www.intel.com.au](http://www.intel.com.au): 1.5ms

d. [www.tpg.com.au](http://www.tpg.com.au): 6.3ms

e. [www.amazon.com](http://www.amazon.com): 2.3ms

f. [www.tsinghua.edu.au](http://www.tsinghua.edu.au): 209ms

g. 8.8.8.8: 79ms

2. Unreachable address:

a. [www.getfittest.com.au](http://www.getfittest.com.au): This website cannot be opened in the chrome. No website is called [www.getfittest.com.au](http://www.getfittest.com.au). From the terminal in the VLAB, we can get the information that is the unknown host.

b. [www.hola.hp](http://www.hola.hp): This website cannot be opened in the chrome. No website called [www.hola.hp](http://www.hola.hp). From the terminal in the VLAB, we can get the information that is the unknown host.

c. [www.kremlin.ru](http://www.kremlin.ru): We can use chrome or other web browsers to open this website. From chrome, we can find this website is for the Russian government. But if we use the ping command we can find the packet loss is 100%. This is because the server of this website may block the data packet to make sure the security of this website. This can avoid some attacks from hackers, such as the DDOS attack.

**Exercise 3: Using traceroute to understand the network topology**

1. By using the traceroute command, we can get the two following pictures below. From the second picture, we can easily find that there are 21 routers between my workstation and [www.columbia.edu](http://www.columbia.edu). Furthermore, from the first picture, we can find that the 5th router is still UNSW. But the 6th router has been changed. Using the 'whois' command we can get the 6th router belongs to AARNET. The 6th router does not belong to UNSW. Therefore, there are 5 routers along the path are part of the UNSW network.

According to Wikipedia – Southern Cross Cable(<https://en.wikipedia.org/wiki/Southern_Cross_Cable>), we can get the distance from Eastern Australia to West America through the cable in the ocean is about 13910 km. From these 2 websites(<https://www.m2optics.com/blog/bid/70587/calculating-optical-fiber-latency>) and the calculator(<https://www.timbercon.com/resources/calculators/time-delay-of-light-in-fiber-calculator/>), we can get the speed of different kinds of fibers. Therefore, the RTT is nearly 140ms. From the first picture, by doing the calculation the RTT between the 7th router and 9th router is 143.3ms. Therefore, between the 7th and 9th router do packets cross the Pacific Ocean.

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2. From the following three pictures, we can find the diverge is 138.44.5.0. According to the previous result(Exercise 3 question 1 third picture), we got by using the 'whois' command, we can find 138.44.5.0 belongs to AARNET. We can get distance information from Google Maps. From my workstation to [www.ucla.edu](http://www.ucla.edu) is nearly 7493.45 miles, the number of hops is 15. From my workstation to [www.u-tokyo.ac.jp](http://www.u-tokyo.ac.jp) is nearly 4909.7 miles, the number of hops is 15. The distance from my workstation to [www.lancaster.ac.uk](http://www.lancaster.ac.uk) is 10570.2 miles, the number of hops is 14. From all these data given above, the number of hops is not proportional to the physical distance.

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A picture containing text

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3. The 1st and 2nd pictures are the result of the Speedtest website. Also, the 3rd and 4th pictures are the results of the Telstra website. The IP address of the Speedtest is 202.150.221.170, and the IP address of Telstra is 203.50.5.178. The path of moving forward and backward are different. This is because the routing path is determined by the routing table of routers. The routers may go different paths in the forward and backward process. Therefore, the forward and backward paths are not the same.

The IP address in forward and backward paths are different. This is because the router connects different networks. Furthermore, the router provides one interface for different networks. Therefore, to separate each network the router should have a different IP address for each network.

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

Delay for [www.uq.edu.au](http://www.uq.edu.au):

Chart, histogram

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Scatter for [www.uq.edu.au](http://www.uq.edu.au):

Chart, line chart

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Delay for [www.ump.edu.my](http://www.ump.edu.my):

Chart, histogram

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Scatter for [www.ump.edu.my](http://www.ump.edu.my):

Chart, scatter chart

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Delay for [www.tu-berlin.de](http://www.tu-berlin.de):

Chart

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Scatter for [www.tu-berlin.de](http://www.tu-berlin.de):

Chart, line chart

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1. From the graph we can easily find that ratios are between 4 and 7. All of these ratios are higher than 2. One reason is the real distance of the routing path may longer than the straight physical distance(a straight line). This is because when we set up the cable under the ocean, we cannot draw a straight line from the start point to the destination. Furthermore, the different routing tables of ISP will also cause that the real distance is more longer. The other reason is that when we talking about delay, there are different kinds of delay. Not only propagation delay, but also nodal processing delay, queueing delay and transmission delay. For example, just like the traffic jam, if some part of the line is busy, the transmission delay will grow. This is due to the fixed bandwidth.

Chart, line chart

Description automatically generated

2. From all these delay graphs, we can find that RTT varies a lot in a period. This is due to the condition of the pathway, whether the pathway is busy or not. A good example, when the router's efficiency will due to the workload in different periods. This can also cause a change in the routing path.

3.The RTT is about 1.5ms from my workstation. The low-level delay can indicate that the routers mostly are in Sydney. Therefore, the delay can stay between 1 ms – 2 ms.

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4. Propagation delay: This kind of delay is equal to the ratio of the physical link length **d** and the speed of propagation **s,** which is **.** Therefore, the propagation delay depends on physical link length and the speed of propagation.

Transmission delay: This kind of delay is equal to the ratio of packet length **L** and link bandwidth **R,** which is.

Nodal Processing delay: This kind of delay is caused by checking bit errors in the packet. If the size of the packet is large, the time of checking errors is longer. Therefore, this kind of delay is determined by the size of the packet.

Queueing delay: This kind of delay is caused by waiting at the output link for transmission. It depends on the congestion level of the router.