Lab 1

Objectives:

- Get familiar with the basic networking tools: ping, traceroute, ifconfig, nslookup
- Gain insights into evaluating network performance and understanding network topology

Prerequisites and Links:

- Week 1 Lectures
- Relevant Parts of Chapter 1 of the textbook
- Introduction to Tools of the Trade (access from Moodle)
- runping.sh (access from Moodle)
- plot.sh (access from Moodle)

Marks: 4 marks

- Each lab comprises of a number of exercises. Not all the exercises for each lab are marked. Only those marked with (*) and written in bold will be marked.
- We expect the students to go through as much of the lab exercises as they can at home and come to the lab ready.
- Please attend your allocated lab and show/explain the answers of the marked exercises to your tutor.
- If lab exercise involves diagrams or plots, you require to show them to the tutor as well.
- Please make sure you **sign the marking form** once the tutor marked your lab. Signing this form implies that you agreed on the mark you received.
- There are 7 labs during this course. For each student, the 5 best performing labs will contribute to your final lab mark.

Exercise 1: Use ping to test host reachability

Are the following hosts reachable from your machine by using ping:

- www.cse.unsw.edu.au
- www.cancercouncil.org.au
- compnet.epfl.ch
- www.intel.com.au
- www.telstra.com.au
- www.hola.hp
- www.amazon.com
- www.wikileaks.org
- www.tsinghua.edu.cn
- www.kremlin.ru
- 8.8.8.8

If you observe that some hosts are not reachable, then can you explain why? Check if the addresses unreachable by the ping command are reachable from the Web browser.

Exercise 2: Use traceroute to understand network topology

1. **(*) Run traceroute on your machine to www.nyu.edu . How many routers are there between your workstation and www.nyu.edu ? How many routers along the path are part of the UNSW network? Between which two routers do packets cross the Pacific Ocean? Hint: compare the roundtrip times from your machine to the routers using ping. (1.5 mark)**
2. Run traceroute from your machine to the following destinations: (i) www.ucla.edu (ii) www.u-tokyo.ac.jpand (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? HINT: You can find out geographical location of a server using the following tool -http://www.yougetsignal.com/tools/network-location/
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 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 . Does the reverse path go through the same routers as the forward path? Why or why not? (1 mark)**

Exercise 3: Use ping to gain insights into network performance

We now use the ping utility to investigate network delay and its implications on network performance. In particular, we will analyse the dependency of packet size and delay.

There is a shell script, runping.sh, provided in moodle that you can use instead of running many pings with different packet sizes by hand. After downloading this script on your machine make sure you can execute it. If not, you will have to execute the following command in the command line: chmod u+x runping.sh. To run the ping traces you may use the runping.sh script as follows: ./runping.sh www.abc.net (or whatever other destination you want to ping). It will automatically run ping for different packet sizes and with 50 ping packets per size. Note, since a ping is sent once per second, this script will take a few minutes to finish. Basically, this script only executes the commands:

```
$ ping -s 22 -c 50 -i 1 www.abc.net -p50
...
$ ping -s 1472 -c 50 -i 1 www.abc.net -p1500
```

and writes the output of the pings to the corresponding files.

Use this script for the following destinations:

(i) www.uq.edu.au (ii) www.nus.edu.sg and (iii) www.tu-berlin.de

In other words, execute the following commands

$ ./runping.sh www.uq.edu.au
$ ./runping.sh www.nus.edu.sg
$ ./runping.sh www.tu-berlin.de

If you cannot execute runping.sh, then fix the permissions by executing the following command in the command line:

$ chmod u+x runping.sh

In case you notice one of the hosts above is not responsive, select the following alternate destinations: (i) within Australia
(www.uow.edu.au , www.flinders.edu.au , www.uws.edu.au) (ii) Asia
(www.tsinghua.edu.cn ,www.sutd.edu.sg , www.iit.ac.in) (iii) Europe
(www.epfl.ch , www.aau.dk , www.uio.no)

Note that all delay values reported are in milliseconds (ms) and reflect the roundtrip time (RTT) between your host and the destinations.

When the runping.sh script is finished for all destinations, you can plot the results using another provided script in moodle, plot.sh, as follows:

$ ./plot.sh www.uq.edu.au-p*
$ ./plot.sh www.nus.edu.sg-p*
$ ./plot.sh www.tu-berlin.de-p*

If you cannot execute plot.sh, then fix the permissions by executing the following command in the command line:

$ chmod u+x plot.sh

The script plot.sh will produce the following files: destination_delay.pdf, destination_scatter.pdf, and destination_avg.txt for each of the destinations (e.g., for www.nus.edu.sg we have *www.nus.edu.sg_delay.pdf* ,*www.nus.edu.sg_scatter.pdf* and *www.nus.edu.sug_avg.txt*).

The graph *destination_delay.pdf* shows how delay varies over time (different colours correspond to different packet sizes), and *destination_scatter.pdf* shows delay vs. packet size as a scatter plot. *destination_avg.txt* contains the average (2nd column) and minimum (3rd column) delay values corresponding to each packet size (1st column).

1. For each of these locations find the (approximate) physical distance from UNSW using Google Maps and compute the shortest possible time T for a packet to reach that location from UNSW. You should assume that the packet moves (i.e. propagates) at the speed of light, 3×10^8 m/s. Note that the shortest possible time will simply be the distance divided by the propagation speed. Plot a graph where the x-axis represents the distance to each city (i.e. Brisbane, Singapore and Berlin), and the y-axis represents the

ratio between the minimum delay (i.e. RTT) as measured by the ping program (select the values for 50 byte packets) and the shortest possible time T to reach that city from UNSW. (Note that the y-values are no smaller than 2 since it takes at least 2*T time for any packet to reach the destination from UNSW and get back). Can you think of at least two reasons why the y-axis values that you plot are greater than 2?

2. **(*) Is the delay to the destinations constant or does it vary over time? Explain why. (1.5 mark)**
3. 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?