University of London International Programmes
CO2222 Data communications and enterprise networking
Coursework assignment 1 2015–16

Statement

This coursework assignment aims to develop your experimental, data handling, presentation and analytical skills and your understanding of the causes of network delays and how utilities, such as ping and traceroute, can be used to analyse network performance.

Learning objectives

- To be able to carry out experiments using different features of the ping utility.
- To be able to carry out experiments using different features of the traceroute utility.
- To be able to enter and display experimental results using spreadsheets.
- To be able to analyse data, particularly relating measurements made to the different main types of network delay (propagation, transmission and queuing delays).

Task 1: Research and write a short report describing the main features and operation of the ping and traceroute utilities, explaining how they may be used to analyse network performance.

Task 2: Using a PC at home or at your institution, find a host near you that responds to a ping command, and carry out Activity 6.3 of Volume 1 of the **CO2222 Data communications and enterprise networking** subject guide to determine the Maximum Transfer Unit (MTU) size. Start by sending an ICMP echo request with 1500 bytes of data that has the Don't Fragment bit set. Then send another similar ICMP echo request with 500 bytes of data. You will probably find that the first ping fails because the "packet needs fragmenting but DF bit set" while the second one succeeds. This means that the maximum data size lies somewhere between 500 and 1499. Continue using a Binary Search until you find the largest amount of data that can be transmitted without fragmentation. This is the largest amount of data an ICMP packet can carry which is less than the MTU size. Indicate what you think this MTU size is and why. Explain why the MTU size has been set to this value.

Task 3: Using a PC at home or at your institution study the correlation between Round Trip Time (RTT) and distance. Identify five host sites, one on each continent, that respond to ICMP echo requests generated by ping commands. Please see the advice section for guidance. Ping each of the five sites you found above and record the average RTT from the ping replies. Using an on-line distance calculator (such as www.indo.com/distance or http://www.geobytes.com/CityDistanceTool.htm) or an atlas, calculate the distance between your own location and the host sites. Enter the hostnames,

RTTs and distances onto a spreadsheet table and draw an XY (Scatter) Graph to show the relationship between RTT and distance. Draw the trend line and calculate the correlation between RTT and distance. Comment on your results, and explain why a positive correlation might exist between RTT and distance with reference to the different components that might contribute to RTT (propagation, transmission and queuing delays).

Task 4: Repeat Task 3, but this time identifying five host sites within your own country that respond to the ping command. Process your results as above and compare and comment on the similarities and differences between them. If there are differences, explain why you think they may be happening.

Task 5: Using a PC at home or at your institution carry out Activity 6.4 of Volume 1 of the **CO2222 Data communications and enterprise networking** subject guide to investigate the effect of changing the initial value in the Time To Live (TTL) field in an ICMP echo request packet.

Choose one of the five hosts from Task 3 above and ping it with an initial TTL of 1 and note the IP address from which the TTL expired message was received. Increment the initial TTL by 1 and repeat the experiment. Carry on incrementing the initial TTL by 1 each time until a reply is received from the host being pinged. Your report should include a list of the IP addresses (and hostnames, if given) of all of the devices that have sent TTL expired messages.

Task 6: Carry out traceroutes (the command is tracert in DOS/Windows) to each of the five hosts you pinged in Task 3 above. Your report should include a list of the IP addresses (and hostnames, if given) of all of the devices that make up the route. Study the routes followed by the packets to these hosts and record the location of the routers. These can often be found within the domain name of the router, or by a "whois" search (http://www.whois.net/) to find the owner of the router. Comment on any peculiarities that may account for some of anomalous results you may have obtained in Task 3 above.

Advice
Finding sites to ping is getting harder, as many network managers have responded to security concerns by filtering ICMP echo request packets. However, there are still many sites that do respond to pings, particularly on academic networks. You can obtain the website URLs of universities from http://www.braintrack.com/ by selecting appropriate countries. If the site is filtering ICMP echo request packets, ping will time out. If replies are received, you should note the domain name for subsequent use.
In order to capture the output of ping and traceroute commands, you can use the > or >> operators provided on most operating systems that use a command line to direct output of commands into files. If during any experiment, any packets are lost, repeat the experiment, as the lost packets will affect the average RTT calculation.
Sometimes routers do not issue TTL expired messages. When this happens a line with three stars appears in the traceroute output. If this happens, you should label the routers

as unknown. If the host has not been reached before traceroute gives up, then find another host instead that can be reached.

Deliverables and marking

Your report should contain between 2,000 and 3,000 words.

Please submit **one** pdf document which is named using the following convention:

FamilyName_SRN_COxxxxcw#.pdf (e.g. Zuckerberg_920000000_CO3323cw2.pdf)
- o **FamilyName** is your family name (also known as last name or surname) as it appears in your student record (check your student portal)
- o **SRN** is your Student Reference Number, for example 920000000
- o **COXXXX** is the course number, for example CO1108, and
- o **cw#** is either cw1 (coursework 1) or cw2 (coursework 2).

For each experiment you should describe the method, display the results in a well-formatted table and, where appropriate, in graphical form and analyse the results you have obtained. Finally you should write a conclusion summarising what you have learnt from the experiments.

The report must contain the following section headings and numbering scheme:

Section No	Heading	Contents	Marks
1	Introduction	Brief description of the ping and traceroute utilities.	5%
2	MTU Size	Method, results and analysis.	20%
3	RTT vs Distance (Global)	Method, results and analysis.	15%
4	RTT vs Distance (Local)	Method, results and analysis.	15%
5	TTL Size	Method and results.	20%
6	Traceroute	Method, results and analysis.	20%
7	Conclusions	Summary of what you have learnt from the Assignment	5%
			100%

[END OF COURSEWORK ASSIGNMENT 1]