COMP 445 – Theoretical Assignment 1 (TA1)

Tristan Glatard
tristan.glatard@concordia.ca

(adapted from Aiman Hanna)
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Concordia University
Department of Computer Science and Software Engineering

All questions will receive equal points. Please submit your assignment as a pdf file on Moodle. The name of the pdf file must contain your name and student id. Your name and student id must also appear in the header of the pdf document. Please answer the questions in the order used below and indicate the question number before your answer (e.g., **Q1**). Wherever possible, briefly indicate the method used to obtain a numerical value, e.g., mathematical formula. Due date: **Feb 3, 11:55pm**.

1 Introduction

Q1 - List two advantages and two drawbacks of organizing network protocols in layers.

Q2 - Explain the difference between bandwidth and throughput. Are there situations where bandwith might be higher than throughput? And where throughput might be higher than bandwidth? If yes, provide examples.

Q3 - Circuit Switching aims at providing a better service through the reservation of the circuit (i.e. circuit is dedicated). Now, considering only the perspective of the communicating users over a Circuit Switching network (i.e. you should not be concerned with the entire utilization of the network or the advantages to other users), is it possible that Circuit Switching may actually end up harming its users instead of providing a better service to them? If yes, provide a scenario/case that shows that. If no, explain why this service will indeed provide the best service to its users at all times.

Q4 - Suppose two hosts, A and B, are d=10,000 km apart and are connected by a direct link of rate R=5 Mbps. Assume further that the propagation speed over the link is s=$2.5.10^8$m/s, and that the packets to be transferred are of size L=2 Mb.

1. What is the propagation delay to send one packet from A to B?
2. What is the transmission delay to send 8 packets from A to B?

Q5 - Starting from the network described in the previous question, now assume that:

- A router X is installed at equal distance of A and B, that is, the network now looks like A – X – B.
- The link from A to X has rate R_1=4 Mbps.
- The link from X to B has R_2=6 Mbps.
- Processing and queuing delays in the router are negligible.

- What is the propagation delay to send one packet from A to B?
- What is the total time needed to send 8 packets from A to B?

Q6 - Perform a `traceroute` between your machine and any other host on the Internet, preferably overseas. Provide snapshots of what was returned and analyze the returned information. Comment on any behavior that looks unusual. Indicate the number of routers between your machine and the targeted host/server.

Q7 - Conduct a small research on the "Mirai" malware and explain how it can be used to attack internet hosts.

2 Application Layer

Q8 - List the application and transport-layer protocol(s) involved in the retrieval of a Web page by a Web browser, assuming that the IP address of the Web server is initially unknown. Explain why these transport protocols are used.

Q9 - Explain what happens when Alice sends an email to Bob and Bob's mail server is down

Q10 - (Textbook, Question P.22 Page 179 (7 th ed.) / 177 (6 th ed.)). Consider distributing a file of size F=15 Gbits to N peers. The server has an upload rate of u_s = 30 Mbps, and each peer has a download rate of d_p = 2 Mbps and an upload rate of u_p. For N = 10, 100, and 1000 and u_p = 300 Kbps, 700 Kbps, and 2 Mbps, fill the following table by the minimum distribution time for each of the combinations of N and u_p for both client-server distribution and P2P distribution.

Client Server

		N		
		10	100	1000
u_p	300 kbps			
	700 kbps			
	2 Mbps			

Peer to Peer

		N		
		10	100	1000
u_p	300 kbps			
	700 kbps			
	2 Mbps			