COSC 328 – LAB 2

Introduction to Networks

2021 Winter Term 1

Deadline: September 27, 2021 @ 11:59 PM (Sharp).

Introduction

In this lab, we will do some practice questions on calculating the performance of application layer protocols. All work must be shown for marks.

Warm-up Problems: The authors of the text have provided interactive problems to help you with understanding the concepts presented in chapter 2. Please take the time to review these problems before attempting the questions. These problems are for your own learning and practice (no marks) but will allow you to review solutions.

a) HTTP GET message: http://gaia.cs.umass.edu/kurose_ross/interactive/http-get.php
b) HTTP RESPONSE message: http://gaia.cs.umass.edu/kurose_ross/interactive/http-response.php
c) DNS and HTTP delays: http://gaia.cs.umass.edu/kurose_ross/interactive/DNS_HTTP_delay.php

Textbook Questions

Answer the following questions from the text book:

Question 1) R9. Recall that TCP can be enhanced with SSL to provide process-to-process security services, including encryption. Does SSL operate at the transport layer or the application layer? If the application developer wants TCP to be enhanced with SSL, what does the developer have to do? **(10 marks)**

Question 2) R18. From a user's perspective, what is the difference between the download-and-delete mode and the download-and-keep mode in POP3? **(10 marks)**

Question 3) R26. In Section 2.7, the UDP server described needed only one socket, whereas the TCP server needed two sockets. Why? If the TCP server were to support n simultaneous connections, each from a different client host, how many sockets would the TCP server need? **(10 marks)**

Question 4) P9. Consider Figure 2.12, for which there is an institutional network connected to the Internet. Suppose that the average object size is 850,000 bits and that the average request rate from the institution's browsers to the origin servers is 16 requests per second. Also suppose that the amount of time it takes from when the router on the Internet side of the access link forwards an HTTP request until it receives the response is three seconds on average (see Section 2.2.5).

Model the total average response time as the sum of the average access delay (that is, the delay from Internet router to institution router) and the average Internet delay. For the average access delay, use $\Delta/(1 - \Delta\beta)$, where Δ is the average time required to send an object over the access link and β is the arrival rate of objects to the access link. **(15 marks)**

a) Find the total average response time.
b) Now suppose a cache is installed in the institutional LAN. Suppose the miss rate is 0.4. Find the total response time.

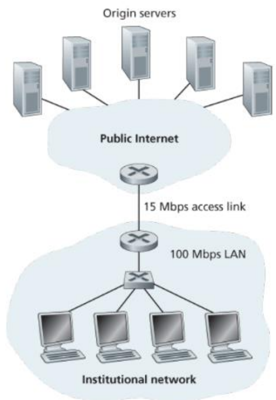

Figure 2.12 Bottleneck between an institutional network and the Internet

Question 5) P22. Consider distributing a file of $F = 15$ Gbits to N peers. The server has an upload rate of $u_s = 30$ Mbps, and each peer has a download rate of $d_i = 2$ Mbps and an upload rate of u. For $N = 10$ and 1,000 and $u = 300$ Kbps and 2 Mbps, prepare a chart giving the minimum distribution time for each of the combinations of N and u for both client-server distribution and P2P distribution. **(15 marks)**

TCP vs UDP (12 marks)

Question 6) Indicate if TCP, UDP, or neither should be used given the following transmission requirements:

a) Reliable data transfer
b) Minimum transmission overhead
c) Guaranteed transmission rate
d) Bounded limits on packet delay
e) Guarantee in-order delivery of data
f) No transmission setup time

HTTP Request and Response (8 marks)

Question 7) Given the following HTTP request, answer the following questions:

```
GET /index.html HTTP/1.1
Accept: */*
Accept-Language: en-ca
User-Agent: Mozilla/5.0 (Windows NT 6.1; rv:2.0.1) Gecko/20100101 Firefox/4.0.1
CLR 2.0.50727; InfoPath.1)
Host: localhost:6789
Connection: Keep-Alive
```

a) What is the full URL of the requested page?
b) Is the browser requesting a persistent or non-persistent connection? How do you know?

Persistent versus non-Persistent Connections (10 marks)

Question 8) Assume you have a HTML file of size 10,000 bits. The HTML file has 4 linked images each of size 50,000 bits. One of the linked images is on a different server machine. To simplify the discussion, assume that the round trip time (RTT) from your browser to either server is 100 ms, and the "link" between browser and server is a 10 Mbps link. Answer these questions:

a) What is the total time to receive the HTML file and all images using non-persistent connections?
b) What is the total time using non-persistent connections but the browser can open up any number of parallel connections?

Caching (10 marks)

Question 9) Given the network diagram below, answer the following questions. Assume that the transmission delay for HTTP GET/RESPONSE and DNS REQUEST/RESPONSE messages is so small that it can be ignored. Transmission delays are only calculated when sending the data file. Both routers, R1 and R2, use store and forward. The transmission delays on the LANs must be calculated, but propagation delays are ignored. The round-trip time from any machine in a.com to b.com is 50 ms. The round-trip time from any machine in a.com to the Internet is 100 ms. Answer these questions:

a) Give the sequence and timing of messages sent when m1.a.com requests a 1 Mbit file from www.b.com. Assume the DNS record and the HTTP file are not cached locally. Also assume that the top-level domain is not cached.
b) Give the sequence and timing of messages sent when m2.a.com requests the same 1 Mbit file assuming the DNS records and file have been cached locally.