COMP2190 – Semester 1 2020/2021

Tutorial 2

Problems

1. Consider an HTTP client that wants to retrieve a Web document at a given URL. The IP address of the HTTP server is initially unknown. What transport and application layer protocols besides HTTP are needed in this scenario? [2, chp. 2, prob. 3]

2. Consider the following string of ASCII characters that were captured by Wireshark when the browser sent an HTTP GET message. The characters *<cr><lf>* are carriage return and line-feed characters, i.e., the italicized character string *<cr>* in the text below represent the single carriage-return character that was contained at that point in the HTTP header. Answer the following questions, indicating where in the HTTP GET message below you find the answer.

   ```
   GET /cs453/index.html HTTP/1.1<cr><lf>HOST: gai
   a.cs.umass.edu<cr><lf>User-Agent: Mozilla/5.0 (
   Windows;U; Windows NT 5.1; en-US; rv:1.7.2) Gec
   ko/20040804 Netscape 7.2 (ax) <cr><lf>Accept:ex
   t/xml, application/xml, application/xhtml+xml, text
   /html;q=0.9, text/plain;q=0.8,image/png,*/*;q=0.5
   <cr><lf>Accept-Language: en-us,en;q=0.5<cr><lf>Accept-
   Encoding: zip,deflate<cr><lf>Accept-Charset: ISO
   -8859-1,utf-8,q=0.7,*;q=0.7<cr><lf>Keep-Alive: 300<cr>
   <lf>Connection:keep-alive<cr><lf><cr><lf>
   ```

   a. What is the URL of the document requested by the browser?
   b. What version of HTTP is the browser running?
   c. Does the browser request a non-persistent or persistent connection?
   d. What is the IP address of the host on which the browser is running?
   e. What type of browser initiates this message? Why is the browser type needed in an HTTP request message?

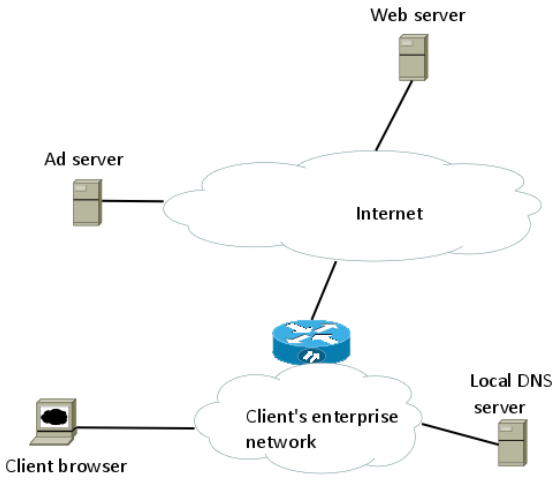
3. The text below shows the reply sent from the server in response to the HTTP GET message in the question above. Answer the following questions, indicating where in the message below you find the answer.

   ```
   HTTP/1.1 200 OK<cr><lf>Date: Tue, 07 Mar 2008
   12:39:45GMT<cr><lf>Server: Apache/2.0.52 (Fedora)
   <cr><lf>Last-Modified: Sat, 10 Dec2005 18:27:46
   GMT<cr><lf>ETag: "526c3-f22-a88a4c80"<cr><lf>Accept-
   Ranges: bytes<cr><lf>Content-Length: 3874<cr><lf>
   Keep-Alive: timeout=max=100<cr><lf>Connection:
   ```

```
Keep-Alive<cr><lf>Content-Type: text/html; charset=
ISO-8859-1<cr><lf><cr><lf><!doctype html public "-
//w3c//dtd html 4.0 transitional//en"><lf><html><lf>
<head><lf> <meta http-equiv="Content-Type"
content="text/html; charset=iso-8859-1"><lf> <meta
name="GENERATOR" content="Mozilla/4.79 [en] (Windows NT
5.0; U) Netscape]"><lf> <title>CMPSCI 453 / 591 /
NTU-ST550A Spring 2005 homepage</title><lf></head><lf>
<much more document text following here (not shown)>
```

a. Was the server able to successfully find the document or not? What time was the document reply provided?
b. When was the document last modified?
c. How many bytes are in the document being returned?
d. What are the first 5 bytes of the document being returned? Did the server agree to a persistent connection?

4. Consider the scenario shown in the figure below in which a client wants to access a web server. The web server is connected to the Internet by a link with a transmission capacity of 1 Gbps, i.e., 1,000,000,000 bits per second.



a. Suppose a web page (including all of its images, stylesheets, and JavaScript, which are stored on the Web server) is 1,000,000 bits long. How long does it take for the server to send a web page (including all of the referenced objects) into the Internet over the gigabit link?
b. What is the maximum number of web pages that the web server can transmit per second, assuming all of the web pages (including all of its images, which are stored on the web server) are the same size as in (a)?

Now let us consider the case that the web server serves a base page, but that the base page has three advertisements, each of which is served by the ad server shown in the figure above.

c. Suppose now that (i) the base web page takes x_1 seconds to transmit into the Internet, and that the client-to-web server RTT is RTT_1, (ii) each advertisement takes x_2 seconds to transmit into the Internet, and the client-to-ad-server RTT is RTT_2. How much time is taken from when the client first clicks on the link to access a web page containing these three ads until the page is displayed? Your answer should be in the form of a formula involving x_1, RTT_1, x_2, and RTT_2. Briefly explain how you arrived at your formula. You should remember that HTTP runs over TCP. You do NOT have to worry about DNS delays for this problem. You can assume that: 1) "small" messages (i.e., messages that do not contain a web page or an image) take zero time to transmit into a link, but do experience a propagation delay; 2) non-persistent HTTP connections are used.

d. Now suppose that the client's browser has a cache and the client has previously visited the web page. The web page at the server has changed since the client last viewed the web page, but the advertisements have not changed. Under the otherwise same assumptions as (c), how much time is taken from when the client first clicks on the link to access a web page containing these three ads until the page is displayed? Your answer should again be in the form of a formula. Briefly explain why your formula here differs from your answer to (c).

e. Let us reconsider (c), but now account for DNS delays. Assume that the local DNS cache is empty. Suppose now that (i) the RTT between the client and the local DNS server is RTT_3, (ii) the time needed to resolve a request through the root, TLD, and authoritative name servers is RTT_4. How much time is taken from when the client clicks on the link to access a web page containing these three ads until the page is displayed, including the DNS delays. Briefly explain how you arrived at your formula.

5.

a. Can a machine with a single DNS name have multiple IP addresses? How could this occur?

b. Can a computer have two DNS names that fall in different top-level domains? If so give a plausible example. If not, explain why not?

6. Suppose that UWI did not have a Web cache. Further, suppose that the Department of Computing has a local DNS server for all computers in the department. You are an ordinary user. Can you come up with a way to determine if an external Web site was very likely accessed from a computer in your department a couple of seconds ago? Explain.

Acknowledgment

Problems 1—3 and 5—6 come from "Computer Networking: A Top-Down Approach," 7/E by J. F. Kurose and K. W. Ross. Problem 4 was developed by J. F. Kurose for his CMPSCI290W exam.