

# CS305 Homework1

**Content:** Chapter 1 and Chapter 2 of *Computer Networking -- A Top Down Approach 7th*

1. Why are standards important for protocols?
2. What are the five layers in the Internet protocol stack? What are the principal responsibilities of each of these layers?
3. Which layers in the Internet protocol stack does a router process? Which layers does a link-layer switch process? Which layers does a host process?
4. This elementary problem begins to explore propagation delay and transmission delay, two central concepts in data networking. Consider two hosts, A and B, connected by a single link of rate  $R$  bps. Suppose that the two hosts are separated by  $m$  meters, and suppose the propagation speed along the link is  $s$  meters/sec. Host A is to send a packet of size  $L$  bits to Host B.
  - a. Express the propagation delay,  $d_{prop}$ , in terms of  $m$  and  $s$ .
  - b. Determine the transmission time of the packet,  $d_{trans}$ , in terms of  $L$  and  $R$ .
  - c. Ignoring processing and queuing delays, obtain an expression for the end-to-end delay.
  - d. Suppose Host A begins to transmit the packet at time  $t=0$ . At time  $t= d_{trans}$ , where is the last bit of the packet?
  - e. Suppose  $d_{prop}$  is greater than  $d_{trans}$ . At time  $t= d_{trans}$ , where is the first bit of the packet?
  - f. Suppose  $d_{prop}$  is less than  $d_{trans}$ . At time  $t= d_{trans}$ , where is the first bit of the packet?
  - g. Suppose  $s=2.5 \times 10^8$ ,  $L=120$  bits, and  $R=56$  kbps. Find the distance  $m$  so that  $d_{prop}$  equals  $d_{trans}$ .

5. Suppose users share a 3 Mbps link. Also suppose each user requires 150 kbps when transmitting, but each user transmits only 10 percent of the time.

- a. When circuit switching is used, how many users can be supported?
- b. For the remainder of this problem, suppose packet switching is used. Find the probability that a given user is transmitting.
- c. Suppose there are 120 users. Find the probability that at any given time, exactly  $n$  users are transmitting simultaneously. (Hint: Use the binomial distribution.)
- d. Find the probability that there are 21 or more users transmitting simultaneously.

6. Why do HTTP, SMTP, and POP3 run on top of TCP rather than on UDP?

7. True or false?

- a. A user requests a Web page that consists of some text and three images. For this page, the client will send one request message and receive four response messages.
- b. Two distinct Web pages (for example, [www.mit.edu/research.html](http://www.mit.edu/research.html) and [www.mit.edu/students.html](http://www.mit.edu/students.html)) can be sent over the same persistent connection.
- c. With nonpersistent connections between browser and origin server, it is possible for a single TCP segment to carry two distinct HTTP request messages.
- d. The *Date:* header in the HTTP response message indicates when the object in the response was last modified.
- e. HTTP response messages never have an empty message body.

8. Consider the following string of ASCII characters that were captured by Wireshark when the browser sent an HTTP GET message (i.e., this is the actual content of an HTTP GET message).

The characters `<cr>` `<lf>` are carriage return and line-feed characters (that is, the

italized character string `<cr>` in the text below represents 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 a 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?

**9.** 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-ST550ASpring 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 there 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?