17/06/2019

Lecture 2 tutorial: Application layer

During tutorials prepare a short report of your activities and show it to your tutor.

Study the following **questions** and verify the correctness of any **answers** if given.

Be aware that the exam question might be directly related to the tutorial questions.

Q1: HTTP version 2
Read the related part of the HTTP version 2 specifications RFC 7540 and describe the structure of the HTTP/2.0 **frame.**

(Please compile a short answer emphasizing the differences between HTTP/1.1)

Q2: The question below is a bit simplistic, however, if by any chance you have missed something it is a quick way to catch up.

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 italicized character string <cr> in the text below represents the single carriage-return character that was contained at that point in the HTTP header).

```
GET /cs453/index.html HTTP/1.l<cr><Lf>
Host: gaia.cs.umass.edu <cr><lf>
User-Agent: Mozilla/5.0 (Windows;U; Windows NT 5.1; en-US; rv:1.7.2)
Gecko/20040804 Netscape/7.2 (ax) <cr><lf>
Accept: ext/xmL, application/xml, application,/xhtml+xml, text/html;
q=0.9,text/plain; q=g.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>
```

Answer the following questions, indicating where in the HTTP GET message above you find the answer.

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?

Q3: The text below shows the reply sent from the server in response to the HTTP GET message in the question above.

```
HTTP/1.1 200 OK<cr><lf>
Date: Tue, 07 Mar 2008 12:39:45GMT<cr><1f>
Server: Apache/2.0.52  (Fedora)<cr><lf>
Last-Modified: Sat, 10 Dec2005 18:27:46 GMT<cr><lf>
ETag: "u526c3-f22-a88a4c80"<cr><lf>
Accept-Ranges: bytes<cr><lf>
Content-Length: 3874<cr><lf>
Keep-Alive: timeout=max=100<cr><1f>
Connection: Keep-Alive<cr><lf>
Content-Type: text/html; charset=ISO-8859-1<cr><1f>
<cr><1f>
<!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"><1£>  <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><1f>
<much more document text following here (not shown)>
```

Answer the following questions, indicating where in the message above you find the answer.

a. Was the server able to successfully find the document or not? What time was the document reply provided?
b. When the document was 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?

Q4: We used the Rex Swain's HTTP Viewer as a HTTP analyzer. This site is no longer available (re-check!)

Find another HTTP analyser to **request** and get the **response** from the site as above: gaia.cs.umass.edu/cs453/index.html

Compare changes in the request/response with respect to Q2 and Q3 (**Answer the questions** as in **Q2** and **Q3**)

Q5: Consider a redirection problem. My web page originally existed on the server www.csse.monash.edu.au/~app. If you click on that side, you will be redirected to users.monash.edu/~app/ .

The question is: find the HTTP source code on the page www.csse.monash.edu.au/~app that performs the redirection. A nice HTTP analyzer would be handy. If you cannot find one, use the Wireshark.

Q6: Suppose within your Web browser you click on a link to obtain a Web page. The IP address for the associated URL is not cached in your local host, so a DNS lookup is necessary to obtain the IP address. Suppose that n DNS servers are visited before

your host receives the IP address from DNS; the successive visits incur an RTT_{DNS} of RTT_1, …, RTT_n. Further suppose that the Web page associated with the link contains exactly one object, consisting of a small amount of HTML text. Let RTT_0 denote the RTT between the local host and the server containing the object. Assuming zero transmission time of the object, how much time elapses from when the client clicks on the link until the client receives the object?

Hint: The total response time will include the time to complete the DNS lookup and round trip time for any communication with the server containing the object.

Q7: Referring to question **Q7**, suppose the HTML file references **eight very small objects** on the same server. Neglecting transmission times, how much time elapses with

a. Non-persistent HTTP with no parallel TCP connections?
b. Non-persistent HTTP with the browser configured for 5 parallel connections?
c. Persistent HTTP?

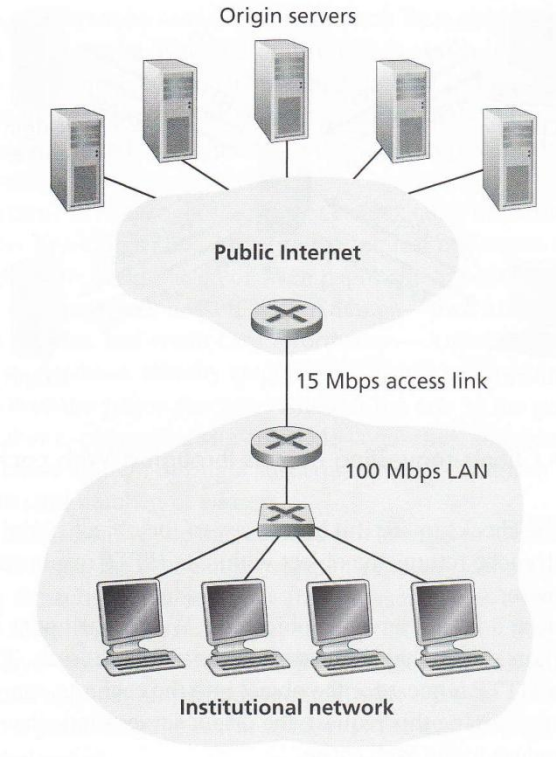
Part (a) is done already. Please attempt (b) and (c).

a)

$$\boldsymbol{RTT_{DNS} + 2RTT_0 + 8 \cdot 2RTT_0 = RTT_{DNS} + 18RTT_0}$$

$(\boldsymbol{2RTT_0}$ **one to establish TCP connecttion ,** $\boldsymbol{RTT_0}$ **the other to send HTTP request − response**$)$

Q8: Refer to lecture slides: **27 – 30**
An institutional network is connected to the Internet in the following way:



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. 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.

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.

Part (a) is done already. Please attempt part (b)

a) The time to transmit an object of size *L* over a link of rate *R* is *L/R*. The average time is the average size of the object divided by *R*:

Δ = (850,000 bits)/(15,000,000 bits/sec) = .0567 sec

The traffic intensity on the link is given by

$\beta\Delta$ = (16 requests/sec)(.0567 sec/request) = 0.907.

Thus, the average access delay is (.0567 sec)/(1 - .907) ≈ .6 seconds.
The total average response time is therefore .6 sec + 3 sec = 3.6 sec.

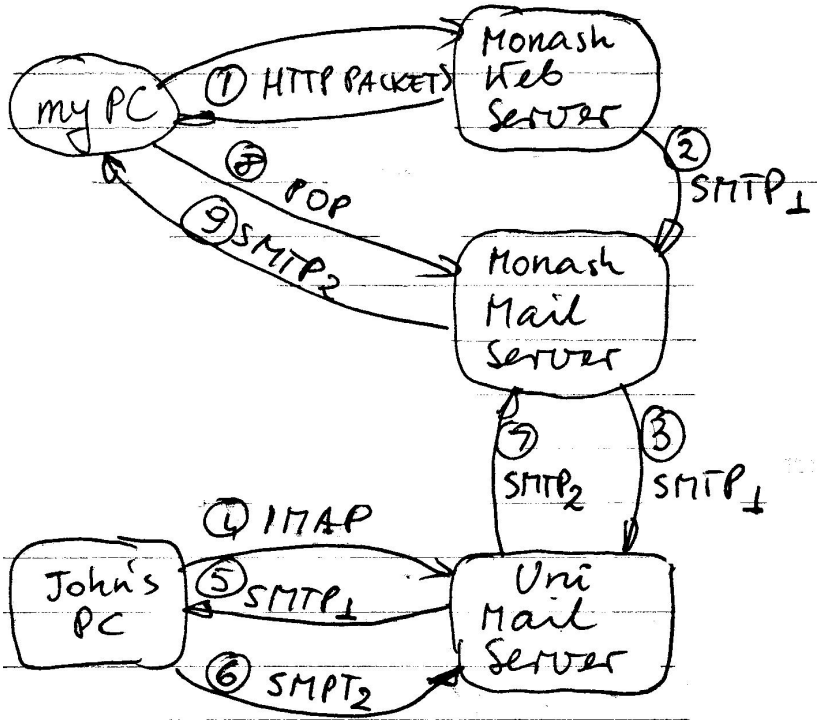
Q9: E-mail.

Assume that:

- You use a **web email** at **Monash** to send an email to John@uni.edu.
- John is using an **IMAP mailer** to check his e-mail and respond to your e-mail.
- You use a **POP mailer** to check John's response.

a. Illustrate in a **single drawing** the above scenario drawing the flow of packets between the computers involved. Annotate all servers and client computers involved.
b. Give a brief step-by-step explanation of the flow of packets. Number the steps and related packets in the drawing.

The drawing (a) and a description of the first step in (b) is done already. Please attempt the rest of part (b)



1. I invoke a web-mailer and exchange HTTP packets with the Web server to prepare e-mail to be sent. […]

Q10: Refer to the slide **36** and a relevant **SMTP** standard and explain how the Message-ID is created. Show where in the standard you have found the relevant information

(Please write a good answer.)

Q11: Briefly describe the **MIME** standard. Note many related RFCs