Sep.21st Homework (Computer Networking)

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R1. What is the difference between network architecture and application architecture?

Solu: Network architecture is the organization of the communication process info layers. Application architecture is designed by an application and it is how any application built.

R2. List five nonproprietary Internet applications and the application-layer protocols that they use.

Solu:

The Web: HTTP.
Remote login: Telnet.
Network News: NNTP.
e-mail: SMTP.
File transfer: FTP.

R3. What information is used by a process running on one host to identify a process running on another host?

Solu: The IP address of the destination host and the port number of the destination socket.

R5. For a communication session between a pair of processes, which process is the client and which is the sever?

Solu: The process which initiates the communication is the client; the process that waits to be contacted is the server.

R6. Suppose you wanted to do a transaction from a remote client to a server as fast as possible. Would you use UDP or TCP? Why?

Solu: UDP. With UDP, the transaction can be completed in one roundtrip time (RTT) - the client sends the transaction request into a UDP socket, and the server sends the reply back to the client's UDP socket. With TCP, a minimum of two RTTs are needed - one to set-up the TCP connection, and another for the client to send the request, and for the server to send back the reply.

R7. 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?

Solu: SSL operates at the application layer. The SSL socket takes unencrypted data from the application layer, encrypts it and then passes it to the TCP socket. If the application developer wants TCP to be enhanced with SSL, he/she has to include the SSL code in the application.

R9. Referring to Figure 2.4, we see that none of the applications listed in Figure 2.4 requires both no data loss and timing. Can you conceive of an application that requires

no data loss and that is also highly time-sensitive?

Solu: e.g. Google Docs where people editing a file together, we need it ensure the accuracy and the timing.

R11. What is meant by a handshaking protocol?

Solu: A protocol uses handshaking if the two communicating entities first exchange control packets before sending data to each other. SMTP uses handshaking at the application layer whereas HTTP does not.

R12. Telnet into a Web server and send a multiline request message. Include in the request message the `If-modified-since`: header line to force a response message with the `304 Not Modified` status code.

Solu: "telnet" command:

It is a command used in windows (also in linux) to connect to the web server. The server responds to the HTTP GET requests. It reply to the client with the requested information.

Command to open the connection with web server:

telnet <domain name of web server> <port number>

example: telnet www.bjtu.edu.cn 80

After establishing the connection with the web server, it is possible to request a specified page from the web server.

Command to request the page web server:

GET <page name> HTTP/1.0

If the page is available then the server sends the page details. It include the "If-modified-since" message with the 304 Not Modified status code in the response.

R13. Consider an e-commerce site that wants to keep a purchase record from each of its customers. Describe how this can be done with cookies.

Solu: When the user first visits the site, the server creates a unique identification number, creates an entry in its back-end database, and returns this identification number as a cookie number. This cookie number is stored on the user's host and is managed by the browser. During each subsequent visit (and purchase), the browser sends the cookie number back to the site. Thus the site knows when this user (more precisely, this browser) is visiting the site.

P1. True or false?

a. With connection between browser and origin server, it is possible for a single TCP segment to carry two distinct HTTP request messages.

b. 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.

c. Two distinct Web pages (for example, www.mit.edu/research.html and www.mit.edu/student.html) can be sent over the same persistent connection.

d. The Date: header in the HTTP response message indicates when the object in the response was last modified.

Solu: F、F、T、F

P2. Consider an HTTP client that wants to retrieve a Web document at a giver URL. The IP address of the HTTP server is initially unknown. What transport and application-layer protocols besides HTTP are needed in this scenario?

Solu: Transport layer protocols:

TCP for HTTP

UDP for DNS;

Application layer protocols:

DNS

HTTP

P4. The text below shows the reply sent from the server in response the 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 4.0transitional//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 textfollowing here (not shown)> "

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

b. How many bytes are there in the document being returned?

c. What are the first 5 bytes of the document being returned? Did the server agree to a persistent connection?

d. When was the document last modified?

Solu: a) The server was able to locate the document successfully. Reason is that The status code of 200 and the phrase OK.

The reply was provided on Tuesday, 07 Mar 2006 12:39:45 Greenwich Mean Time.

b) There are 3874 bytes in the document being returned.

c) The first five bytes of the returned document are : <!doc. The server agreed to a persistent connection, as indicated by the Connection: Keep-Alive field

d) The document index.html was last modified on Saturday 10 Dec 2005 18:27:46 GMT.

P5. 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 con- tained 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: gaia.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-s,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. Does the browser request a non-persistent or a persistent connection?

b. What is the URL of the document requested by the browser?

c. What version of HTTP is the browser running?

d. What is the IP address of the host on which the browser is running?

Solu: a. The browser is requesting a persistent connection, as indicated by the Connection: keep-alive.

b. gaia.cs.umass.edu/cs453/index.html

c. HTTP/1.1

d. This is a trick question. This information is not contained in an HTTP message anywhere. So there is no way to tell this from looking at the exchange of HTTP messages alone. One would need information from the IP datagrams (that carried the TCP segment that carried the HTTP GET request) to answer this question.

P7. Consider Figure 2.12, for which there is an institutional network connected to the Internet. Suppose that the average object size is 900,000 bits and that the average request rate from the institution' s browsers to the origin servers is 15 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 two 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 $\Delta/(\mathbf{1}-\Delta\boldsymbol{\beta})$, where Δ is the average time required to send an object over the access link and $\boldsymbol{\beta}$ 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 institution LAN. Suppose the hit rate is 0.4. Find the total response time.

Solu: a. $\Delta = 900{,}000\text{bits}/15{,}000{,}000\text{bits/sec} = 0.06\text{sec}$

The traffic intensity on the link is given by $\beta\Delta = (15 * 0.06) = 0.9$.

Thus, the average access delay is $0.06sec/(1-0.9) = 0.6sec$. *The total average response time is therefore* $0.6sec + 2sec = 2.6sec$.

b. The traffic intensity on the access link is reduced by 60% since the 60% of the requests are satisfied within the institutional network. Thus the average access delay is $(0.6sec)/[1-(0.4)(0.9)] = 0.9375\text{sec}$. *The average response time is* $0.9sec + 2sec = 2.9sec$ *for cache misses. So the average response time is* $0.4 * 2.9sec = 1.16sec$. *Thus the average response time is reduced from 2.6sec to 1.16sec.*

P9. Referring to Problem P8, suppose the HTML file references three objects on the same server. Neglecting transmission times, how much time elapses with

a. Non-persistent HTTP with parallel connections?

b. Non-persistent HTTP with no parallel TCP connections?

c. Persistent HTTP?

*Solu: a. RTT1+…+RTTn+2RTTO+7*2RTTO = 16* RTTO+ RTT1+…+RTTn.*

*b. RTT1+…+RTTn+2RTTO+2*2RTTO = 6* RTTO+ RTT1+…+RTTn.*

c. RTT1+…+RTTn+2RTTO+RTTO = 3 RTTO+ RTT1+…+RTTn..*