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Midterm - 10/15/2020

1) Suppose users share a 20 Mbps link, and each user transmits continuously at 5 Mbps when transmitting. Each user transmits only 30 percent of the time. (1) How many users can be supported by this link when using circuit switching? (2) What is the utilization of the link?

1) 20 / 5 = 4 users can be supported.
2) The utilization of the link is 30%.

2) Under the same setting as the problem above. Assuming that packet-switching is used with 10 users. (1) What is the probability that only one user (anyone among the 10) is transmitting, and the rest are not transmitting? (2) What is the probability that less than 3 users are transmitting at the same time? Note: You can show the equations without calculating the numerical results.

1) Probability that only one user is transmitting and the rest are not is $(0.3)(0.7)^9$
2) Probability that 3 users are transmitting is $C^{i=10,3}(0.3)^3(0.7)^2 + C^{i=10,2}(0.3)^2(0.7)^1 + (0.3)^{10}$

3) Given the network below, where L_1, L_2, L_3 are the length of the links in meters, R_1, R_2, R_3 are the transmission rate in bits/second, and the propagation speed is P meters/second. Sender S is sending packets of size K bits to the receiver R. Assume that we neglect the processing and queuing delay. (1) What would be the end-to-end delay between S and R? (2) What is the throughput between S and R?

1) The end-to-end delay between S and R is (K/R1) + (K/R2) + (K / R3).
2) End-to-end throughput between S and R is min(R1, R2, R3)

4) (Transmission/propagation delay) Consider a highway that has a tollbooth every 100 km, and cars travel on the highway at a rate of 100 km/hour. Assume that 8 cars travel together as a caravan and travel in a fixed order. Suppose each tollbooth services a car at a rate of 4 minutes per car, and no other cars except these 8 cars are on the highway. Finally, suppose that whenever the first car of the caravan arrives at a tollbooth, it will not be processed by the toll booth but wait at the entrance until all other cars arrive and line up behind it.

(i) What is the total time required for a whole caravan to travel from the entrance of the first tollbooth to the entrance of the next tollbooth (all cars should be lined up.) Note: show the complete calculation process to earn full credit. (4 pts)

4 x 8 = 32 + 100km / 100km/h = 1(hr) === **92 minutes**

- (ii) What is the meaning of the 5 minutes processing time at the toll booth? (Note: this is asking you which type of the delay it is). (2 pts)

  This is the transmission delay or transmission time.

- (iii) According to the calculation in (i), will the second car arrive the next tollbooth before the seventh car's departure from the first tollbooth? Provide your evaluation here (only provide the Yes or No answer will not earn you the credit). (4 pts)

  No, the second car will not arrive at the next tollbooth before the seventh car departs. 4min x 2 + 60min = 68 min 4x7 = 28min

5) What are the "identifiers" required for a client (browser) to access a web server?

IP address and port number.

6) Given the following directory structure on midterm.bradley.edu, where all the web contents reside in the "www" directory. Provide URI to access user Bradley's HTML file. **midterm.bradley.edu/home/bradley/**

7) Given an HTML page whose content contains 1 images, 1 CSS stylesheet, and 1 JavaScript files. When using a web browser to download the full content of this HTML page, how many RTTs does it take to complete the download if we use (1) non-persistent HTTP and (2) persistent HTTP? Here, we neglect the file transmission/download time. (2 pts/each)

1) Non-persistent: One round Trip Time (RTT) for handshake, and one RTT for request, response. 4 total files —> 2RTT x 4 files = 8 RTT's total.

2) Persistent: 1 RTT for setting up connection and one for every file after. 4 files + setup = 5 RTTs.

8) What does it mean if your browser receive a 304 response status code? What about 400 code?

A 304 status code means not modified, the page has not been modified since the last visit and there is no need to re-download the data. A 400 code means bad request, the server can't process the request due to an error.

9) Provide the URI to query your name through Google Search. Note: In the query, your first/ middle/last name should be separated by a space. (2 pts)

https://www.google.com/search?q=gavin+paul+forsberg

10) What are the characters required to separate the header field and message body of an HTTP message? (2 pts) **CRLF \r\n**

11) Web caching: given the following assumptions – (1) the clients on average send out 5 requests per second (2) one average each request would download 10 Mbits of data (3) the round-trip-time from the access router to one of the servers is 2 seconds (4) the access link rate is 30 Mbps (5) the LAN has link rate 500 Mbps (5) there is a proxy server in the LAN, which fulfills 70% of all the requests from the clients. We also know that it takes 30 ms for clients to access the content on the proxy server. Show your calculation steps to earn full credit.

i. What is the access link utilization? (4 pts)
   5 requests x 10mbps / 100mbps = 50%
ii. What is the total response time for the client to complete the web requests?
   Total = internet delay + access delay + LAN delay = 2 sec + min + usecs = msec

12) Identify two authoritative DNS servers at the Stanford University. What are the commands you use to get the authoritative DNS servers? (4 pts)

stanford.edu nameserver = abalone.stanford.edu
standford.edu nameserver = ns6.dnsmadeeasy.com
I was able to find these servers by entering the commands:
nslookup >> set query=ns >> stanford.edu

13) When you create a startup company BURocks, you would like to get a domain name **burocks.com**, set up your own web site/server **web.burocks.com**, and run a mail server **mail.burocks.com**. You would also make **dns.burocks.com** the authoritative DNS server. (1) What resource records (RRs) should be added to the .com TLD? (2) What RRs should be added to your authoritative DNS server? (8 pts) (Note: we assume that your network has IP addresses in 1.2.3.0/24, so you can assign the IP addresses within the range of 1.2.3.1 – 1.2.3.254 to all the servers. Each service/server uses a unique IP address.)

.com > (burocks.com, dns.burocks.com, NS)
(dns.burocks.com, 1.2.3.1, A)
auth DNS > (www.burocks.com, 1.2.3.2, A)
(smtp.burocks.com, 1.2.3.3, A)
(mail.burocks.com, stmp.burocks.com, MX)

14) P2P vs. Client/Server: how much time does it take to distribute a 500 Megabits file to 4 different clients? Assume that the server's upload capacity is 100 Mbps, each client has upload capacity of 10 Mbps and download capacity of 50 Mbps.

i. (a) Client-Server (4 pts)
   max(4x500mb/100mbps, 500Mb/50mbps) = (20,10) = 20

ii. (b) Peer-to-Peer (4 pts)
   max(500Mb/100Mbps, 500Mb/50mbps, 4x500 / 500mbps + 4 x 10Mbps) ==
   max(5, 10, 44) == 44

iii. (c) If the number of clients is changed from 4 to 20. What will be the time for client-server and peer-to-peer structures? (4 pts)
   Client-Server: max(20x500mb/100mbps, 500Mb/50mbps) = (100, 10) = 100
   P2P: max(500Mb/100Mbps,500Mb/50mbps, 20x500 / 500mbps + 20 x 10Mbps)=
   max(5, 10, 220) = 220

15) (Read the RFC) When we sent an e-mail through playground.bradley.edu using the simple mail transfer protocol, we issued a command HELO bradley.edu. (1) Which command is the extended version of HELO? (2) When we use the extended version of the HELO command, what should be entered after this command? (2 pts/each)

1) EHLO is the command for the extended version of HELO.
2) EHLO is a normally a multiline reply, following the code 250 and a hyphen for all but the last line, and the code and space for the last line.

(source: https://tools.ietf.org/html/rfc2821#page-29).

16) (Read the RFC) Following the question above. If we run the following commands when connecting to an SMTP server at MIT, who will receive the e-mail? (4 pts)

HELO mit.edu
MAIL FROM: abc@google.com
RCPT TO: xyz@apple.com
DATA
From: kkk@yahoo.com
To: omg@facebook.com
Good luck with your midterm exam! QUIT

This e-mail is going to be sent to omg@facebook.com.