Computer Networks (CS 341)

Department of Computer Science and Engineering

Indian Institute of Technology Guwahati

Mid-semester Examination, Duration- 120 minutes

Total marks -60, Date- 21 September 2021

Instructions: Please read the following instructions closely.

1. **The question paper is divided into three Sections.**
2. **All the questions are subjective/numerical questions.**
3. **In case of numerical questions, the step-wise calculation is necessary.**
4. **A hand-written explanation of the answers should be uploaded. You can scan/take a photo of your answers for each section and send us by uploading it.**
5. **Name your file as "FIRSTNAME_ROLLNO_section*".**
6. **Mark each page with page number.**
7. **You can login 30 minutes before the stipulated time for checking your connection.**
8. **An additional 15 minutes will be given to you for uploading your scripts.**
9. **Use your time wisely. Any papers sent via email after the stipulated time, will not be considered for evaluation.**

SECTION A

1. State true or false and justify your choice. Only justification carries marks. (0.5x8 marks)

   a. HTTP response messages never have an empty message body.

   b. With non-persistent connections between browser and origin server, it is possible for a single TCP segment to carry two distinct HTTP request messages.

   c. If a DNS server has no clue about where to find the address for a hostname then server asks the root server.

   d. Congestion control prevents overflowing the receivers.

   e. HTTP response messages never have an empty message body

   f. UDP is called connectionless because all packets are treated independently by the transport layer.

   g. A user needs to send the server some information using HTTP. The request line method used is SEND.

   h. TCP is a self-clocking protocol.

2. How does web caching reduce the delay in receiving a requested object? Will it be helpful in reducing the delay for all objects (including objects that are not cached) requested by a user or for only some of the objects? Why? (4 marks)

3. State the differences between circuit switching and packet switching. (5 marks)

4. Explain slow-start in TCP. What steps are taken by the TCP sender when congestion is detected in the network while it is in the slow-start state? (3+3 marks)

5. You have a link of bandwidth 10 Mbps and latency of 10 ms. Your friend has a link of bandwidth 1 Mbps and 5ms latency. Which link do you consider is better for file downloads? Why? (3 marks)

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SECTION B

1. Consider the following scenario where Alice sends a message to Bob. Assume that both Bob's and Alice's user agents use the HTTP protocol. (6 marks)

   a. At point 2 in the diagram, what protocol is being used?

   b. At point 4 in the diagram, what protocol is being used?

   c. At point 6 in the diagram, what protocol is being used?

   d. Does SMTP use TCP or UDP?

   e. Is SMTP a 'push ' or 'pull' protocol?

   f. Is HTTP a 'push' or 'pull' protocol?

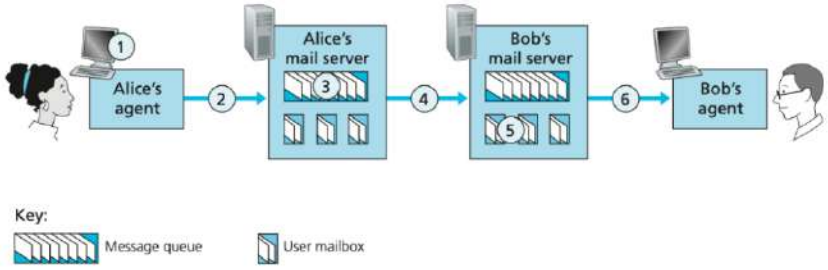


Figure 2.15 ♦ Alice sends a message to Bob

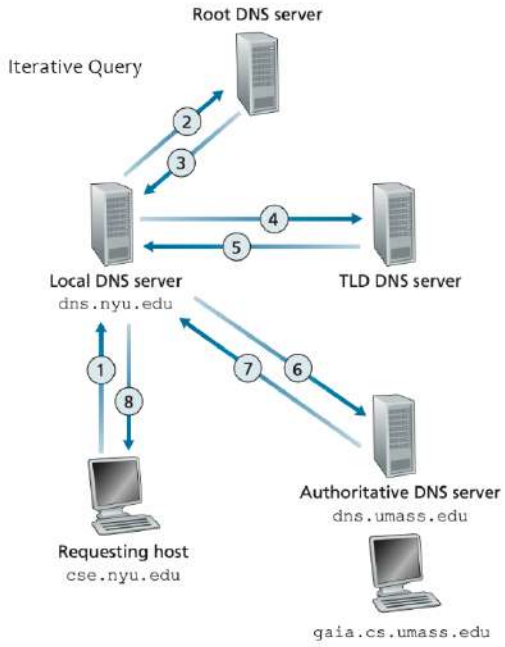
2. Hosts A and B are each connected to a router R via 10 Mbps links (A ----- R ------B). The propagation delay on each link is 20 microseconds. R is a store and forward device i.e. it doesn't transmit the packet on the R-B link until the whole packet is received on the A-R link. Suppose R forwards a packet 35 microseconds (processing delay) after it has finished receiving it. Calculate the total time required to transmit 10,000 bits from A to B, in the following two cases: (i) as a single packet, and (ii) as two 5000 bit packets sent one right after the other ; show the sequence of events in this case. (3+5 marks)

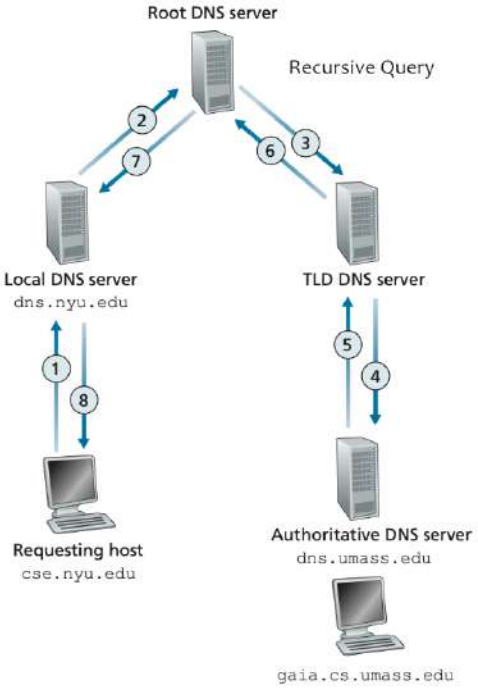
3. Assume that a user is trying to visit gaia.cs.umass.edu, but his browser doesn't know the IP address of the website. In the figure below, consider the scenario with recursive query and give answers to the following queries:
(4 marks)
   a. Between steps 1 and 2, where does the Local DNS server check first? Answer with 'User', 'DNS Local', 'DNS Root', 'DNS TLD', or 'DNS Authoritative'.

   b. Between steps 2 and 3, where does the root DNS forward the request to? Answer with 'DNS Local', 'DNS Root', 'DNS TLD', or 'DNS Authoritative'.

   c. Between steps 4 and 5, where does the authoritative DNS forward the response to? Answer with 'DNS Local', 'DNS Root', 'DNS TLD', or 'DNS Authoritative'.

   d. In steps 6-8, the response is sent back in the reverse direction until it reaches the user. What type of DNS record is returned?


Root DNS server
Iterative Query
2
3
4
5
Local DNS server
dns.nyu.edu
TLD DNS server
1
8
7
6
Authoritative DNS server
dns.umass.edu
Requesting host
cse.nyu.edu
gaia.cs.umass.edu


Root DNS server
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SECTION C

1. Hosts A and B are communicating over a TCP connection, and Host B has already received from A all bytes up through byte 126. Suppose Host A then sends two segments to Host B back-to-back. The first and second segments contain 80 and 40 bytes of data, respectively. In the first segment, the sequence number is 127, the source port number is 302, and the destination port number is 80. Host B sends an acknowledgement whenever it receives a segment from Host A. (2x3+4 marks)

   a. In the second segment sent from Host A to B, what are the sequence number, source port number, and destination port number?

   b. If the first segment arrives before the second segment, in the acknowledgement of the first arriving segment, what is the acknowledgement number, the source port number, and the destination port number?

   c. If the second segment arrives before the first segment, in the acknowledgement of the first arriving segment, what is the acknowledgement number?

   d. Suppose the two segments sent by A arrive in order at B. The first acknowledgement arrives after the first timeout interval. Draw the timing diagram, showing these segments and all other segments and acknowledgements sent. Assume that there is no additional packet loss. For each segment in your figure, provide the sequence number and number of bytes of data; for each acknowledgement that you add, provide the acknowledgement number.

2. Calculate the total time required to transfer a 1.5 MB file in the following cases, assuming a RTT (Round Trip Time) of 80 ms, a packet size of 1 KB, and an initial 2x RTT of "handshaking" before the data is sent. (2x3 +4 marks)

Note:

→ RTT/2 will be the propagation time.

→ Assume queueing and processing time to be negligible.

a. The bandwidth is 10 Mbps and data packets are sent continuously.

b. The bandwidth is 10 Mbps, but after we finish sending each data packet we must wait one RTT before sending the next packet.

c. The link allows infinitely fast transmit, that is, transmission time is 0. However, there is a wait time of one RTT after every 20 packets are sent.

d. Zero transmission time as in (c). The first packet is sent and then there is a wait time of one RTT. The next two packets are sent, then there is a wait time of one RTT. The next four packets are sent, then there is a wait time of one RTT, and so on.